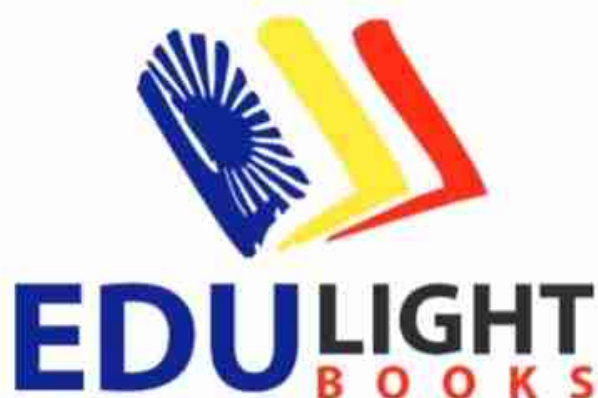




**GEOGRAPHY**

**FORM 2**



**UPDATED CURRICULUM**

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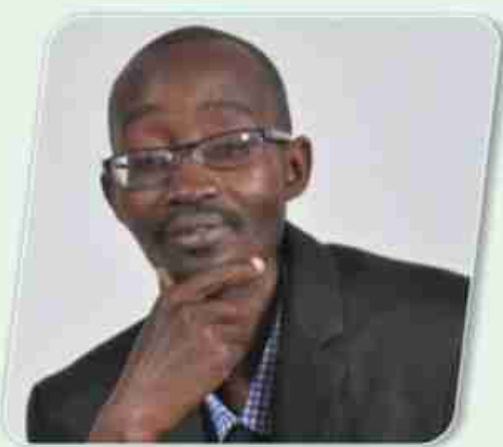
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## Dedication

To the victims of Cyclone Idai;  
Even in the darkest hours the Lord is with us. Our geography is changing.

## Acknowledgements

We would want to thank Mr Stanely Duri (Ndoda reKanyi), he went there and saw the suffering of our people. Of course, he had to shed a tear but remembered to tell the story. We would also want to thank the following people for making the compilation of this book a resounding success:

Mr Sauramba G - his ITC skills are indispensable

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Mrs Chipepera - the mathematician who wished she was a geographer

Mr Munyu P - I know he will follow this one religiously

Mr Nyakunengwa N - his counsel is always good

Mrs Duru - you always gave good advice

Our families - for being patient and understanding

# Aims

The aims of this book are to:

- The aims of this book are to:
- equip learners with skills in statistical and cartographic techniques
- develop practical skills of inquiry, observation, recording and interpretation of geographic data
- promote an understanding of environmental management issues
- promote sustainable exploitation, processing and economic use of minerals and other resources
- develop in learners an understanding of societal issues of HIV/AIDS, climate change and disaster risk management
- develop an appreciation of diverse communities and cultures worldwide
- promote an understanding of environmental patterns, dynamics and relationships

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## Introduction

**New Trends in Geography Book 2** is designed to assist learners beginning their studies in Geography at secondary level. This book covers 12 topics which are Weather and climate, landforms and landscape processes, ecosystems, natural resources, energy and power, map work and GIS, minerals and mining, environmental management, agriculture and land reform, industry, settlement and population, and transport and trade. This book is part of the New Trends in Geography series comprising of book 1, 2, 3, and 4. It is hoped that learners will benefit and develop the necessary skills through the use of this book.



## WEATHER AND CLIMATE

**Objectives**

By the end of this chapter, you should be able to:

- 
- outline weather hazards.
  - describe causes and effects of weather hazards.
  - suggest measures to reduce weather hazards.
  - describe how human activities contribute to weather changes.
  - evaluate the effects of human influence on weather.
  - describe Zimbabwe's climate zones.
  - relate Zimbabwe's climate zones to various economic activities.
  - describe climate variability.
  - describe effects of climate variability.
  - suggest solutions to the effects of climate variability.

**Introduction**

Weather is the condition of the atmosphere at a particular place and time. Climate refers to average weather conditions for a particular area recorded over a longer period of time, for example 30 to 40 years. The elements of weather, types of climate and other aspects were covered in New Trends Book 1. This chapter focuses on weather hazards, weather changes, Zimbabwe's climate zones and climate variability.

**UNIT 1.1****WEATHER HAZARDS**

Weather hazards are extreme atmospheric conditions which causes danger, discomfort to people, their property and livestock. Weather conditions becomes hazards when they become extreme. We need rainfall, wind to generate power, clouds, lightning for nitrogen fixation and the sun for solar power and photosynthesis of plants. However, when these elements of weather become excessive they become harmful. If temperatures are too high people suffer skin burns (skin cancer). Very high temperatures lead to heat waves. Very low temperatures leads to frost bites and freezing to death. High humidity also affect people since there are some who are sensitive to high humidity and they find it difficult to breathe under such conditions. Strong winds destroy buildings and leads to death of people. Too much rain leads to leaching of nutrients, floods and destruction of property and loss of life (As what happened in eastern parts of Zimbabwe, Mozambique and Malawi due to Cyclone

Idai in 2019). Little or less rainfall causes drought which brings drastic effects to human beings. Weather hazards may cause natural disasters when they occur. A natural disaster is a dangerous event caused by natural processes such as tropical cyclones and floods, causing death of people and animals, and destruction of property. Weather hazards are becoming more frequent and more severe due to climate change. Droughts are becoming more severe, as well as floods and heat waves.

Weather hazards include floods, tropical cyclones, droughts, lightning, global warming, and heat waves.

## Floods

Flooding involves the overflowing of water from a river or river, lake or other bodies of water usually causing destruction of property, crops and infrastructure.



*Fig 1.1: Tsholotsho flood victims being evacuated in 2017*

## Causes of floods

The causes of floods are both physical and human. They include:

### (i) Bursting of dams

When dams burst the water is released in large volumes. This water floods the surrounding areas, for example, Tokwe- Mukosi in Masvingo in 2014.

**(ii) High rainfall intensity of long duration**

When an area receives a lot of rainfall lasting for a long period, the soil's infiltration capacity is exceeded. The excess water flows down the slope causing floods in low lying areas.

**(iii) Melting of snow**

Polar glaciers or areas covered with snow melt due to effects of global warming this leads to the melting water flowing down slopes to low lying areas where flooding takes place.

**(iv) Deforestation**

Cutting down trees reduces interception of water. The rain water quickly flows into the channel leading to flooding.

**(v) Stream bank cultivation**

This causes siltation of dams and lakes. The rivers become shallow hence are quickly filled with water causing flooding of surrounding areas.

**Effects of floods**

When floods occur, they bring negative effects to human communities. These effects include:

- death of people and animals due to drowning and being washed away by flooding waters.
- destruction of property and homes as thousands of people are left homeless.
- destruction of infrastructure, for example roads, bridges and power lines.
- displacement of people.
- destruction of crops.
- spread of water borne diseases such as cholera.

**Measures to reduce floods and their effects**

The effects of floods can be reduced through:

- construction of artificial levees on the banks of the rivers.
- afforestation and reforestation.
- putting sand bags across the channels to divert the water from reaching homes.

- straightening and widening river channels.
- putting flood warning systems.
- evacuating people from low lying areas (Fig 1.1).
- construction of dams upstream to store the water preventing it from flooding



*Fig 1.2: Water inflated flood barriers in North America*

The water inflated property barriers as those shown in Fig 1.2 are used to stop flooding water from reaching people's homes. Closed drainage pipes increase the risk of flooding. Hence, removing sand and other objects from drainage pipes reduces the risk of flooding.



*Fig 1.3: Blocked drainage pipes increase the risk of flooding*

### Case study: Flooding in Muzarabani

*Muzarabani is one of Zimbabwe's low-lying areas, at an altitude of 356m. This low-lying area is susceptible to severe flooding given its low altitude. Water from different catchment areas flow down towards Muzarabani. It experiences perennial flooding, from January to the end of the rain seasons in March. However, due to climate change, these floods sometimes happen when they are not expected. Floods usually occur between January and March. In 2007 a severe flood occurred from 2 to 3 December. The causes of flooding in Muzarabani include tropical cyclones, for example, Cyclone Eline in 2000 and cyclone Japhet in 2003. Tropical cyclones are discussed in detail in New Trends in Geography Books 3 and 4. Excessive rainfall received and rapid overland flow into the low-lying area leads to accumulation of water causing flooding. The effects of floods in Muzarabani include damage to houses, infrastructure and crops. In 2007 December more than 1000 families were affected by the floods with about 400 of them losing almost everything. The floods in Muzarabani are usually declared national disasters because they affect large number of people. Mitigating strategies are usually led by civic organizations and the government. These include early warning systems by the Metrological Services Department. Provision of temporary shelter, food, water, clothing and evacuation of people from the affected areas were some of the measures taken. Besides Muzarabani, the other areas frequently affected by floods are Mount Darwin and Glendale area of Mazowe. In February 2018, 85 people were left stranded. Thirty huts and 34 blair toilets were destroyed.*

**Adopted from: The Herald; 22/02/18**

### Exercise 1.1

- What is a weather hazard? (2)
- State any 4 weather hazards. (4)
- Describe the causes and effects of floods. (6)

### Droughts

A drought is a long period of time without rain. Usually this period without rain is when it is expected to rain but it does not rain. Under Savanna climate, rains are expected in summer. If there is very little or no rain in a given rain season, that is a drought. Some parts of Zimbabwe experience drought after every 10 years, such that in 1982, 1992, 2002 and 2012 droughts were expected in some parts of Zimbabwe.

## The causes of drought

Droughts are caused by a number of factors which include:

**(i) The rain shadow effect**

The rain shadow effect involves the reception of low or no rainfall by an area lying on the leeward side under relief rainfall. Most of the rainfall is by the windward side. In Zimbabwe, the rain shadow effects are experienced by areas such as Nyanyadzi. Most of the rainfall from warm moist air originating from the Indian Oceans is received by Chimanimani and the air sinks on the Nyanyadzi side after losing most of the moisture. This causes droughts in Nyanyadzi.

**(ii) Offshore trade winds**

Offshore trade winds are the winds which blows from the land to the sea. For rain to occur, there is need for warm moist air to bring the water. The moisture in the air is derived from water bodies such as oceans, dams and rivers. The winds blowing from dry land surfaces such as Sahara Desert are dry. When these blow over an area, they do not bring rain. There is need for them to be modified by blowing over water bodies for them to bring rain. For example, the tropical continental air mass from Sahara Desert is modified by blowing over Mediterranean Sea to cause rain in Europe, but in Africa it causes drought because it will be dry.

**(iii) Deforestation**

It is the cutting of trees without replacing them. Trees are important in the water cycle (hydrological cycle) since they release water through transpiration. Cutting down trees in large number reduces the sources of water for transpiration hence droughts become frequent.

**(iv) Stream bank cultivation**

Stream bank cultivation involves growing crops close to the river channel. Farmers are supposed to grow crops at least 30m away from the river channels. However, due to the need to be near water supply and to grow crops on fertile alluvial soils, crop cultivation is practiced on the flood plains just next to channel. The soil next to the channel is loosened and it therefore becomes vulnerable to erosion. It is eroded and deposited in rivers and dams. This reduces the water holding capacity of rivers and dams. These water bodies dry easily. The drying of water bodies reduces the sources of water for evaporation. Reduced evaporation water sources causes droughts.

**(v) Distance from the sea**

Drought is a condition of aridity. Areas that area far away from the seas experience frequent droughts. This is because water bearing winds will reach

these areas after losing a lot of moisture. Deserts such as Sahara are located far away from oceans. Air masses reach these after dropping most of the moisture.

### (vi) Global warming

Global warming is an element of climate change involving a general increase in the temperature expected by many places. In the Polar Regions ice caps are retreating and polar glaciers are melting due to global warming. In the tropics water bodies and vegetation dry up due to excessive evapotranspiration. The drying up of water sources for the hydrological cycle leads to little or no rainfall.

### (vii) El Nino

The El Nino cycles causes drought because it brings alternative cycles of above average rainfall and below average rainfall.

## The Effects of drought

Drought lead to severe negative effects which include:

- death of livestock.
- hunger and starvation.
- malnutrition.
- drying of water bodies and death of water species.
- migration of wildlife such as birds to better species.
- a decrease in the amount of hydroelectricity generated due to falling water levels in lakes and dams.
- wilting of crops.
- strong soil erosion due to death of vegetation exposing the soil.
- closure of companies which use raw materials from agriculture.
- shortage of drinking water.

## Measures to control the effects of droughts

The effects of droughts can be controlled by:

- growing drought resistant crops and rearing drought resistant livestock. Crops varieties such as rapoko, millet and sorghum are resistant to drought. Livestock breeds such as Afrikander cattle, donkeys and goats resist droughts.
- practicing irrigation agriculture.

- properly storing food during years of better harvests.
- importing food from other such as maize from other countries, for example, the importation of maize from Kenya.
- initiating food for work programmes in the affected communities.
- food donations to the affected communities.
- drilling boreholes to supply clean drinking water.
- introduce water conservation methods.

### Case Study: The Drought - Zimbabwe 1992

*Zimbabwe experienced a severe drought in 1992- 1993 growing season. In most parts of the country the season begun well, promising to be quite productive. The rain season then ended abruptly leaving the crops when they needed the water serious. The crops soon dry and nothing was harvested, the residue was used for stock feeds. The dry spell continued into 1993. Soon rivers run dry and people and livestock had to share the few remaining water sources. In areas such as Zaka in Masvingo, food shortages were acute with people resorting to wild fruits such as amarula fruits. Different beverages and cakes were made from the wild fruits.*

*Pastures dried and, in most cases, there was literary no grass. Gazers such as cattle were the most affected. The cattle grew weak and most of them got trapped in the mud where they were attempting to find greener pastures and water. Some family lost the entire heads. The staple sadza also become scarce and some family had to depend on meat from the dying beasts for days. In most rural areas school children could collapse due to hunger. The government and Non- Governmental Organisations provided aid. The government imported maize from other countries. Yellow maize was imported through Kenya. Feeding programmes were initiated in schools and villages to avert malnutrition, hunger and starvation. When in 1993 the rains finally came in Zaka, Ndanga area at least about 25 000 heads of cattle had been lost and about 2500 families were leaving under acute food shortages and depending on aid from either the government or Non-Governmental Organisations. The entire country had suffered the effects of the drought. Lakes such as Kariba suffered from reduced discharge and it affected the generation of Hydroelectricity power. Most rivers even those usually flowing throughout the year dried. Shallow wells were dug in the river beds in areas where there were no boreholes.*



## Exercise 1.2

- What is drought? (1)
- State any 6 measures to reduce the effects of droughts (6)
- What are the effects of droughts (6)

## Tropical Cyclone

A tropical cyclone is a low-pressure system. It is also called a hurricane in the United States and a Typhoon in Japan. The development, distribution and structure of a tropical cyclone is covered in Book 4. At this level it is important to understand that a tropical cyclone is a weather hazard because it is associated with strong winds travelling at great speeds of about 200km/hour, heavy rainfall and lightning. These conditions pose dangers to humans, their property and livestock. Examples of tropical cyclones include cyclone Eline (2000), Cyclone Hurricane Katrina (2005), Cyclone Fiona (2016), Japhet (2017) and Idai (2019).

## Causes of tropical cyclones

Tropical cyclones are natural weather hazards. They are not a result of human effort. Tropical cyclones are caused by the presence of warm ocean temperatures reaching above 26°C and the abundant moisture supply in oceans. The warm moist air is forced to rise and as it rises it expands. Convective currents are set into motion and vertical spiral bands of warm moist air fuel the cyclone. Due to convective currents, thunder and lightning occur during tropical cyclone. The tropical cyclones require abundant supply of moisture under warm conditions.

## The effects of tropical cyclones

The effects of tropical cyclones include:

- strong winds destroy homes.
- destruction of infrastructure such as bridges and roads.
- flooding from the torrential rainfall associated with tropical cyclones.
- loss of life.
- storm surges (These are very high waves at sea. They cause flooding of coastal areas.)
- destruction of crops.
- severe soil erosion.
- death of livestock.
- leaching of soil nutrients.
- spread and outbreaks of water borne diseases.
- high costs of rebuilding infrastructure



*Fig 1.4: The effects of tropical cyclones (Cyclone Idai; Chimanimani- 2019)*

### Measures to reduce the effects of tropical cyclones

The effects of tropical cyclones are reduced by:

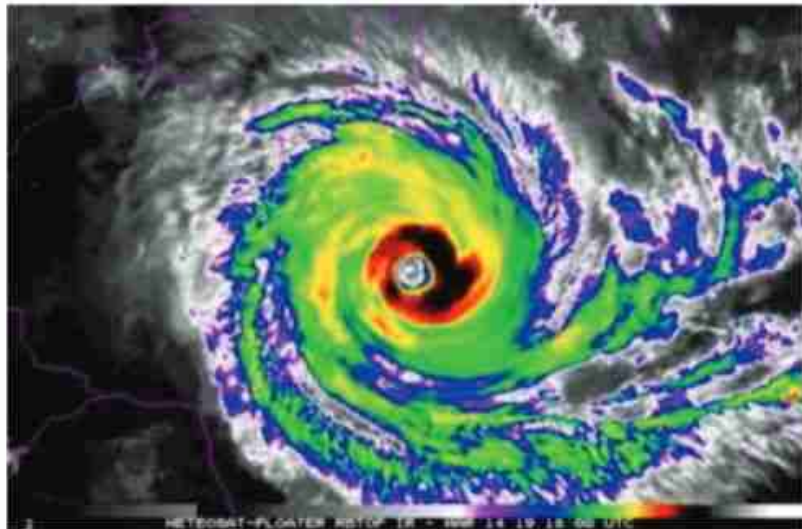
- Using early warning systems. This enables the people to prepare for the coming cyclone so as to take measures to avoid the extent of the destruction caused.
- Evacuation of people living in low lying area
- Keeping emergency supplies of food, medicines, and water
- Closing windows so that debris does not fall into homes
- Staying indoor during the cyclone
- Constructing lightning conductors
- Organising rescue teams and operations
- Donating food, tents, and medicines

### Case Study: Cyclone Idai (March 2019)

Cyclone Idai left a trail of destruction in parts of Zimbabwe between 14 and 18 March 2019. The Zimbabwe Meteorological Services Department (MSD) had earlier on reported that the Eastern parts of the country should expect rainfall and windy conditions. On the 15th of March the MSD warned that Masvingo, Manicaland, Mashonaland East and Central provinces would start experiencing cloud and wind conditions. About 50mm of rainfall were expected within 24 hours. Cyclone Idai made landfall in Beira on the 14th of March. Manicaland, Masvingo and parts of Matebeleland were affected. Manicaland, and especially Chimanimani and Chipinge Districts, was the most affected.

### Early Warning

Apart from weather forecast, the MSD urged the public to follow official communication channels for accurate information and to ignore messages from unauthorised sources. The Civil Protection Unit (CPU) warned the public to stay alert of possible flooding when the cyclone hit. The warning specified that the cyclone could cause flooding and damage to homes and infrastructure. The CPU



*Fig 1.5: Cyclone Idai approaching landfall in Mozambique (14-03-19)*

*Source: The Washington post*

further instructed that communities had to maintain vigilance and to access weather updates and pay attention to the needs of those with disabilities and chronic illnesses. The CPU clearly stated that in the case of strong winds, it was safe to shelter in the houses with the strongest roofs and close windows and doors (Times live, 16/03/19). The communities were told to be on the lookout for rising water levels and quickly move to safe places when there was need to do so. Those living in towns and cities were warned to use the usual fire, ambulance, police and clinic emergence services.

### Chimanimani and Chipinge Hit

When Cyclone Idai finally struck, Chimanimani and Chipinge were the most affected in Zimbabwe. People in those districts could have taken hid of the early warning by MSD and CPU but the unexpected happened. Idai struck in the middle of the night. In Chimanimani the most affected areas are Ngangu, Gongga, Kopa, Charleshood Farm, Machongwe and Vhimba. Ngangu was cut off from the surrounding areas leaving villagers marooned. When the cyclone hit these areas, it brought heavy rainfall and strong winds. The most affected areas in Chimanimani are surrounded by mountains. The steep mountain sides led to rapid runoff flooding the nearby streams. In Ngangu, tanks supplying water to the area bursted and this led to huge volumes of water flooding the area. Landslides and rock falls were triggered by the rain. Rocks fell into the valley destroying homes and infrastructure. In Chipinge the town experienced flooding and damage to homes.



*Fig 1.6: Chipinge and Chimanimani Flooded  
Pictures Courtesy of Stanely Duri (2019)*

### The Effects of Cyclone Idai

Cyclone Idai destroyed infrastructure and homes. It also led to death and displacement of people. Roads were blocked and vehicles stuck in the mud. In Chimanimani four bridges were washed away. Intensive rainfall and violent wind led to the falling of trees. The water soaked the soil leading to mudflows from the steep slopes into the valley. Rocks fell off the steep slopes into the valley. In Chipinge, at least 20 000 houses were damaged. The cyclone affected about 250 000 people in Chimanimani and Chipinge District. In Rusitu Valley 500 people went missing. At least 154 death we're reported both in Chipinge and Chimanimani.



*Fig 1.7: Landslides in Chimanimani  
Picture Courtesy of Stanely Duri*

The cyclone also left 77% (114 000 people) in Chimanimani in need of food assistance. About 35 000 households with over 120 000 people and over 60 000 children in urgent need of protection. In Chimanimani and Chipinge 95% of the road networks were damaged. Bridges at Mhandarume, Matsororo, Mvumvumvu, Biriri, Muusha Primary School and Nyabonde were destroyed. Forty-eight schools, 18 water points and 10 bridges were damaged. St Charles Luanga High School was one

of the schools which suffered much, with 200 learners, teachers and supporting staff left stranded. Manyera Dam in Vumba was weakened posing yet another danger to the communities downstream. Power lines were also damaged plunging Chimanimani into darkness.



*Fig 1.8: Cyclone Idai damaged infrastructure and homes*  
*Source: Stanely Duri (2019)*

### Reaction to the Disaster

The affected people might have taken heed to stay indoors but the cyclone hit and destroyed the homes which were supposed to protect them. Some were caught unaware at the middle of the night. Some climbed at the roof tops and higher grounds. Some tried to cross the fast-flowing rivers but succumbed. The nearest clinics and police stations assisted the people but some of the institutions which were supposed to assist the people were also destroyed. In Chimanimani, a hotel provided shelter for the people. Government officials and politicians visited the area. Funds were mobilised through mobile money transfers such as Ecocash. The Zimbabwe National Army flew into the affected areas to rescue the marooned and retrieve the bodies of the deceased. Appeals were made to the international



*Fig 1.9: Members of the ZNA assisting in rescuing and retrieving bodies*

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The people were in dire need of clean water, food and shelter, and these were provided by well-wishers and the government. Those who survived the disaster were left traumatized and it could take some time for the wounds to heal. There shall therefore be the need to keep on assisting them and to rebuild the broken communities.

### Case Study: Cyclone Dineo

*Cyclone Dineo that was downgraded to a tropical storm before it hit the country on Friday has caused widespread destruction in Matabeleland and Midlands provinces leaving one person dead, hundreds homeless and a majority of areas impassable for rescue missions. Tsholotsho District is a low-lying area in Matabeleland North which seems to have borne the brunt of the driving rain that has lashed Bulawayo, Masvingo, Midlands, Matabeleland North and South since Friday last week.*

*The Civil Protection Unit has evacuated more than 400 people that were marooned by floods in the district since Saturday, with about 300 more said to be still stranded. The entire district is virtually inaccessible by road. By the end of the day yesterday, the Air force of Zimbabwe was still airlifting people from 10 affected villages to Sipepa Secondary School and Sipepa Hospital.*

*The affected villages include Mahlosi, Mahlaba, Thamuhla, Mbamba, Mele, Lutshome, Maphili and Mbanyana. Villagers that looked bone-tired after spending more than 24 hours seeking higher ground to avoid drowning could not hide their relief as they disembarked from a helicopter that was evacuating about 16 people at a time.*

*A majority survived the floods with clothes on their backs. Government officials flew to Tsholotsho to assess the situation. The ministry of Local Government assured the nation that it would engage the Ministry of Public Service, Labour and Social Welfare to assist with more food for the affected families. Most importantly the families have requested to be relocated. The Tsholotsho Rural District Council was tasked to identify alternative land for the families. As assistance from other stakeholders was still being mobilized, the government would bring food and medicine to assist the affected. School children were integrated in the local schools where the families were relocated.*

*Insiza, Mberengwa, Bulilima and Mangwe were also affected and the CPU was assisting affected people in all these areas. Rescued villagers went through chilling experiences. They endured the horror of watching their homesteads being destroyed by the floods. It strained them mentally and physically. Some were working in the fields when they were marooned by the floods. They sought refuge on an anthill and stayed there for several hours. A big snake which also ran away*

*from the floods came to hide exactly where people had sought refuge. Villagers moved to higher ground through the water which was waist deep while the men carried children on their heads.*

*Travelers were stranded after Khami River along the Bulawayo-Tsholotsho road became impassable due to the floods. Some motorists waited the whole day for water to subside while others had to turn back and use Solusi Road. In the Midlands, one person died and livestock was swept away by floods after torrential rains fell in the province for four days, with Mberengwa District being the epicenter of destruction. The rains destroyed vital bridges, homesteads, roads, crops, livestock, schools, hospitals and clinics.*

*The water flooded homesteads and accumulated up to window level. Small livestock was swept away and some villagers had to climb on top of trees and stable buildings to escape. 'Furniture and food were either destroyed or swept away. Huts and granaries collapsed. This incident is a disaster for sure. It has left many people from my ward in despair,' said. Mr Dube. He said villagers were now living in fear of suffering further damages if the rains persisted. He said a number of houses were on the brink of collapsing. Gwanda District this time survived the devastating effects of floods as no negative reports were recorded.*

**Adopted from The Chronicle, [www.chronicle.co.zw](http://www.chronicle.co.zw) (21 February 2017)**

### Exercise 1.5

- (a) What is a tropical cyclone? (1)
- (b) State any 3 conditions which are associated with tropical cyclones, making them weather hazards (3)
- (c) From the above case study;
  - (i) What should have done to reduce the effects of Cyclone Dineo? (5)
  - (ii) Describe the measures which were taken to assist the people of Tsholotsho (5)

## Lightning

Lightning is a bright flash of electricity produced by a thunderstorm. All thunderstorms produce lightning and are very dangerous. If you hear the sound of thunder, then you are in danger from lightning. Lightning kills and injures more people each year.



## The causes of lightning

Lightning is an electric current. Within a thundercloud way up in the sky, many small bits of ice particles collide against into each other as they move around in the air. All of those collisions create an electric charge. After a while, the whole cloud fills up with electrical charges. The positive charges or protons form at the top of the cloud and the negative charges



Fig 1.10: Lightning

or electrons form at the bottom of the cloud. Since opposites attract, that causes a positive charge to build up on the ground beneath the cloud. The ground's electrical charge concentrates around anything that sticks up, such as mountains, people, or single trees. The charge coming up from these points eventually connects with a charge reaching down from the clouds and the lightning strikes. The effects and measures to avoid dangers caused by lightning are shown in table 1.1 below.

Table 1.1: The effects and measures to avoid dangers

The Effects of lightning	Measure to avoid dangers caused by lightning
<ul style="list-style-type: none"> <li>• Nitrogen fixation</li> <li>• Loss of life</li> <li>• Destruction of property</li> <li>• Death of livestock</li> <li>• Power cuts</li> <li>• Destruction of trees</li> </ul>	<ul style="list-style-type: none"> <li>• Construction of lightning conductors</li> <li>• Staying indoors during storms</li> <li>• Staying away from electric appliances during storms</li> <li>• Boarding closed vehicles and not open trucks during storms</li> <li>• Switching off cellphones during thunderstorms</li> <li>• Staying in low places where you are not the tallest object</li> <li>• Seeking shelter away from tall trees</li> <li>• Staying away from lightning conductors during thunderstorms</li> </ul>

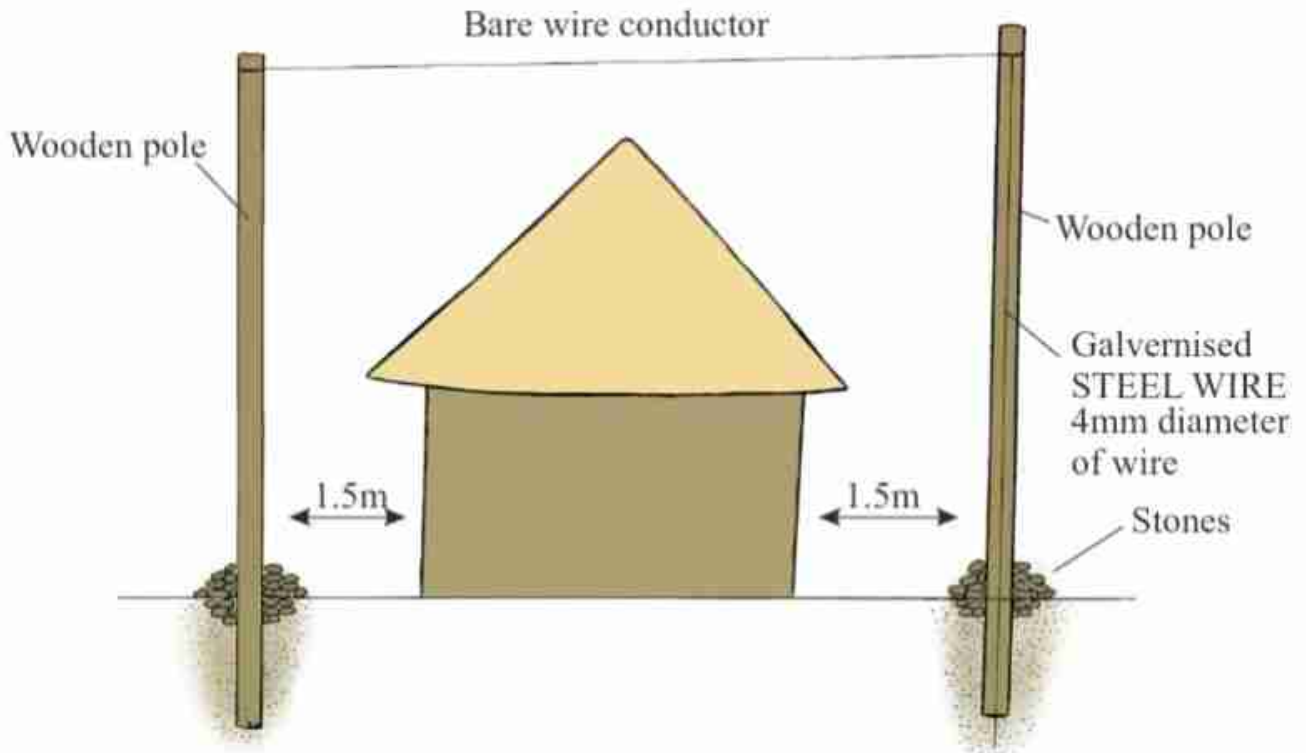
## Lightning conductors

Lightning conductors are devices used to trap lightning so that it does not structure objects or structures but is sent to the ground. There are different ways of making lightning conductors. These include:

- **Two poles and bare wire conductor**

This type of lightning conductor is made up of two tall poles which are taller

than the building to be protected by at least 1 meter. The two poles are placed about 1.5 meters away from the structure on two opposite sides of the building. A galvanised steel wire of at least 4 mm diameter is put at the poles such that it passes above the building. It is pulled and buried at the foot of



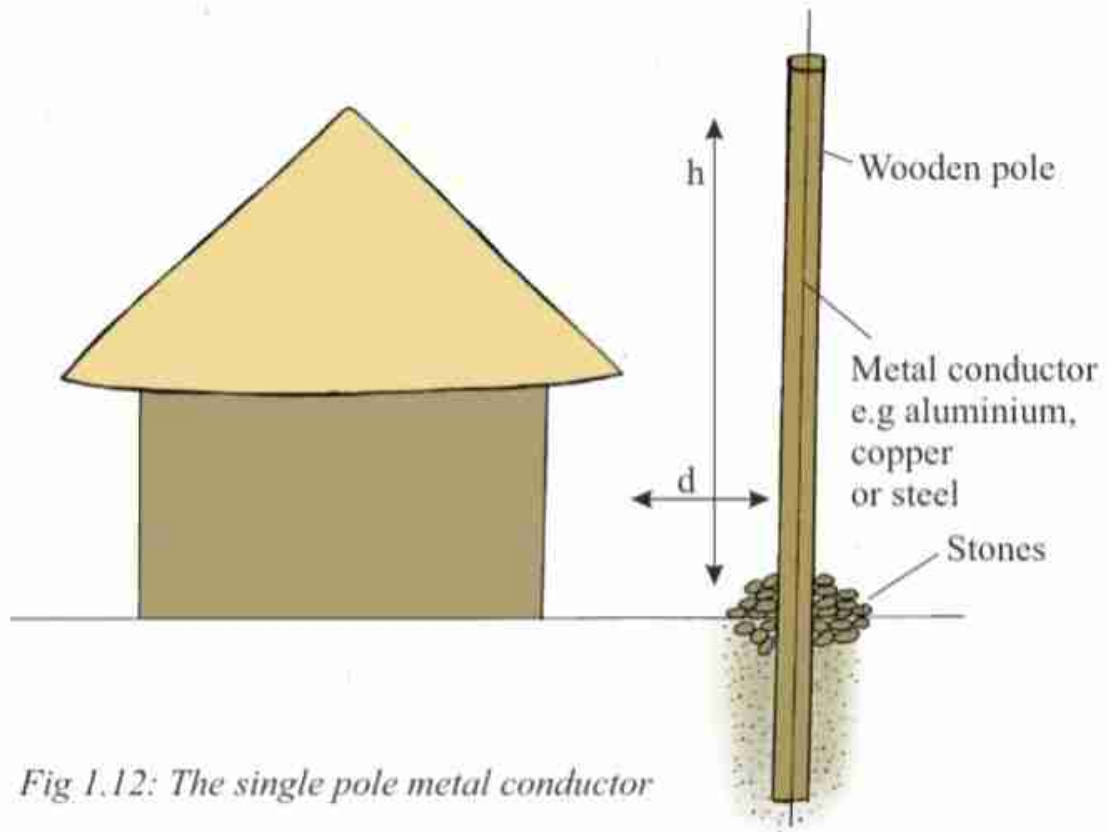
*Fig 1.11: The two pole and bare wire conductor*

The rocks put at the foot of the poles should be sharp to deter people and animals from leaning against the poles lest they get stricken by lightning.

See

• **Single pole metal conductor**

This is the lightning conductor which comprises of a single pole, with a single conductor such as aluminum, copper or steel as shown in fig 1.12.

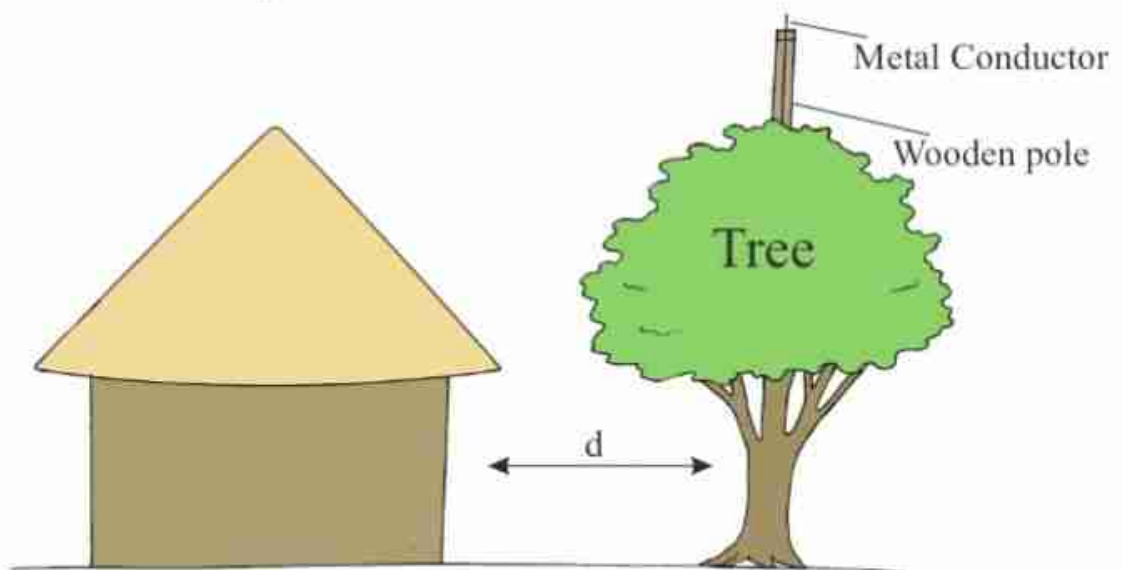


*Fig 1.12: The single pole metal conductor*

The wooden pole's height ( $h$ ) should be twice the height of the building to be protected. The distance of the pole from the building ( $d$ ) should be half the height of the pole.

- **Metal conductor in a tree**

This lightning conductor is fitted in a tree close to the building to be protected. A wooden pole is fixed at the top of the tree where the metal conductor is placed as shown in fig 1.13 below.



*Fig 1.13: The metal conductor in a tree*

The distance of the tree from the building must be at least half the height of the tree.

### **Task 1.1: Constructing a lightning conductor model**

Using card boxes or any other available material, make a model of the house or hut protected from lightning using a lightning conductor. The lightning conductor should be made up of wooden poles and wire. Compile a detailed description of how your lightning conductor protects the house or hut from lightning.

## **UNIT 1.2**

## **HUMAN ACTIVITIES AND WEATHER CHANGES**

Weather is important to human beings as it determines human activities such as farming. As a result, intentionally and unintentionally, human beings influence the weather. Humans influence weather through the following processes:

- **Cloud seeding**

Cloud seeding is the process of spraying gases such as sulphur into the atmosphere to increase the amount of condensation nuclei in the atmosphere. Condensation nuclei refers to hygroscopic substances which have an affinity for water. These substances enable clouds to form giving rainfall. Without condensation nuclei rainfall could not form. Through spraying chemicals into the atmosphere provides the condensation nuclei for clouds to form. Cloud seeding increase the amount of rainfall received by an area.

- **Use of cloud dispersants**

The ability of clouds to produce heavy rainfall through storms is reduced by spraying cloud dispersants such as silver iodide. This way we are able to influence the prevailing weather conditions.

- **Construction of wind breaks**

Wind breaks are used to reduce the velocity of the wind so as to reduce the effects of strong winds such as blowing away building roofs. Trees are grown to form wind breaks in areas affected by strong winds.

- **Construction of dams**

Dams provides the source of water for evaporation. They also induce localised land and sea breezes and leads to fog and rain in the surrounding areas.

- **Deforestation/ afforestation/ reforestation**

Deforestation is the indiscriminate cutting down of trees leaving an area bare. Afforestation is the planting of trees where there are no trees. Reforestation involves planting trees where trees have been cut. Deforestation reduces the source of water for transpiration leading to drier weather conditions. It also creates bare surfaces with high albedo. Areas with sparse vegetation therefore experience high temperature. Afforestation and reforestation lead to growth of vegetation which makes an area cool due to shade created by vegetation which has a low albedo. Through deforestation, reforestation and afforestation, humans unintentionally influence weather because the aim of the activities are not to change weather experienced.

- **Heating systems**

During the cold winters heaters and fires are used to alter the weather conditions. Internal heating systems and air conditioners also change weather conditions locally. Frost is prevented through the use of heaters. Fog is dispersed using heaters.

- **Urbanisation**

Urbanisation is the creation of towns and cities. It leads to the removal of natural surfaces and deforestation. The natural ground is replaced by tarmacs and concrete surface. Vegetation is removed to pave way for construction of tall buildings with asbestos and other roofing materials. These buildings absorb heat from the sun making the urban areas experience high temperatures than their rural counterparts. Factories in urban areas produce heat and smoke which forms a thick cloud above the urban areas. The thick cloud induced by smoke acts like a blanket keeping heat from escaping back into the atmosphere. This makes urban areas warmer than rural areas and that is referred to as the **heat island effect**.

Human activities have positive and negative effects on the weather. Positive effects include:

- Increasing the amount of rainfall, for example, through cloud seeding
- Stopping climate change, global warming and desertification.

## Climate change, greenhouse effect and global warming

### Climate change

Climate change is a shift in the weather conditions and expected climatic patterns. Temperatures at global level are generally getting warmer. The general increase in the temperatures experienced by the earth is called **global warming**. The tropics are

getting warmer, so are the poles. Rainfall reliability is getting poor and droughts are becoming common, for example, heat waves and floods. Human beings cause climate change through the emission of greenhouse gases into the atmosphere. **Greenhouse gases** are gases which absorb heat reflected by the Earth preventing it from escaping back into the atmosphere. These gases include water vapour and carbon dioxide. The gases are important for keeping temperatures moderate, however an increase in these gases due to human activities leads to more heat being trapped causing global warming. The emission of more of these gases depletes the ozone layer which shields the Earth from excessive heat from the sun. The depleted ozone allows more heat to reach the Earth's surface. Ozone depletion is caused by:

- Burning fossil fuels
- Emission of gases from vehicles and air planes
- Deforestation
- Chlorofluorocarbons (CFCs)

### The greenhouse effect

The greenhouse effect is the process by which the Earth traps heat from the sun, preventing it from escaping back into the atmosphere thereby keeping the Earth warm. When the Earth's surface absorbs energy from the sun, it gets warmer. For the Earth to be cooled, it should release back the energy received from the sun in form of long wave radiation.

Natural surfaces can release considerable amount of

heat making the Earth's surface cooler. However, the removal of Vegetation and creation of concrete surfaces, tarmacs, and asbestos roofs increase surfaces which trap heat from the sun, releasing very little amounts back. This makes the Earth warmer as if in a greenhouse.

The greenhouse traps heat from the sun during the day. Its walls trap the heat which

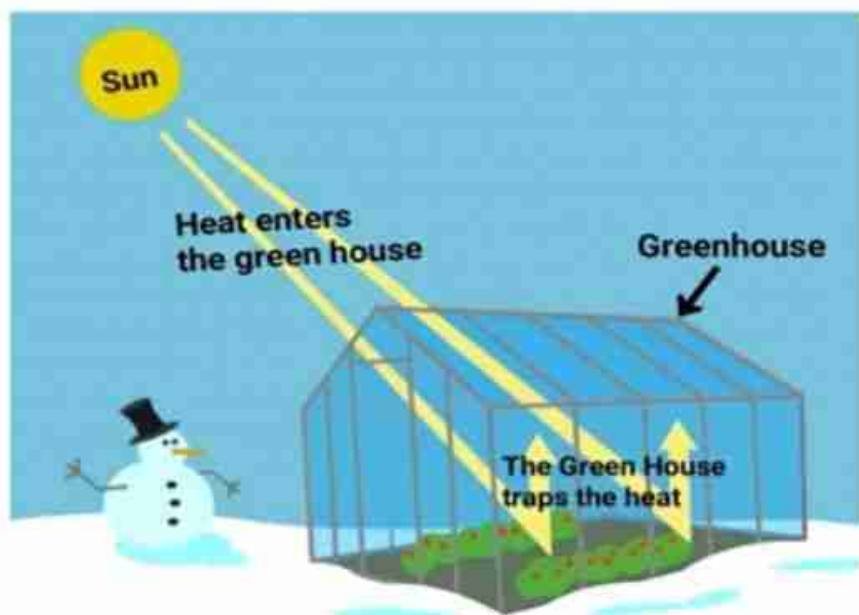


Fig 1.14: The concept of the greenhouse

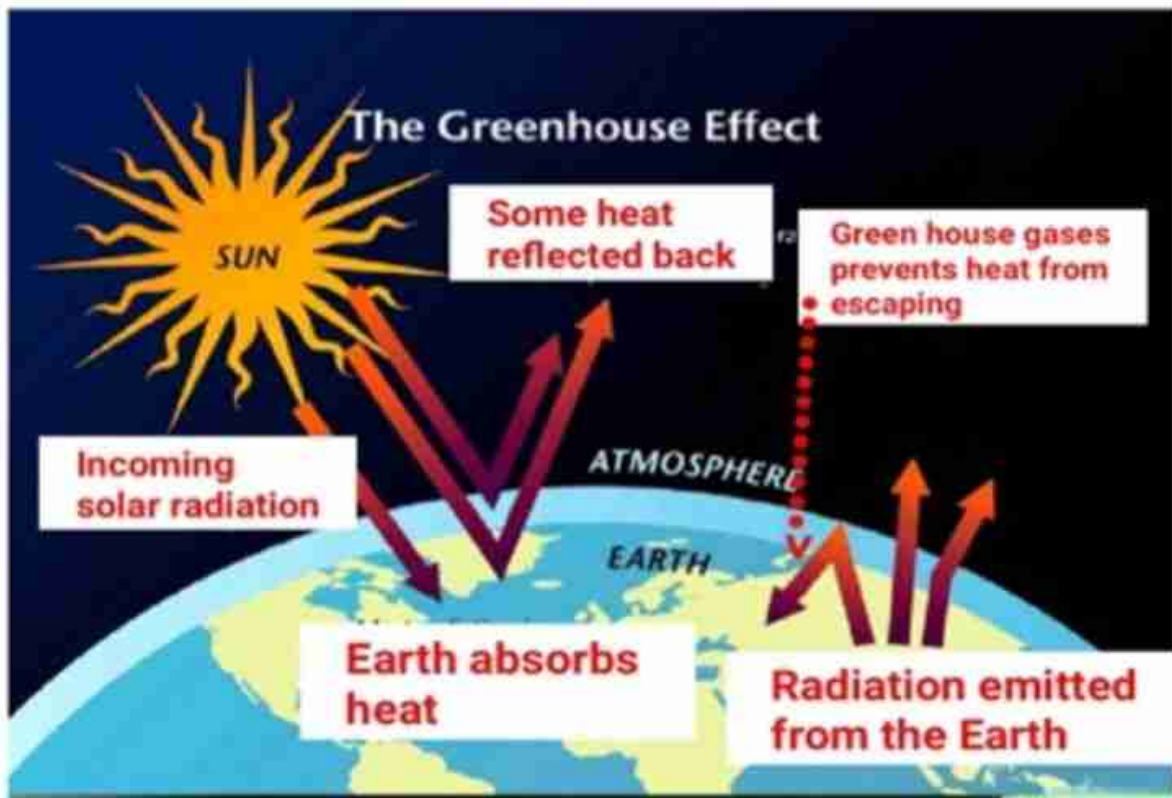


Fig 1.15: The greenhouse effect

Human activities such as deforestation and air pollution cause the greenhouse effect. Deforestation removes vegetation which clean the air of excess carbon dioxide. The removal of vegetation leaves bare surfaces which absorbs more heat from the sun. Air pollution from human activities increases the amount of greenhouse gases in the air. These are the gases which absorbs heat and block heat from escaping back into the atmosphere through radiation. Examples of greenhouse gases are carbon dioxide, methane, ozone, nitrous oxide, chlorofluorocarbons and hydrofluorocarbons. These trap heat making the Earth resembles the greenhouse. The greenhouse effect changes the climate of a given area making it warmer, hence it is linked to global warming.

## UNIT 1.3

## ZIMBABWE'S CLIMATIC ZONES

Zimbabwe experiences a tropical Savanna climate or tropical continental climate. It is also referred to as the seasonally humid climate. This is a climate characterized with hot-wet summers and cold - dry winters. Most of the rainfall is received during the summer when temperatures are high. This is the climate experienced by other Sub- Saharan countries such as Zambia. Zimbabwe is within the tropics, located between  $16^{\circ}$  and  $22^{\circ}$  south of the equator.

Though Zimbabwe generally experiences a tropical continental climate, there are clear differences in the rainfall amounts and temperatures received by different areas. Therefore, Zimbabwe has sub-types of Savanna climate which include:

- **Humid savanna (humid tropical)**

This type of savanna is found close to the equator and receives about 1250mm of rainfall. It is also referred to as humid tropical climate. It contains more trees than grasses and is also known as Savanna woodlands.

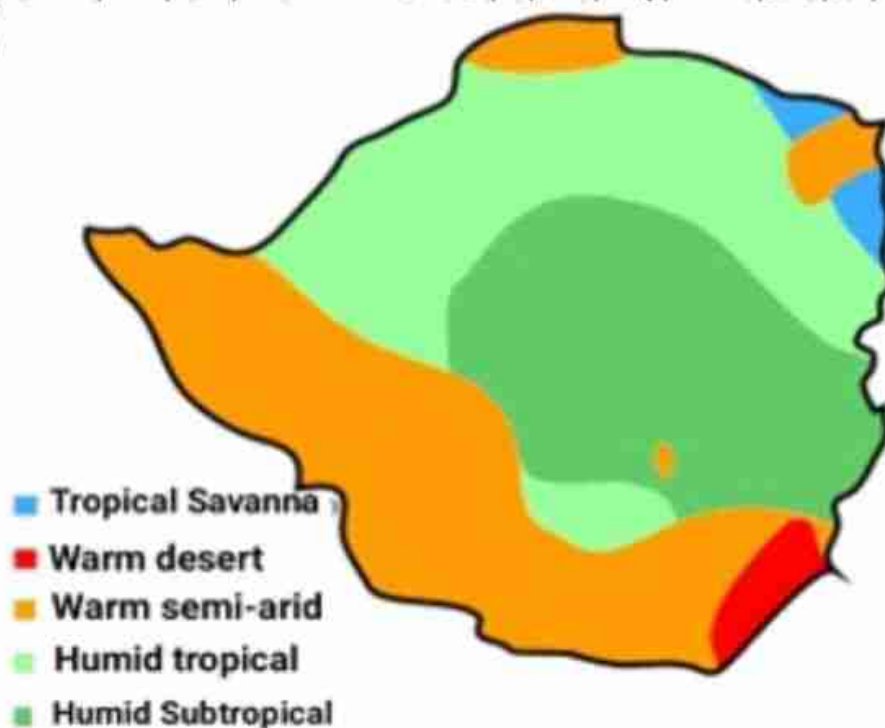
- **Semi-humid savanna (humid subtropical)**

This receives annual rainfall of about 800mm and is dominated by grassland. It is also known as grassland or parkland savanna. An example of this climate is Zimbabwe's Highveld.

- **Semi-arid savanna (warm semi-arid)**

This climatic region is found closer to the desert and receives annual rainfall less than 500mm for example Zimbabwe's Low veld. It is associated with more thorny trees and is also known as shrub savanna or dry savanna.

In fig 1.16 below some of Zimbabwe's climatic regions show are the tropical savanna, warm desert, warm semi-arid, humid tropical and humid subtropical as receive different a

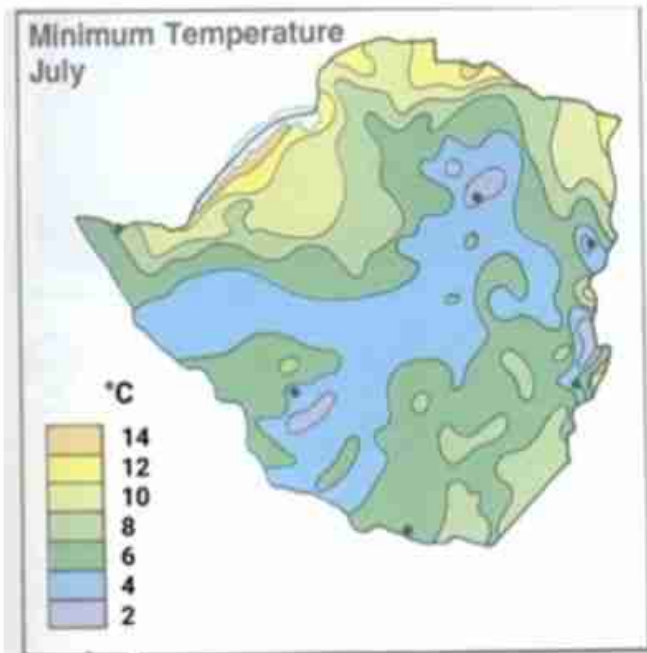


*Fig 1.16: Zimbabwe climatic regions*



Areas falling under natural farming region 1 such as the Eastern parts receives the highest amounts of rainfall, above 1800mm. this zone is influenced by the South Eastern trade winds.

Zimbabwe is made up of varying climatic regions. The north-east corner is made up of savanna climate while as the south-eastern part experiences arid conditions with low rainfall amounts. Parts of Matebeleland experience warm arid conditions whereas the central and eastern parts of Zimbabwe fall under humid tropical and humid Subtropical climate. These variations in climatic conditions in Zimbabwe influence economic activities. Agriculture largely depends on climatic conditions.



### Temperature

There is clear temperature variation in Zimbabwe. Low latitudes tend to have high temperatures than high latitudes. The Zambezi Valley, Kariba, Chirundu, Hwange, and Mbire are some of Zimbabwe's hottest area. These areas are low latitudes. The Zambezi Valley experiences temperatures between 22.25°C and 25°C. The central part of the country experiences warm temperatures ranging from 17°C to 20°C. The eastern Highlands are the high latitudes in Zimbabwe. These areas receive the lowest temperatures. Macheke and Marondera are also some areas with low temperatures.

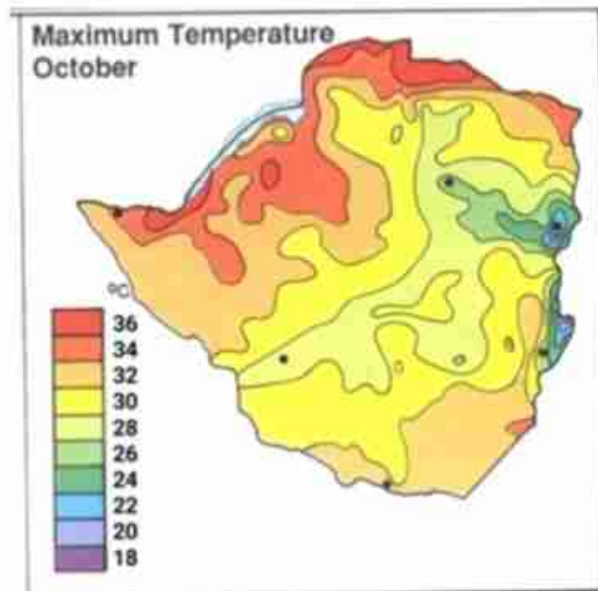


Fig 1.17: Temperature variations in Zimbabwe

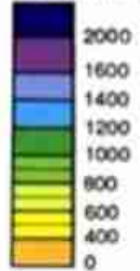
### Climate zones and economic activities

Climate zones determine the economic activities practiced in a given area. This is because economic activities such as farming are influenced by temperature, rainfall and other elements of climate. There are five distinctive natural ecological regions in Zimbabwe. These regions are clear climatic zones existing in Zimbabwe. They

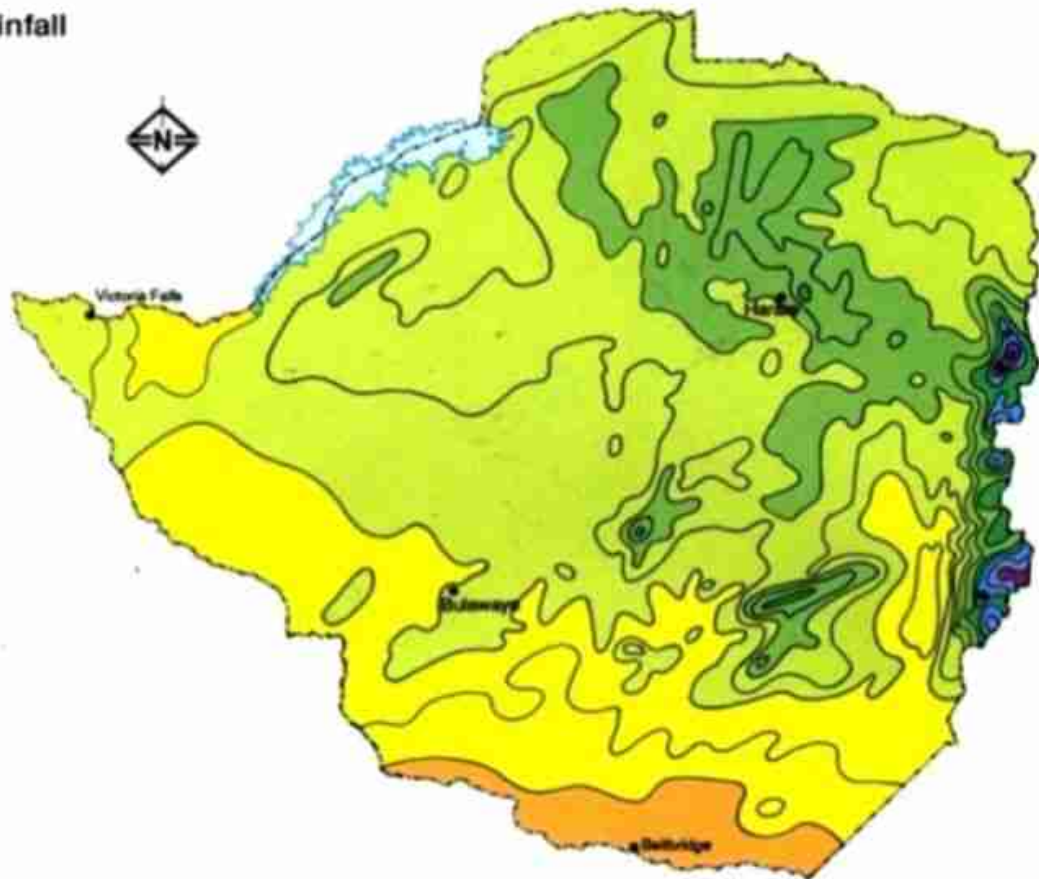
receive varying temperature and rainfall amounts hence each region can support certain activities.

### Annual Rainfall

Rainfall in mm



c



*Fig 1.18: Zimbabwe rainfall distribution*

Zimbabwe is made up of varying climatic regions. The north-east corner is made up of savanna climate while as the south-eastern part experiences arid conditions with low rainfall amounts. Parts of Matebeleland experience warm arid conditions whereas the central and eastern parts of Zimbabwe fall under humid tropical and humid Subtropical climate. These variations in climatic conditions in Zimbabwe influence economic activities. Agriculture largely depends on climatic conditions.

Table 1.2: Zimbabwe climatic zones and economic activities

Climatic Zone (Region)	Climatic conditions	Economic activities
1	High rainfall- 1500mm per year Low temperatures due to high altitudes.	Suitable for specialized and diversified farming. Crops such as maize, potatoes, coffee, and tea are grown. Plantations and forestry are also key economic activities. These have attracted many other industries such as paper, timber and tea processing. Companies such as allied Timbers and Mutare border Timbers are examples.
2	This region receives between 700mm and just above 1000mm of rainfall. The temperatures are moderate.	The climatic conditions of this zone make it favourable for agricultural production of maize, tobacco, cotton, citrus fruits and livestock. Processing of these products is done in areas located within the climatic zone for example, Dairy Companies such as Gushungo Holdings in Mazowe.
3	This region receives rainfall amounts lower than those received by region 1 and 2. The region receives between 500 and 800mm of rainfall per year. It is generally a warmer region.	The climate conditions of this zone support the production of livestock. Drought resistant crops are produced, for example rapoko, millet and sorghum. Cash crops grown include tobacco and cotton. Economic activities in the zone revolves around these agricultural activities since Zimbabwe is agro-based but mining and manufacturing also play a significant role.

4	This zone receives 450mm to 650mm of rainfall per year. It is affected by severe dry spells.	The zone is suitable for growing fodder crops and livestock production. Wildlife production is also a major economic activity in the region. Other economic activities in this zone are tourism and hunting
5	This is the driest region. Very low amounts of rainfall are received that is below 450mm per year. Temperatures are very high in this region.	It is not suitable for crop production. Livestock and wildlife production are the key economic activities. Safaris and national parks are the sources of income in this region.

### Exercise 1.4

- (a) Describe the temperature - rainfall distribution patterns shown in fig 1.19.
- (b) State any 2 causes of temperature and rainfall distribution patterns shown in fig 1.19. (2)

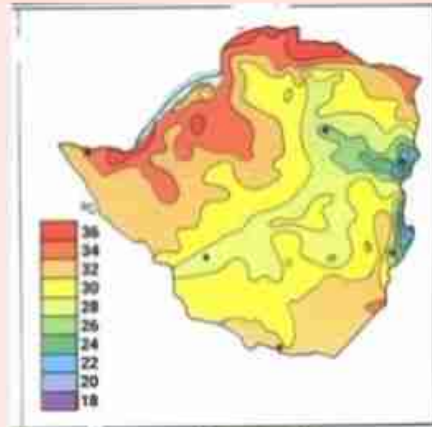


Fig 1.19

- (c) Fill in the table below (7)

Region	Economic activities and crops grown
1	1. .... 2. .... 3. .... 4. ....
2	1. .... 2. .... 3. ....

## UNIT 1.4 CLIMATE VARIABILITY

Climate variability involves the changes in climatic conditions from one place to another and within a given area from time to time. An area can change from being cool to being warmer, from receiving high rainfall to receiving very low rainfall and the seasons may also change. An increase in the average temperatures experienced by given places on Earth is called global warming. Global warming is part of climate change/ Zimbabwe is also being affected by global warming. The annual average temperatures in Zimbabwe shows an increase in the last century. The minimum temperatures experienced have increased by above 2%. The rainfall amounts are decreasing in most cases. Some of the most affected areas in Zimbabwe are Masvingo and Matebeleland. These are vulnerable because most parts of these provinces fall under regions 4 and 5. Since the 1960s these areas have experienced a drop in the amounts of rainfall received by 15%. Climate change in Zimbabwe does not entails an increase in temperatures and a decrease in the amount of rainfall but an increase of rainfall in some cases. For example, the Eastern parts of Zimbabwe experienced an increase in the amounts of rainfall received. The other effects of climate change include drought, cyclones and floods.

### Effects of climate variability

Climate variability has severe effects in Zimbabwe and these effects include:

- **Low agricultural production**  
Farmers who depends on natural rainfall are struggling due to unreliability of rainfall. The drier parts of Zimbabwe are the most affected and yields continue falling with decreasing rainfall amounts.
- **Population pressure on the land**  
The wetter parts of Zimbabwe such as the Eastern Highlands have experienced an influx of people due to high rainfall amounts received. Farmers have generally moved from the drier western parts of the country to the wetter eastern parts. This is increasing pressure on the land in the western region causing severe environmental threats.
- **Drying of water bodies**  
A decrease in the amount of rainfall and the rise of temperatures affects water bodies such as rivers, dams and lakes. Increasing evaporation leads to an increase in the amount of evaporation. This increased evaporation leads to a fall in the water level of lakes and dams. Lakes such as Chad, for example, have reduced water levels due to increasing aridity.

- **Increased incidents of diseases**

Increasing temperatures have increased the prevalence of diseases such as malaria and skin cancer. Mosquitoes breeds well under warmer conditions. Global warming has therefore increased the prevalence and resistance of pests and diseases. Skin cancer cases are increased by increasing temperatures due to global warming.

- **Destruction of property due to extreme events**

Extreme events include cyclones, floods and heat waves. Cyclones and floods destroy infrastructure and property.

- **Loss of biodiversity**

The term biodiversity refers to the different animal and plant species existing in given ecosystems. Due to changing climate some species finds it difficult to survive and they either migrate to other regions or perish.

## **Solutions to the effects of climate variability**

The effects of climate variability are diverse. There is need for well-coordinated plan of action to deal with climate variability. Drier regions experience low agriculture productivity and there is need for solutions to deal with aridity. The solutions to climate variability in Zimbabwe depend on the challenges within a good region. The solutions to the effects of climate variability include:

- Growing drought resistant crops in areas of low rainfall such as rapoko and sorghum
- Rearing drought resistant animals in areas of low rainfall such as tuli and mashona cattle breeds.
- Resettling people from areas of low rainfall
- Practicing irrigation in areas of low rainfall
- Vaccination against diseases in areas infested with pests and diseases such as the Zambezi Valley
- Putting legislation to control environmental degradation to reduce global warming
- Practicing afforestation and reforestation
- Use of early warning systems in areas experiencing extreme climatic hazards
- Practicing specialisation in terms of economic activities, for example areas with good climate can grow crops whereas areas of low rainfall practice ranching

### Exercise 1.5

- (a) Define the term climate variability. (1)
- (b) Outline the effects of climate variability. (6)
- (c) State the solutions to the effects of climate variability. (5)

### SUMMARY

- ✓ Weather hazards are extreme atmospheric conditions which causes danger, discomfort, damage and illness to humans, property and animals
- ✓ Tropical cyclones are weather hazards because they bring violent wind, thunder and lightning which destroys property and kill people
- ✓ Drought leads to hunger, starvation malnutrition and death to people and livestock
- ✓ Lightning conductors are used to protect property and life from the effect of lightning
- ✓ Floods affect low lying areas such as Muzarabani and Mount Darwin in Zimbabwe
- ✓ Economic activities are affected by climate variability
- ✓ Altitude and latitude lead to climate variability in Zimbabwe
- ✓ Zimbabwe's rainfall amounts vary from the East to the West with the east being wetter than the West
- ✓ There are various ways of dealing with climate variability which include practicing irrigation agriculture and growing drought resistant crops

### GLOSSARY

**Biodiversity:** it is the variety of plants and animals coexisting in an ecosystem

**Carrying capacity:** it is the maximum number of the available resources can support without facing environmental problems

**Cloud seeding:** it is the process of artificially applying condensation nuclei into the atmosphere so as to aid rain formation

**Deforestation:** it is the indiscriminate cutting down of trees to leave an area bare

**Global warming:** it is an increase in the average temperatures experienced by an area

**Drought:** it is a long period of time without rainfall

**Lightning:** it is the discharge of electric power from clouds in the sky to the ground

**Population pressure:** it is the pressure exerted on available resources by the number of people using the resources or living in an area

**Tropical cyclone:** it is an intensive low-pressure system associated with destructive winds, thunder and heavy rains

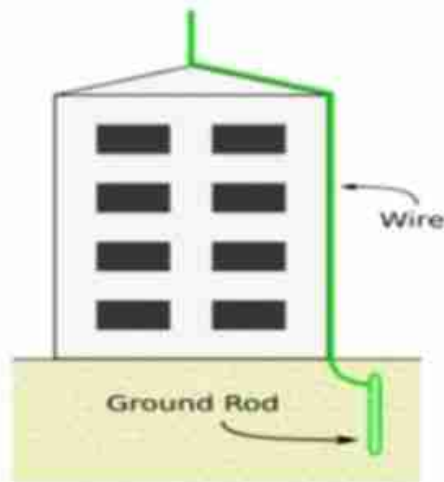
**Urbanisation:** it is the creation of towns and cities leading to an increase in the number of people living in towns and cities and a shift from the primary sector to secondary and tertiary sectors of the economy.



## Multiple Choice

- The most precious thing to save in case of a weather hazard is
 

A. Property	B. Livestock
C. Human life.	D. houses
- Name the weather hazard prevented using the method shown in fig 1.20 below



- |                     |              |
|---------------------|--------------|
| A. Tropical cyclone | B. Storm     |
| C. Thunder          | D. Lightning |
- Which of the following is a low-lying area vulnerable to floods in Zimbabwe?
 

A. Nyanga	B. Mount Darwin
C. Vumba	D. Marondera
  - The best way to assist people marooned by floods is
 

A. Waiting for the recession of the water	B. Evacuate them using helicopters
C. Provide weather forecast	D. Early warning system
  - Which one is not a weather hazard
 

A. Earthquake	B. Blizzards
C. Cyclones	D. Drought

## Structured Questions

- Define the terms global warming and weather hazard. (4)
  - Outline the nature of hazards caused by cyclonic weather conditions. (4)
    - Describe the causes and solutions to the effects of tropical cyclones. (6)
  - Describe the causes of climate change. (6)
    - What do you think should be done to reduce the dangers caused by floods.

(5)

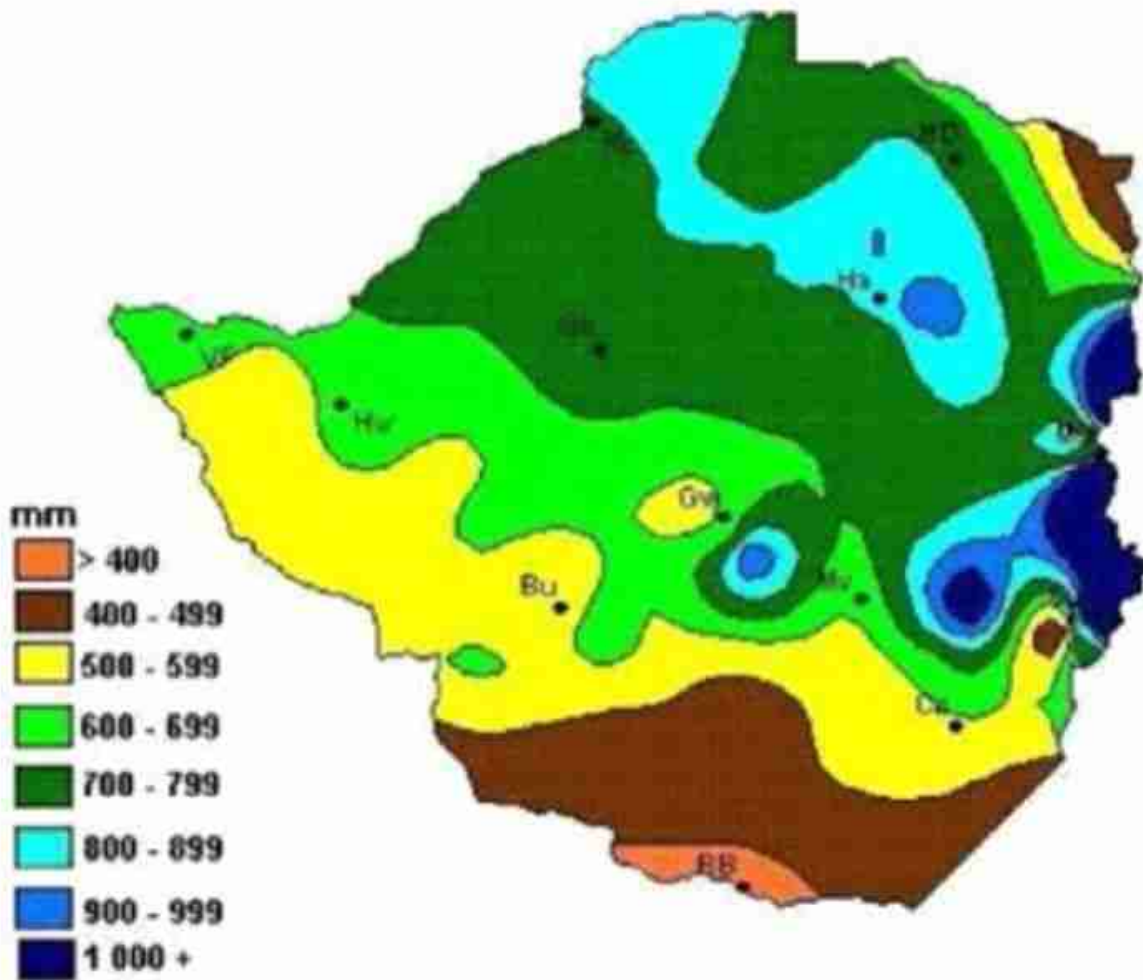


Fig 1.21

- (i) Describe the climate zones shown. (6)  
(ii) State the economic activities practiced in the above shown climatic zones. (4)
- b) Describe climate variability in Zimbabwe. (4)  
c) What are the effects of climate variability? (5)  
d) How can the effects of climate variability be reduced? (7)  
e) Describe the procedures you would take to protect your family from lightning (5)

# 2

## CHAPTER 2

### LANDFORMS AND LANDSCAPE PROCESSES

#### Objectives

By the end of this chapter, you should be able to:

- identify the main types of rocks.
- describe the formation of main rock types.
- describe the characteristics of various rocks under each main type of rocks.
- classify rock types.
- describe the main types of weathering.
- distinguish between mechanical and chemical weathering.
- describe Landforms resulting from weathering.
- illustrate the internal structure of the Earth with a diagram.
- describe the parts of the internal structure of the Earth.

#### Introduction

Rocks for different Landforms and influence the landscape. In New Trends in Geography Book 1 we looked at different Landforms and landscapes. This chapter looks at the different types of rocks and how they are formed. It also looks at different types of weathering and the resultant Landforms.

#### UNIT 2.1 ROCKS

A rock is the solid matter made up of joined minerals and or organic matter. Rocks break down to form soil. Rocks are ubiquitous resources that is useful for construction and forms a significant part of the Earth's crust. They form different Landforms depending on the processes operating on them and the nature of the rock. There are various types of rocks.

#### The Rock Types

The rocks are classified according to:

- mineral composition
- permeability
- texture of constituent particles
- particle size

There are three major types of rocks and these are:

- Igneous rock
- Metamorphic rock
- Sedimentary rock

## Igneous rocks

Igneous rocks are rocks formed from the solidifying magma. Red hot liquid rock called magma is ejected during volcanic activity. When the magma solidify on the Earth's surface extrusive igneous rocks are formed but when it solidifies beneath the surface, intrusive igneous rocks are formed. Intrusive granite rocks and extrusive granite rocks have different characteristics. Intrusively formed igneous rocks are coarse textured. They have big crystals visible by naked eye. This is a result of gradual cooling during formation. Extrusive igneous rocks develop very fine crystals due to the rapid rate of cooling since the lava forming the rocks is exposed to weather elements. Examples of intrusive igneous rocks are diorite, gabbro, granite, pegmatite, and peridotite.

Extrusive igneous rocks include andesite, basalt, dacite, obsidian, pumice rhyolite, scoria, and tuff.

## Intrusive igneous rocks

### Diorite

Diorite is a coarse-grained, intrusive igneous rock that contains a mixture of feldspar, pyroxene, hornblende, and sometimes quartz.



*Fig 2.1: Diorite rock*

### Granite

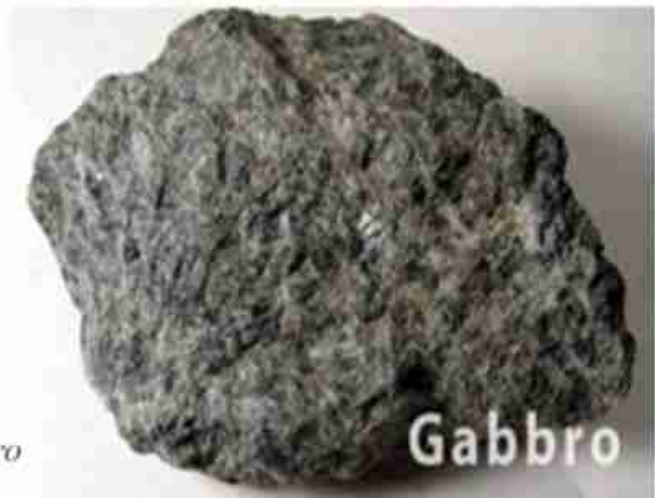
Granite is a coarse-grained, light-colored, intrusive igneous rock that contains mainly quartz, feldspar, and mica minerals.



*Fig 2.2: Granite rock*

**Gabbro**

Gabbro is a coarse-grained, dark-colored, intrusive igneous rock that contains feldspar, pyroxene, and sometimes olivine.



*Fig 2.3: Gabbro*

**Peridotite**

Peridotite is a generic name used for coarse-grained, dark-coloured, ultramafic igneous rocks. Peridotites usually contain olivine as their primary mineral, frequently with other mafic minerals such as pyroxenes and amphiboles. Their silica content is low compared to other igneous rocks, and they contain very little quartz and feldspar. Peridotites are economically important rocks because they often contain chromite. They are not only a source chromium ore; they can also contain diamonds, and, they have the potential to be used as a material for sequestering carbon dioxide. Much of Earth's mantle is believed to be composed of peridotite.



*Fig 2.4: An example of peridotite igneous rock*

**Pegmatite**

Pegmatite is a light-colored, extremely coarse-grained intrusive igneous rock. It forms near the margins of a magma chamber during the final phases of magma chamber crystallization. It often contains rare minerals that are not found in other parts of the magma chamber.

## Extrusive Igneous rocks

### Basalt

Basalt is a fine-grained, dark-colored extrusive igneous rock composed mainly of plagioclase and pyroxene.



*Fig 2.5: Basalt rock (fine grained and dark)*

### Dacite

Dacite is a fine-grained, extrusive igneous rock that is usually light in colour. It has a composition that is intermediate between rhyolite and andesite.



*Fig 2.5: Dacite rock (fine grained)*

### Andesite

Andesite is the name used for a family of fine-grained, extrusive igneous rocks that are usually light to dark grey in colour. They often weather to various shades of brown, and these specimens must be broken for proper examination. Andesite is rich in plagioclase feldspar minerals and may contain biotite pyroxene or amphibole. Andesite usually does not contain quartz or olivine



*Fig 2.6: Andesite igneous rock*

Andesite is typically found in lava flows produced by stratovolcanoes. Because these lavas cooled rapidly at the surface, they are generally composed of small crystals. The mineral grains are usually so small that they cannot be seen without the use of a magnifying device. Some specimens that cooled rapidly contain a significant amount of glass, while others that formed from gas-charged lavas have a vesicular or amygdaloidal texture.

### Obsidian

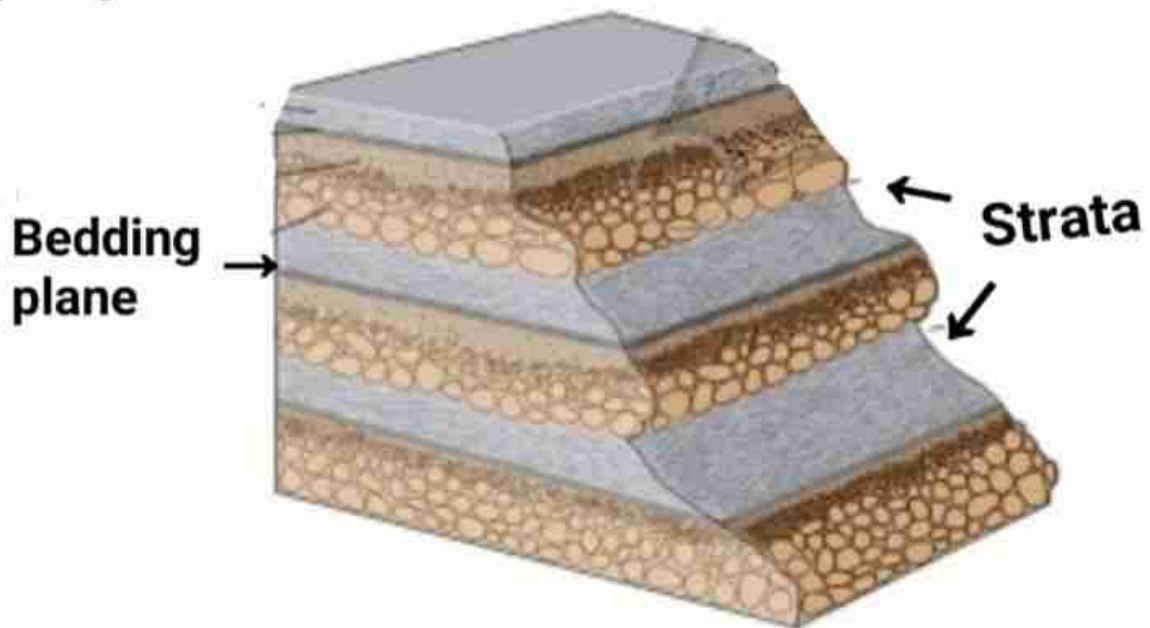
Obsidian is a dark-colored volcanic glass that forms from the very rapid cooling of molten rock material. It cools so rapidly that crystals do not form.



*Fig 2.7: Obsidian igneous rock*

### Sedimentary rocks

Sedimentary rocks are rocks formed from sediments derived from other rocks. The process whereby materials derived from other rocks through weathering and erosion are compacted together to form a rock is called sedimentation. The sedimentary rocks are common and some of them are important minerals such as coal. The formation of sedimentary rocks takes millions of years, sometimes involving the turning of fossils into a rock. Fossils are animal and plant remain. Sedimentary rocks contain bedding planes and strata. Strata are different layers made up of different sediments compacted together. Bedding planes are the boundaries or margins separating strata.



*Fig 2.8: Strata and bedding planes of a sedimentary rocks*






A bedding plane is the surface that separates successive layers of a stratified rock from its preceding layer. Strata are the horizontal layers or beds laid down as sediments accumulate.

Sedimentary rocks are grouped into three and these are groups are according to how the rocks are formed.



### Mechanically formed sedimentary rocks

These are the sedimentary rocks formed from pieces of weathered rocks and eroded rock fragments. The fragments are deposited where they are compressed to form a rock. Sedimentary rocks formed this way are also referred to as clastic sedimentary rocks. The size of sediments forming the rock determine the characteristics of the resultant rock. Rounded rock particles such as pebbles, gravel and boulders mixed with smaller sediments form conglomerate sedimentary rocks. The larger rock particles are joined together by smaller pieces. In some cases, sand particles deposited by water or by wind from long distance are cemented together to form sand stone. Breccia sedimentary rocks are formed by rock particles of varying sizes the same way conglomerates are formed. However, in this case the particles joining to form the rock are angular and sharper. Table 2.1 below shows the different types of mechanically formed sedimentary rocks.

Table 2.1: Mechanically formed sedimentary rocks

Rock example	Formation and description	Picture
Sand stone	It is formed from materials from other rocks. The particles are eroded and deposited, for example sand. Weathered rock particles also form the rock. Sand stone is porous.	
Conglomerate sedimentary rock	It is formed by varying rock particle sizes. Gavel, pebbles and boulders form this rock. The particles are joined together to form a rock.	
Breccia	It is made up of gravel, pebbles and boulders. These rocks are sharper and angular.	
Silt stone	It is formed from particles derived from other rocks through weathering. It is a fine- smooth rock because of silt particles contained.	
Shale	Shale is formed by clay and sand. It is reddish Brown in colour. It is smooth and fine textured.	



Banded iron stone	This rock is made up of quartz and iron. It is a hard rock	
Clay	It is a fine-grained rock found in water logging areas such as vleis	

### Chemically formed sedimentary rocks

Chemically formed sedimentary rocks are those rocks formed through chemical reaction. Water contain different minerals and when the water becomes stagnant, high temperatures evaporates the water. The chemicals contained in the water remain behind and they end up accumulating and being compacted to form a rock. The rocks formed through this process are crystalline and they include:

- **Limestone**

Limestone rocks are light coloured rocks containing calcium carbonate ( $\text{CaCO}_3$ ). They are formed when water containing calcium carbonate and calcium magnesium carbonate precipitates from the water. The water dissolve chemicals to form a solution. High temperatures lead to evaporation of water leaving the chemicals behind. The process whereby water evaporates from a solution is also referred to as precipitation. This should not be confused with the precipitation of water falling from the atmosphere to the ground.



*Fig 2.9: The limestone rock*

- **Chert**

This is a hard-fine grained sedimentary rock formed from the precipitation of water from a solution leaving behind silica. Chert is a well compacted rock.



*Fig 2.10: Chert a sedimentary rock*

- **Evaporates**

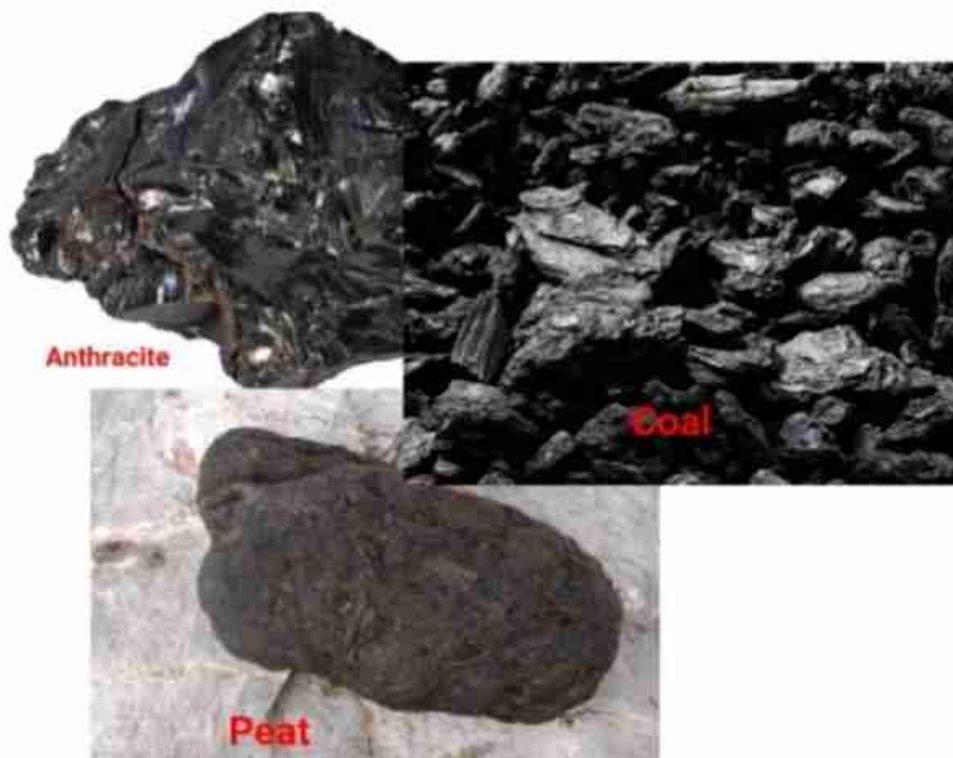
Evaporates sedimentary rocks are rocks formed from the evaporation of saline water. Water in oceans and lakes may contain salts. When the water evaporates from the lakes and seas it leaves behind salts which are cemented to form rocks such as rock salt and gypsum.



*Fig 2.11: Rock salt a form of evaporates sedimentary*

### Organically formed sedimentary rocks

These are sedimentary rocks made from plant and animal remains. They are also referred to as fossil rocks. Fossils are dead plant and animal remains. These are deposited and sometimes buried under the sea, lakes or ground. Over millions of years the plant and animal remain are compressed and turned into a rock. Sedimentary rocks formed this way include:



- **Coal**

Coal is a rock or mineral formed by degraded plants in the absence of oxygen. The plants decay and in the absence of oxygen turned into a rock which

contains carbon. The ideal environments for the formation of coal are swamps.

- **Peat**

This is a rock formed from decaying plants just like coal. It is fibrous and brown in colour. That is the characteristic of coal in its early stages of formation. Peat changes with time to become lignite which is a brown coal (bituminous).

- **Anthracite**

Anthracite is a hard, black coal formed from peat. Peat first turns into lignite which then turn into anthracite.

- **Limestone**

Limestone rocks are sedimentary rocks formed from animal remains. Remains from animals such as bones from aquatic organisms, for example, hellfish accumulates on the seabed. They are turned into a smooth limestone rock containing calcium carbonate.



*Fig 2.12: Organically formed sedimentary rocks*

## **Metamorphic rocks**

Metamorphic rocks are formed from the conversion of igneous and sedimentary rocks or other metamorphic rocks due to great heat and pressure. Great heat and pressure help to change the form and chemical composition of the rocks leading to the formation of a new rock type. The process of changing of the physical and chemical composition of a rock to form a new rock is called metamorphism. The changing of rocks through metamorphism alters the porosity, texture and density of the rocks. Metamorphic rocks are coarser, have high density and are less porous than rocks from which they are formed.

## **Process of Metamorphism**

The process of metamorphism does not melt the rocks, but instead transforms them into denser, more compact rocks. New minerals are created either by rearrangement of mineral components or by reactions with fluids that enter the rocks. Pressure or temperature can even change previously metamorphosed rocks into new types. Metamorphic rocks are often squished smeared out, and folded. Despite these uncomfortable conditions, metamorphic rocks do not get hot enough to melt, or they would become igneous rocks.

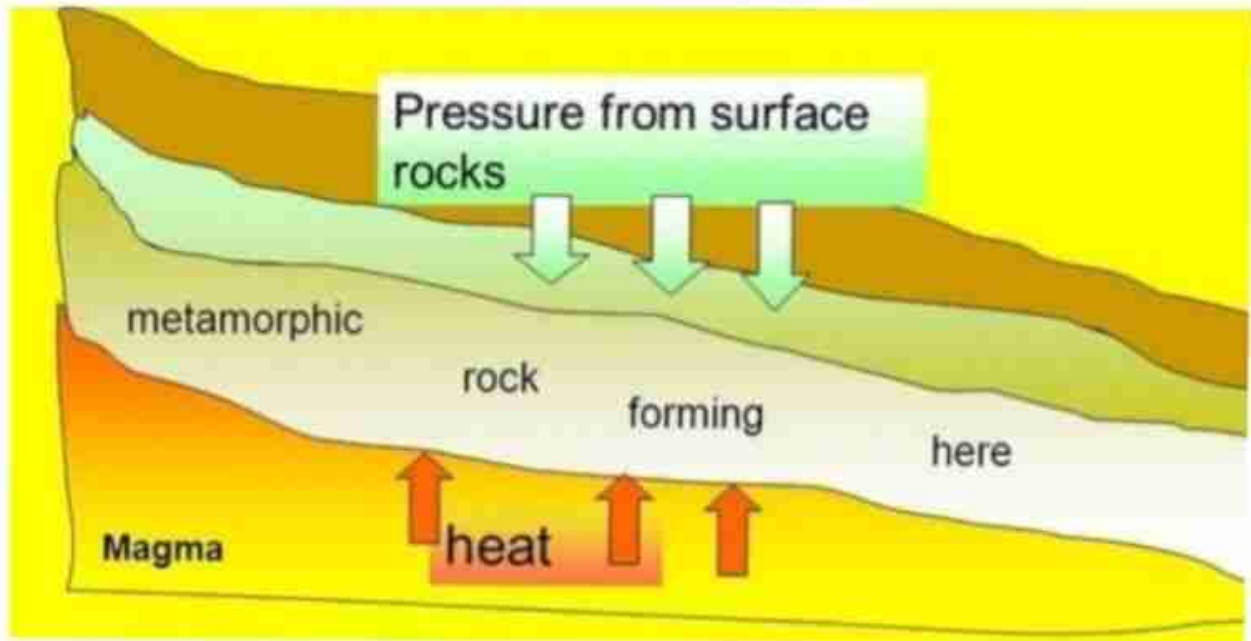


Fig 2.13: The formation of metamorphic rock

As shown in Fig 2.13 above metamorphic rocks are formed when igneous, sedimentary or metamorphic rocks are subjected to pressure and heat. Heat from below and pressure from the material burring the rocks lead to the process of metamorphism.

## Common Metamorphic Rocks

- **Foliated Metamorphic Rocks**

Foliated metamorphic rocks are strongly banded rocks. These include gneiss and schist. Foliated means the parallel arrangement of certain mineral grains that gives the rock a striped appearance. Foliation forms when pressure squeezes the flat or elongate minerals within a rock so they become aligned. These rocks develop a platy or sheet-like structure that reflects the direction that pressure was applied. Some of the foliated metamorphic rocks are:

- **Slate:** slates form at low metamorphic grade by the growth of fine-grained chlorite and clay minerals. The preferred orientation of these sheet silicates causes the rock to easily break along parallel planes, giving the rock a slaty cleavage. Some slate breaks into such extensively flat sheets of rock that it is used as the base of pool tables, beneath a layer of rubber and felt. Roof tiles are also sometimes made of slate.



- **Phyllite:** phyllite is a low-medium grade regional metamorphic rock in which the clay minerals and chlorite have been at least partly replaced by mica minerals, muscovite and biotite. This gives the surfaces of phyllite a satiny luster, much brighter than the surface of a piece of slate. It is also common for the differential stresses under which phyllite forms to have produced a set of folds in the rock, making the foliation surfaces wavy or irregular, in contrast to the often perfectly flat surfaces of slaty cleavage.
- **Schist:** Schist is a product of medium grades of metamorphism and is characterized by visibly prominent, parallel sheets of mica or similar sheet silicates, usually either muscovite or biotite, or both. In schist, the sheets of mica are usually arranged in irregular planes rather than perfectly flat planes, giving the rock a schistose foliation (or simply schistosity). Schist often contains more than just micas among its minerals, such as quartz, feldspars, and garnet.
- **Amphibolite:** it is a poorly foliated metamorphic rock, usually consisting largely of the common black amphibole known as hornblende, plus

plagioclase, plus or minus biotite medium-high metamorphic grades. Amphibolite is also listed below in the section on unfoliated metamorphic rocks.

- **Gneiss:** Gneiss is a high-grade metamorphic rock. Many types of gneiss look somewhat like granite, except that the gneiss has dark and light stripes whereas in granite randomly oriented and distributed minerals with no stripes or layers.
- **Migmatite:** It is a combination of high-grade regional metamorphic rock, usually gneiss or schist and granitic igneous rock. The granitic rock in migmatite probably originated from partial melting of some of the metamorphic rock, though in some migmatites the granite may have intruded the rock from deeper in the crust. In migmatite you can see metamorphic rock that has reached the limits of metamorphism and begun transitioning into the igneous stage of the rock cycle by melting to form magma.



*Fig 2.13: Foliated metamorphic rocks*

### **Non-Foliated Metamorphic Rocks**

Non-foliated metamorphic rocks do not have a platy or sheet-like structure. There are several ways that non-foliated rocks can be produced. Some rocks, such as limestone are made of minerals that are not flat or elongate. No matter how much pressure you apply, the grains will not align! Another type of metamorphism, contact metamorphism, occurs when hot igneous rock intrudes into some pre-existing rock. The pre-existing rock is essentially baked by the heat, changing the mineral structure of the rock without addition of pressure.

- **Hornfels:** hornfels are very hard rocks formed by contact metamorphism of shale, siltstone, or sandstone. The heat from the nearby magma heats the sedimentary rocks and recrystallizes the minerals in them into a new texture that no longer breaks easily along the original sedimentary bedding planes. Depending on the composition of the rock and the temperature reached, minerals indicative of high metamorphic grade such as pyroxene may occur in some hornfels, though many hornfels have minerals indicating medium grade metamorphism.
- **Amphibolite:** amphibolites are dark-coloured rocks with amphibole, usually the common black amphibole known as hornblende, as their most abundant mineral, along with plagioclase and possibly other minerals, though usually no quartz. Amphibolites are poorly foliated to unfoliated and form at medium to medium-high grades of metamorphism from basalt or gabbro.
- **Quartzite:** quartzite is a metamorphic rock made almost entirely of quartz, for which the protolith was quartz arenite. Because quartz is stable over a wide range of pressure and temperature, little or no new minerals form in quartzite during metamorphism. Instead, the quartz grains recrystallize into a denser, harder rock than the original sandstone. If struck by a rock hammer, quartzite will commonly break right through the quartz grains, rather than around them as when quartz arenite is broken.
- **Marble:** marble is a metamorphic rock made up almost entirely of either calcite or dolomite, for which the protolith was either limestone or dolostone, respectively. Marbles may have bands of different colours which were deformed into convoluted folds while the rock was ductile. Such marble is often used as decorative stone in buildings. Some marble, which is considered better quality stone for carving into statues, lacks colour bands.



*Fig 2.14: Non-foliated Metamorphic rocks*

Metamorphic rocks and the parent rocks from which they are formed are shown in table 2.2 below.

*Table 2.2: Metamorphic rocks and their parent rocks*

Parent rock	Metamorphic rock formed
Shale/ mudstone (sedimentary)	Slate
Granite (igneous)	Gneiss
Mudstone/ shale	Schist
Limestone (sedimentary)	Marble
Sandstone (sedimentary)	Quartzite
Mudstone/ shale (sedimentary)	Hornfels
Mudstone/shale (sedimentary)	Phyllite
Slate (metamorphic)	Schist
Basalt (igneous)	Schist
Coal (sedimentary)	Anthracite

### Importance of rocks

Zimbabwe has several rock types. These rocks are very important because lead to formation of a variety of Landforms such as those discussed in Unit 2.1 of this chapter. The Landforms are very important because they promote tourism. For example, Victoria Falls, Mutarazi Falls, Chinhoyi Caves and Matopos. Infrastructure such as bridges and stadia are build using materials from rocks. Roads are surfaced using materials from rocks and some rocks are a source of minerals. Table 2.3 below shows the different types of rocks, their functions and examples of features formed.

Rock	Descriptive example of function
Basalt	Forms the resistant layer of Victoria Falls
Sandstone	Forms the weaker eroded part of Victoria Falls
Limestone	Forms underground cavities such as Chinhoyi Caves
Granite	Forms part of the Great Dyke which contain minerals
Soapstone	Used to make sculptures
Coal	Is a sedimentary rock mined to produce Thermal Power at Hwange



**Task 2.1: Identifying rocks**

In your local areas collect at least 8 different rocks. Identify the type class (sedimentary, metamorphic or igneous) of each rock. After that try to name the rock such as granite, basalt or limestone.

**Exercise 2.1**

(a) State the metamorphic rocks formed from each of the following rocks.

Granite

Coal

Limestone

Basalt. (4)

(b) Describe how the following rocks are formed

(i) igneous rocks (4)

(ii) sedimentary. (4)

**UNIT 2.2****WEATHERING**

Weathering is the gradual disintegration and decomposition of rocks in situ. Weathering is a gradual process, taking thousands or millions of years for rocks to finally decompose. The rocks affected either disintegrated or decompose depending on factors such as the nature of the rock and climate. To disintegrate is to break into smaller particles and to decompose is to decay usually due to chemical reaction. The rocks decompose and break down in situ, that is without moving.

Weathering takes place through different processes depending on the type of weathering. There are three types of weathering and these are:

- Physical weathering
- Chemical weathering
- Biological weathering

**Physical weathering**

Physical weathering is the breaking down of rocks without changes in their mineral or chemical composition. Rocks contain different minerals or chemicals. For example, granite contains mica, feldspar and quartz. Physical weathering leads to the breaking down of rocks without affecting the chemicals inside the rock. The rocks break down to form different sizes of particles such as grains and blocks. The

processes of physical weathering include:

- **Insolation**

Insolation is the process whereby continuous heating and cooling causes rocks to expand and contract weakening them to cause disintegration. This process is also called thermal shattering or temperature changes. It is common in arid and semi-arid areas where diurnal temperature extremes are experienced. Day temperatures in these regions are extremely high, reaching up to  $40^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ . These high temperatures are due to clear skies. The regions also experience low night temperatures, falling to  $0^{\circ}\text{C}$ . Night temperatures falling because clear skies allow solar radiation received during the day to escape back into the atmosphere as long wave radiation. The increase and decrease of temperature continuously weaken the rocks.

Increasing temperatures cause rocks to expand and falling temperature causes rocks to contract. Joints develop due to the continuous process of expansion and contraction. The joints are parallel to the rock surface and are called curvilinear

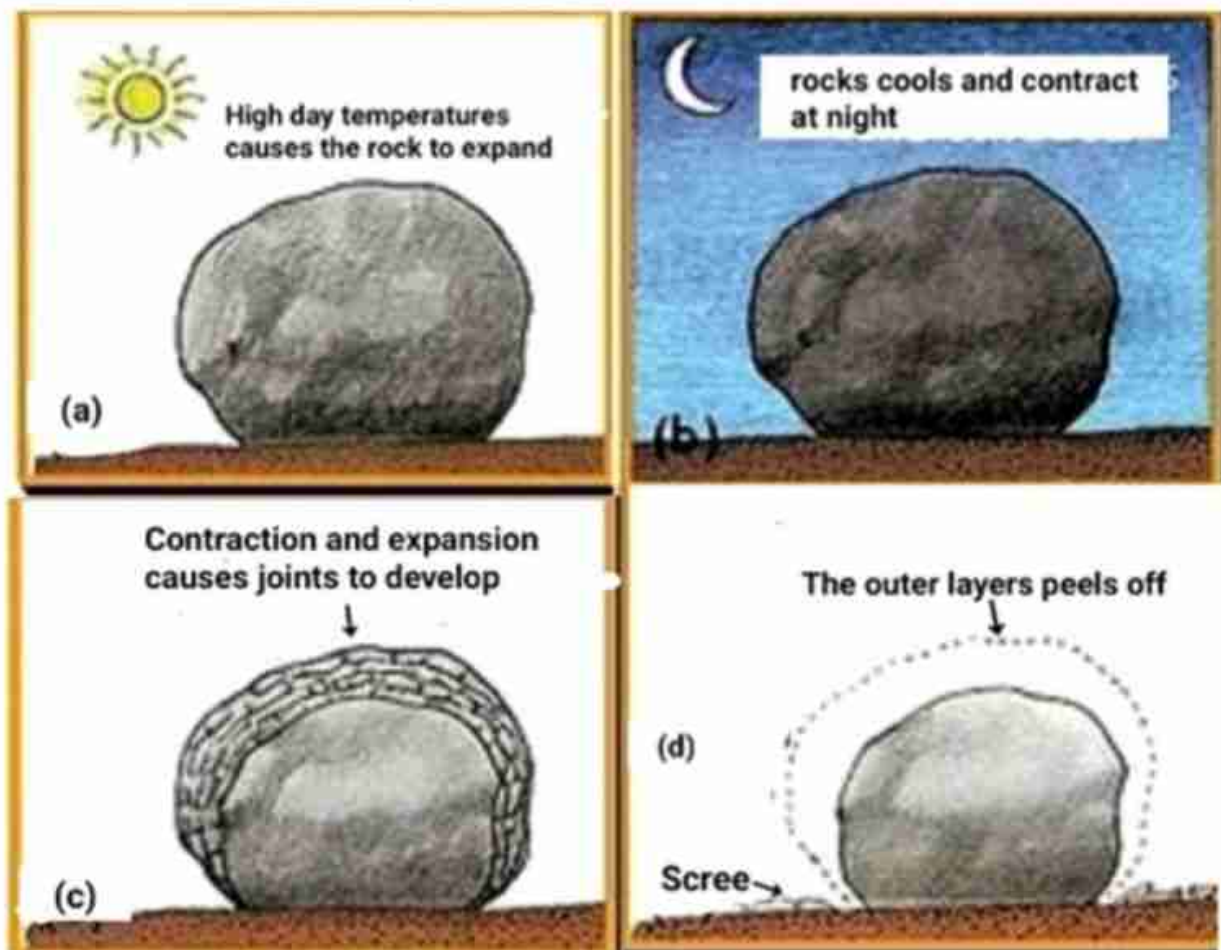


Fig 2.15: Insolation leads to exfoliation

In fig 2.15 (a) during the day the sun heats the rocks causing them to expand, at night the rocks contract as shown in fig 2.15 (b) due to low temperatures. Expansion and contraction lead to the development of joints as shown in fig 2.15 (c). The joints weaken the rock and the outer layers peel off as shown in fig 2.15 (d).

The peeling off of the outer layers of the rock is called exfoliation or onion weathering. The outer layers of the rock peels off like the layers of an onion. Exfoliation leads to the formation of exfoliation domes. Insolation forms fallen slabs, block and granular disintegration.

- **Frost Action**

Frost Action is the process whereby water in liquid form enter rock joints to freeze inside the joints causing the enlargement of joints. Water in liquid form occupies less space but when it freezes it occupies more space hence it forced rock joints to enlarge thereby causing the rock to break. This process is also referred to as freeze thaw. It is common in areas experiencing moderate rainfall and where temperatures frequently fall o freezing point. For frost action to take place the rocks should have joints to hold water (fig 2.16)

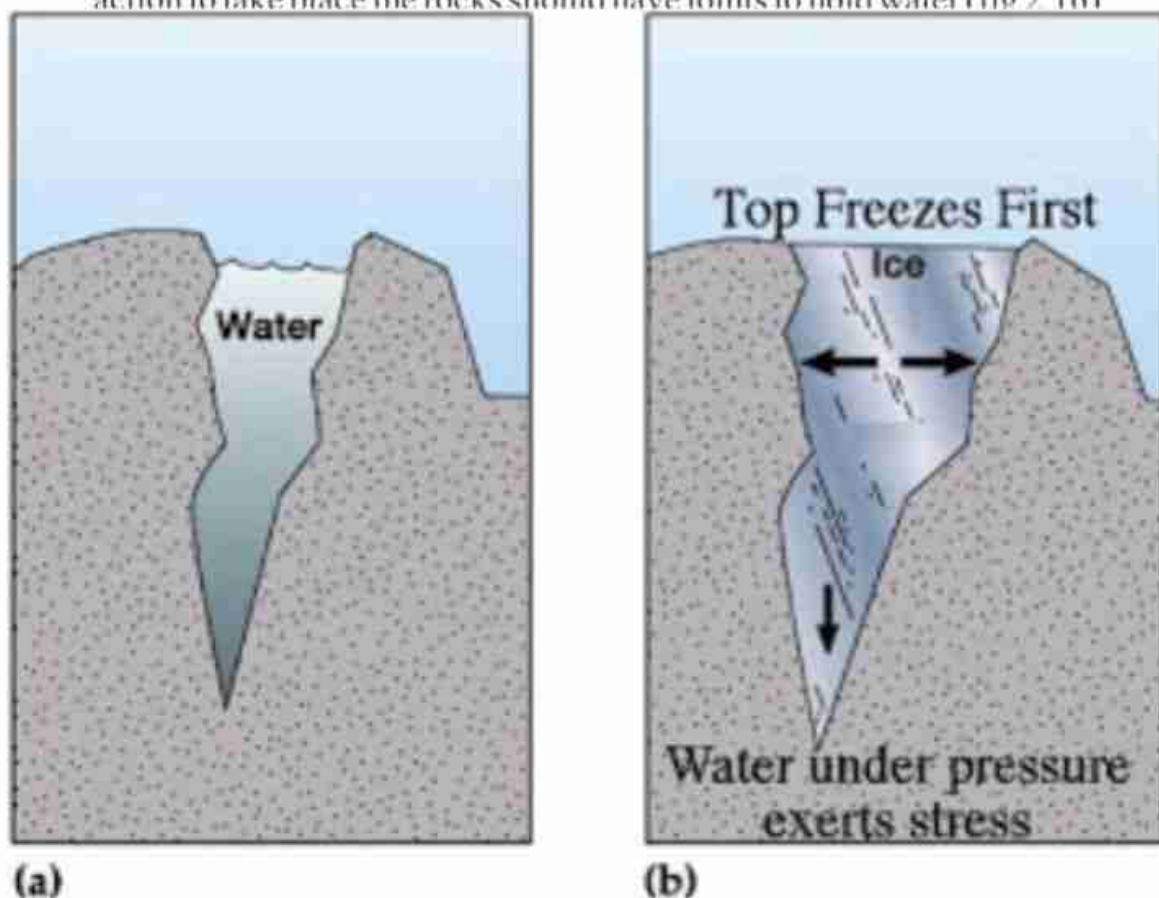



Fig 2.16: Frozen water occupies more space hence forces joints to grow



As shown in fig 2.16 above frozen water occupies more space thereby forcing rock joints to enlarge. As the joints grow bigger, part of the rock ends up breaking from the major rock in a process called block disintegration. When small grains are formed it is called granular disintegration.

- **Pressure release or dilatation**

Dilatation is the process whereby rocks formed underground expand due to their exposure to the surface by erosion. Plutonic rocks are under great pressure from the materials burring them (over burden) and the pressure compresses them. When the rocks are later exposed by erosion, they are relieved of the pressure so they expand. During expansion joints develop. The joints weaken the rock and when they are formed around the surface of the rocks, exfoliation may take place just like under insolation.

- **Salt crystallisation**

Salt crystallisation involves the accumulation of salt crystals inside rock joints. In arid and semi- arid regions high evaporation rates leads to high rate of capillary action. Capillary action draws water from the ground to the surface. This water contains salts formed by processes such as eluviation and illuviation. The water containing the salts enters rock joints and when the water evaporates it leaves behind salts crystals. As the salt crystals accumulate, they exert pressure on the rock enlarging the joints. The rock will end up breaking down along the enlarging joints. When the salts alter the chemical composition of the rock, chemical reactions occur causing the rocks to decompose chemically. Hence salt crystallisation is both a physical and a chemical process.

## **Chemical weathering**

Underchemical weathering rocks decay due to chemical Al reactions rakinglace.Rocks contain chemicals, for example, limestone contains calcium carbonate and granite contain mica, feldspar and quartz. Chemical weathering targets such chemicals and weaken them. For such chemical reactions to take place there is need for warm- humid conditions. It is said when there is moisture, for every 10°C increase in temperature the rate of chemical reaction increases by twice or thrice. The chemical weathering processes include:

- **Solution**

Solution is the process whereby rocks are weathered by dissolving to form a solution. Soluble rocks such as rock salt easily dissolve in water. The presence of weak acids such as humid and carbonic acids in water help in the

dissolving of rocks. Humic acids are formed when water reacts with humus and carbonic acids are from acidic rain formed when carbon dioxide from air pollution reacts with water. The moisture or water containing acids enters the rocks and affect the chemicals inside them causing decomposition.

- **Carbonation**

The process of carbonation involves carbonic acids in rainfall reacts with calcium carbonate in limestone to form calcium bicarbonate. Calcium bicarbonate is soluble hence it dissolves in the carbonic acids and is carried away in solution.

- **Hydrolysis**

This is a chemical weathering process whereby hydrogen in water reacts with minerals. This reaction weakens the rocks causing them to decompose. Feldspar which is contained in granite reacts with water to form clay. The other minerals contained in granite disintegrate.

Hydrolysis is another key reaction associated with chemical weathering. When water (H<sub>2</sub>O) separates into H<sup>+</sup> and OH<sup>-</sup> ions, the elements can react with ions in the minerals and destroy their atomic compositions, usually forming new minerals. This is what happens when feldspar and hornblende come into contact with water. They form clay, a new mineral.

- **Salt crystallisation**

This is both a chemical and physical process. The physical aspects of this weathering were discussed under physical weathering process. The salts accumulating inside rock joints affect the chemicals inside the rock. This causes the rocks to decompose.

- **Oxidation**

Oxidation is a chemical weathering process involving the reaction of iron contained in the rock with oxygen contained in water. The reaction between iron and oxygen forms iron oxide (rust). The reaction is shown as:



Rusting affects the metals by weakening them and causing them to decay. Rocks containing iron are weakened by the formation of rust. The conditions necessary for oxidation to take place therefore include the presence of water and oxygen and high

temperatures to speed up the chemical reaction.

- **Hydration**

It is the chemical weathering process involving water entering the rock leading to the weakening of the rock. Porous rocks absorb water during the wet periods and swell. During the dry periods rocks contract. The process of expansion and contraction weakens the rock. It also affects the chemicals contained inside the rocks thereby causing the decomposition of the r

### Biological weathering

Biological weathering involves the disintegration and decomposition of rocks due to the actions of flora and fauna. Plants and animals cause rocks to weather. In some cases, biological processes are either classified as mechanical or chemical processes.

### Exercise 2.2

- (a) (i) Define the terms weathering and defoliation (20)  
 (ii) List the 3 types of weathering (3)
- (b) Describe the following weathering processes  
 Insolation            frost action            solution  
 carbonation            salt crystallization (10)

## UNIT 2.2.1 PHYSICAL AND CHEMICAL WEATHERING

Chemical and physical weathering are two different types of weathering. The differences between the two are shown in table 2.1 below.

Table 2.1: The difference between physical and chemical weathering

Physical weathering	Chemical weathering
<ul style="list-style-type: none"> <li>• It does not the rock's chemical composition</li> <li>• It is active even in dry conditions</li> <li>• It causes the disintegration of rocks into smaller particles</li> <li>• It is dominant even in areas where temperatures oscillate around zero degrees Celsius</li> </ul>	<ul style="list-style-type: none"> <li>• Affects the rock's chemical composition</li> <li>• It is active under moist conditions</li> <li>• It causes the decomposition of rocks</li> <li>• It is dominant in areas where temperatures are always high</li> </ul>

<ul style="list-style-type: none"> <li>• It takes place on rocks exposed at the surface</li> <li>• Most processes are active in arid and semi- arid areas</li> <li>• It is active even where there is sparse vegetation cover</li> </ul>	<ul style="list-style-type: none"> <li>• It takes places even on underground rocks</li> <li>• Its rate is high in humid tropics</li> <li>• It is more active where there is dense vegetation cover</li> </ul>
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Physical and chemical weathering are different as shown in table 2.1 above. The rate of physical weathering tends to be high in arid and semi-arid areas where processes such as freeze thaw, thermal shattering (insolation) and salt crystallization are active. Low rainfall and temperature fluctuations breaching extremes increases the rate of such weathering processes. Physical weathering leaves the chemical or mineral composition of the rock intact whereas chemical weathering target rock chemicals causing them to decompose. Chemical weathering is dominant in humid tropics. These are regions which receives high rainfalls of above 1600mm per year and high temperature above 26 degrees Celsius. High temperatures and high rainfall increase the rate of chemical reaction.

### Deep weathering

Deep weathering is the process whereby underground rocks are chemically weathered whilst they are underground. It is one of the characteristic features of chemical weathering distinguishing it from physical weathering. It is also called subsurface weathering. Water containing acids such as humic and carbonic acids infiltrate and percolate through rock pore spaces and joints to affect the chemicals inside the rocks. As a result, the rocks decompose underground. Deep layers of weathered material called regolith are formed. The regolith reaches 60 meters of depth. The conditions favouring the development of deep regolith in humid tropics include:

- **High amounts of rainfall**

Constant moisture presence facilitates decomposition of rocks. Rocks in humid tropics are constantly under humid conditions hence they decompose faster to form deep regolith.

- **High temperatures**

Constantly high temperatures increase the rate of chemical decomposition forming deep layers of regolith.

- **Tectonic stability**

Tectonic stability entails rare occurrence of folding, faulting and earthquakes. This helps the regolith to accumulate without disturbances.

- **Presence of vegetation**

Vegetation facilitates both the accumulation of deep regolith and the occurrence of deep weathering. Vegetation provides humic acids from

### Exercise 2.3

- What is deep weathering. (2)
- State the factors which lead to formation of deep regolith in humid tropics. (4)
- Distinguish between physical and chemical weathering. (6)

## UNIT 2.3 WEATHERING LANDFORMS

Weathering leads to the formation of different landforms. These landforms vary in form and size according to the rock type. The feature formed by weathering are so distinctive on granite and limestone rocks.

### Landforms formed in areas of granite rocks

In areas of granite rocks the following features are formed:

- **Dwala**

Dwalas are dome-shaped surfaces of bare rock. They are also called ruware. They are low lying, rising to less than 5 meters above the surrounding surfaces. They are usually surrounded by soil with their sides buried under the soil. Dwalas are formed when rocks buried underground are exposed due to erosion. The rocks buried and underground where formed through solidification of magma.



*Fig 2.19: Dwala (Matobo National Park)*



- **Castle Kopje and tors**

Tors/kopjes/castle kopjes are inselbergs. Tors are the same as kopjes even though some sources attempt to distinguish between the two. Different names are applied in different localities to what are essentially the same landforms. **Kopje** is an Afrikaans word meaning a small isolated hill made of granite rock piles. **Tor** is a Scottish word meaning hill. They appear as a large, free-standing outcrop that rises abruptly from the surround smooth and gentle slopes of a rounded hill summit or ridge crest. They are resistant rock features that have been made by weathering. They are usually less than 5 meters in height.



*Fig 2.20: Castle Kopje (Matopos- Zimbabwe)*

- **Tafoni**

These are strange cavernous structures formed on granite rocks. Coarse granular granite rocks experience differential weathering. This is when one part of the rock is weathered faster than the other part due to differences in mineral composition. The part containing the darker mica in granite heats faster than the light-coloured quartz hence



*Fig 2.20: Tafoni showing honey comb pattern*

differential weathering takes place. The part being weathered faster is curved into a deep where a series of these depressions occur on granite, a complex structure looking like a honey comb is formed. Granite landforms are found in many parts of Zimbabwe which include Domboshava, Mutoko, Ndanga, Zaka, Makoni, Marange, Nyanga, Njelele, Tsholotsho and Rutenga. Granite is important for construction. Mutoko is the source of black granite used in

construction and tombstone making.

### Landforms formed in limestone regions

Areas where limestone is the major rock are referred to as karst regions. The nature of limestone lead to the formation of specific features and these are:

- Limestone pavements
- Underground caves
- Underground streams
- Gorges
- Sink holes, uvalas, poljes and dolines

### Limestone pavements

Limestone pavements are series of furrows called grikes and ridges called clints, formed on limestone rocks due to carbonation occurring along the joints. The parts along the joints are weathered leaving the unjointed parts standing to form ridges.

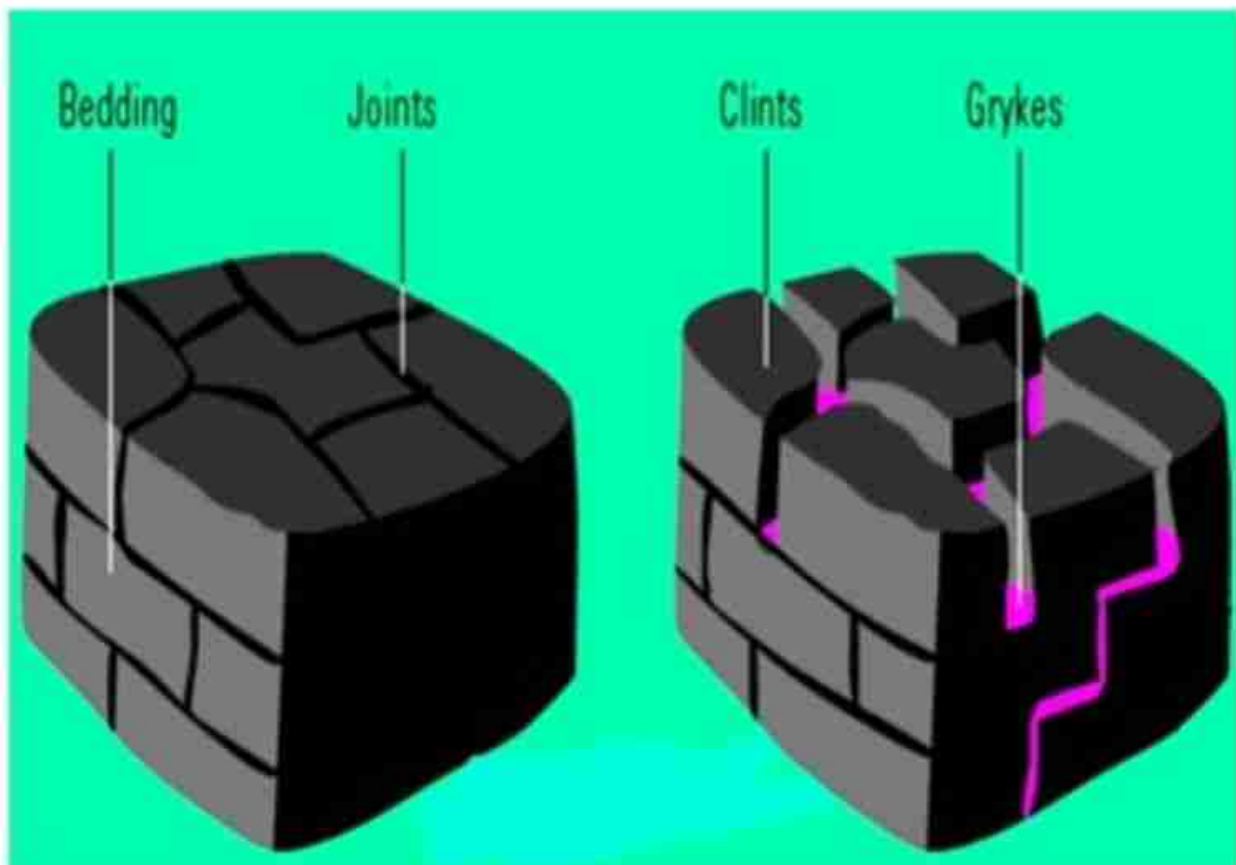


Fig 2. 23: Limestone pavements

## Underground caves

Underground caves are also called caverns. These are formed from weathering being active underground, curving the interior of the limestone rock into an opening. These underground caves tend to have lines of weakness on which solution continues to take place at the roof of the cave. Materials dissolve by acids such as carbonic acids drip from the roofs of the caves to the floor of the cave. Calcium carbonate contained in limestone easily dissolve to form a thick solution containing soda. The solution dripping from the roof to the cave floor accumulate to form spike like features growing from the ground called stalagmites. At

the roof of the caves the thick porridge of dissolved rock minerals grows downwards and these are called stalactites. Stalactites and stalagmites later join to form pillars.

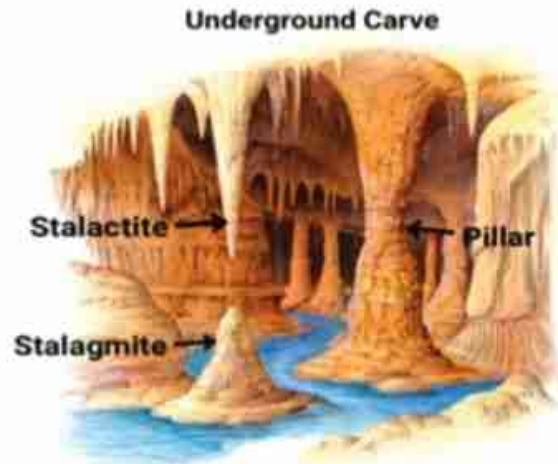


Fig 2.24: Underground cave with stalactites and stalagmites

Chinhoyi caves is a good example of the underground caves. The underground caves are of great importance. Some of them are part of our heritage bearing crucial historic implications such that they become major tourist attractions. They are also important for learning. To understand underground caves better you may need to plan an educational tour to Chinhoyi caves.

## Underground rivers

Karst regions are usually associated with underground streams. When streams reach limestone rocks, they disappear into depressions formed by solution called swallow holes. Swallow holes are depressions formed along joints by the process of carbonation and solution. Water accumulates on the joints wearing them away through carbonation to form swallow holes. They are called swallow holes because they appear to be swallowing the streams. The rivers may flow for longer distances underground. Fig 2.4 above shows an underground river emerging in an underground cave. A good example of an underground river is Puerto Princess River in the Philippines.

### Case Study: Underground River (Puerto Princess)

*The Puerto Princesa Subterranean River National Park is a protected area of the Philippines located about 80 kilometres north of the city center of Puerto Princesa, Palawan. The river is also called Puerto Princesa Underground River. The national park is located in the Saint Paul Mountain Range on the western coast of the island. It is bordered by St. Paul Bay to the north and the Babuyan*

*River to the east. The City Government of Puerto Princesa has managed the National Park.*

**Adopted from: [www.whc.unesco.org](http://www.whc.unesco.org)**

### Gorges

The roofs of underground caves collapse to form gorges which are deep- steep sided depressions. These gorges may contain water is at the flow of the carven there is a river.

### Sink holes, uvalas, dolines and uvalas

A sinkhole or a cenote, swallet, swallow, or uvala is a depression or hole in the ground caused by some form of collapse of the surface layer. Most are caused by karst processes, for example, the chemical dissolution of carbonate rocks. Sinkholes vary in size from 1 to 600 m in diameter and depth, and vary in form from soil-lined bowls to bedrock-edged chasms. Sinkholes may form gradually or suddenly, and are found worldwide.



*Fig 2.25: Sinkhole (Madrid, Spain)*

*Source: [www.wikipedia.org](http://www.wikipedia.org)*

The features formed by weathering on both limestone and granite rocks are of great economic importance. They attract tourists and provide materials for building. Limestone provides some of the most important building materials and is used in different industrial processes.

### Task 2.2: Identification of landforms

In your local areas take photographs of different landforms. Make an album of the landforms of different landforms. Below the pictures state its location, name and the rock type. You may take at least three photographs per land form type but the landforms should be different.

### Exercise 2.4

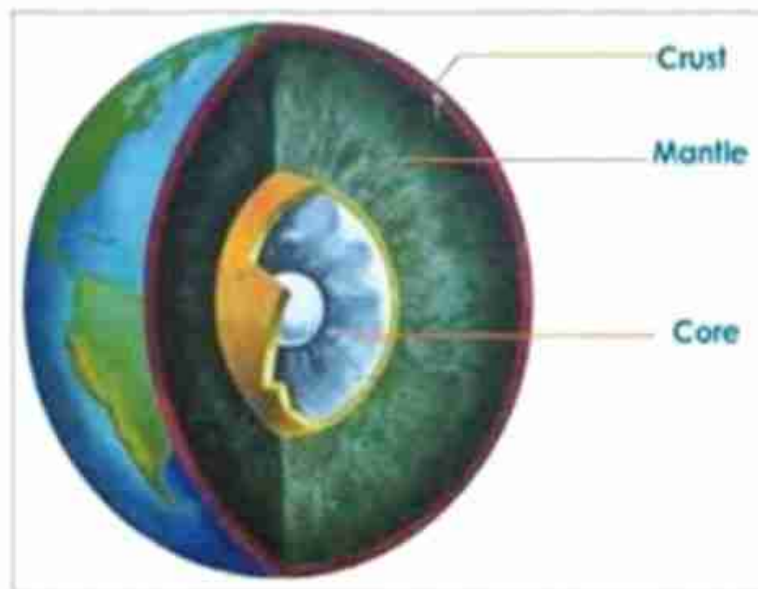
- State any 3 features formed in areas of granite rocks. (3)
- With the aid of diagrams, describe any 2 granite and limestone landforms. (8)

## UNIT 2.4 THE STRUCTURE OF THE EARTH

The earth is a sphere or spheroid as shows in fig 2.25 below. Early scientists believed the Earth was flat but advanced studies later proved the Earth is indeed a sphere in space with other planets. Galileo was one of the early philosophers to discover that the Earth is a sphere. Later on, scientists were able to get information about the Earth's interior. Some clues about the Earth's interior are found from activities such as:

- Volcanic activity
- Earthquake
- Mining
- Borehole drilling

The Earth's interior is made up of 3 major components shown in fig 2.26 below.



*Fig 2.26: The structure of the Earth*

### The core

The core is divided into two; the inner core and the outer core. The inner core is also referred to as the center of the Earth. This layer is in solid form, and experiences high temperatures reaching 5500 degrees Celsius. It is made up of iron and nickel and covers 1400km in diameter. The outer core is about 2000km thick and temperatures ranging from 4500 degrees Celsius to 5500 degrees Celsius are experienced. Though it is made up of iron and nickel, it is in liquid or plastic form.

### The mantle

This is the layer found after the outer core as we move outwards from the centre of the Earth as shown in fig 2.29 above. This layer is made up of semi-liquid rocks. Iron and

magnesium are the major minerals making up this slayer. It is about 3000 km thick. Where the mantle is separated from the crust temperatures are around 500 degrees Celsius whereas near the outer core the mantle experiences about 4000 degrees Celsius. The mantle is separated from the crust by a layer called the Mohorovic discontinuity.

### The crust

The crust is the outer layer of the Earth. This layer is divided into two; the continental crust and the oceanic crust. This layer makes the different plates. The continental crust ranges from a thickness of 40km to 70km. The oceanic crust is made up of heavier rocks of basaltic origin whereas the continental plate is made up the granitic rocks. It is, made up of silica and magnesium yet the continental crust is made up of silica and aluminium. The summary of the layers of the Earth's interior is shown in table 2.2 below.

Table 2.2: The layers making the structure of the Earth

Layer of the Earth	Characteristics
Inner core	It is the centre of the Earth. It experiences temperatures of up to 5500C It is solid and is made up of iron and nickel It is 1400km in diameter
Outer core	It is liquid or plastic in nature Its temperatures range from 4500C to 5500C It is about 2000km thick It is made up of iron and nickel
The mantle	It is made up of semi-solid rocks It is about 3000km thick It is made up of iron and magnesium Temperatures are between 500C and 4000C
The crust	Is the outer layer Made up of the continental and oceanic crust

### Exercise 2.5

- (a) Draw a well labelled diagram to show the structure of the Earth (5)  
 (b) Describe the parts of the Earth you have labelled in (a) above in terms of size, temperature and mineral composition (12)

### SUMMARY

- ✓ The three major types of rocks are igneous, sedimentary and metamorphic
- ✓ Igneous rocks are formed from solidifying liquid rock called magma
- ✓ Sedimentary rocks are formed from particles from other rocks and organic matter
- ✓ Metamorphic rocks are formed through the conversion of igneous, metamorphic and sedimentary rocks through great heat and pressure
- ✓ Sedimentary rocks are mechanically, chemically and organically formed
- ✓ The major types of weathering are chemical, biological and mechanical weathering
- ✓ Physical weathering involves the disintegration of rocks without changing their chemical composition
- ✓ Chemical weathering involves the decomposition of rocks due to chemical reaction
- ✓ Deep weathering is the form of chemical weathering which occur to rocks buried under the ground
- ✓ The physical weathering processes include insolation, freeze thaw and dilatation
- ✓ Chemical weathering processes include oxidation, hydrolysis, hydration, carbonation and salt crystallization
- ✓ Features formed by weathering vary from on rock type to another
- ✓ Limestone pavements, poljes, uvalas, dolines, underground caves, stalactites and stalagmites are formed in karst regions
- ✓ Castle kopjes, tors, dwalas and bonhardts are formed by weathering of granite rocks
- ✓ The Earth is a spheroid and its interior is made up of different layers
- ✓ The inner core, outer core, the, mantle and the crust are the layers of the Earth

**GLOSSARY**

**Block disintegration:** It is the process of physical weathering whereby huge angular boulders fall off from the major rock

**Capillary action:** it is the upward movement of water or moisture from the ground to the surface

**Denudation:** it is the process of stripping or removing layers of soil or other materials to make the deeper surfaces bare

**Erosion:** It is the wearing of the top soil by water, wind and animals

**Exfoliation:** It is the peeling of the outer layers of the rock

**Granular disintegration:** it is the process of physical weathering involving the breaking down of rocks into very small particles called grains

**Karst regions:** these are areas with limestone rocks

**Magma:** it is red- hot molten rock which solidifies after ejection by volcanic activity to form rocks

**Metamorphism:** it is the process by which rocks change their physical and chemical form

**Regolith:** this is a layer of weathered materials found in their original position

**Talus:** these are weathered rock particles also called scree or debris

**Weathering:** it is the gradual disintegration and decomposition of rocks in situ



## TEST

## Multiple Choice

1. The diagram below shows a granite rock which is in a tropical region.



Fig 2.27

The process responsible for the formation of curvilinear joints in fig 2.27 above is

- A. Carbonation                      B. chelation  
C. exfoliation                        D. freeze thaw

2. Study the table below and answer the following questions

Month	J	F	M	M	J	J	A	S	O	N	D
Temp (C)	26	26	25	27	27	27	26	25	24	26	26
Rainfall (mm)	200	160	140	155	200	210	100	156	180	160	200

- A. Exfoliation                                      B. freeze- thaw  
C. hydrolysis                                      D. pressure release
3. Which of the following is a landform formed in Karst regions?
- A. Cavens    B. tafoni  
C. castle kopjes                                      D. dwalas



- b) Describe the following weathering processes;
- (i) Frost action
  - (ii) Insolation
  - (iii) Oxidation
  - (iv) Carbonation (12)
9. a) Distinguish between physical and chemical weathering (4)  
 b) Study fig 2.29 Below which shows a process of weathering



*Fig 2.29*

- (i) Name the weathering process taking place. (1)
  - (ii) Describe the process taking place. (5)
- c) (i) Draw a labelled diagram to show the structure of the Earth. (4)  
 (ii) Describe the layers of the structure of the Earth. (6)
- d) Describe the economic importance of any one rock found in Zimbabwe. (5)

## ECOSYSTEMS

**Objectives**

By the end of this chapter, you should be able to:

- identify habitats in a local ecosystem
- local biomes in Africa
- identify inputs, processes and outputs in each biome
- explain the adaptation of vegetation and animals in each biome
- describe sustainability of ecosystems
- identify strategies for conserving local forests
- construct fireguards around the school
- plant trees in the locality
- control local erosion
- identify potential business from local ecosystem
- design a small business using local ecosystems
- run a small business using local ecosystems

**Introduction**

In Book 1 we defined an ecosystem as a community where there is interaction between biotic and abiotic organisms. This means that ecosystems are made up of a variety of organisms interacting. The interaction leads to the existence of different types of ecosystems with different inputs, processes and outputs. This chapter looks at habitats in local ecosystems, biomes, inputs, processes and outputs in biomes, sustainability of ecosystems, conservation of ecosystem and entrepreneurship linked to ecosystems.

**UNIT 3.1****BIODIVERSITY**

Biodiversity refers to the total variety of animal and plants on Earth. It is also referred to as biological diversity. It is measured by the count of species in an area. The number of species in an area gives species richness. Kenya, for example has 1000 species of birds whilst forests of Great Britain and eastern North America are home to fewer than 200 species. There are various diversity aspects within a given biome. A biome is a large, naturally occurring ecosystem comprising of plants and animals living in a specific habitat. The aspects of diversity within a given biome are:

- habitat diversity
- species diversity
- generic diversity

## Habitat diversity

The term habitat refers to shelter or home for living organisms. Habitat diversity refers to the total variety of habitats for organisms within a given biome. Different organisms require certain conditions to survive. There various example of habitats for organisms and they include:

- hedgerows
- woodlands
- wetlands
- freshwater
- coastal habitats
- grasslands

Within these macro habitats there are micro habitats. For example, within woodlands there are openings or holes which form habitats for small objects such as lizards and insects. Tree trunks are habitats for many organisms whereas bigger organisms such as mammals find shelter from trees and caves. Habitat diversity is important because:

- It enables a variety of organisms to survive and breed
- It leads to the existence of many species within a given area
- It enables the conservation of plant and animal resources
- It promotes the interaction amongst organisms

## Species diversity

It is the number of species and the abundance of each species that are found in a particular ecosystem. The number of species that live in a certain location is called species richness. The term abundance refers to the number of individuals of each species. For example, there might be 1000 black rhinos in Hwange National Park. Species diversity can be considered on a small scale, such as a forest or on a large scale where the totality of all species on Earth are considered. There are about 1.8 million different species classified on Earth. Scientists continue discovering new species every year. There between 5 and 30 million species on Earth including those that are unclassified, according to estimates. Each year approximately 13000 new species are added to the known list. In 2013 the green palm-pit snake was discovered in Honduras. In 2014 the olinguito was see discovered in Columbia and Ecuador.

Tropical rainforests are habitats for more species and most of the new species are discovered in these regions. The tropical rainforests cover 7% of the total land on Earth. It is however home to 50% of the species on Earth. For example, Costa Rica is home to over 1,400 species of orchids, 1200 species of butterflies and 600 species of birds. Africa is also home to a number of species. Parts of Africa have tropical rainforest biomes, for example, in DRC, Equatorial Guinea and Nigeria. These biomes are home to different species of reptiles, mammals, birds and insects. The

Savanna due to varying climatic conditions is able to support a variety of species. The varying seasons in Savanna climate enable various organisms to survive. During the cold winters those organisms which do well under cold conditions thrive and they hibernate during the hot season. The biomes in Savanna therefore support a number of species including those which do well under warm conditions and those which favour the cool conditions.

### Genetic diversity

A gene is defined as a physical and functional unit of heredity. Genes are passed on from one generation of organisms to another. In biodiversity there are various organisms with varying genes. In a biome that has more organisms there is a wide pool of genes. Genetic diversity means that there are many organisms within an ecosystem which are unique. Genetic diversity is important because:

- Genes determine the ability of an organism to survive under given conditions
- A variety of genes allows species to cross breed giving new species
- Genetic diversity leads to existence of more unique species

### Exercise 3.1

- a) Define the following terms:
  - (i) Biodiversity
  - (ii) Habitat diversity
  - (iii) Gene diversity (6)
- b) Why do you think habitat diversity is important? (6)

### Task 3.1: Local Species diversity

Spend at least an hour in your garden for 3 days. Try to identify the different species of insects that are present in your garden. Take note of differences in their colour, size, body, and feeding habits. Record the number of different species that you come across.

How many species of insects were you able to identify?

**UNIT 3.2****BIOMES IN AFRICA**

Africa has a number of biomes. The varying climatic conditions across the continent leads to the existence of different biomes. Fig 3.1 below shows the different biomes found in Africa. These include the tropical rainforest, tropical grasslands, and tropical deserts.

### Tropical Grasslands

The tropical grasslands are also known as the Savanna ecosystem or tropical continental ecosystem. These biomes cover most of Africa and Zimbabwe has that type of ecosystem. It is located in areas between  $10^{\circ}$  and  $23.5^{\circ}$  north and south of the equator. Countries with this type of biome are Zimbabwe, Zambia, Botswana and Malawi.

### Natural inputs of Savanna

The rainfall amounts received in the Savanna varies. The Savanna biomes receiving high rainfall receives up to 1200 mm per year whereas the drier savanna receives below 700 mm. this rainfall is received in summer. The summer are warm receiving temperatures up to  $27^{\circ}\text{C}$  and moist receiving most of the rainfall. The winters are dry and cool. Whereas savanna generally receives rainfall in summer and is dry in winter, there are variation. Savanna include:

- **Guinea Savanna**

This is the savanna which receives rainfall amounts between 1000 mm and 1200 mm per year. Average temperatures reach  $27^{\circ}\text{C}$  and the temperature range is small.



*Fig 3.1: Guinea Savanna*

- **Grassland savanna biomes**

These receive rainfall between 600 mm to 1100 mm per year. This climate has clear winter and summers. Temperatures reach  $30^{\circ}\text{C}$  in summer whereas winter temperature falls to below  $10^{\circ}\text{C}$ .



*Fig 3.2: Grassland savanna biome*

- **Acacia Savanna biome**

Summer temperatures of between  $33^{\circ}\text{C}$  and  $20^{\circ}\text{C}$  are experienced. Rainfalls between 250 mm to 500 mm.



*Fig 3.3: Acacia savanna biome*

### Processes in savanna

Savanna biomes are marked by a number of processes. Veld fires are common in these biomes especially at the onset of summer. Tall grass which is common in savanna support grazing. Human processes such as mining and construction are also common in these biomes. Soil erosion is also high during the beginning of summer season.

### Outputs

Tall grass and scattered trees are common in savanna. This type of ecosystem has a large variety of animal and plant species. The reasons for large numbers of different plant and animal species in savanna include:

- Availability of a variety of food for organisms
  - Availability of a variety of habitat for organisms
  - Good climatic conditions
  - Different seasons facilitate existence of species needing varying conditions
- This biome comprises of the vegetation type shown in fig 3.4.



*Fig 3.4: Tropical savanna*



## Adaptation of Organisms in savanna

Organisms in tropical savanna adapt to suite the conditions experienced in these biomes. The ways in which the organisms adapt include:

### Adaptation by plants

- **Trees shed their leaves in winter**  
Winters in savanna are dry. During that season trees shed their leaves so as to reduce the rate of transportation. They will grow leaves at the onset of the summer season.
- **Trees grow long tape roots**  
The tress in savanna grow long tape roots to enable the trees to draw water from the ground during the dry season. Frequent droughts in parts of the savanna also mean that trees have to adapt to avoid drying during the dry spells.
- **Trees develop thick bucks**  
The thick barks assist the tress to resist veldfires which are frequent in savanna. The trunks also store water hence savanna trees develop huge trunks such as baobab and amarula.
- **Trees have needle shaped trees**  
Trees in the savanna develop needle shaped or small leaves. Such leaves have a small surface area exposed to the sun. this minimize the rate of transpiration.
- **Umbrella shaped trees**  
The trees in savanna are umbrella shaped. This is to keep the area under the tree protected from the sun. this reduces the rate of evaporation from under the tree.
- **Trees have thorns**  
The trees are thorny to prevent destruction by animals.
- **Vegetation lies dormant in the dry season**  
Some vegetation in the savanna are dormant during the dry season. The rate of growth is reduced. Some even stop reproduction. Grass dry during the dry season and become green during the rainy season.

### **Adaptation by animals**

Savanna climate has plenty of food for animals. It supports both grazers and browsers. Grazers feed on grass whereas browsers feed on trees. Because savanna has both grass and trees, it supports more animals. The presence of herbivores attracts carnivores such as lions, cheetahs, and leopards. These animals adapt for survival in the savanna. Giraffes have very long necks to enable them to access time leaves for food. Some animals change their skin color to match the changes of vegetation with seasons.

### **Tropical rainforest**

These are the biomes located between 0 and 10 north and south of the equator. Countries experiencing this type of biomes include the Amazon Basin, DRC, Equatorial Guinea, Nigeria, and West Africa.

### **Natural inputs**

Tropical rainforest receives rainfall throughout the year, the rainfall amount receives per year ranges from 1800 to 2500 mm per year. The temperatures are high throughout the year; hence the annual temperature range is very small. Maximum temperatures reach 27°C and minimum average temperatures are between 24°C and 25°C. this gives low temperature ranges of 2°C to 3°C. moist conditions prevail throughout the year leading to high and trees do not shed leaves because they are always green hence humus content does not reach savanna levels. The soils in these biomes are latosols.

### **Processes in Tropical rainforests**

The processes active in tropical rainforests include weathering and leaching. Weathering is the gradual decomposition and disintegration of rocks in situ. In tropical rainforest both surface and sub-surface weathering is active due to prevailing conditions. High temperatures and rainfall increase the rate of chemical reaction hence chemical weathering is high. Processes such as eluviation and leaching are also active. Leaching leads to the loss of soil nutrients in area where forests are cleared.

Human activities are also affecting tropical rainforests. Processes such as commercial logging and mining are also practiced in tropical rainforest.

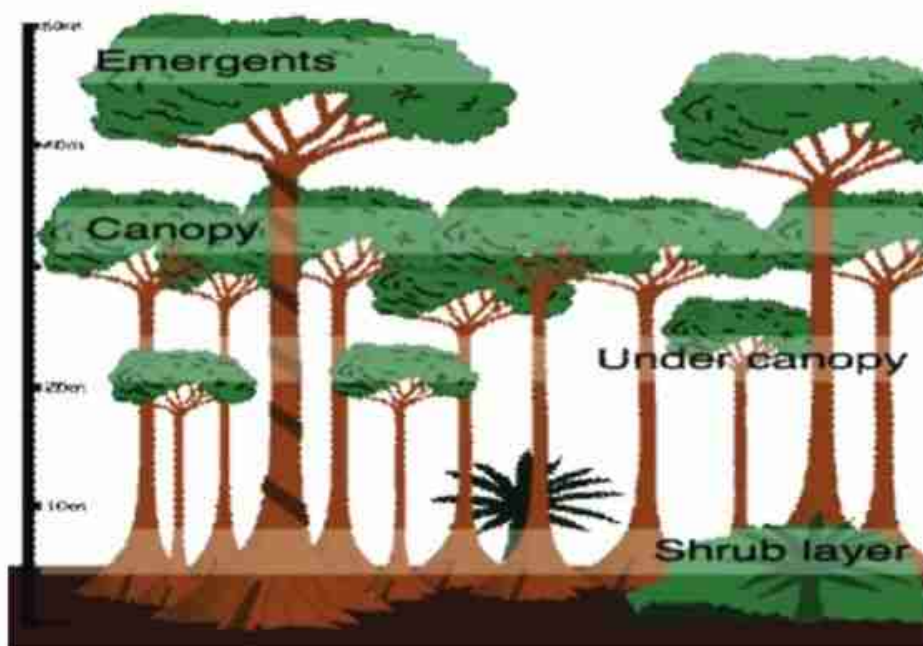
### **Outputs**

Tropical rainforest biomes are dense forests comprising of 3 layered vegetation. The thick forests area results of high rainfall and high temperatures which increases the rate of plant growth. The dense forests attract a number of species. They provide home and food to a variety of species thereby becoming biological diversity reserves. The diversity of species is estimated to be above 180 species per hectare. These are species of both plants and animals. Medicines, honey and wood are extracted from these biomes. The thick forests provide the breeding ground for different species.



*Fig 3.4: There is biological diversity in Tropical Rainforests*

The vegetation develops 3 layers which are the shrubs, canopy and emergency. The three layers of tropical rainforests are shown in fig 3.5 below.



*Fig 3.5: Multi-layered tropical rainforest vegetation*

**The emergent**

These are the tall trees in a tropical rainforest. They reach up to 45 m high. They grow tall to reach out for sunlight and also because the conditions in these regions promote rapid growth of vegetation. The vegetation has broad leaves meant to increase the surface area for transpiration to take place. Because of low sunlight penetration to the floor of the forests, there is limited undergrowth save for fungi (mushrooms). Animals in these biomes use the tall trees to spot prey and to hide from predators.

**The canopy**

This layer comprises of the upper and lower canopy. The upper canopy reaches about 30m. Like the emergent, trees in this layer have broad leaves and have tall trunks which gets slender from the ground. Most of the animals are found in this layer. These include monkeys, snakes, chameleons, and other small mammals. They are found in this layer because it offers a good habitat and camouflage from the thick leaves. The lower canopy has narrow crowns. Animals are also found in this layer because there is plenty of food.

**Shrubs, climbers and undergrowth**

This layer of tropical rainforest vegetation is found on and near the ground. The shrubs are short plants which include ferns. There is very little undergrowth in these biomes. This is because there is lack of sunlight at the surface of these biomes. Climbers grow up the tree trunks to reach the top of the trees. Micro-organisms are active at the ground, for example, fungi due to abundant moisture and high temperatures.

**Adaptation of organisms in tropical rainforests**

Plants and animals adapt to survive in tropical rainforest biomes. Adaptation by plants include:

- Developing broad leaves to increase the rate of transpiration to increase the rate of loss of excess water
- Trees develop buttress roots to support the tall trees and also because there is no need for them to search for water underground.
- The trees grow very tall due to competition for sunlight
- The tree trunks are smooth to allow the draining of excess water
- The tree leaves are leathery to withstand very high day temperatures

**Animals adaptation include:**

- Animals change colour to match the vegetation so as to avoid predators and to catch prey, for example, chameleon
- Some organisms imitate other organisms, for example, some worms look like droppings of birds to avoid being eaten by birds
- Developing strong poison, for example, frogs develop strong poison for protection against predators



Fig 3.6: Adaptation of organisms in tropical rainforest biomes

### The importance of tropical rainforests

Tropical rainforests are important because:

- They are habitat to a lot of species
- They provide food to a lot of species
- They provide a sanctuary for endangered species
- They are a source of medicines
- They are a source of food, for example, honey
- They help to fight climate change and global warming by absorbing carbon dioxide.

### Exercise 3.2

- (a) With the aid of a diagram, describe the vegetation in the tropical rainforest. (6)
- (b) Describe the following processes occurring tropical rainforest. Given reasons for
  - (i) Leaching (3)
  - (i) Weathering (3)

**Task 3.1: Local Biome Identification**

From what you have studied so far,

Identify the type of the ecosystem (biome) your local area falls under. Make a list of the features which justify your classification of your local ecosystem. Identify ways in which human being are influencing the structure of your local ecosystem.

**Tropical desert**

Tropical deserts are ecosystems found 20 to 30 degree north and south of the equator. In Africa these include Sahara, Kalahari and Namib Desert.

**Natural inputs**

Desert ecosystems receives very low rainfall which is below 250 mm per year. In deserts day temperatures are very high, reaching up to 40C whereas night temperatures fall to 0C due to clear skies. Very high day temperatures and low night temperatures give a very high daily temperature range, for example 40C (40C- 0C). Humidity is very low. Though they have a great potential for high evaporation and transpiration, the rates are very low due to lack of water sources.

**Processes**

Various processes are active in deserts. Though they are arid, they occasionally receive rainfall which leads to rapid growth of plants. The plants grow very fast, mature and die to wait for the next occurrence of rain to grow again. The organisms in these biomes exchange nutrients but they have adapted to store nutrients in their bodies for as long as possible. Processes such as capillary active are rapid, where minerals and nutrients are drawn from the ground to the surface creating laterites. Weathering also occur but the soil remains unfertile because of less humus and also because the rate of physical weathering is predominant.

**Outputs**

Low rainfall and high temperatures limit the growth of vegetation. Scrub is characteristic of deserts. There is less biodiversity in deserts due to harsh climatic conditions. Reptiles and some mammals survive in deserts.

**Adaptation of organisms**

Planta and animals have adapted to desert conditions in various ways which include:

- Developing small stomata to reduce the rate of transpiration
- Plants store water in their roots or tubers
- Trees develop waxy leaves to reduce transpiration
- Trees develop long tape roots to draw water from underground
- Plants develop needle shaped leaves to reduce the rate of transpiration
- Plants grow and mature very fast

Some of the plants which have adapted well to the arid biomes of deserts are:

- **Euphorbia**

These are plants containing melkbos in their stems. Melkos in a milky fluid meant protect the plant. Rhinos eat the plant.



*Fig 3.7: Euphorbia plant*

- **Welwitschia**

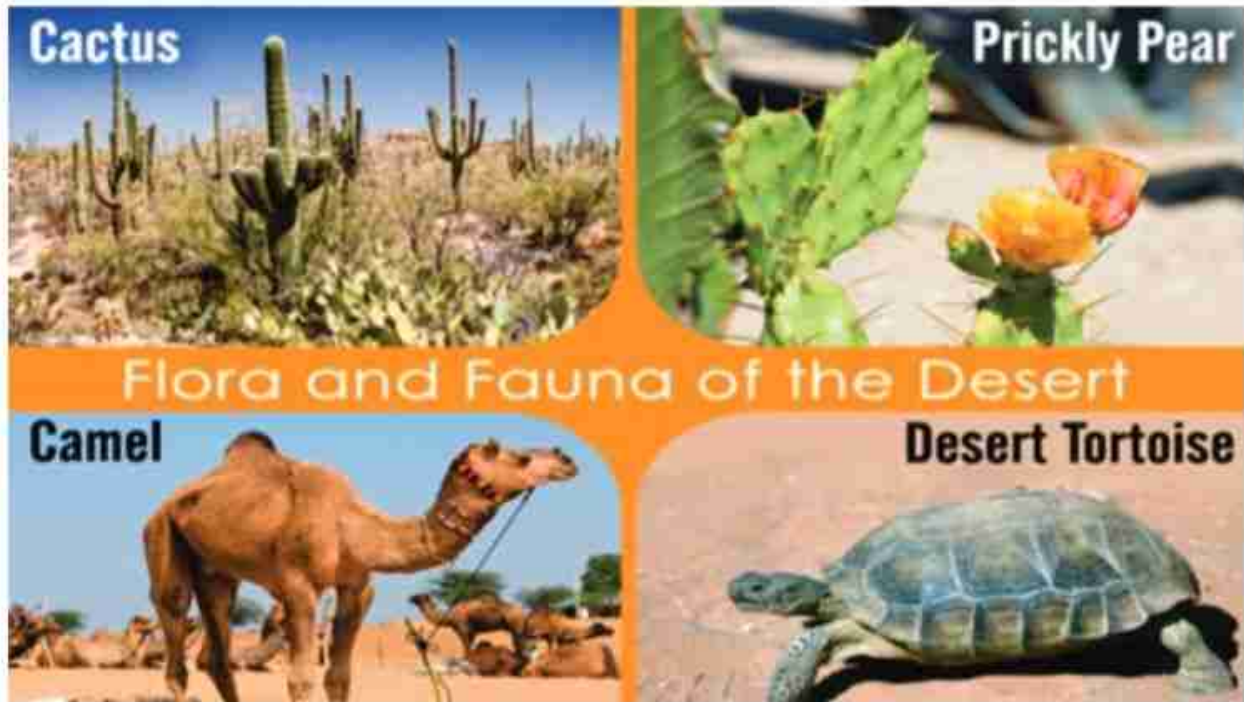
This is a plant with large leaves and deep roots. It is eaten by animals.

- **Wara**

This is a plant which grow in the sand and has very long tap roots to draw water. It stores water in its fruits and small desert mammals and insects eat the fruits.

Animals have also adapted to desert condition through:

- Storing water in their bodies
- Developing broad hooves so as to avoid sinking in the sand, for example, camels
- Developing protective eyelids, for example, the desert eagle. To protect eyes from dust storms when flying
- Changing skin colour to match the colour of the soil, for example, snakes
- Reducing sweating by closing sweat glands



*Fig 3.8: Flora and fauna that has adapted desert conditions*

Some animals which have adapted to desert conditions include:

- Camels: these mammals have padded feet, flapped nostrils, humps, spiky hairs to cool the body
- Scorpions: desert scorpions have hard shell surface to protect against the sun
- Gemsbok: these are mammals surviving on very little water.
- Shrew: small mammals which as long snouts to dig up insects.

### Human activities in deserts

Desert biomes have been used for a number of activities which include mining, motor racing, weapon testing, film making, tourism and scientific researches.

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## The Case of Deserts

### Biomes Facts

The desert biome is an ecosystem that forms due to the low level of rainfall it receives each year. Deserts cover about 20% of the Earth. There are four major types of desert in this biome - hot and dry, semiarid, coastal, and cold. They are all able to inhabit plant and animal life that are able to survive there.

### Interesting Desert Biome Facts:

- Although the daytime temperatures of the desert biome are very hot, they can get very cold at night.
- The Sahara Desert is the largest desert in the desert biome. It covers over 300 million square miles.
- The vegetation does not grow very tall so the desert biome can only accommodate small animals, rodents, and reptiles. These animals can escape the harsh Sun by hiding under small scrubs or hiding in burrows.
- Many desert animals tend to be nocturnal, sleeping during the day and coming out at night when the temperatures are more tolerable.
- Because there is hardly any standing water in the desert biome, animals either store water in their bodies or get their water needs met by the foods they eat.
- Dust storms occur when the wind picks up dust from the surface. These storms can be up to 1 mile high and travel over a hundred miles.
- The plants that are able to grow in the desert biome store water in their stem. They normally grow spaced out so that their roots can extend and find water.
- Some deserts are so hot that when it rains, the water evaporates in the air before ever hitting the ground.
- There are some deserts in Antarctica that are known as cold deserts. They are considered deserts because of the small amount of vegetation that grows there.
- The driest desert on Earth receives on average 1 centimetre of rainfall every 5 to 20 years.
- Because body fat retains heat, most desert animals have an adaptation that allows them to store all their body fat in one area of their body. The camel stores all its body fat in its hump.
- Cacti have many adaptations to survive in the desert. Their spines protect them from being eaten by animals and their waxy outer covering keeps moisture from escaping.
- Cold deserts (like in Antarctica) have very little plants and grasses. The ones they do have only grow during the summer.
- The desert biome is actually a big tourist attraction. People enjoy rock climbing, dirt biking, and hiking in the desert.
- The desert biome can be found on every continent except Europe.

Source: [www.softschools.com](http://www.softschools.com)

## UNIT 3.3 SUSTAINABILITY OF ECOSYSTEMS

The sustainability of ecosystems involves their ability to continue existing in a better state for future generation of organisms to enjoy using the same ecosystem. Apart from plants and animals ecosystems are also support human beings. We depend on ecosystems for resources. Natural resources such as forests, wildlife, air, water, and the sun are all aspects of ecosystems. Through our exploitation of these resources, we exert pressure on the ecosystems. Generations after generation we depend on ecosystems. This means that there is need for us to ensure that when we exploit the natural resources we do it in a way which ensures that future generations will able to use the same resources. Human activities such as construction, mining, agriculture, manufacturing and fishing are likely to have severe negative effects on the ecosystems if they are not well managed. Components of the ecosystem need to be allowed to continue existing in a better state. Human impacts should not degrade the ecosystems such that they continue existing.

Ecosystems are made up of biotic and abiotic components. The biotic components are plants and animals. The abiotic components include water, air and soil. All these components can be degraded by human activities if they are not sustainably utilized. Sustainable utilization of plants involves practicing afforestation and reforestation as well as using alternative sources of energy. This enables forests to regrow. Animals are **sustainably** managed through allowing them to breed and protecting their habitats. Water, air and soil components of ecosystems are **sustainably** utilized through protecting them from pollution. If these components are not protected from the adverse effects of human activities, they will be degraded causing severe negative reactions within ecosystems. Issues such as climate change and global warming will affect the ecosystem causing extinction of some species hence threatening biodiversity.

As we have seen there is a strong relationship between humans and the environment. There is interdependence between man and the environment. There is need for man to wisely manage the environment and this is done through:

- **Legislation**  
Environmental legislation involves enacting laws which control the exploitation of resources which are part of the environment. Different countries enact different acts to protect the environment. International treaties, conventions and protocols are also signed. Zimbabwe's supreme environmental law is the Environmental Management Act and the Environmental Management Agency (EMA) is responsible for enforcing the law. There are many other acts which seek to protect ecosystems from harmful effects of certain human activities such as the Mines and Minerals

Act which aims to protect the environment from the harmful effects of mining.

- **Improvement of technology**

Improvements in technology increases efficiency of equipment used. For example, the invention of electric cars and trains reduced the amount of air pollution this protects the ecosystems from harmful effects of pollution.

- **Public awareness**

This involves providing the communities with knowledge on how well they should protect their environment to conserve ecosystems. They are also made aware of the importance of protecting ecosystems. The communities became active in protecting ecosystems if they are provided with the knowledge.

- **Habitat protection**

Sustainability of ecosystems is ensured through the protection of habitats. Forests and marine ecosystems are habitat to a variety of species. Most species struggle to survive because of lost habitats. The habitats are protected through proper waste disposal afforestation, creation of nature reserves, and construction of fireguards to protect forest.

### Exercise 3.3

- In what ways can ecosystem sustainability at a local scale be ensured? (7)
- Why do you think it is important to sustainability use ecosystems? (6)

## UNIT 3.4 LOCAL FORESTS CONSERVATION

Forests are important in any ecosystem. They provide habitat and food to a number of organisms. They help to absorb carbon dioxide hence helping to fight climate change. Forests are under threat from increasing population which means an increase in the demand for wood and land for farming. Growing urban settlements are also encroaching into woodlands. The rate of deforestation increases as settlements grow. Veld fires also destroy forests. In savanna veldfires are common at the onset of the summer season. These fires burn large areas destroying forests. They are either natural or man-made. Man-made veld fires are intentionally and unintentionally started. There is a belief that burning the dried grass increases the rate of growth of new grass when the rains come. People therefore intentionally start veldfires hoping for better pastures when the rains come. Intentional veldfires are also started by

hunters wishing to expose animals and to make hunting with dogs easier. Natural processes such as lightning as start veld fires.

Local forests conservation involves efforts to protect forests so as to avoid their depletion. Conserving local forests involves taking efforts to wisely exploit forests and to protect them from degradation by veldfires and deforestation. To conserve forests at local scale the following ways are important:

- **Use of alternative sources of energy**

This involves reducing the dependence on wood as a source of energy. Solar energy and biogas can be used and this conserves forests at local level.

- **Afforestation and reforestation**

The growing of trees where there have never been trees is called afforestation and reforestation is the growing of trees where trees have been cut down. Replacement of trees through reforestation ensures that forests are maintained and afforestation increases the forests available locally.

- **Setting green belts**

A green belt is an area that is set aside from forest clearance. Urban sprawl is stored from clearing forests at the margins of the urban build up area. These green belts help to conserve forests around urban areas.

- **Setting up nature reserves**

Nature reserves are areas set aside to provide a good environment for wildlife to survive. Nature reserves allow forests to grow without much disturbances.

- **Selective firewood extraction**

To avoid deforestation there is need to selectively extract wood. When extracting firewood, cut down old and dying trees and let the young ones grow. More mature trees yield more wood hence fewer are needed. Pruning branches rather than cutting down entire trees is also helpful.

- **Construction of fireguards**

A fireguard is a preventive measure to stop veld fires crossing over into a forest area. Fire guards work in such a way that an area is cleared of any grass and trees such that when a veld fire reaches the fire guard, the flames are weak and easy to manage. The fire may even die upon reaching the fireguard since there is no grass to keep the fire burning.

### How to construct a fire guard

A fireguard is a belt of land that is cleared of all inflammable material in order to control the spread of veld fires. A standard fireguard is one which measures at least

9metres wide on either side of a boundary line/fence. It then follows that between two properties, the fireguard becomes at least 18metres wide. Internal fireguards of at least 4, 5 meters should be constructed in addition to the existing pathways and roads to ensure extra- protection of properties and other valuables. The width of the fireguards should be increased if the area is surrounded by tall grass.

In Zimbabwe fireguards should be constructed before the end of June every year. This is to prepare for the onset of summer when veldfires are common. Fireguards should be constructed around homes, farms, paddocks, woodlots, orchards, nurseries croplands and boundary fences.

### Methods of constructing fireguards

There are various methods which can be used to construct fireguards. The choice of any one technique over the other is dependent upon such variables like labour costs, availability of farm machinery, skills and knowledge. They include:

- **Use of a tractor or ox-drawn plough**

The tractor and ox-drawn plough is used to clear off vegetation in the 9m wide strip if resources permit. In the event that resources are limited, the tractor/plough can clear vegetation within 2m wide on each side of the 9m wide strip then the remaining vegetation can be burnt. However, the use of fire during fireguard construction is greatly discouraged as it can spread and destroy vegetation.

- **The hoeing and mowing**

These methods can also be used to clear the vegetation on the 9m strip. Mowing can be done in areas of sparse vegetation and low rates of wind whereby slashers or sickles can be used to cut off grass and no burning is done.

- **Controlled burning**

This method involves the use of fire to burn grass and flammable organic matter around properties. The fire is watched and controlled then extinguished after making the fire guard. It is considered costless and time effective but it is the least encouraged the fire can get out of hand. Controlled burning may be done early in the morning before dew evaporates from the grass. If this method is used, weather conditions should be conducive as advised by the Meteorological Services Department (MSD), avoid windy days. Firefighting equipment such as fire beaters, water filled knapsack sprayers and bowsers should always be ready.

**Task: Fire guard construction**

Construct a fireguard around your school campus.

## UNIT 3.5 SOIL EROSION

Soil erosion is the wearing away of the top soil by water, wind, and ice. The top fertile soil is washed away leaving infertile soil. Excessive erosion leads to the development of gullies. Without proper soil conservation techniques, soil erosion is a major problem. In most areas where vegetation has been cleared for farming.

It is estimated that communal areas lose 50 to 70 tonnes of soil per hectare per year. The causes of soil erosion include:

- Deforestation
- Stream bank cultivation
- Cultivating along the slopes
- Overgrazing
- Veld fires
- Poor soil conservation practices
- Mining
- Drought

Soil erosion has severe adverse effects which include:

- Siltation of rivers and dams
- Loss of soil fertility leading to reduction of yields
- Development of gullies
- Increased frequency of flooding
- Loss of water holding capacity

Soil erosion can be prevented through the following ways:

- Ploughing across the slopes
- Terracing
- Afforestation
- Paddocking to reduce overgrazing
- Educating the community to stop veldfires
- Practicing mixed farming
- Creating wind breaks to stop erosion by wind

## Planting trees

Tree planting is very important and should be practiced even in our local areas. Trees protect the soil from erosion. They also help to reduce the effects of air pollution by absorbing carbon dioxide. They are habitat to animals and birds and they are also a source of food for both humans and animals. Zimbabwe recognises the importance of tree planting. The first Saturday of every December is the National Tree Planting Day.

The day is set aside to motivate the nation to plant and conserve trees, enlighten the nation on the importance of forests and woodland resources, enhance biodiversity and household security. It is important for trees to plant trees in their local communities because:

- Trees provide firewood
- Trees provide habitat for wild animals
- Trees help to cool temperatures
- Trees help in the hydrological cycle
- Trees are a source for food, for example, fruits and tubers
- Trees are a source of medicine
- Trees support ecosystems-based businesses such as bee keeping.

Both exotic and indigenous trees can be grown. Planting trees at a local level is quite possible and recommended. You may have to choose the type of trees which grow well in your local area. Consider the soil type and climatic conditions. Some trees grow well in areas under agro-ecological region 1 and two which received high rainfall. In that region exotic trees and indigenous trees grow well. Exotic trees such as pine and wattle grow well. In agro-ecological region 4 and 5 encompassing parts of Matebeleland mopane trees grow well. To plant trees, you may not need to wait for the National Tree Planting Day. It can be undertaken as an ongoing process, replacing trees cut down and planting trees where deforestation has taken place.

To plant trees, it is important to start by identifying the areas suitable for your plantation. If you are in urban areas consider the location of pipes and power lines. If the trees are planted below the power lines when they grow they will get in contact with the power lines posing danger to people. Trees are usually sown as seeds and the seedlings will be transplanted. You may choose to buy seedlings for planting. The seedlings can also be gathered from the bushes where they grow naturally. If you are to sow the seeds first, you will have to buy the seeds or collect them. Seeds for indigenous trees can be collected from bushes. Seeds for exotic trees can be purchased from botanical gardens or from the Forestry Commission. Once you have the seeds sow them in a necessary in polythene bags. You may improvise by collecting empty packs of sugar and other commodities to use as polythene bags. That way you can save on expenses and also help cleaning the local area. Your necessary should be fenced from animals which can eat the growing seedlings. After

the seedlings have grown to the recommended level according to the type of trees transplant them to the plantations or areas you want them to grow.

**Task: Tree Planting**

Collect seeds from the local indigenous trees. Research on how the seeds are sown. Sow them and after they reach transplanting level, plant them in an area within your locality where vegetation has been destroyed.

## UNIT 3.6 BUSINESSES IN ECOSYSTEMS

The local ecosystems may have the potential for business activities. There are a number of businesses which can run from the local ecosystems. These include:

- **Ecotourism**

This involves tourists visiting an area to enjoy the unspoiled (pristine) natural environment. In most developed countries urban dwellers visit the country side to enjoy the fresh natural environment. It can however be practiced in both rural and urban areas.

- **Bee keeping**

Bee keeping is one of those businesses which are based on the ecosystems. The bees are kept for honey production. It is an ecosystem-based business because it depends on the natural community of organisms. The vegetation, water and other aspects of ecosystems are important in this business. The honey is sold. The quality of honey depends on the surrounding vegetation. A diversity of trees in proves the quality of honey. The honey is processed to produce many other products for consumption and skin treatment.

- **Herb production**

The growing of herbs is also another business which can be run using the local ecosystems. It involves growing or maintaining trees, herbs and shrubs with medicinal properties. The roots, barks and leaves are harvested for sale to people with different ailments. There is need to sustainably run this business by conserving the vegetation.

- **Manure collection**

Ecosystems are sources of organic fertilisers for crops. The organic fertilisers is received from decaying plant leaves and excreta from animals. The manure collected and sold to people with gardens and farms. For sustainability of this business there is need for conserving forests so that they keep producing humus.



- **Indigenous seeds and seedlings production**

Indigenous trees such as the hardwoods are facing danger from over harvesting. They need to be conserved lest they get extinct. It is a viable business to collect their seeds and sow them to produce seedlings for sale. Many other trees with medicinal properties can provide viable businesses through producing their seedlings.

- **Worm production**

Worm production involves artificially growing worms for sale. The worms are sold to fishers. They promote the conservation of wetlands.

### How to design a small business using the local ecosystems

To start a small business in your local ecosystem you need to follow some of the steps below:

#### 1. Formulate the idea

This involves identifying what is that you want to do. You need to refine the idea and be realistic. Make sure what you want to do is feasible. Always keep your ideas real.

#### 2. Write a business plan

A business plan is a written document showing the purpose the business, the activities involved in the business, the goals as well as how you will finance the finance to startup costs.

#### 3. Determine the legal structure of the business

You need to determine the likely legal frameworks that will affect your business. Make sure whatever you are doing is within the legal expectations of your country. In some cases, you may need to seek permission to use certain ecosystems from the local leadership such as village heads and chiefs. Make sure that your activities do not affect other surrounding communities.

**4. Register** your business if there is need to do so. Most of the ecosystems-based businesses do not need registration. Hence, they are easy to start.

#### 5. Build a team

Where you cannot work sole it is advisable to build a team so that to share ideas and responsibilities. This will minimise costs.

Some of the small business based on ecosystems can be started using very few financial and material resources. All that is needed is to identify opportunities within your local ecosystems. Ascertain the things that you need to start the business and acquire them. Marketing shall also prove viable for your business. Some of the businesses based on ecosystems may involve keeping the ecosystems clean, for

example, collection of wastes such as papers, cans, plastics and scrap metal. These are sold for recycling and they have proved quite lucrative.

**Task: Small Businesses using the local ecosystems**

Identify a project that you think is viable within your local ecosystem. Make a draft of your plans identifying the inputs you need, the processes involved and how you would market your products.

## SUMMARY

- ✓ Habitat, genetic and species diversity are important aspects of biodiversity
- ✓ Habitat diversity is important because it supports the existence of different organisms in an ecosystem
- ✓ Savanna, tropical rainforests and deserts are examples of biomes or ecosystems
- ✓ Each biome has its own inputs, processes, outputs and organisms need to adapt to conditions in these biomes
- ✓ Desert biomes experience very harsh conditions
- ✓ Tropical rainforests have the largest number of biological diversities owing to plenty of habitat and food for organisms
- ✓ For sustainability, human need to conserve the ecosystems
- ✓ The use of clean energy, setting up nature reserves and constructing fire guards are some of the ways of protecting ecosystems
- ✓ Soil erosion is one of the processes affecting ecosystems
- ✓ Ecosystems present a variety of business opportunities
- ✓ To run an ecosystems-based business there is need to be well organised and to protect the ecosystems

## GLOSSARY

**Biodiversity:** it refers to the total variety of animals and plants on Earth

**Biome:** it is a community of plants and animals that have the same characteristics for the environment in which they exist

**Ecosystem:** it is a community of organisms interacting amongst each other and their environment

**Ecotourism:** it is a form of tourism where people enjoy visiting the natural environment

**Genetic diversity:** refers to the various genes found within given organisms

**Habitat diversity:** refers to a variety of shelter or home for living organisms

**Species diversity:** it refers to the number of species and the abundance of each species that are found in a particular ecosystem

## TEST

## Multiple Choice

- A variety of places to live for organisms is referred to as
  - genetic diversity
  - habitat diversity
  - genetics
  - biomes
- Most parts of Zimbabwe is made up of which type of ecosystem
  - tropical continental
  - tropical equatorial
  - tropical desert
  - micro ecosystem
- Table 3.1 below shows the processes, inputs and outputs

Inputs	Processes	outputs
Rainfall between 1800 - 2500mm	Leaching	Multi-layered vegetation
Annual temperature range 2C to 3C	Chemical weathering	Thick forests
	Timber logging	
	Mining	

- Which biome is represented by the elements shown in table 3.1 above?
- Desert
  - tropical savanna
  - grassland savanna
  - tropical equatorial
- Which of the following is part of adaptation by desert organisms
    - developing bigger pore spaces
    - hibernation
    - developing broad leaves and bigger stomata
    - storing water in their bodies
  - How does the Environmental Management Agency help in the sustainability of ecosystems?
    - enforcing conservation measures
    - starting veld fires
    - deforestation
    - polluting the environment
  - What would be the best soil conservation measures to be carried out in areas with steep slopes?
    - water harvesting
    - crop rotation
    - terracing
    - applying fertilizers

## Structured Questions

- a)(i) What is biodiversity? (1)  
 (ii) Describe the following aspects of biodiversity  
 Habitat diversity    genetic diversity    species diversity (6)

- a) (i) With the aid of a diagram describe and explain the vegetation of tropical rainforests (7)  
(ii) Explain how plants and animals adapt to tropical rainforest conditions (6)
- b) AS the minister of Environment what recommendations would you give for sustainable exploitation of local ecosystems? (5)
8. a) Explain how animals in deserts adapt to their environment (7)  
b) What are the causes of soil erosion in Zimbabwe? (6)  
c) Identify any one ecosystem-based business you would run and describe why you think the business is viable. (7)  
d) Explain any 3 ways of ensuring sustainability of ecosystems (5)

# 4

## CHAPTER 4

### NATURAL RESOURCES

#### Objectives

By the end of this chapter, you should be able to:

- Describe the growth of population and its effects on resources
- Describe the factors influencing exploitation of natural resources

#### Introduction

Population growth has severe impacts on the natural resources. The term population refers to the total number of people living in a given area. Natural resources are naturally occurring substances which are useful to humans. Human population depends on natural resources for survival hence changes in population obviously affect the natural resources. This chapter looks at population growth, its effects on resources and the factors affecting the exploitation of natural resources.

#### UNIT 4.1

#### POPULATION GROWTH

The term population growth refers to an increase in the number of people living in a given area. It should not be confused with the term population change which may refer to both an increase or a decrease in population. Population growth can be result of an increase in birth rate when death rate is falling. An increase of population due to decreasing death rate and high birth rate is called natural population growth. A given area's population may increase due to an increase in immigrants. Immigrants are people coming into a given area as a result of having migrated from where they used to live. A consideration of birth rate, death rate and migration give overall population growth.

The rate of population growth is high in developing countries such as those of sub-Saharan Africa (Zimbabwe, Zambia, and Malawi). In these countries population growth rate is above 2.5% per year. The growth rates for different are shown in table 4.1.

Table 4.1: Population growth rates

Continent	Growth rate (%)
Africa	2.25
Americas	1.03
Asia	1.06
Europe	0.10
Oceania	1.47
World	0.17

The doubling time refers to the time it takes for a population to double itself. The lesser the doubling time the likely it is for population to strain the available resources. Though some resources are renewable and are more able to regenerate, rapid increasing population strain the natural resources hindering their regeneration. If population growth is unchecked or controlled but mechanisms such as birth control, it can increase exponentially yet resources at their best increase arithmetically as shown in fig 4.1 below.

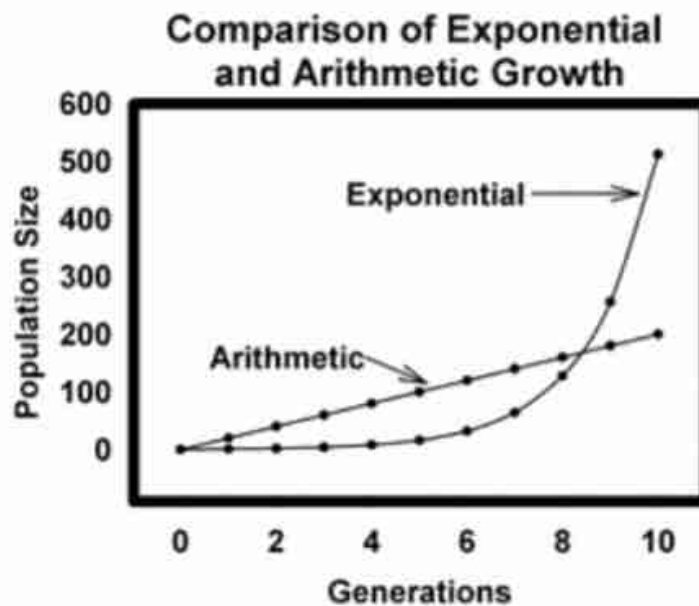


Fig 4.1: Arithmetic and exponential population increase

In fig 4.1 above the available resources are increasing at a very low rate. This is called an arithmetic increase. An exponential increase is a rapid increase in population. It is also referred to as a geometric increase (2, 4, 16, 32). The world population is increasing at an exponential rate. It is estimated that by 2100, the world population will be about 18 billion. The world population will therefore experience an explosion. Population explosion is the rapid increase of population such that it reaches very high levels within a short period of time. Generally, across the world

death rate has decreased owing to improved medication, diet and nutrition. More people are living longer. The ability to live longer is called longevity and the average number of years a person born in a given area may expect to live is called life expectancy. Developed countries have high life expectancy because of improved medication and improved diet and nutrition. Developing countries have low life expectancy however, the situation is improving. This means generally the rate at which people die has been reduced when at the same time birth rates are still high in most developing countries. Per every minute the world's population increases by 162 people.

For Southern Africa the rate of population increase is 3% per year. This is a high rate of population increase. Most African countries have high rates of population increase. Zimbabwe's rate of population increase is 2.2% per year. In 20015 Zimbabwe's population was 15 424 303 and increased to 15 742 255 in 2016. Improvements in medication, diet and nutrition and the general living standards has led to high life expectancy.

### **The effects of population growth on resources**

The term resources refer to aspects of the living and non-living environment which are useful to humans. Water, forests, soil, and minerals are all resources. These resources are renewable and non-renewable. Renewable resources are those which can replace themselves once they are used. In any given area the available resources can support a given maximum number of people without experiencing environmental problems. The population size which the available resources can support without experiencing problems is called carrying capacity. The Earth's size does not change. This means that most of the resources are finite yet population keep growing. Population growth have severe effects on the resources.

### **Land and population growth**

The land or soil is important to humans. Settlements are built on the land and crops are grown on the soil. Land is generally finite since it does not expand. Though we can increase the land available for agriculture and settlement, we cannot extend the Earth's total land area. On the contrary, as we have seen, human population is increasing exponentially. The increasing human population leads to the following effects on the land:

- **Overcultivation of land**

Increasing human population lead to shortage of land. Population densities have become very high. Population density is the number of people per unit area. It is expressed as people per square kilometre. An increase in the number of people per unit area means that there is pressure on the land. There are dense settlements and over use of land. The land is overcultivated since the farmers cannot afford to leave the land fallow. The soil becomes weak and less productive.

- **Loss of soil fertility**

With the increase of population over use of the land for agriculture is high. The soil loses its fertility due to poor farming methods such as monoculture and ploughing along the slopes. Land suitable for cultivation is cultivated since population increase leads to shortage of land causing farmers to cultivate unsuitable land such as steep slopes.

- **Soil salinization**

Soil salinization involves an increase in the soil's salt content. The mineral composition of the soil changes due to chemicals applied by farmers. Farmers use artificial fertilisers and irrigation to increase production. These chemicals accumulate in the soil forming a whitish layer on soil surfaces where irrigation is poorly managed. Increasing population put pressure on the land to produce more for the increasing population numbers.

- **Desertification**

This term refers to the extension of arid conditions from arid areas to non-arid areas. The term arid means dry and deserts are the arid areas. Desertification is caused by the increase in population. The increasing population clears vegetation for settlement and agriculture and put pressure on available water resources. This affects the hydrological cycle leading to a decrease in rainfall amounts. Areas become drier and vegetation adapts to dry conditions. The soil structure is affected by reduced amounts of humus due to removal of vegetation.

- **Soil erosion**

Over- cultivation and other poor farming methods lead to soil erosion. The soil becomes weak and less fertile due to over cultivation. Vegetation which binds the soil particles is cleared. This makes the soil vulnerable to erosion. Gullies develop making the land seriously degraded.

- **Land pollution**

Land pollution involves the dumping of materials where they are not supposed to be dumped leading to defacing the land or damaging the soil quality. Land pollution degrades the land making it unusable for certain activities. For example, severely polluted land by chemicals can be a health hazard and useless for crop production. Land pollution by oil leakages destroys organisms living in the soil. The cause of land pollution includes:

- Poor collection of domestic refuse
- Industrial effluent
- Sewage disposal and bursting pipes



- Oil leakages
- Spilling chemicals

The major pollutants are plastics, papers, cans and bottles. These increase with increasing population.



*Fig 4.2: Land pollution*

The growth of population means that more wastes are generated and their disposal becomes a problem and they end up being poorly disposed causing pollution. The signs of severe population pressure on the land include:

- Gullies from soil erosion
- Poor soil structure due to over-cultivation
- Low soil fertility
- Reduction of vegetation cover
- Decreasing yield
- Over crowdedness of settlements
- High population densities

### **Forest and population growth**

Growing population has severe effects on forests or vegetation. This is so because forests play a significant role in human life as a resource. Forests are an important resource to human beings because:

- They are a source of wood for construction
- They are a source of fuel
- They help to absorb carbon dioxide and oxygen
- They are a source of food, for example, honey and fruits
- They are a source of medicines
- They are habitat to wildlife
- They promote tourism
- They help to prevent soil erosion by binding the soil particles together

There is a positive correlation between population growth and the disappearance of forest. This means that there is an increase in the clearance of forests with an increase in population. As the population grows the demand for forest resources increases. In Zimbabwe the most densely populated region has low vegetation density. The highest rates of deforestation are in communal areas, where 50% decline in vegetation cover was experienced in 1963. As population increases so does the demand for firewood. More land is demanded for agriculture as population increases. As a result, more vegetation is cleared to pave way for farming.

### Water and population growth

Water is an important resource which support all life forms. As the population grow, so does the demand for water. The available water sources such as dams, lakes, and reservoirs are put under pressure by the growing population. The signs of population pressure on water resources include:

- Severe water pollution
- Scarcity of water

Growing population leads to severe water pollution. The water is used as a mode of transport and increasing population leads to over use of water as a mode of transport. This increases the levels of pollution. The scarcity of water also becomes a problem and in Zimbabwe cities such as Harare and Masvingo face water shortages occasionally due to rapidly increasing population.

### Case Study: Lake Chivero - Water Pollution

*The pollution in Lake Chivero has reached alarming levels, an issue that needs to be dealt with swiftly and urgently as the lake is Harare's main water source. The situation is not being made easier by the El-Nino effect that has greatly affected the country, leading to a rapid decline in water levels in major water suppliers of the country. Currently, the country's dams are on average 51 percent full at a time when dams should be spilling.*

*Water supply in Harare had been reduced by 18 percent, bringing it down to 450 million litres per day when the city needs about 800 million litres per day. According to Environmental Management Agency (EMA) spokesperson, Mr Steady Kangata, the situation at the lake is deplorable. He said the pollution is a result of the activities in urban settlements. "Urban settlements' pollution such as sewer bursts is affecting our water bodies," said Mr Kangata.*

*Lake Chivero is a reservoir that gets water from the surrounding catchments that feeds into it. The major settlements that have contributed to the pollution include Chitungwiza, Ruwa and Epworth. Lake Chivero is downstream of the capital, while Chitungwiza is within the Upper Manyame Sub-Catchment Area such that most sewers discharge from Harare and Chitungwiza end up in the water sources. These areas are densely populated and are prone to sewer bursts.*

*However, there are a number of other reasons that have led to the pollution of Harare's water. "Stream bank cultivation, effluent from industries and sewer bursts, among others are polluting the lake", said Mr Kangata. There is urgent need to intervene so as to curb the pollution. Everyone has the constitutional right to access clean and safe water. The Harare City Council's acting communications manager, Mr Michal Chideme said the council is currently working on improving water treatment. "The rehabilitation of Crowbrough and Firlie sewage treatment plants is almost complete since the major polluters have been fixed," said Mr Chideme.*

*The city council is working with Tongji University and the University of Zimbabwe to get more sustainable treatment chemicals. In addition to that, the city council says it has procured pipes to fix all the corroded pipes along river crossings. According to Mr Kangata, local authorities need to have fully functional water processing systems that will help in processing the water. He also highlighted that there is need for by-laws that regulates industries and prohibit them from discharging harmful substances into water sources.*

*Land for agricultural purposes must be clearly demarcated in order to avoid stream bank cultivation as the practice contaminates water bodies. Awareness campaigns will also come in handy. Despite the water shortages, the city is losing a lot of water through pipe bursts that are littered across the city. "The city is prioritizing the Kunzwi and Musami dams so as to provide alternative sources of water for Harare citizens" said Mr Chideme. Citizens are encouraged to save the little water that is available.*

*"There is need for consumers' behavioral change. They should use water conservation methods," Mr Chideme stressed.*

**Source: [www.sundaymail.co.zw](http://www.sundaymail.co.zw)**

### Exercise 4.1

- (a) State any 4 signs of population pressure on the land. (4)
- (b) Describe the effects of population pressure on forests and land. (6)

## UNIT 4.2

## NATURAL RESOURCES EXPLOITATION IN AFRICA

Africa has a rapid growing population with most countries experiencing annual growth rates above 2.5%. Natural resource exploitation involves the extraction and use of natural resources such as land, water, minerals, wildlife and forests. Rapid population growth is threatening the sustainability of resources in Africa. The resources exploited in Africa include:

- **Forests**

Forests are exploited for fire wood, timber and agriculture. Access to alternative energy sources such as solar and electricity is poor in some parts of Africa. The people therefore depend firewood. The development of settlements due to increasing human population leads to the clearing of forests for construction and to create new farms.

- **Wildlife**

The term wildlife refers to both animals and plants which are not domesticated. These are an important resource. Wildlife is a major source of income through hunting and tourism. The wild animals' area source of meat and they are also hunted for their skins, horns and bones. Trade in elephants, rhinos, leopards and pangolins are quite lucrative. Hence, wildlife exploitation is quite high in most developing countries of Africa which depend on exportation of raw materials.

- **Water**

The largest portion of the Earth is water. Oceans, lakes and rivers are the sources of water. All life forms (Flora and fauna) need water to survive. Humans need water in their bodies and to produce food through farming. Though 71% of the Earth's surface is made up of water, not all this water is clean enough for use by humans, animals and plants. Water as a resource is exploited for domestic, industrial and religious use. Water is used for transportation parts of rivers such as Zambezi, Congo, and Nile. Oceans are also used for water transportation. Other human activities such as irrigation and generation of hydroelectricity power are also carried out as a way of

exploiting water resources, for example at Lake Cahora Bassa in Mozambique on the Zambezi River.

### Factors influencing the exploitation of forests

The exploitation of forests in Africa is influenced by:

- **Demand**

The demand for forest products keeps increasing with the increasing population. Hard woods are demanded for their durable furniture. The demand for land also leads to increased exploitation of wood. In Zimbabwe an increase in the number of tobacco farmers has led to an increase in the demand of hard woods for curing tobacco. Commercial logging of forests has also led to an increased demand of firewood. Forest resources such as gum, rubber and palm oil's demand increase with increasing population leading to over-exploitation of the forests.

- **Technological advancement**

Technological advancement refers to improvements or developments in technology. Due to human development, new methods of exploiting natural resources are being invented. The exploitation of forest resources is influenced by the ease with which forests can be harvested. Machines which can cut and process wood have improved greatly. Saw mills and tree cutting machines have increased the ease with which trees are cut. This has led to an increase in the rate at which forests are cleared.

- **Accessibility**

The term accessibility refers to the ease with which forests can be reached. Areas that are well connected by road and rail way network enable the transportation of wood. Wood is bulky and difficult to transport unprocessed. Tropical rainforests which are far away from roads and railway lines are not easily accessible than those near transport routes. Tropical rainforests are difficult to clear and construct roads.

- **Availability of alternative sources of energy**

In most African countries wood is a cheaper alternative source of energy. Most of the people cannot afford electricity or solar because of poverty, are therefore exploited extensively leading to depletion of forest resources.

- **Economic needs**

The economic needs of a given country determine the rate at which forests are cleared. A primary sector-based economy thrives on extraction of raw materials such as forests (wood). This influences the way in which forests are exploited.

## Exercise 4.2

- Describe the factors affecting the distribution of forests in Zimbabwe (6)
- Describe the factors which affects the exploitation of forests in Africa (6)

### Case Study: Zimbabwe Nature of Forests and Exploitation

*In Zimbabwe about 90% of the energy provisions in rural communities is from wood. Fifteen percent of this demand for wood is fulfilled from forests. From 1990 to 2000 Zimbabwe lost 7 times more of its forest cover than the world average rate. Rapid deforestation in some parts of the country is believed to be a driving force in the yearly increase of food shortages in these areas. The rate of deforestation in Zimbabwe is about 1.5% per year. In communal areas a 50% decline in vegetation cover was experienced between 1963 and 1978. The need for land for agriculture clears about 60 000 hectares of land annually over this period.*

*Zimbabwe has a variety of forests. Varying climatic conditions support different types of forests. Zimbabwe's hard woods and soft woods are important. They are used for timber and furniture making. Forests are managed by the ministry of Environment and Natural Resources. The ministry run programmes to conserve forests. The forestry Commission work with the ministry to manage and develop forests. The Environmental Management Agency (EMA) also assist in protecting forests from veld fires and deforestation. Indigenous forests are those forests made up of trees native to Zimbabwe. These were not imported from other countries but are part of our heritage. These include mukwa, msasa, teak and mcimbi. The indigenous forests are constantly under threats from deforestation. They make good quality furniture and their demand is high. They produce good quality wood for firewood and for tobacco and brick curing. Recent trends have led to the harvesting of hard woods for making wooden plates and sculptures. The government has responded to this through legislation. EMA enforces the protection of the hard woods. Reserves such as Chirinda in Mount Selinda have been set to protect indigenous woods. These reserves have become habitats to several wildlife species which include blue duiker, guineas fowls and barks.*

*Exotic trees are also important in Zimbabwe. These are trees which originated from other countries but now grow in parts of Zimbabwe. Examples of these are pine, wattle, and gum trees (eucalyptus). The exotic trees grow faster compared to indigenous trees though they are not resistant to harsh conditions and are selective in terms of climatic conditions where they grow. The exotic forests provide softwoods used for building, furniture, plywood, cardboard boxes and extraction of tannin.*

Deforestation is the major threat to Zimbabwe's forests. An average of 80 000 to 100 000 hectares of vegetation are cleared each year. In most communal areas the households depend on wood for energy as shown in fig 4.4 below.

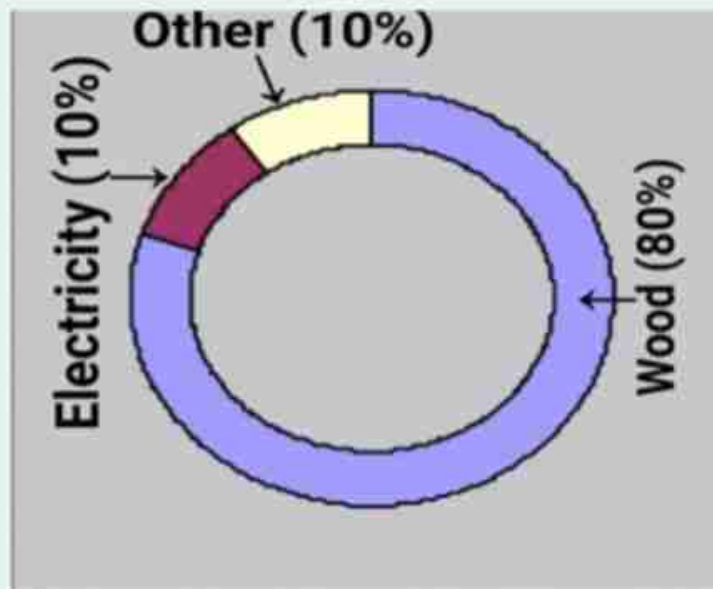


Fig 4.4: Communal household energy sources

In the communal areas 80% of the households depend on wood for firewood. Access to electricity is poor. The rural electrification programme is assisting but that is not enough. Some urban areas still do not have electricity due to rapid urbanization. Urban populations are also depending on wood for cooking.

Africa has a variety of forests due to variations in climate. The savanna climate support tall grass and sparse trees. Hard woods grow well in this climatic region. Countries such as DRC, Nigeria, Equatorial Guinea and parts of West Africa are home to tropical rainforests. These forests are under threat from increasing human population. Estimates says that by 2020 some tropical rainforests will disappear.

The disappearance of forests has drastic effects which include:

- Desertification - Rainforests assist in the hydrological cycle because they are a source of water for transpiration.
- Loss of biodiversity
- Loss of medicines
- Global warming and climate change
- Land degradation

## Wildlife

The term wildlife refers to all living things, plants and animals found in the natural environment and are not domesticated by human beings. Wildlife is directly linked to forests because forests are their habitat. The over-population of forests affects wildlife. Demand for wildlife products such as meat, tusks, horns and hides increase with an increase with the increase in population. A number of wildlife species have come under threats from human population and some of the endangered species are elephant, black rhino, pangolin, African wild dog and flame lily. These endangered species are covered in Book 1. Across Africa there are a number of other wildlife species which are also under threat. These include the impala, zebra, sable and mountain gorillas. The factors affecting exploitation of wildlife in Africa are:

- Lack of involvement of local communities in wildlife management
- Availability of illegal markets for endangered species
- Corruption by government officials who fund poaching activities
- Lack of modern techniques to manage and monitor wildlife
- Climate change
- Weak economies which encourage developing countries to trade in rather than protect endangered species

The growing human population is reducing the space for wildlife and large numbers of wildlife are migrating from some parts of Africa. The best way to protect wildlife management programme such as the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE). Which has improved wildlife management in Zimbabwe.

## Fish

Fish are an important natural resource. Besides being a source of nutrients, fish is a source of income for many families and countries. Fish have led to the emergence of the fishing industry. Fishing areas in Southern Africa are shown in fig 4.5 below

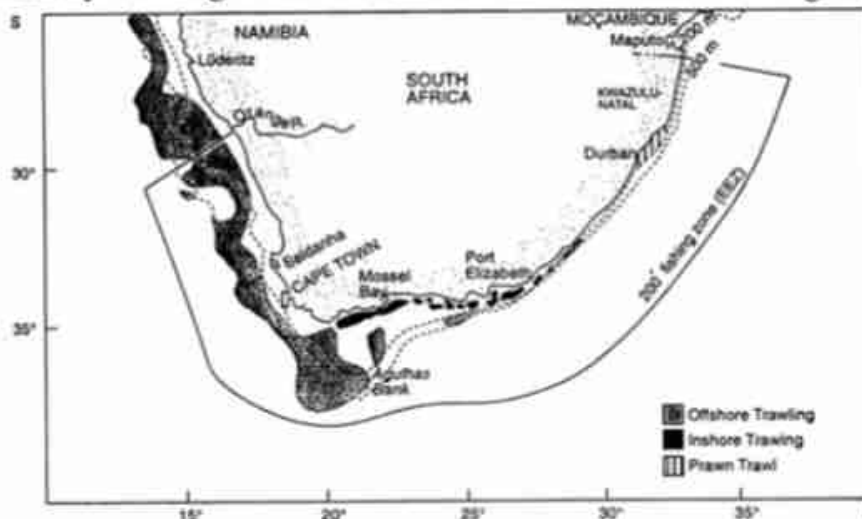


Fig 4.5: Fishing grounds in Southern Africa



The Physical factors affecting the exploitation of fish in Africa include:

- **Availability of fish food**

Fish shoals are found where there is plenty of fish food. Wide continental shelves give shallow water where plankton (fish food) grow. Areas covering the south-eastern, southern and south western coasts of African here wide continental shelves. Plankton grow in these wide continental shelves hence more fish are found.

- **Ocean currents**

On the western coasts of Africa there is more fishing grounds than on the western parts because ocean currents such as Benguela cold current lead to growth of plankton on the western coasts. The Moroccan west coast is a rich fishing ground because the Canary Current brings nutrients to shallow waters allowing fish food to grow.

- **Availability of breeding grounds for fish**

For fish to breed there is need for suitable grounds. Moderate temperatures are ideal. The shallow waters of the shallow continental shelves provide ideal breeding grounds. For example, the Agulhas Bank on the western coast of Africa is a spawning ground for fish. Spawning grounds are places where fish lay eggs.

- **Good natural ports**

The natural ports are used as fish ports. These are found in ports such as Cape Town and Walvis Bay. Availability of these ports makes the exploitation of fish easier and more profitable.

The Economic factors affecting fishing are:

- Market
- Transport networks
- Capital
- Technology

### Market

The availability of a ready market stimulates the exploitation of fish. Some fishing ports have developed to become towns and cities. For example, Cape Town and Walvis Bay. The large population in these ports provide a ready market for fish and fish products. Foreign markets are also important. Countries such as Namibia exports fish to countries such as Zimbabwe. This promotes exploitation of fish in Namibia.

### Transport networks

Fish are perishable so they need to reach the market faster. Through refrigeration of trucks has increased our abilities to preserve fish, well developed transport network improves the speed which fish can reach the market.

### Technology

Technology is important in the fishing industry because it increases efficiency in the exploitation of fish. Recent developments have improved the effectiveness of fishing. The use of remote sensing techniques such as SONAR and RADAR in fishing enables effectiveness in locating fish shoals. More fish is caught and management of fish resources has greatly improved. Breeding grounds of fish can now be easily identified and monitored.

### Capital

Fishing is an expensive to run especially on a commercial basis. The equipment needed for is expensive. Fish boats and nets and are expensive. Modern fishing equipment use modern technology to find fish shoals and is expensive. Some companies process the fish hence there is need for more money to build the factories. Availability of cheap loans will assist the fishing firms to capitalize.

### Availability of storage facilities

Fish is a perishable product which if not properly stored losses will be made. Boats and trucks are now refrigerated such that the fish caught remains fresh for long. There is no wastage of fish and this helps towards sustainable management of fish

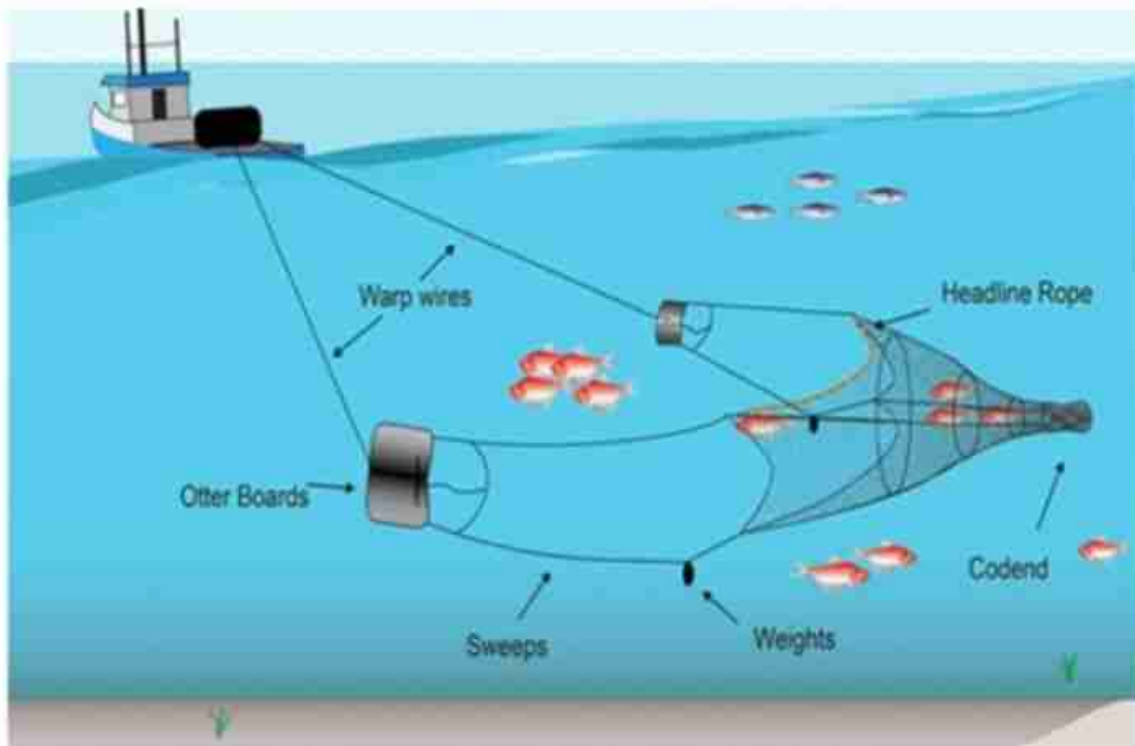


Fig 4.6: Modern fishing techniques

## Water

About 70% of the Earth is made up of water but only 20% of the water is safe for humans, animals, and plants. The growing human population is putting pressure on the available water resources. The factors affecting the exploitation of water include:

- **Access to the sea**

Countries which are landlocked such as Zimbabwe have limited access to the sea. They cannot fully exploit the water for transport and energy generation. They depend on inland water bodies such as dams, lakes and rivers.

- **Level of technology**

Development of technology increases the rate at which water is exploited as a resource. Technology to transport water over long distances has increased the rate at which water is exploited. In the USA arid areas in California are provided water from long distances. Technology to purify water also increases the exploitation of water. Poor technology advancement in most developing countries mean that old technology is still in use. Cooling of engines is still done using water and this leads to water pollution. The exploitation of water in Zimbabwe is greatly affected by pollution.

## Land

The land is important because it is needed for settlement and for agriculture. The use of land is affected by a number of factors which include:

- **Population growth**

The growth of population mean that more land is needed for settlement and agriculture. Population densities increases due to population increase.

- **Land tenure**

Land tenure system refers to the system determining land ownership and rights to use the land. It is important in the exploitation of land as a resource. The land tenure system gives farmers the rights to develop the and also to use it for specific activities. Land tenure systems which gives the farmers total ownership of land encourages the farmers to conserve the land since the land belongs to them.

- **Government policy**

The government set policies on the nature of land use. The land use patterns are determined by the government. Programmes such as land reform also affect the use of land as a resource. The government can decide to leave land aside for nature reserves, national parks and sanctuaries for wildlife. Hence, government policy is very important in the exploitation of land.

- **Climate**

The use of land is linked to climate. Settlements and agricultural activities are determined by climate. Land in regions of better climate tend to be intensively used for agriculture. Areas with moderate climate tend to have dense populations since they attract more people.

The land is affected by several challenges which include:

- Deforestation
- Overgrazing
- Monoculture
- Stream bank cultivation
- Desertification

### Minerals

Africa has a large number of different minerals. Most nations thrive on the exports of minerals. Minerals are non-renewable. The demand for mineral resources and their products increases with the increase in population. New Trends Book 1 looked at the different uses of minerals. Most of the equipment and machines we use are made from minerals. The plates, pots and jewellery we use are produced from minerals. The demand for equipment increases as the population increase. Zimbabwe alone has 66 minerals discovered. These include diamonds, platinum, and gold. Most of African nations are well known for their mineral wealth.

*Table 4.2: Southern Africa countries mineral deposits and production ranking*

Country	Mineral	World Ranking
Botswana	Diamond	1st
South Africa	Gold	5th
Zambia	Copper	6th
Zimbabwe	Chrome	2 <sup>nd</sup>
DRC	Cobalt	1 <sup>st</sup>
Malawi	Uranium	10 <sup>th</sup>

*Source: www.mining.com*

There are various factors which affect mining in Africa. These include:

- **Infrastructure development**

The term infrastructure refers to basic facilities needed for communities to function well. The facilities constituting infrastructure include roads, communication networks, railway lines a bridge. These influence mining in Africa because their presence makes the exploitation of minerals easier. About 78% Africa's mining areas are well connected with roads or rail

transport systems. Remote mining areas which are inaccessible breed illegal mining and gross environmental degradation.

- **Government policy**

The exploitation of minerals is influenced by government policy. The government of the country in which the minerals are found has the responsibility to ensure that minerals are exploited sustainably. Legislation should be put in place to govern mineral exploitation. Mining policies have to be drafted in such a way that the local people benefit. The largest percentage of mining companies in most African countries are foreign owned. There is therefore the need for the government to draft policies which makes sur that the minerals are sustainably exploited.

- **The occurrence of mineral**

Availability of the mineral deposits affect the exploitation of minerals. Countries with more mineral deposits can afford to exploit huge volumes of the minerals for local use and exploitation. The geological formations within which the mineral deposits are found also influence their exploitation. Mineral seams which are deep a within massive rock strata are expensive and dangerous to extract. Advanced equipment is needed to mine such minerals. Costs- Benefit- Analysis have to be conducted to see if extracting such minerals will be lucrative. The concept of Cost- Benefit- Analysis will be covered in New Trends in Geography Book 4.

- **Labour supply**

The exploitation of minerals is influenced by the supply of labour. In most African countries there is high rates of unemployment. For example, in Zimbabwe unemployment is about 90%. Most of the unemployed have various qualifications and skills. High unemployment makes labour cheap because there is a huge supply of labour. However, where labour is expensive mining activities are reduced. The more the supply of labour, the high the rate of mineral exploitation.

- **Demand for mineral products**

The presence of more industries using minerals as inputs or raw materials lead to an increase in the demand for minerals. High demand of minerals and products made from minerals leads to an increase in the rate at which minerals are exploited.

- **Level of economic development**

A country's level of economic development affects the exploitation of minerals. Poor countries of the third world depend on foreign capital investment for them to be able to exploit their own minerals. Foreign companies therefore make concession with African governments. For their

capital investment into mining, the companies exploit huge quantities of minerals leading to exhaustion and environmental degradation. Developing countries depend on exportation of unprocessed minerals hence they exploit more of the minerals over a short period.

The exploitation of minerals has severe negative effects which include:

- Land degradation
- Pollution of water from chemicals such as mercury
- Air pollution from the processing of minerals
- Death of wildlife and livestock from water pollution
- Destruction of wildlife habitat

## SUMMARY

- ✓ Birth rate and death rate affect population growth
- ✓ Developing countries have high population growth rates exceeding 2.5% per year
- ✓ Developed countries have low population growth rates
- ✓ If unchecked population grows exponentially yet most of the resources are finite
- ✓ Overpopulation occurs where there are more people than the resources
- ✓ Under population refers to the situation where there are more resources than the people
- ✓ Optimum population is a situation where there is a state of equilibrium between the population and resources
- ✓ Rapid population growth leads to overpopulation
- ✓ Population growth affects resources such as water, land, forests, minerals and wildlife
- ✓ The exploitation of minerals in Zimbabwe and Africa is influenced by various factors
- ✓ Forests are mostly affected by deforestation due to population

## GLOSSARY

**Birth rate:** it is the number of live births per 1000 people per year

**Carrying capacity:** it refers to the maximum number of people the available resources can support without experiencing problems

**Death rate:** it is the number of deaths per 1000 people per year

**Deforestation:** it involves the indiscriminate cutting down of trees without replacing them

**Demand:** it is the quantity of resources that people are willing and able to buy

**Exponential population growth:** it is a rapid growth of population due to factors such as high birth rate and low death rate

**Migration:** it is the movement of people from one area to another resulting in more or less permanent change of home

**Natural resources:** these are elements of the natural environment which are useful to humans

**Optimum population:** it is a situation where there is an equilibrium between population and resources

**Over population:** it is the situation where there are more people than the resources

**Population:** it refers to the total number of people living in a given area

**Wildlife:** it refers to all living things which are not domesticated

## TEST

## Multiple Choice

- The exponential growth of population in developing countries is a result of
  - high death rate
  - high birth rate
  - overpopulation
  - under population
- Study fig 4.7 Below which shows percentage change in population and resources over the past century in four countries and answer the following question

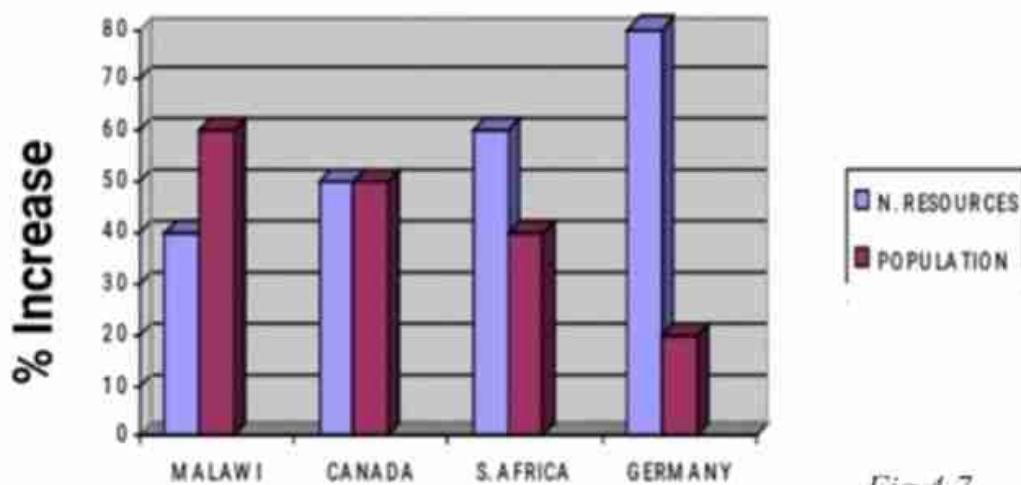


Fig 4.7

Canada's situation can best be described as

- under population
  - over population
  - optimum population
  - carrying capacity
- Which of the following is not a factor affecting fishing?
    - the depth of seams
    - climatic conditions
    - market
    - labour
  - The major cause of forests degradation in Zimbabwe's communal areas is
    - reforestation
    - deforestation
    - poaching
    - ploughing down the slopes
  - Overfishing depletes fish by-
    - allowing them to breed
    - scaring fish away
    - reducing the water quality
    - reducing their chances to breed
  - The major cause of land pollution in most of Zimbabwe's cities is
    - slurry
    - sewage
    - uncollected refuse
    - industrial effluent
  - Which of the following is the reason for high rates of deforestation in Zimbabwe's urban areas?
    - shortage of electricity
    - veld fires
    - acidic rain
    - industrial growth



8. The types of pollution shown in fig 4.8 is called



*Fig 4.8*

A. graffiti and land  
C. Water and air

B. rock paintings and air  
D. land and air

### Structured Questions

9. a) Describe the terms:

- (i) Carrying capacity
- (ii) Exponential population growth (4)

b) Study fig 4.8 Below and answer the following questions



*Fig 4.8*

- (i) Describe the scene in fig 4.8 Above (7)  
 (ii) Describe the effects of the situation shown above to natural resources (7)  
 c) Explain why there is generally an increase in the demand for water in most Zimbabwean cities (6)
10. a)(i) What is over population? (2)  
 (ii) State the signs of overpopulation in any one area you know (5)  
 b) Study table 4. Below and answer the following questions

Year	2010	2012	2014	2016	2018
Population Density (pple/km <sup>2</sup> )	12	13	14	15	16
Deforestation rate (% per year)	2.1	3.4	5.5	2.5	1.8

- (i) Describe the changes shown in table 4.3 above (5)  
 (ii) Give reasons for a fall in the rate of deforestation in 2016 and 2018 (6)
- b) What are the challenges and solutions to problems faced in the exploitation of natural resources (7)

# 5

## CHAPTER 5

### ENERGY AND POWER DEVELOPMENT

#### Objectives

By the end of this chapter, you should be able to:

- Explain the importance of energy in economic activities
- Examine the advantages and disadvantages of using different types of energy
- Justify the choice of using the different types of energy

#### Introduction

In both developed and developing countries energy is very important. Most human activities which have led to economic development depend on energy. Aspects of economic development such transportation, production and commerce are made possible by the availability of energy. New Trends in Geography Book 1 focused on types and sources of energy, environmental effects of energy and factors affecting the affecting the sitting of plants. This chapter focuses on the importance of energy in economic activities, the merits and demerits of different types of energy and the choice of using the different types of energy.

#### UNIT 5.1

#### ENERGY

The term energy refers to any form of power which is used to accomplish different economic activities. Energy or power source occurs in different forms which includes liquids, solids and gases. Table 5.1 below clearly shows some of the energy forms common in Zimbabwe and their examples.

Table 5.1: Common energy forms in Zimbabwe

Example of energy	Form/ State
Coal	Solid
Petrol	Liquid
LP Gas	Gas
Methane	Gas
Hydroelectric Power	Kinetic

Apart from playing a commercial role in daily household chores like cooking, heating, and lighting energy plays a pivotal role in economic activities. It should be noted that without energy operations in agriculture, mining and manufacturing sector of the economy will be grounded.

### Importance of Energy in Agriculture

Zimbabwe's economy is agro-based. Many families in the country are sustained by agriculture and agro-based activities. Operations in the agricultural sector is facilitated by the use of different sources of energy. Some of the energy sources commonly used are electricity, wood, petrol, diesel and solar. Of recent, the use of solar energy is becoming common as it is now widely used in agriculture for lighting, warming and pumping water.

Different sources of energy are used to accomplish different tasks in agriculture. Some of the energy uses includes the following:

- Wood fuel is used to cure tobacco.
- Solar energy is used to pump water from boreholes for irrigation purposes.
- Hydroelectric power energy is also used to pump water from dams, wells and boreholes for irrigation.
- Coal and charcoal are used for drying crops and curing tobacco.
- Wind energy is used to pump water using windmills.
- Petrol and diesel are used to plough the land, transport inputs to the farm and the produce to the market.



*Fig 5.1: Energy used for irrigation in agriculture*

### Importance of Energy in Mining

Mining refers to all processes through which minerals are extracted from the ground. Energy also plays a pivotal role in the mining sector. Energy is quite useful to fulfil the following operations:

- In shaft or underground mining hydroelectric power is used for lighting the tunnels.
- Hydro electrical energy is also used to pump water from the underground during mining operations. This is done to reduce chances of tunnel flooding.
- Diesel and petrol energy are used in excavators and lifters to transport the



*Fig 5.2: Energy lighting tunnels in mining*

### **Importance of Energy in Manufacturing Sector**

The term manufacturing refers to all processes through which raw materials are processed into semi-finished and finished products for example at ZISCO, iron ore is processed into steel bars and sheets. The manufacturing process is facilitated by the use of various sources of energy. Some of the uses of energy in manufacturing are:

- Electrical machines are used to fulfil most manufacturing processes for example spinning machine in the ginnery industries needs electrical energy to operate.
- In manufacturing sector electrical energy is also used by conveyor belts which are quite useful in transporting finished and semi-finished products faster for improved industrial efficiency.
- Coal is used in the heating and melting of metals and certain mineral ores.
- Petrol and diesel are quite useful in the transportation of raw materials to



*Fig 5.3: Machines use energy in manufacturing*

### Exercise 5.1

1. a) Define the term energy. (1)
- b) List any five types of energy. (4)
- c) Outline the importance of energy in agriculture, mining and industry. (15)

## UNIT 5.2

## THE SOURCES OF ENERGY

There are various sources of energy available for utilisation by people in different countries.

The choice and justification on which energy source to be used depends on several factors, some of these includes:

- Availability
- Accessibility
- Possession of relevant technology to exploit them.
- Government policies towards energy access and use.
- Efficiency of the energy source
- Costs incurred to obtain the energy
- Environmental impacts of the energy source
- Renewability or non-renewability of the energy source

## Water

Water is an energy source which is crucial in the production of hydroelectricity power. It should be noted that of all the energy sources hydroelectric power is the most used. In its production water falling from a gradient is used to turn turbines and generate electrical energy. In Zimbabwe there are several hydro electrical power stations which includes Kariba, Chipendeke and Nyawamba in Honde valley. It should be noted that Kariba is the main hydro electrical power station in Zimbabwe.

Though central in agriculture, mining and manufacturing sectors hydroelectric power has its own advantages and disadvantages. The table below shows the advantages and disadvantages of hydroelectric power.

*Table 5.2: The advantages and disadvantages of Hydroelectricity power*

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It can be used to accomplish several tasks of transporting lighting and heating.</li> <li>• It is a renewable source of energy.</li> <li>• It is clean that is, it does not pollute the environment.</li> <li>• It ensures high energy output.</li> </ul>	<ul style="list-style-type: none"> <li>• There are limited sites to setup hydroelectric power stations.</li> <li>• It is very expensive to establish.</li> <li>• Dams constructed reduces water amounts downstream.</li> <li>• Dams create fertile grounds for outbreak of water borne diseases like typhoid and bilharzia.</li> <li>• Dam construction consumes much animal habitats and agricultural land.</li> </ul>

## Wind energy

The wind is used to turn turbines and generate electrical energy or pump water. Just like any energy source it has its own advantages and disadvantages. Some of these includes those shown in table 5.3 below.

*Table 5.3: The advantages and disadvantages of wind energy*

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It is renewable energy source</li> <li>• It is clean hence environmentally friendly</li> <li>• It is cheap to maintain</li> </ul>	<ul style="list-style-type: none"> <li>• There are limited sites to setup wind farms.</li> <li>• Relatively expensive to establish</li> </ul>

## Wood Fuel

Wood is the commonly used energy source in most African countries. This is because its abundant, cheaper and locally available in many environments. However, the continued increase of population in several countries has endangered several wood forests resources. The table below shows some of the advantages and disadvantages of wood fuels. In 2010 in Zimbabwe wood fuel amounted to about 50% of the total energy used nationally.

Table 5.4: The advantages and disadvantages of wood

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It is cheap in most rural areas</li> <li>• It is accessed free of charge</li> <li>• Used for different purposes like drying, heating, canning and smocking.</li> <li>• Its waste products ashes are used as fertilisers.</li> </ul>	<ul style="list-style-type: none"> <li>• Deforestation destroys animal habitats.</li> <li>• Its burning pollutes the air.</li> <li>• Damaged forests tend to cause rapid soil erosion.</li> <li>• Air pollution caused by the use of wood fuel results in respiratory diseases in people.</li> </ul>

### Task 1: Conservation of wood

- As a class formulate an environmental club.
- Collect seeds of indigenous and exotic trees.
- Plant these trees on your schools open spaces.

## Solar energy

Solar refers to power obtained from the sun. In most communities' people uses solar panels to tap suns energy. The taped energy is stored in batteries. One of the most prominent battery companies EXIDE introduced solar batteries to meet the ever-increasing demand for solar electric energy.

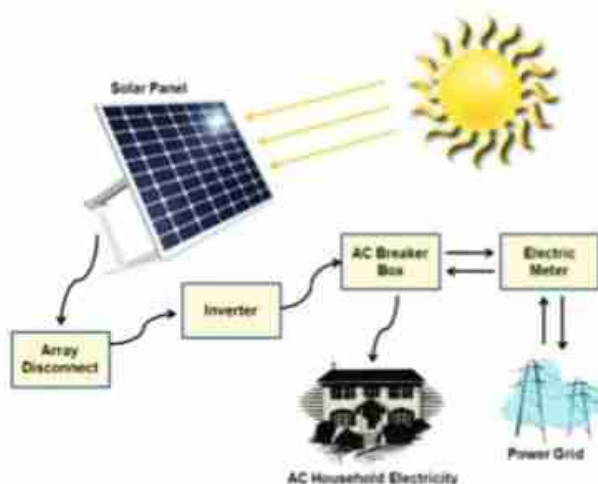


Fig 5.4: Solar energy system



The table 5.4 below shows some of the advantages and disadvantages of solar energy.

Table 5.4: The advantages and disadvantages of solar energy

Advantages	Disadvantages
-It is a renewable source of energy	-Installation of solar facilities its relatively expensive
-It is abundant in most tropical area	-Solar energy is affected by bad weather like overcast skies
-Solar facilities are relatively cheap to maintain	-Obtaining high energy outputs is often very expensive and not affordable
-It is friendly to the environment since it does not pollute the environment.	

### Biogas

Biogas is an energy source which is obtained through decomposition of raw cow dung and organic matter in a biogas plant which is illustrated below. The anaerobic decay of vegetation matter will produce gas which is mainly used for cooking. The table below shows some advantages and disadvantages of biogas.

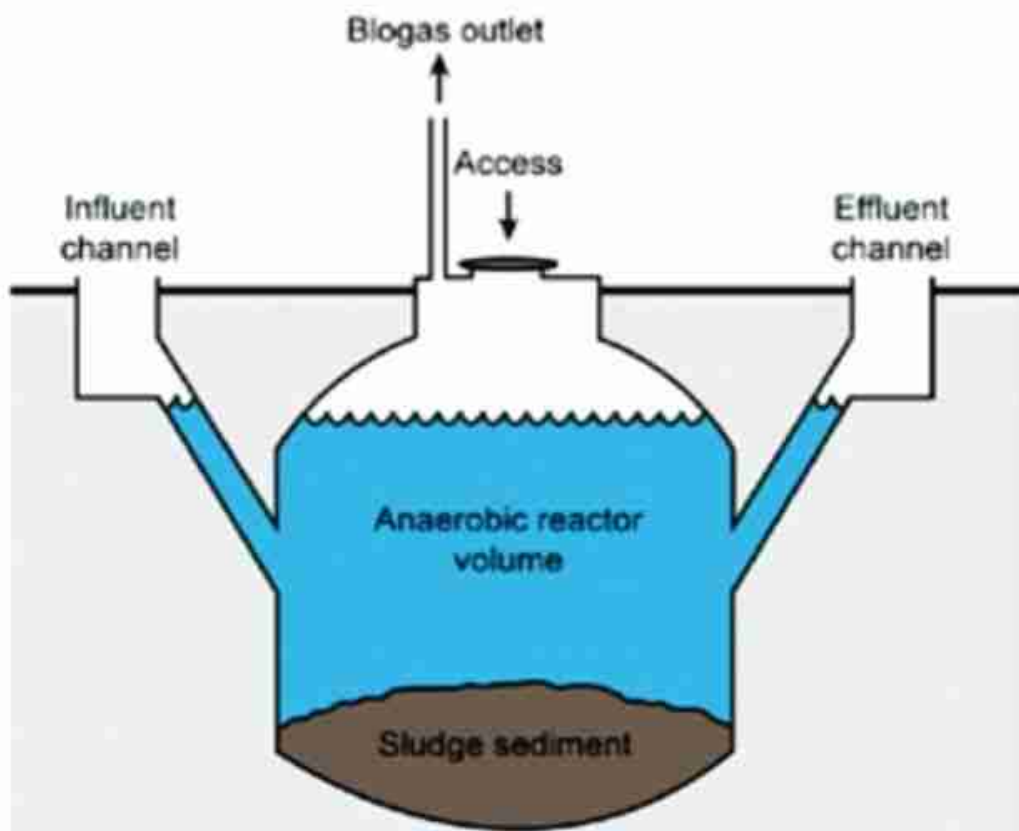


Fig 5.5: The biogas digester

Table 5.5: The advantages and disadvantages of biogas

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It is cheap as it uses animal and plants waste</li> <li>• It is renewable</li> <li>• It is clean, that is it is, friendly to the environment</li> <li>• Raw material used are locally available</li> <li>• Waste decayed material can be used as garden manure</li> </ul>	<ul style="list-style-type: none"> <li>• It is only useful on a communal scale</li> <li>• It is not suitable to use at a large scale.</li> </ul>

## Nuclear energy

Nuclear energy refers to energy obtained from radio-active substances for example uranium and plutonium. These are catalysed to enrich their reaction. In the process of reaction electric current is introduced and radio-activity is accelerated, more heat is produced. The heat is in turn used to heat water which turn turbines to produce electric energy.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It has a very high output of energy</li> <li>• It is an efficient energy source.</li> <li>• Nuclear energy is relatively clean if exploited with necessary precautions.</li> </ul>	<ul style="list-style-type: none"> <li>• Radio-active substances pollute the environment.</li> <li>• It is fairly expensive.</li> <li>• It is often abused by producing countries to produce nuclear weapons.</li> <li>• Disposal of nuclear waste is quite problematic; hence it results in several health problems.</li> </ul>

## Exercise 5.2

1. Study fig 5.6 below and answer the following questions



*Fig 5.6*

- Describe the scene in the photograph (5)
- Why is wood fuel commonly used in most African countries? (3)
- Outline the advantages and disadvantages of wood fuel (12)

### Animal/draught power



*Fig 5.7 ox drawn cart*

Draught power is one of the most common sources of power in most Zimbabwean communal areas. Animals mainly used to offer draught power are cattle and donkeys. However, some societies utilise draught power of the buffalo which are known of their strength and resilience.

Draught power is quite useful in the agricultural sector. Draught is used to till the land, weed, transport inputs to farms and transporting of the produce from the farm to proper storage facilities.

The table 5.7 below shows some of the advantages and disadvantages of draught power energy.

Table 5.7: Advantages and disadvantages of draught power

•  
•

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It is cheap.</li> <li>• It is readily available.</li> <li>• It requires little technical skills to operate.</li> <li>• Suitable for use on small farms.</li> </ul>	<ul style="list-style-type: none"> <li>• Slow and tedious to use</li> <li>• Less careful use of draught power results in soil erosion.</li> <li>• Often affected by climate conditions for example drought.</li> <li>• Not suitable for use on large farms.</li> </ul>

### Fossil fuels

The term fossil fuel refers to energy sources which are extracted from the ground. The most common example of fossil fuel in Zimbabwe is coal. In Zimbabwe coal is mainly used in thermal power stations to generate electricity. Coal is mainly mined in Zimbabwe at Hwange colliery.

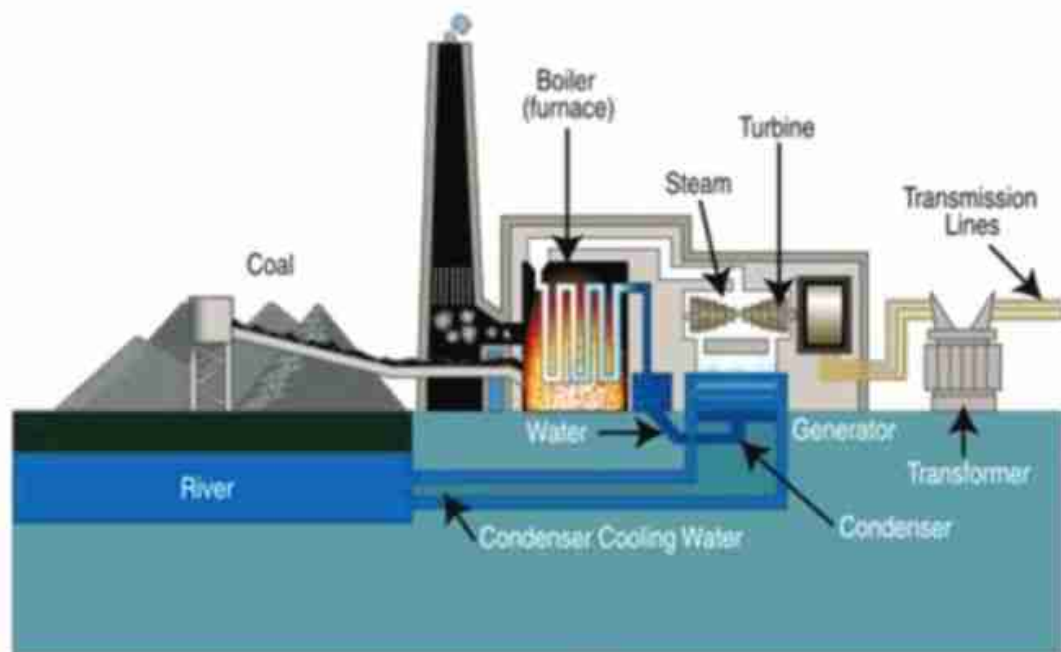


Fig 5.8 Thermal Power Generation

There are several reserves in Zimbabwe of about 21 mineral deposits. The total coal reserves are estimated to be above 20 billion tones. Some of coal deposits in Zimbabwe are at Bubi, Mkushe, Sebukwe and Sengwa.

Table 5.8 below shows some of the advantages and disadvantages of coal.

*Table 5.8: The advantages and disadvantages of coal*

Advantages	Disadvantages
<p>It has more than one industrial use that is heating, melting and smelting.</p> <p>Its mining creates employment opportunities.</p> <p>It is relatively cheap when compared with other energy sources.</p> <p>It produces relatively high amount of energy.</p>	<p>It is non-renewable.</p> <p>Its mining and use cause water, land and air pollution.</p> <p>Coal is a dirty and bulky energy source.</p>

### Exercise 5.3

1. Study fig 5.8 below and answer the following questions



Fig 5.9

- Describe the scene in the photography. (5)
- Give the advantages and disadvantages of using draught power energy. (10)

## UNIT 5.3

## CHOOSING THE SOURCE OF ENERGY

As we have seen different types of energy have their own advantages and disadvantages. It is therefore crucial for energy users to choose the source of energy that gives them the best of advantages while at the same time minimising the disadvantages. Growing environmental concerns have also led to some forms of energy virtually being avoided. There have been strong campaigns against the use of dirty forms of energy. Dirty forms of energy are those that cause gross environmental pollution. Globally there is emphasis on green energy. Some countries are finding it difficult to shift to better forms of energy because of a number of factors. The choice of the source of energy for any given area or country depends on:

- **The availability of the energy source**

The choice for the source of energy exploited largely depends on the availability of the energy. The energy source that is available in large quantities is usually accessible to most people hence it is used more than the energy sources which are scarce. For example, in Zimbabwe's rural areas, 70% of the population depends on wood because it is the most available source of energy. Rural electrification is poor but Zimbabwe is well endowed with more forests though increasing population is rapidly depleting the forests.

- **The cost of the energy**

The cost of the source of energy source plays a significant role in determining the people's choice to use the form of energy. The cost of the energy source involves the cost of buying the energy and the cost of generating the energy. Energy source which are expensive to exploit for energy generation deter their use especially in developing countries where there is lack of capital. People who use energy are rational hence they opt for cheaper sources of energy. Industries, for example, would opt for cheaper energy sources to maximise profits. This explains why most industries in Zimbabwe do not depend on diesel and petrol generators to power their machines because fuel is more expensive than solar and electricity.

- **The amount of energy required**

The amount of energy required to power machines determines the choice of the source of energy. Energy users could opt for cheaper energy or that which is readily available but if the power generated by the energy source is

inadequate for the need, the users are forced to opt for a better source of energy. There are some machines and processes which demand high energy hence the users are restricted to the sources of energy producing high energy.

- **Legislation**

Governments put legislation to protect the exploitation of certain sources for energy. In Zimbabwe, the Water Act and the Forestry Act protect water and forests respectively. The Zimbabwe National Water Authority (ZINWA) enforces the water legislation to make sure that those using water resources comply with the requirements. Those wishing to make use of water as a source of energy may fail to do so if they cannot comply with the demands of legislation. The Environmental Management Agency enforces legislation on the protection of the environment. It controls environmental hazards such as deforestation by undertaking patrols to identify areas where forests are being cleared.

- **Nature of the equipment used**

The equipment used determines the types of energy required. Households and industries using electrical appliances are forced to use the energy sources which produce electric power. Most rural households do not own electrical stoves and refrigerators hence their dependence on wood is justified.

- **Technological advancement**

Advances in the level of technology affect the choice of the sources of energy. Technological development enables the exploitation of certain forms of energy. Generation of energy from sources such as nuclear and geothermal, for example, requires expensive technology. Technological developments have also led to the development of equipment which uses

## SUMMARY

- ✓ Energy refers to any source of power used to accomplish a task.
- ✓ There are several types of energy which include water, wind, solar and draught.
- ✓ Wood fuel is commonly used in Zimbabwe.
- ✓ Energy availability is crucial to accomplish different tasks in agriculture, mining and the manufacturing sectors of the economy.
- ✓ The choice and justification of an energy source to be used depends on availability, affordability, efficiency and environmental impacts.
- ✓ Each energy type has its own advantages and disadvantages.

## GLOSSARY

**Energy:** refers to any form of power used to accomplish a task.

**Agriculture:** It is the practise of growing crops and rearing animals for family consumption or for sale.

**Mining:** It is the extraction of raw materials from underground.

**Draught:** It is source of power obtained from the livestock



## TEST

**Multiple Choice**

- Which of the following is a non-renewable source of energy?
 

A. wood	B. wind
C. water	D. coal
- Which of the following is a renewable source of energy?
 

A. Solar energy	B. Coal
C. Petroleum	D. Uranium
- The following are energy examples except:
 

A. Coal	B. Hydro-electric power
C. Methane	D. Liquid
- What is the main source of electricity in Zimbabwe
 

A. Nuclear power	B. Hydro-electricity
C. Wood fuel	D. Coal
- What is the main source of electricity in Zimbabwe?
 

A. Coal	B. Water
C. Oil	D. Uranium

**Structured Questions**

- (a)(i) What is energy? (1)  
 (ii) Explain the importance of energy to the following economic activities:  
 Farming  
 Mining  
 Manufacturing (12)  
 (b) Describe the advantages and disadvantages of nuclear energy (6)  
 (c) Justify the source of energy you would recommend for a rural area in Zimbabwe (6)
- (a)(i) Distinguish between renewable and non-renewable sources of energy (6)  
 (ii) State any renewable and non-renewable sources of energy (5)  
 (b) What are the advantages and disadvantages of hydroelectricity power (7)  
 (c) Outline the factors that should be considered when choosing the source of energy to use (7)

## NATURAL RESOURCES

**Objectives**

By the end of this chapter, you should be able to:

- describe the concept of contour lines
- determine altitude using contour lines
- identify landforms using contour patterns
- describe the concept of gradient
- calculate gradient of a slope
- apply gradient data to understand phenomena on the map
- describe types of land use on a map
- explain determinants of land use zoning on maps
- identify land use patterns on a map
- describe types of land use patterns
- explain processes influencing land use patterns

**Introduction**

To be able to interpret a map, you need to acquire the necessary skills. A map compresses of a series of symbols and markings calling out for the interpreter's attention. Without the necessary skills one will surely miss a lot of information rendering the map useless. Topographic maps have become very common because of their ability to show a lot of information over a wide area. New Trends In Geography Book 1 looked at some of the skills you must develop. This chapter looks at the concept of contour lines, identification of Landforms using contour patterns, the concept of gradient, description of land use on the map and the land use patterns on the map.

**UNIT 6.1****CONTOUR LINES**

Contour lines are lines drawn on a map to show areas of the same altitude. These lines join or connect areas with the same altitude. Altitude is the height above sea level and on most topographic maps it is given in meters. The contour lines are drawn in brown colour. The aspects of the contour lines are shown in fig 6.1 below.

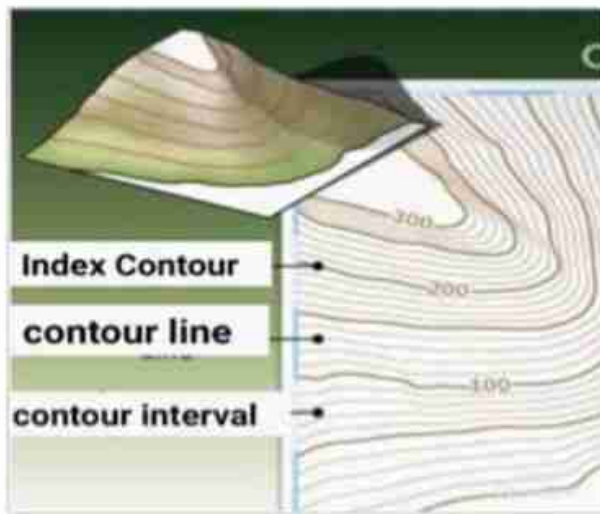


Fig 6.1: Aspects of contour lines

The index contour lines are bold than the other ordinary contour lines. Usually these have their height stated. The contour interval is the difference from one contour line to another given in meters. It represents the margin by which height increases or decreases. In most topographic in Zimbabwe, the contour interval is 20 meters. Most of the contour lines are just ordinary contour lines. Ordinary contour lines are many compared to the index contours. Their contour interval is also 20 meters. Given the contour interval one can get the contour reading of the next successive

contour lines by either adding or subtracting 20 meters. The contour lines form rings around a given location denoting the height of the Landform. The inner ring contour line represent the highest altitude of the Landform or the summit if it is a mountain. The outer contour shows the foot of the Landform.

The contour interval in fig 6.2 above is 20m. The contour lines have a difference of 20 m. From 980 to 960 and then 940. As we move from the contour line at the centre, the contour reading decreases showing a decrease in altitude. As we move up towards the central contour line the contour reading increases showing an increase in altitude.

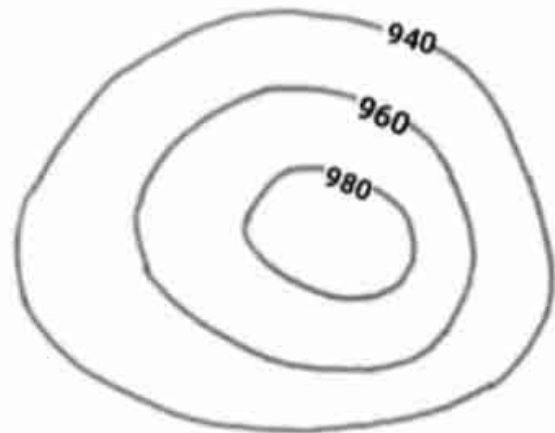


Fig 6.2: Contour lines and contour interval

In fig 6.3 above the contour interval is 20 m. This is given by the difference between the contour line 1100 and 1080. Contour line A is therefore 1120 ( $1100 + 20$ ). Contour line B is 1040 ( $1080 - 20$ ) and C is 1020 ( $1040 - 20$ ). An inner ring contour shows an increase in altitude hence we add 20 m per every contour line according to contour interval. An outer ring contour represents a decrease in altitude hence we subtract 20 m to get the altitude of the outer contour line.

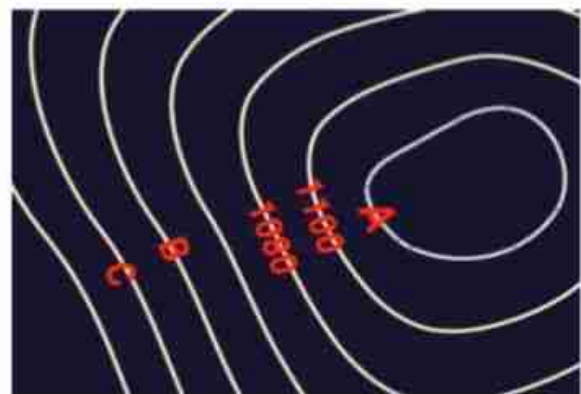
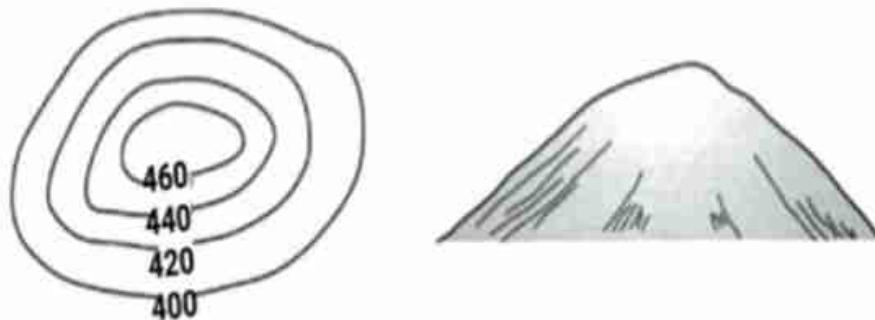


Fig 6.3: Contour interval and contour reading

Contour lines also show Landforms and slope forms. The appearance of contour lines shows Landforms such as hills, mountains, Plateaus, cliffs, gorges, and ridges. They also show different slope forms such as gentle slope, steep uniform, undulating, convex and concave slopes. The different types of slope and Landforms and contour appearance include:

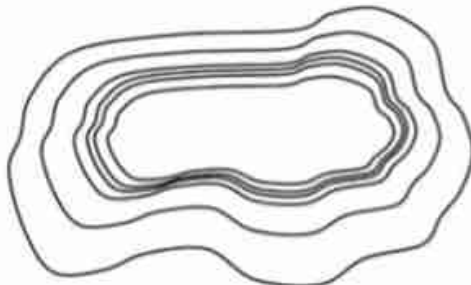
- **The conical hill**



*Fig 6.4: The conical hill*

The contour lines for a conical hill are circular and closer to show the steep sides of the conical hill.

- **Mountain**



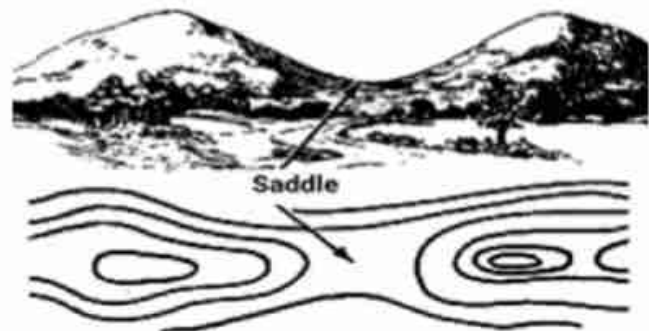
*Fig 6.5: Mountain*

A mountain is shown by contour lines which are closely packed to show the steep sides. In fig 6.5 the top of the mountain has well-spaced contour lines making it a Table Mountain. The top part of the mountain is gentle or a plain. The difference between a mountain and a hill is that a mountain is higher and bigger. Mountains are usually above 700 m high whereas hills are below this altitude.

- **Saddle**

A saddle is a low-lying area between two summits.

A saddle is shown by closely spaced contour lines separated by an area of sparsely packed contour lines.



*Fig 6.6: Saddle*

- **Ridge**

The contour lines are elongated to show horizontal extend. A ridge is a steep sided narrow strip of high land. Some ridges cover several kilometres in terms of horizontal distance yet their width is low. The

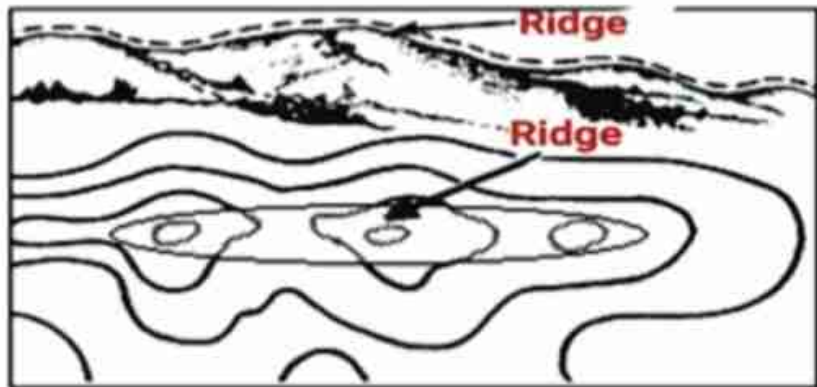


Fig 6.7: The Ridge

altitude of ridges varies but elongated contour lines on a topographic map shows a ridge.

- **Plateau**

A plateau is a high steep sided feature with a gentle sloping top. Plateaus are table like features with a flat top and steep sides as shown in fig 6.7.

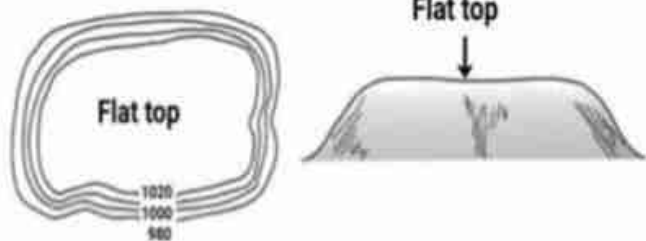


Fig 6.7: A plateau

- **Cliff**

A cliff is the steep side of a slope also called the scarp. It is shown by contour lines which are closely packed such that they touch. The more the number of touching contour lines, the higher the cliff.

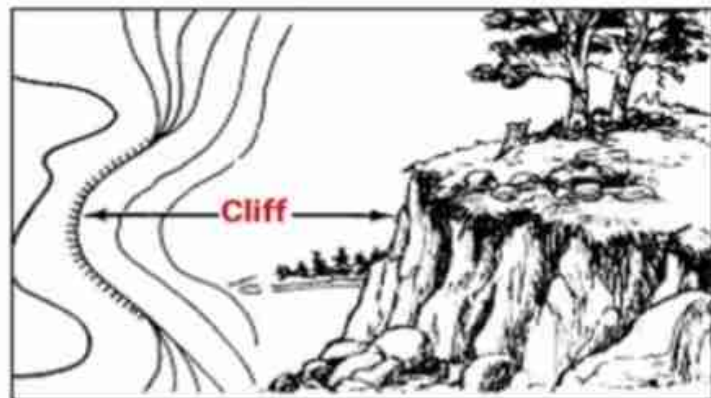


Fig 6.8: Cliff

In fig 6.8 the touching contour lines shows a cliff. The more the touching contour lines, the higher the cliff.

- Slope steepness**

A gentle slope is shown on a map using contour lines which are far spaced. Steep slopes are shown using closely packed contour lines as shown in fig 6.9 below.



Fig 6.9: Steep slope and gentle slope on map

- Even slope**

An even slope maintains its form. It does not change in terms of steepness or gentleness. It is shown on a topographic map using evenly spaced contour lines as shown in fig 6.10.

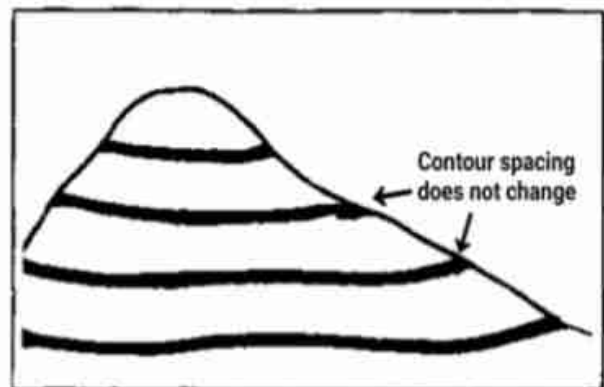


Fig 6.10: Even slope

As shown in fig 6.10 on even slope the spacing of contour lines does not decrease or increase.

- Undulating slope**

An undulating slope is a slope which is not regular. The slope is made up of alternating steep and gentle segments.



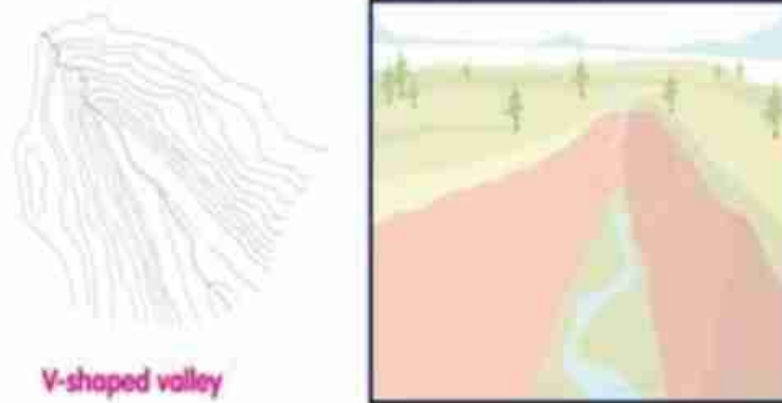
Fig 6.11: Undulating slope shown on real ground and by contour lines

- Convex slope and concave slope**

Convex slopes are shown by close contour lines at the bottom of the slope and get far apart up the slope. Concave slopes are shown using close contour lines at the top which gets apart at the foot of the slope.

- **V-shaped valleys**

Valleys are elongated low-lying depressions usually with a river flowing through it. The contour lines are V or U-shaped as shown in fig 6.12 below.



V-shaped valley

shaped valleys

### Determining altitude of features on a map

The altitude of physical and human features shown on a map is determined using contour lines. To find the altitude of a mountain summit find the altitude of the last contour line at the highest point of the mountain. The altitude of features such as dip tanks, huts and aerodromes are also found using contour lines.

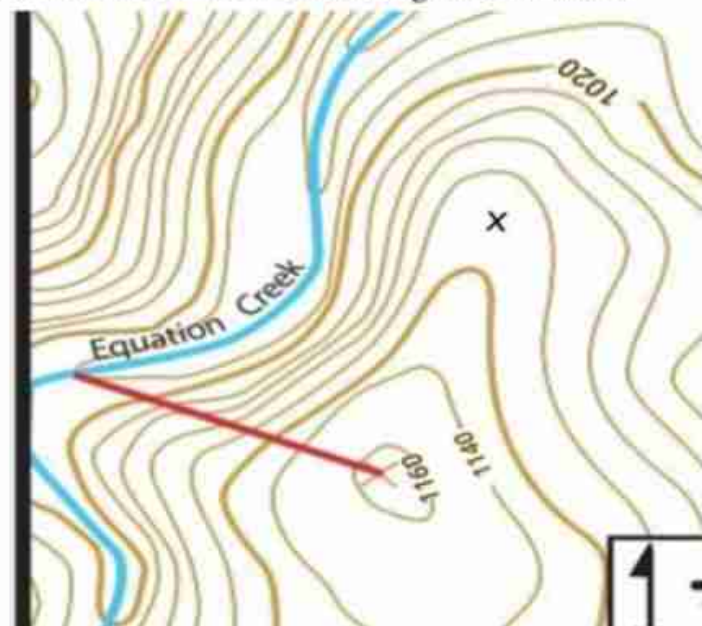


Fig 6.13: Finding the altitude of features

The altitude of X in fig 6.13 is 1110. The dot is found between 1100 and 1120. It is therefore half way the 20m between the 2 contour lines hence it is found 10m from the two contour lines. This gives its reading as 1110m.

The altitude of features is also given using spot heights and trigonometrical stations. A spot height is a dot which has a reference number and the altitude. A trigonometrical station is a triangle which has a reference number and an altitude. These are discussed in detail in New Trends in Geography Book 1. To understand the landforms shown on the topographic map, models are handy. A model is a miniature representation of physical features. They are small objects made to represent the actual things. For example, the Earth is represented by the globe. The globe is a model of the Earth. Physical features such as hills, gorges and waterfalls can be shown using models. To construct a good model, follow the next steps:

1. Acquire the materials needed. Landform models can be made from clay, cement or any other materials. You can construct the models on a surface of your choice. A wooden board can be the ideal platform.
2. Decide the size of the models. Some models are not drawn to scale. They are just drawn to show the major features of the real objects or landforms.
3. Observe contour behaviour or appearance of the real landforms. If you are making the models using topographic maps, you need to understand the features represented by different contour spacing. If you are constructing the models from observing real landforms focus on the real landform and mould a model of corresponding appearance to the real thing,
4. On a platform such as a wooden box mould the model into the exact shape of the real landform.
5. Mark the successive contour lines to show the changes in altitude on your model.

### Task 6.1: Construction of models

In groups

Using accessible materials, make models of a conical hill, Plateau, v-shaped valley, and saddle.

### Exercise 6.1

- (a) Draw the contour lines showing the following features:  
 (i) Conical hill    (ii) plateau    (iii) plateau    (iv) gorge
- (b) Besides contour lines, what else is used to show altitude on a map? (2)
- (c) Identify the readings of the index contour and the contour interval in 6.2 (2)



## UNIT 6.2 GRADIENT

Gradient is the ratio between the different in altitude between two points and the horizontal distance between the two points. It shows the steepness of the slope. The difference in altitude between two points is called the vertical interval (VI) and the ground distance between the two points is called the horizontal equivalent (HE). It is calculated as:

$$G = \frac{VI}{HE}$$

Where:

G is the gradient between two points

VI is the difference in height

HE is the horizontal distance between the two points

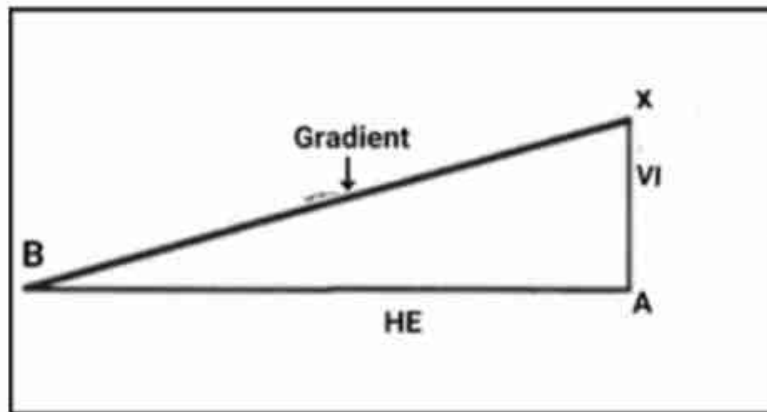


Fig 6.14: Gradient

As shown in fig 6.14 is the horizontal distance from A to B. The difference in height between A and B is shown as XA which is the vertical difference high. The gradient is XB.

For contour lines which are close to each other the gradient is steep whereas is important for various purposes. The steepness of the slope determines the easiness with which infrastructure can be constructed. Gradient also determine precautions for using the land for farming. Railway lines and roads, for example, require specific gradient for them to be safe, railway lines require a gentle gradient of 1: 66. Drivers have to know which gear to engage on steeper gradients. The rate of overland flow depends on gradient. On steep gradients surface runoff is high.

### Gradient and map phenomena

The map represents 3 dimensional (3D) features on a 2-dimensional (2D) surfaces. When 2D features do not show height of the objects. The use of contour lines on map enables the presentation of 3D features on 2D surface. The gradient of features and the landscape is shown using contour lines. Steeper gradient has low horizontal

distance per vertical rise. A gradient of 1:10 is a steep slope than 1: 100. A gradient of 1:10 means that a vertical rise of a meter is equal to 10 meters of travel. The 1:100 gradient means for every 1 m vertical rise there is 50 m of horizontal travel. This is shown in fig 6.15.

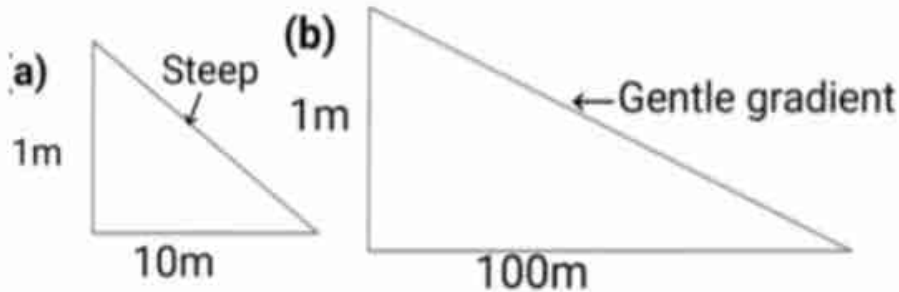


Fig 6. 15: Gentle and steep gradient

In fig 6.15 (a) the slope is rising steep over a short distance. This gives a steep gradient than in fig 6.15 (b). to understand map to make use of gradient. Cliffs have steep gradients. The contour lines are closely spaced giving steep gradient. This is different from plains.

## Exercise 6.2

- State the formula for calculating gradient (1)
- Use fig 6.16 below answer the following questions



Fig 6.16

- Using the scale 2cm represent 1km calculate the gradient of the road from contour line 5800 to the spot height 2860 (x to y) (3)
- Give 2 situation where gradient calculation are important (4)

## UNIT 6.3 LAND USE PATTERNS

The term land use patterns refer to the sequences of how land in an area is used. There are various types of land use and these are:

- **Agriculture**  
This refers to the use of land for the growing of crops and rearing of animals. The growing of crops produces it's a different land use patterns such as plantations, extensive farms and intensive farms.
- **Mining**  
Mining is a common land use in areas where there are mineral deposits.
- **Residential**  
The residential use of land involves using the land for people to live. These are the areas where people's homes are found. In rural areas these are shown by huts other settlements. In urban areas these are shown by huts and other settlements. In urban areas different residential zones are found. These include low income (high density) medium income (medium density) and low income (low density suburbs).
- **Forestry/vegetation**  
These are areas where forests and vegetation grow.
- **Industry**  
These are areas where manufacturing and processing building are found. The different land uses are shown on topographic maps. You need to be able to identify these land uses on a map. The key or legend will help you to identify the different land uses. On a map the common land uses include cultivation, tourism and recreation, ranching, forestry, natural bushes and residential. To identify a land use pattern, you will need to use the key to see the colour code or symbol representing the land use. Cultivation is shown in pink. Tourism and recreation are shown by the presence of recreation facilities such as lakes, dams and golf courses, tourist attractions such as historic monuments and rock paintings, beaches and hotels. Cattle ranging is usually shown by availability of pastures and dip tanks. Administration is shown by the presence of administrative offices and law enforcement offices such as courts and police offices. Residential land use is shown by different residential building density. Low income residential areas have closely packed houses compared to high income residential areas.

Settlements are shown by different patterns. Radial settlement pattern is

shown on the map by buildings spreading outwards from a central point outwards. Linear settlement pattern is shown by building such as huts found along rivers or roads. The factors affecting land use patterns are:

- **Relief**  
The configuration of the land determines land use patterns. Mountain rugged terrain may lead to dispersion of land use. Mountains and hills are barriers to certain land use types. Availability of water bodies and open sloping spaces determine land uses. Steep slopes make certain land uses difficult.
- **Soil type or rock type**  
The land use depends on the rock type and soil type. The nature of crops grown depends on the type of the soil.
- **Availability of natural resources**  
The availability of mineral resources determines the land use patterns. Where natural forests exist conservation, tenets say that they should be conserved. Hence areas natural forests are usually dedicated towards forestry. Areas with mineral deposits are also dedicated to mining.
- **Climate**  
Zimbabwe is divided into different agro-ecological regions. These regions experience different climatic conditions. The climatic conditions determine the type of land use for each region. Regions receiving better amounts of rainfall are suitable for the growing of crops. Ranging is practiced in drier regions.
- **Land tenure**  
The term land refers to the ownership of the land and the rights to sue the land. Ownership of the land gives the owner a choice as to the land use pattern deemed necessary.
- **Government policy**  
The central government and the local government are responsible for planning different land uses. Government therefor set regulations as to how land in certain areas is used.

## Processes Influencing land use patterns

The processes influencing land use patterns include:

- **Resettlement**  
Resettlement programmes such as Zimbabwe's A1 and A2 models influence

land use patterns. The land which was not used for cultivation was brought into cultivation after land reform. Commercial farms are fragmented into small farms thereby affecting the nature of land use.

- **Urban Sprawl**

Urban sprawl is the growth of urban built up areas into rural areas just outside the urban built up areas. Urban sprawl changes the land uses in areas around the cities. The vegetation around the cities is cleared to pave way for urban buildings.

- **Climate change**

Climate is a major component determining land uses. The changing of climate means that the activities carried out also change. Desertification due to climate change may entail a change from crop production to other forms of land use.

- **Population growth**

Population also influence land uses. Where there is low population density, land uses demanding extensive pieces of land are possible. The growing

## SUMMARY

- ✓ Contour lines are used to show altitude on a map
- ✓ The index contour lines is bold and the contour interval is the difference in meters from one contour line to another
- ✓ Different landforms are shown by contour lines
- ✓ Models are used to show the appearance of landforms in reality
- ✓ Gradient is the steepness of the slope
- ✓ Gradient determine the nature of land use on various slopes
- ✓ The different land uses shown on a topographic map include cultivation, recreation, forestry and game ranching
- ✓ Factors affecting land use patterns include land tenure, government policy, climate and relief
- ✓ The processes affecting land use include population growth, urban sprawl and climate change

## GLOSSARY

**Contour lines:** these are drawn on a topographic map to show areas of the same altitude

**Gradient:** it refers to the steepness of the slope

**Land tenure:** it refers to who owns the land and who has the right to use it

**Map:** it is a representation of a given area drawn on a piece of paper to scale

**Relief:** it is the configuration or the nature of the land

**Saddle:** it is a low land dividing two high lands

**Urban sprawl:** it is the growth of the urban build up area into the surrounding rural areas

## TEST

## Multiple Choice

For questions 1-4 use fig 6. Below

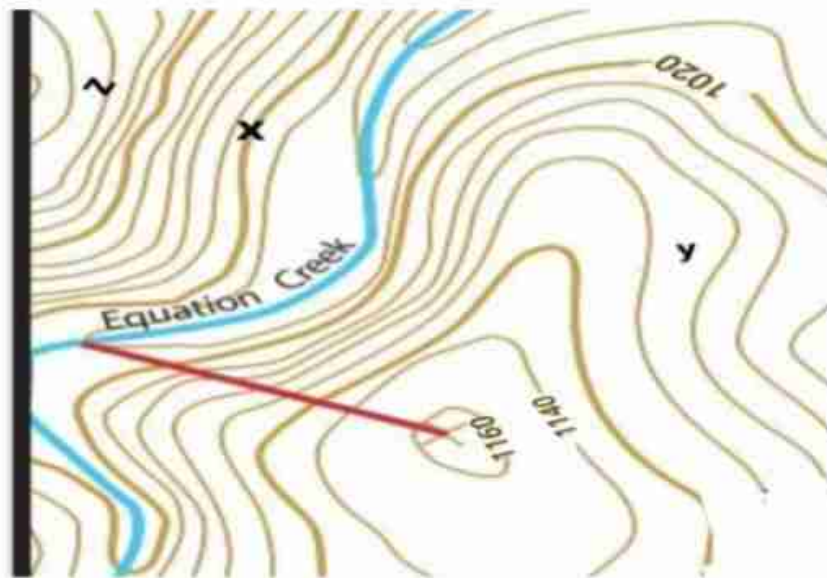


Fig 6.16

- The altitude of x is
 

A. 1000	B. 1020
C. 980	D. 1040
- The altitude of y is
 

A. 1190	B. 1090
C. 1080	D. 1070
- Using the scale of 2cm representing 1km, what is the gradient of the red line
 

A. 1:3	B. 1:50 000
C. 1:1	D. 1:10
- The altitude of z is
 

A. 1180	B. 1080
C. 1800	D. 1140
- the contour interval used on most of the topographic maps in Zimbabwe is----
 

A. 1.50 000	B. 50
C. 20	D. 50 000
- the feature shown by the contour lines below is ---
 

A. Hill	B. plateau
C. saddle	D. mountain

**Structured Questions**

- 7.(a)(i) State any 3 ways of showing altitude on a topographic map (3)  
(ii) Using contour lines draw diagrams to show the appearance of conical hills, ridges, cliffs, saddle and plateaus on a topographic map (5)  
(iii) What are models and why do you think they are important? (4)
- (b) Identify situations where gradient calculations are important (6)
- (c) Describe the factors affecting land use on the map (7)



# 7

## CHAPTER 7

### MINERALS AND MINING

#### Objectives

By the end of this chapter, you should be able to:

- describe the term mining.
- describe factors affecting mining in Zimbabwe.
- describe mining methods in Zimbabwe.
- identify methods used in prospects for gold.
- describe physiochemical properties of alluvial minerals.
- identify methods used in gold panning
- outline challenges associated with gold panning
- suggest reasons to improve contributions done by gold panners to national economy

#### Introduction

In Zimbabwe mining have been practised for quite long. Early states such as Great Zimbabwe, Mapungubwe and Mutapa practised mining among other economic activities. Since then mining has evolved and today it is a major foreign currency earner and the fulcrum of economic development for many states. New Trends in Geography Book 1 looked at the different minerals in Zimbabwe, the uses of minerals, and the processing of minerals in Zimbabwe. This chapter looks at the factors affecting mining in Zimbabwe, mining methods, prospecting for gold, physiochemical properties of alluvial minerals, methods used in gold panning and the challenges associated with gold panning.

#### UNIT 7.1

#### WHAT IS MINING?

Mining refers to the process through which minerals or are extracted from the ground. Zimbabwe is exhausted with a variety of minerals some of which are exploited commercially, some of the common minerals in Zimbabwe includes gold, diamond, nickel, asbestos, copper and many others.

The map below shows mines and minerals distribution in Zimbabwe.



Fig 7.1: The distribution of minerals in Zimbabwe

## Factors affecting mining in Zimbabwe

There are several factors affecting mining. These factors can be classified as physical sector economy and political.

### Capital

In mining the term capital refers to the money needed to start mining operations. Money in mining is required to purchase the land, buy mining machinery and setup the basic infrastructure which makes mining operations feasible. Due to lack of meaningful capital by indigenous people the mining sector in Zimbabwe is dominated by transnational companies like Anglo American Cooperation and Lonrho.

### Technology

Technological equipment is quite essential in the exploitation of minerals. The level of technology a company possesses determines the scale at which mining operations are conducted. Companies with a shallow capital base conducts mining at a smaller scale whilst those with larger capital bases conducts mining operations on a large scale.

### Labour costs and Availability

Labour costs and availability have a direct relationship with capital which a mining company has. Mining companies thrive on skilled, semi-skilled and unskilled labour.

## Markets

All mining operations are done on a commercial basis. The market size and availability determine mining operations in Zimbabwe. Minerals with great value have a greater market than those with less value like quartz.

## The qualities of mineral ores

Minerals with high quality grades are often preferred by miners since they are more profitable than low grade minerals.

## Political situation

The political atmosphere of a country affects mining operations in Zimbabwe. Mining companies avoid investing their money in an unstable political atmosphere since there are higher risks of incurring losses in war torn unstable countries.

## Government Policies

Government policies may either encourage or discourage the mining of certain minerals. The government also supports mining by offering incentives and developing infrastructure in mining areas.

### Activity 7.1

- a. Define the term mining (1)
- b. What factors influence the exploitation of minerals in Zimbabwe (10).

## UNIT 7.2

## MINING METHODS

Different methods are used to extract minerals from the ground. Mining methods are determined by the nature in which the mineral occurs and the depth at which the mineral is found. Some minerals occur on the earth's surface whilst some occur beneath the surface.

### Open Cast Mining Method

This mining method is commonly used where minerals are found close to the surface. Machines like excavators, bulldozers and draglines are used to remove the overburden and the minerals are extracted.

### Advantages of Open Cast Mining

- It is one of the cheapest mining methods.
- It uses simple tools which require little or no training to use.
- Since operators work above the ground, open cast mining method poses less danger to miners.

## Disadvantages

- This method reduces the natural beauty of an area by leaving open pits, mine dumps and distorts the original land scape.
- Open cast methods destroy vegetation hence results in serious soil erosion, river and dam siltation.
- This method can be used to extract minerals occurring near the surface only. It is not feasible to use in mines where minerals occur several metres below the surface.
- It destroys agricultural land.

## Shaft Mining Method

This mining method is used where the minerals are found several meters underground. Shafts are created to access the mineral. Mineral ores mined are carried up to the ground for processing. At times it uses explosions to blast rocks containing minerals. Tunnels should be properly supported to avoid collapsing and well-lit to ensure occupational safety to miners. The shafts can be inclined or vertical. The difference between inclined shafts and vertical shafts are shown in table 7.1 below.

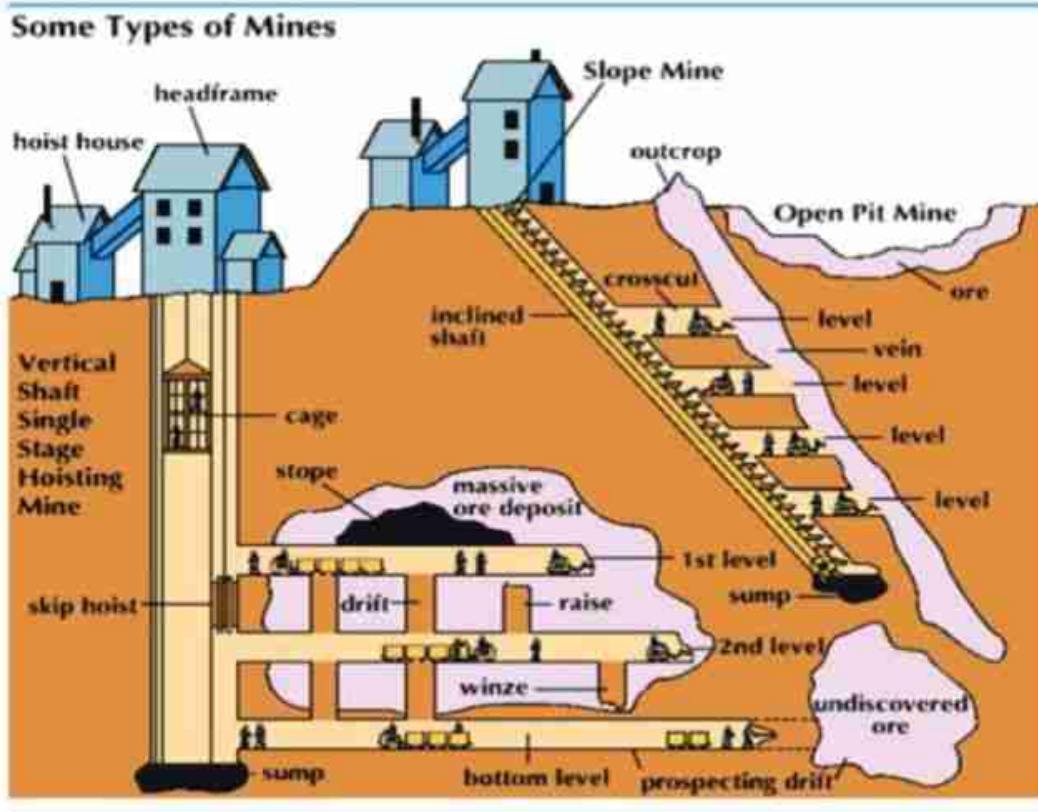


Fig 7.2: The methods of mining

## Advantages of shaft mining method

- This mining method is quite useful in extracting minerals occurring deep underground at several metres.

- Due to its complex nature and demands it creates employment opportunities to skilled, unskilled and semi-skilled workers.

### Disadvantages

- It is one of the most expensive method since huge sums of money is required to buy mining machinery and construct tunnels to access the mineral ores.
- Operating in tunnels poses danger for miners' lives since chances of gas poisoning and tunnels collapse are very high.

### Draft/Adit Mining

This mining method is used when a mineral ore occurs on valley sides. On such mining sites either horizontal or vertical tunnels are dug to extract the mineral ore. Conveyers or wagons are used to carry the ore to the surface where it is partially processed.

### Advantages

- It is a cheap mining method since the ore occurs on the valley sides.
- It creates employment opportunities to local people
- Its damage to agricultural and settlement areas is minimum.

### Disadvantages

- It is dangerous to miners since the horizontal and inclined tunnels may collapse and kill miners.
- It destroys vegetation and distorts the landscape especially at processing sites.

### Panning

Panning is also called alluvial mining. This mining method is used to extract mineral ores which are deposited along river beds. A mineral like gold in Zimbabwe is found along major rivers. The Department of Natural Resources (2009) reported that about 600 000 people are directly involved in gold panning activities along 5000 km of Zimbabwe's major rivers including Mazowe, Angwa, Insiza, Runde and Bubi This mining method involves the mining of alluvial soils, serving and separation of impurities from the mineral using simple machinery like pans.



*Fig 7.3: Gold panning along Insiza river*

### Advantages

- It is a cheap mining method since it has simple tools.
- It is less dangerous since operations are done on top of the surface.
- It is a source of livelihood to many families.

### Disadvantages

- It is one of the mining methods which destroys the environment.
- It causes serious soil erosions, river and dam siltation.
- Miners are at higher risk of losing life in times of floods and tunnel collapse.

#### Activity 7.2

- List any three mining methods you know (3)
- Draw a full labelled diagram showing the vertical shaft mining method (6)
- What are the advantages and disadvantages of shaft mining method (10)

### Gold panning in Zimbabwe

Gold panning has become one of the most lucrative business in several provinces including Midlands and Manicaland. Panning is mainly done by artisanal miners locally known as *Makorokoza* (Amakorokoza). Although panning is a source of livelihood to several families, the increase in the number of artisanal miners gave birth to several challenges. Midlands province recorded about 7801 crime cases between January and June in 2018. Most of these criminal cases were committed in mining areas.

Gold panning is the simplest cheapest and oldest way of extracting gold using a pan. In panning alluvial deposits containing minerals are scooped into a pan where it is agitated or shred in water. The gold will then sink at the bottom of the pan. Mercury is then used to gather the gold granules.

## UNIT 7.3

## PROSPECTING METHODS FOR GOLD

Gold prospecting refers to the act of searching for gold deposits. Ways of prospecting for gold vary depending on the type of gold deposits and the gold native of occurrence.

Some of the common prospecting methods include:

- **Hydrogeochemical prospecting method**

In this prospecting method, water samples collected from wells, springs and boreholes are tested by chemicals. Usually such water sample gives a clue on the presence or non-presence of gold deposits.

- **Physio-chemical properties of alluvial minerals**

Alluvial mineral deposits are largely constituted by ground soil sand and clay and mineral particles. Several alluvial minerals like gold and tin are found in the lower parts of a river course usually in flood plains. In Zimbabwean, alluvial minerals the most common is gold which is found along rivers like Mutare river, Odzi river in Manicaland, Mazowe in Mashonaland.

### Testing for gold

Various methods can be used to test for gold. The commonly used one is a native act test. The perform thus test the following procedures should be followed.

1. Get your gold sample to be tested.
2. Scratch the sample using a nail file.
3. Apply a small drop of nitric acid to the scratch and allow them to react.

The following findings are likely to be made.

#### Probable Finding 1

After the reaction if the gold sample immediately turns green it is fake gold.

#### Probable finding 2

After the reactions if there are no signs of reactivity then the piece of gold is most likely from real gold.

### Testing for diamond

Diamond is one of the precious minerals found in Zimbabwe. It is mainly mined in Manicaland province in Chiadzwa. It is of paramount that you should know how to test for the genuineness of a diamond piece since it is a precious gem. The following tests can be done.

#### The hydro test

In the hydro test water is used to test for the diamond quality.

##### Procedures

1. Take your diamond sample.
2. Obtain a drinking glass and fill it half way with water.
3. Carefully drop the gem sample into the half-filled water glass.

#### Findings

Real diamonds have a relatively higher density so if it is genuine it should not sink to the bottom of the glass. If it floats on top of the water or takes a while to sink it is a fake diamond.

### The Fog tests

1. Diamonds can also be tested using the fog method procedure
2. Take the diamond sample and hold it between your two fingers.
3. Make a breath on the sample with a puff of air

**NB:** A light fog can be formed on the diamond sample because of the moisture generated from the breath puff.

If the fog disappears from the diamond sample instantly its mostly likely genuine diamond.

If it takes several minutes for the fog to disappear its most likely a fake diamond.

### The Ultra-violet radiation test

Ultraviolet radiation is also used to test for diamond genuineness.

#### Procedure

1. Place the diamond Sample under a UV light for a while.
2. Watch the reaction of the diamond with light.

#### Observations

After reacting with UV most genuine diamonds emit a sparkling blue coloured glow. However, some do not emit a blue coloured glow.

**NB:** The UV test should be complimented by other tests because failure to emit a blue glow does not mean if a fake diamond.

### Task: Mineral sample collection

Find a sample of any mineral locally available and then test that mineral in the school laboratory.

### Challenges associated with gold panning

Although gold panning is contributing meaningfully towards the national economy. Gold panning is resulting in several social, economic and environmental problems. Some of these includes:

- Many panners are not registered or licenced so gold panning is encouraging illegal trading of minerals.
- Several panning sites lacks the basic social amenities like safe water, lighting, roads and shelter. They become hot spots of hygienic diseases like cholera and typhoid.
- Quarrelling and fighting of miners is common at panning sites. In some instances, quarrels and fights degenerates into murder cases.



- Panning causes river and dam siltation.
- Government loses revenue in panning activities because most panners do not pay taxes.
- Panning leaves open pits which becomes dangerous traps to livestock, wild animals and people.
- Loss of life due to collapse of miners for example in 2019 more than 20 miners perished in Battlefield disaster.

### Improve the contribution of gold panners to the national economy

There are several ways through which gold panners contributions to the national economy can be increased. Some of these includes:

- Legalising and liberalisation of panning so that panners will also meaningfully contribute into all the mining basket.
- The government should fund panning operations and develop infrastructure and social amenities in panning sites.
- Environmentally educating panners on the need to conserve the environment.
- Urging panners to pull resources together so that they can finance their mining operations meaningfully.

The contribution of panners to the country's Gross domestic Product (GDP) should be emphasised and promoted because they play an important role. Most of the minerals the panners mine cannot be mined profitably by large firms. This is because alluvial minerals occur in very small deposits in most cases. However, the small-scale minerals produce a big percentage of minerals such as gold. In 2018 for example, the small-scale miners including the illegal panners contributed 60% of the gold sold to Fidelity (Mbizi; 2019). In 2017 they contributed 53% of gold production exported to bring foreign currency. As a result, the panners play a significant role in the economy. Improving their contribution will help in developing the country. Setting ways through which they can contribute meaningfully will also assist in setting panning standards that also protects the environment and protect the panners from criminals and reduce corruption.

### Exercise 7.3

1. (a). Define the term panning (1)  
 (b). List any five tools used by panners in Zimbabwe (5)  
 (c). Gold panning in Zimbabwe has several benefits and problems. Clearly outline them (15).

2. Study fig 7.4 and answer the following questions



*Fig 7.4*

- Describe the scene in the photography. (5)
- What are the challenges associated with gold panning in Zimbabwe. (7)
- What measures would put in place to improve the contribution of gold panners to national economy. (5)

## SUMMARY

- ✓ Mining refers to the extraction of minerals from the earth's surface.
- ✓ There are several physical, social, economic and political factors which affects mining in Zimbabwe.
- ✓ Open cast, shaft, adit and panning are the common mining methods used in Zimbabwe.
- ✓ Open cast and panning are the cheapest mining methods.
- ✓ There are physical and electronic methods used for gold prospecting.
- ✓ Gold panning results in social, environmentally and economic challenges.
- ✓ The contributions of panners can be improved into the national economy if there is government assistance, education and if they are encouraged to pull resources together to finance their mining operations.

## GLOSSARY

**Mining** -extraction of minerals from underground.

**Capital**-money needed to finance mining operations.

**Accessibility** -how reliable a mineral ore is.

2. Study fig 7.4 and answer the following questions



Fig 7.4

- Describe the scene in the photography. (5)
- What are the challenges associated with gold panning in Zimbabwe. (7)
- What measures would put in place to improve the contribution of gold panners to national economy. (5)

## SUMMARY

- ✓ Mining refers to the extraction of minerals from the earth's surface.
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## GLOSSARY

**Mining** -extraction of minerals from underground.

**Capital**-money needed to finance mining operations.

**Accessibility** -how reliable a mineral ore is.

**Mine dumps**-Heaps of waste materials from the mines.

**Aesthetic** -natural beautiful of an area.

**Blasting**-use of explosive to disintegrate rocks containing minerals.

**GDP:** This refers to the Gross Domestic Product which is the monetary measure of the total goods and services produced by a country per year.

## TEST

**Multiple Choice**

1. Mining is
  - A. The buying and selling of minerals
  - B. The extraction of minerals from the ground
  - C. Exporting of minerals over seas
  - D. The processing of minerals into finished and semi-finished products.
2. The main advantages of open cast mining is that
  - A. It is done in rural areas
  - B. It is cheap
  - C. It required IT facilities
  - D. It is done in every Zimbabwe province.
3. Why is mining normally done by Transnational Companies and the government in Zimbabwe?
  - A. Local people are not interested
  - B. The governments and TNC's enjoy monopolising the mining industry
  - C. Private individuals lack capital to do mining
  - D. Private individuals are denied mining rights
4. Which of the following minerals is panned along river bank in Zimbabwe
 

A. Uranium	B. Diamond
C. Gold	D. Quartz
5. Which one is a lot of factor which affect mining in Zimbabwe.
 

A. Capital	B. Labour costs
C. Rainfall amounts	D. Government policies.
6. Diamond as a mineral can be tested using
 

A. The Fog Test	B. Hydrolysis
C. Thermal method	D. Shattering method.
7. The contribution of gold panners to national economy can be improved by
 

A. Legalising and legislation	B. Arresting of panners
C. Closing panning sides	D. Export the panel gold.

**Structured Question**

8. (a)(i). Define the term mining (1)
- (ii). Describe any 3 factors affecting mining in Zimbabwe (6)
- (b) Study fig 7.5 and answer the following questions



*Fig 7.5*

- (i) Identify the method of mining shown in fig 7.5 above (1)
  - (ii) What are the advantages and disadvantages of the mining method shown? (7)
  - (iii) State any other mining methods used in Zimbabwe
  - (c) Why do you think panners are important in Zimbabwe and give ways in which the government can assist them (7)
- 9.(a)(i) State the methods used in prospecting for gold (4)
- (ii) Describe the physiochemical properties of alluvial minerals (5)
- (b) Study fig 7.6 below and answer the following questions



*Fig 7.6*

- (i) Identify the method of mining used to extract minerals in fig 7.6 (1)
  - (ii) State some of the tools used in the process shown in fig 7.6 (5)
  - (iii) What are the challenges associated with the mining process shown in fig 7.6? (5)
- b) What can be done to promote maximum contribution of mining to the Zimbabwean economy? (5)

facilitates the existence of other aspects of the environment such as plants. There are various types of erosion which are:

- **Splash erosion**

This is the form of erosion involving the detachment of soil particles due to the force of raindrops. The detached raindrops block the pore spaces of the soil preventing overland flow. The water flowing down the slope washes with it the top soil.

- **Sheet erosion**

This is the form of erosion involving the removal of the thin layer of the top soil by running water. A thin glass of water covering a wide area as sheet flooding erodes the top layer of soil over a wide area. Gradually, depending on the amount of rainfall received the surface is worn away.

- **Gully erosion**

This form of soil erosion involves water running down small channels called rivulets wearing away the bed and the banks of the small channels. This deepens and widens the channel. The rills develop through erosion to form gullies.

Soil erosion is a form of degradation because it depletes the land by making it less fertile and less productive for agriculture. The soil structure is altered by soil erosion. The removal of the top soil containing humus leaves behind less fertile soil with loose structure due to lack of humus. Humus binds the soil particles together. Through erosion the productivity of the soil is reduced. Severely eroded soil is difficult to work on and less productive. Plants find it difficult to grow on eroded land. Trees reduce soil erosion but the trees are also threatened by soil erosion. Soil erosion exposes the roots of trees and in some cases even washes away the trees especially in the case of isolated trees.

### **Causes of soil erosion**

Soil erosion is caused by several factors. These factors are both physical and human factors.

#### **Human causes of soil erosion**

##### **Deforestation**

He cutting down of trees without replacing them leaves the soil exposed to agents of erosion. The bare land surface becomes very dry and vulnerable to wind erosion. The wind blows away the soil. Overland flow water washes away the top soil leaving thin infertile soils. The roots of the trees bind the soil together preventing it from being washed away by wind.



# 8

## CHAPTER 8

### ENVIRONMENTAL MANAGEMENT

#### Objectives

By the end of this chapter, you should be able to:

- describe forms of environmental degradation
- describe the causes of environmental degradation
- explain the effects of environmental degradation
- outline mitigation measures
- identify impacts of climate change on the environment
- explain pros and cons of climate change
- describe climate change mitigation measures

#### Introduction

Environmental management awareness has improved since the end of 20<sup>th</sup> century. This is due to improvement in technology enabling the spread of information and the gathering of environmental data. Environmental concerns such as climate change, ozone depletion, global warming, desertification and deforestation have highlighted the world to the need for well-coordinated actions to protect the environment. New Trends in Geography Book 1 covered the aspects of the environment, pristine and degraded environments and the concept of environmental management. This chapter looks at the forms of environmental degradation, causes of environmental degradation, mitigation measures and climate change.

#### UNIT 8.1 ENVIRONMENTAL DEGRADATION

Environmental degradation is the depletion or degeneration of aspects of the environment. The term depletion refers to the exhaustion of aspects of the environment. Degeneration involves the worsening of the state of the environment. Physical and human activities lead to the degeneration of aspects of the environment.

#### Forms of environmental degradation

There are various forms of environmental degradation and these include land degradation, water pollution, air pollution, forests degradation, noise and visual pollution.

#### Soil erosion

Soil erosion is the form of land degradation involving the wearing of top soil by water, wind and ice. Soil is an important component of the environment since it

**Overgrazing**

Overgrazing involves the grazing of more animals on a piece of land than that which the land can support. The maximum number of animals which can graze on a given piece of land without causing environmental problems is called carrying capacity. Exceeding this carrying capacity leads to overgrazing which is shown by the depletion of pastures and loss of vegetation. Once vegetation is lost the soil is exposed to agents of soil erosion.

**Monoculture**

Monoculture is the growing of one crop on a given piece of land year after year. This poor method of farming leads to poor soil structure. Crops growth becomes poor and hence the soil in the farms is barely covered hence it is vulnerable to soil erosion. Soil fertility is important because it binds the soil particles together such that is not easily dislodged by water or wind. Monoculture reduces the soil fertility hence the soil particles becomes loose and easily dislodged by agents of erosion.

**Stream bank cultivation**

Stream bank cultivation involves the growing of crops near the channel. The soil along the banks is washed into the channel where it causes siltation of the channel or of the dams downstream. The water bodies such as dams and rivers become shallow and can no longer hold much water hence they dry. This affects the water cycle and vegetation fails to grow exposing the soil to further erosion. The vicious cycle of erosion continues. One cause leads to another and unless soil erosion is controls it will become a major form of environmental degradation.

**Veldfires**

Veldfires are natural or man-made intentional and unintentional fires which destroy vegetation homes and infrastructure. The veld fires destroy vegetation. In Zimbabwe veldfires are common during the onset of the summer season. The vegetation is destroyed such that when the rains begin the soil is unprotected hence the rate of soil erosion is high.

The other human causes of soil erosion are ploughing down the slopes and pulling sledges.

**Physical Causes of soil erosion****Drought**

Drought is a prolonged time without rain. It leads to death of vegetation. The soil becomes bare and it is therefore subjected to agents of soil erosion.

**Floods**

Floods washes away large amounts of soil and leaves the soil infertile. Once the soil is infertile vegetation will not grow well and that makes the soil vulnerable to erosion.

## The Effects of soil Erosion

The effects of soil erosion include:

- **Loss of soil fertility**

Soil erosion wears away the top soil. The top soil is the source of soil nutrients from humus and artificial fertilisers. Soil erosion wears away the top soil and its nutrients to leave the top soil less fertile. The top soil becomes very thin and, in some cases, more compact horizons of the soil are exposed. These are rock stony and do not support growth of crops. It has been estimated that some soils will become shallow for growth of maize in some parts of Zimbabwe due to soil erosion.

- **Decrease in yields**

Once the top soil is worn away, the remaining layers of the soil are less fertile and yields for farmers decrease. Food security become a problem.

- **Injury and death of livestock**

Soil erosion form series of gorges and pits which pose dangers to livestock. Cattle and other livestock k die from falling in the pits.

- **Siltation of water sources**

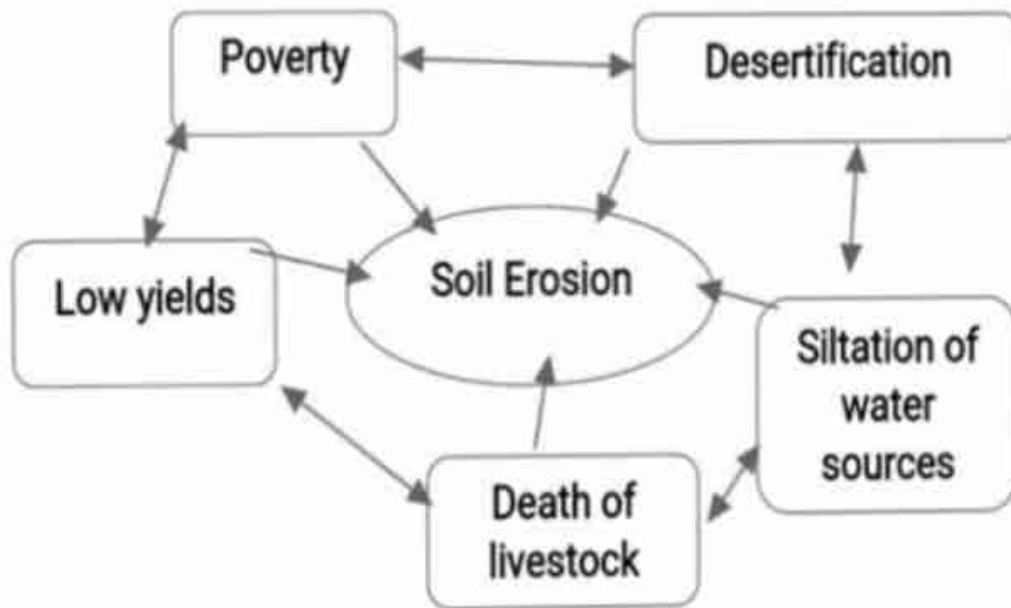
The soil washed away is deposited in water bodies such as rivers, dams, and lakes. The soil fills these water bodies reducing their water holding capacity. The rivers and lakes dry affecting the hydrological cycle.

- **Desertification**

Desertification is the spread of arid conditions from arid areas to non-arid areas. Soil erosion makes the soil poor hence it cannot support growth of plants. The soil being washed away causes siltation of water bodies. Evaporation and transpiration (evapotranspiration) rates are reduced hence areas which used to receive high rainfall become arid. The rainfall amounts received are lowered.

- **Poverty**

The falling rainfall amounts and decreased fields reduces the people income. Livestock die and the people become poorer. Most of the people in the developing countries depend on agriculture hence, a decrease in agriculture production will affect their level of income negatively. Developing countries also depend on the export of cash crops such as tobacco.



*Fig 8.1: The vicious cycle of soil erosion*

Soil erosion triggers several effects forming a vicious cycle difficult to escape. Once soil erosion has degraded an area upgrading the eroded land calls for a more comprehensive approach. The effects of soil erosion lead to other severe effects. As shown in fig 8.1 above, erosion leads to desertification. Desertification is the extension of desert or arid conditions from arid to non-arid areas. Desertification is both a cause and effect of soil erosion. Poor soil fertility due to soil erosion leads to poor vegetation growth thereby exposing the soil to erosion. Soil erosion leads to siltation of water bodies. Siltation is a result of streams bank cultivation which is caused by poor rainfall amounts due to desertification. Siltation of water bodies reduces the sources of water for livestock hence there is death of livestock. Falling yields due to poor soil fertility leads to poverty since the people's source of income is reduced. Poverty lead to more land degradation due to deforestation as people sell firewood for a living. Poverty leads to an increase in activities such as gold panning. Such activities lead to severe soil erosion and the vicious cycle of erosion is maintained.

### **Mitigation of soil erosion**

The effect of soil erosion can be mitigated through a number of measures. The measures to reduce the effects of soil erosion and to stop soil erosion include:

- **Afforestation/ reforestation**

Afforestation involves planting trees where there has never been trees and reforestation involve planting trees where trees have been cut down. These two processes help in fighting soil erosion because planting trees help to bind the soil particles together. Tree roots hold the soil together such that it is not easily dislodged by the flowing water, wind or ice. When trees are grown where erosion has been progressing they have the effect of reducing the

amount is soil lost or trapping the soil eroded from somewhere thereby helping in filling up the forming gullies.

- **Gully filling**

Gully filling is the process of covering gullies so that they stop growing. It is a method of reclaiming degraded land and it also stops the growth of the gullies. A variety of materials are used to fill the gullies. These include stones, tree branches and soil. In some cases, the gullies are filled with wastes. Organic wastes are the most appropriate since they can easily integrate into the soil system. Plastics and other synthetic materials will take years before decomposing. Some of them emit toxins in soil. Batteries and other components containing radioactive chemicals may cause severe environment degradation if they are used to fill gullies.

- **Planting sisal fibres**

The sisal fibre is resilient even under the hardest conditions. Soil erosion is high in areas of low rainfall because of poor vegetation growth. Once gullies form they become difficult to control. Planting trees may prove difficult due to poor soil structure and low rainfall. The sisal fibre plant is able to grow under such conditions. Once its roots establish into the soil, it binds the soil around it and multiply in number to cover a wide area. This way it is able to effectively bind the soil preventing it from being eroded.

- **Ploughing across the slope**

Ploughing across the slope involves ploughing in such a way that furrows go across the dip of the slope. The furrow therefore traps water from flowing down the slope. This reduces the amount of soil washed down the slope.

- **Making contour ridges**

Contour ridges are barriers made across the slope to trap overland flow. The water is collected by the contour ridges and directed away from the fields. The contour ridges are made up the slope to protect the soil down the slope. A series of these protect fields from soil erosion.

### Case study: Soil Erosion in Zimbabwe

*In Zimbabwe, soil erosion has become a major cause of concern. The World Bank carried a survey in 62 and Zimbabwe was ranked in the top twenty most eroded countries. An average of more than 640 wheelbarrows of soil is lost per year per hectare in the most eroded parts of Zimbabwe. These most eroded parts include the Save Runde Catchment Area according to the Civil Protection Unit (2009). The major causes of soil erosion in Zimbabwe are population pressure on the land,*

*overpopulation, deforestation and poor methods. It has been highlighted that in Zimbabwe's most communal areas there have been a positive core relationship between population density and the rate of soil erosion.*

The most eroded areas are those with high population densities. Communal areas in agro-ecological regions 3, 4, and 5 are the most vulnerable. These include Marange-Bocha (Mutare), Bikita (Masvingo), Gokwe, Gwanda (Matebeleland), Hwange and parts of Mount Darwin. The effects of rapid soil erosion in most parts of Zimbabwe includes a decrease in yields due to loss of soil fertility, destruction of infrastructure and siltation of rivers. Siltation from soil erosion is affecting rivers such as Angwa, Inziza, Bubi and Save. Districts such as Mazowe, Kadoma (ward 12,14, 15 and 16), Umguza District (Ward 1 and 2) are some of the worst affected districts. In Gokwe soil erosion has led to destruction of infrastructure such as roads and bridges.



*Fig 8.2: Soil Erosion in Gokwe destroying the road*

*Prevention has proved to be cheaper than reclaiming eroded land. Tree planting and proper methods of farming have been introduced in some of the affected areas. For example, in Nyanga planting of grass has assisted in lowering the rate of soil erosion. In Gokwe sisal fibres have been planted in some areas and they have lowered the rate of soil erosion. The scourge of soil erosion is a major threat to Zimbabwe's food security as it reduces agricultural productivity and negatively affect the hydrological cycle.*

**Adopted from the Civil Protection Unit (2009)**



*Fig 8.3: Dumping of wastes on the streets*

- **Bursting of sewage pipes**  
Sewage bursts have become common in most of Zimbabwe's urban residential areas. This is due to population pressure. This has become a major cause of land pollution.
- **Oil leakages**  
The transportation of oil by road or pipeline is another cause of land pollution. Oil transportation by road leaks or is spilt during accidents. The oil causes pollution of the land. Pipeline get damaged through wear and tear as well as vandalism which leads to pollution of land.
- **Spraying to control pests and diseases**  
Praying chemicals to control pests and diseases is another source of land pollution. Chemicals such as DDT were used to control pests in agriculture but they ended up polluting the land and the entire food chains in the ecosystems.

### **Mitigation strategies against land degradation**

The degradation of land through land pollution is solved through:

- Regular collection of refuse
- Awareness campaigns
- Clean up campaigns
- Digging compost pits
- Provision of litter bins
- Punishing those dumping wastes on the streets

## Water pollution

Water pollution is the most common form of marine environments degradation. Water pollution involves the dumping or disposal of wastes into water sources which reduces the quality of water. Water pollution causes degradation of water. Polluted water tends to contain chemicals which may be hazardous to human beings, animals and vegetation. The signs of water pollution include:

- **Bad smell**  
Some polluted water bodies produces bad smell. The smell of polluted water depends on nature of pollutants.
- **Colourfulness**  
Water in its natural state is colourless. When water becomes colourful it is a sign that it contains certain dissolved substances. Polluted water usually takes a certain colour depending on the nature of the pollutants.
- **Change in chemical composition**  
Water pollution changes the chemicals contained in water. The soil PH may change as well as the minerals contained in the water.
- **Death of aquatic species**  
Water living species die from water pollution. They find it difficult to survive in the polluted water. These organisms are usually consumed by their prey hence the chemicals polluting the water spreads up the food chain.

## The causes of water pollution

The causes of water pollution include:

- Sewage disposal
- Oil leakages
- Eutrophication.
- Industrial effluent
- Dumping of domestic wastes

## Sources of water pollution

The sources of water pollution include suspended particles, nutrients and pathogens.

### Suspended particles

These are particles which float in water. The suspended solids include silt and clay from runoff, industrial wastes and sewage. More suspended wastes reduce water clarity and affects the water temperature.



### Nutrients

Nutrients comprises of chemicals which are useful for plants and other organisms. These are washed into water bodies where they alter the chemical composition of water.

### Pathogens

Pathogens comprises of water borne bacteria, viruses and protozoans.

### Mitigation of water pollution

The effects of water pollution are reduced through:

- Watershed mapping
- Management and protection of water sources
- Spraying to remove water weeds
- Imposing fines on those polluting the water

### Forest Degradation

The degradation of forests involves the depletion of areas covered with vegetation. As the world population grows, the total area covered by forests is rapidly decreasing. This is because as the total population increases, the demand for land for cultivation and also increases. More forests are therefore cleared to have way for human settlement and agriculture. Forests are renewable because they can regenerate. Once they are cleared in such a way that they are not given room to generate, they become depleted. The major forms of forest degradation are:

- Veld fires
- Deforestation
- Acidic rain

### Veld fires

Veld fires involves fires that usually go out of hand. These fires can start natural or can be started by human beings without the intention of destroying large areas of vegetation but they may go out of hand. As a result, they end up consuming large areas of forests. Exotic and indigenous forests are destroyed and their abilities to regenerate in compromised.

### Deforestation

Deforestation involves the cutting down of trees without replacing them, usually leading an area bare. Deforestation increases with increasing population. As the population increases so does the demand for wood. Seventy percent of the rural population depends on wood fuel hence the rate of forests clearance is faster due to demand for wood. Newly resettled tobacco farmers also contributed in increasing the rate of deforestation. Demand for land for farming and settlements also contributes towards forest depletion.

### Acid Rain

Acid rain involves rain water containing weak acids such as carbonic acid. These acids are as a result of air pollution. The weak acids affect vegetation causing it to wilt, for example, in Hartz Mountain in Germany vegetation has died because of acidic rain.

### Visual pollution

Visual pollution involves anything which makes viewing certain landscapes or objects unpleasant. Graffiti is a form of visual pollution. The signs of visual pollution are:

- Haze due to dust and air pollution
- Garbage heaps and landfills
- telecommunication and electric wires and poles
- Sign boards
- Barren lands and degradation
- Smoke from chimneys

### Graffiti

The term graffiti refers to images or words scratched or painted on property. It includes any type of public markings and can be as simple as written words or complex wall murals. Graffiti has a long history beginning with the origins of human civilization. During the early stages of civilisations rock paintings, were the earliest form of graffiti. Today graffiti has become a common feature of inner cities and ghettos. More than just being mere display of artistic prowess, it has become a major political campaign strategy, a way of showing discontent with political dispensations and a reflection of the perceived social ills. The factors contributing to graffiti include:

- High rates of unemployment
- Lack of exposure to artistic platforms
- Political grievances
- Social strife

Graffiti is a form of degradation because it defaces buildings and monuments. Some of the paintings and markings are offending and maybe written using dirt materials. Use of vulgar language is common in graffiti. Despite having severe negative effects, graffiti provides information to people making the community aware of certain issues.

### Positive effects of graffiti

- It provides information to the people
- It makes people aware of certain events or things

### Negative effects of graffiti

- Some graffiti is offending
- The use of vulgar language instils negative behaviour in youths
- It defaces buildings



*Fig 8.4: Graffiti on the walls*

Graffiti is found in various places which include toilets, bathroom walls, durawalls, rocks, tanks, building walls and a tarred road surface.

### Noise pollution

Noise pollution involves the production of very high noise levels which surpasses the set tolerance limits. The tolerance limits level is the level of noise people can withstand. It is a form of environmental degradation because it destructs operations and creates health hazards. The causes of noise pollution include:

- **Manufacturing industry**  
Manufacturing industries generate noise. The machines used in manufacturing provides sounds which may affect other operations.
- **Air craft**  
Air craft make more noise which disrupt operations and threaten people's health. Areas found near aerodromes and airports.
- **Construction**  
Construction operations make noise which disrupt other operations.

### The effects of noise pollution

The effects of noise pollution include:

- Deafness
- Cracking of buildings
- Migration of animals

Solutions to effects of noise pollution include:

- Provision of protective clothing, for example, ear muffs
- Putting legislation to enforce compliance with accepted noise levels

### Exercise 8.2

- (a) Describe the causes of the following forms of environmental degradation
- water pollution
  - deforestation. (6)
- (b) What can be done to reduce the effects of deforestation? (6)

## UNIT 8.2 CLIMATE CHANGE

Climate change refers to a shift in the average weather conditions experienced by a given area. There is plenty of evidence showing that the climate is changing or has changed over the past century. The major issues linked to climate change include global warming and the Green House effect. The evidence showing that the climate is changing include:

- Temperature changes
- Pollen analysis
- Tree ring studies
- Melting of polar glaciers

### The Environmental effects of climate change

Climate change has severe effects on the environment. These effects include:

- **Extreme events causing environmental degradation**  
Climate change leads to frequent occurrence of extreme weather conditions such as heatwaves, floods and tropical cyclones. These extreme weather conditions have negative effects on the environment. Excessive temperatures lead to over evaporation of water bodies and wilting of vegetation. Tropical cyclones lead to rockfalls and severe soil erosion.

- **Extinction of species**

Climate change leads to extinction of plant and animal. Increasing or decreasing temperatures and rainfall amounts affects animal and plant species. Some of them fail to adapt to the changing climatic conditions hence they get extinct.

- **Rising sea level**

The changing climate leads to the melting of glaciers. The melting waters flows to the sea where it increases the volume of water in the seas. The level of the sea rises and the coastal areas are flooded by sea waters. The rising sea level leads to deposition in rivers and flooding of coastal regions.

- **Drying of water bodies**

Climate change has led to a fall in the water levels in some water bodies. High rates of evaporation and decreasing rainfall amounts leads to the reduction of the levels of water bodies. For example, Lake Chad shows a great reduction in the water levels. The different markings at the sides of the lake shows that the lake's water levels have decreased. The lake used to receive more rainfall during wetter periods.

- **Stunted growth of vegetation**

Tree rings are a major source of evidence on climate change. The growth of trees in areas receiving high rainfall is high. The trees therefore develop different rings than those in areas receiving low rainfall. Where there is high rainfall the tree rings are broad signifying rapid growth. A change in the size of the tree rings shows that the conditions did not favour rapid growth in those years. Due to climate change specifically the reduction in amounts of rainfall, trees grow slowly as show by their tree rings. This affects their sustainable exploitation as they can not regenerate faster after exploitation. An increase in rainfall amounts leads to rapid growth of vegetation.

- **Desertification**

Desertification is the spread of arid conditions to non-arid area. It is caused by climate change. A reduction in the amount of rainfall causes changes in terms of vegetation as the vegetation adapts to arid conditions. Vegetation dies and the soil becomes bare and susceptible to wind erosion. Wind landforms becomes common hence areas which where once wet becomes deserts.

**UNIT 8.3****THE PROS AND CONS OF CLIMATE CHANGE**

Climate change has a variety of benefits and disadvantages to communities and ecosystems. The pros and cons of climate change varies from one area to another.

**The advantages or pros of climate change are:**

- It makes cold regions warmer and therefore increase the rate of plant growth
- It leads to an increase in rainfall amounts received by certain areas
- It makes some places habitable by making conditions favorable, for example, areas once covered by glaciers
- It leads to inventions as people fight the effects of climate change, for example, new farming methods
- It makes some areas more accessible, for example thick forests becomes less dense due to reduced amounts of rainfall
- It opens up new areas for exploitation of resources, for example, the provision of more land where glaciers melt

**The disadvantages or cons of climate change are:**

- The disappearance of islands and low-lying areas due to rise in sea levels
- Extinction of animal and plant species
- Death of people, and animals from extreme events such as floods
- A fall in the amounts of rainfall
- Prevalence of diseases such as skin cancer due to heat waves
- Food insecurity due to droughts and other extreme events such as floods
- Some plants find it difficult to grow due to increase in temperatures, for example, deciduous trees which need frost
- Increasing temperatures reduces frost which kills fungi and pests
- Death of people due to weather hazards such as floods, tropical cyclones and heat waves
- Rise of sea level; it has been estimated that by 2100 the sea level will have risen by 1m

**Climate change mitigation strategies**

The negative effects of climate change can be reduced through a number of ways. These ways include:

- **Construction of dams**

Constructing dams helps to store water for use during the dry spells. The small amounts of rainfall received due to climate change in some areas is

harvested and stored such that it is not lost through overland flow. The water can then be used to irrigate crops and this helps to reduce food shortages.

- **Constructing greenhouses**

Greenhouses help to improve conditions for growing crops. In areas receiving very low temperatures, greenhouses create better conditions for growing crops. Temperatures inside green houses are warmer hence where climate change has led to fall in temperatures are controlled to enable the growing of crops.

- **Cloud seeding**

Cloud seeding involves the spraying of gases into the atmosphere such that they aid the formation of clouds. For rainfall to form there is need for condensation nuclei. Condensation nuclei is present in form of hygroscopic substances which have affinity for water. The substances attract water droplets allowing them to grow leading to rain. Without such substances the chances of rainfall formation are slim. Spraying gases such as Sulphur increases the amounts of rainfall received therefore reducing a reduction in rainfall amounts owing to climate change.

- **Afforestation and reforestation**

Afforestation is the growing of trees where there were no trees whereas reforestation is the planting of trees where trees have been removed. Planting trees assist in reducing temperatures and providing a source of water for transpiration.

- **Growing drought resistant crops**

Where rainfall amounts are being reduced by climate change and droughts are becoming frequent, growing drought resistant crops and keeping drought resistant animals will assist in averting food shortages. Such crops include rapoko, millet and sorghum.

- **Changing methods of farming**

A shift in the methods of farming can be necessary to reduce the effects of climate change. The methods used when high amounts of rainfall were received may not work where low amounts are now being received. Methods such as zero tillage may be proper.

- **Disaster preparedness**

There is need for comprehensive disaster preparedness systems climate change has led to the frequent occurrence of weather hazards such as tropical cyclones and floods. This helps to reduce the number of deaths and loss of property in case of the hazards.

**Task: Identifying the evidence of climate change at a local scale**

In your local areas, verify whether the temperatures, rainfall amounts, frequency of droughts, floods and changes in vegetation over the past 50-100 years show that climate is changing or has changed. Use the following as your source of information:

- The Meteorological Department
- Local farmers
- Agritex officers
- Village heads or chiefs
- The elderly in your area

**Exercise 8.3**

- (a) What is climate change? (1)
- (b) Give evidence to show that climate change is real (4)
- (c) What do you think should be done to reduce the effects of climate change in your local area? (7)

**SUMMARY**

- ✓ Soil erosion, land pollution, water pollution, visual pollution and noise pollution are some forms of environmental degradation
- ✓ Splash, rill, sheet and gully erosion are the types of erosion
- ✓ Erosion is caused by both human and physical causes
- ✓ Soil erosion has severe negative effects on the environment and the people
- ✓ Once soil erosion takes place it triggers a cycle of other environmental reactions
- ✓ The signs of land pollution include change in soil colour, poor fertility, poor structure, odours and change in chemical composition
- ✓ The causes of land pollution include poor sewage disposal, dumping of refuse on empty spaces and streets, and oil leakages
- ✓ Deforestation is the major cause of forest degradation
- ✓ Graffiti is a form of visual pollution
- ✓ Noise pollution can cause cracking of buildings, disruption of other operations and deafness
- ✓ Climate change leads to frequent occurrence of extreme weather conditions
- ✓ Climate change has its own advantages and disadvantages



**GLOSSARY**

**Aquatic species:** these are organisms which live in water

**Cloud seeding:** it is the process of introducing hygroscopic substances into the atmosphere to aid cloud formation and to increase the amount of rainfall

**Drought:** it is a prolonged period without rainfall

**Environmental degradation:** it is the degeneration or depletion of land, water, air and other aspects of our surroundings

**Eutrophication:**

**Graffiti:** refers to images scratched or painted on property

**Soil erosion:** it is the wearing away of top soil by water, wind and ice

## TEST

**Multiple Choice**

1. The type of soil erosion where water the water washing away the soil is concentrated in rivulets is called-

- A. splash erosion                      B. gully erosion  
C. rill erosion                            D. sheet erosion

2. Study fig 8.5 Below and answer the following questions



*Fig 8.5*

The degraded environment shown in fig 8.5 can be upgraded through;

- A. Gully filling                            B. recycling  
C. afforestation                         D. paddocking
3. The residents of a residential area near an aerodrome are likely to be affected by;
- A. visual pollution                        B. noise pollution  
C. graffiti                                    D. land pollution
4. The best way to reclaim polluted water is-
- A. drilling boreholes                        B. reuse  
C. watershed mapping                      D. recycling
5. Which of the following is not an effect of deforestation
- A. the greenhouse effect  
B. increased rainfall amounts  
C. increase in atmospheric carbon dioxide  
D. Biodiversity loss

6. The graph in fig 8.6 below show the different sources of land degradation in Bulawayo

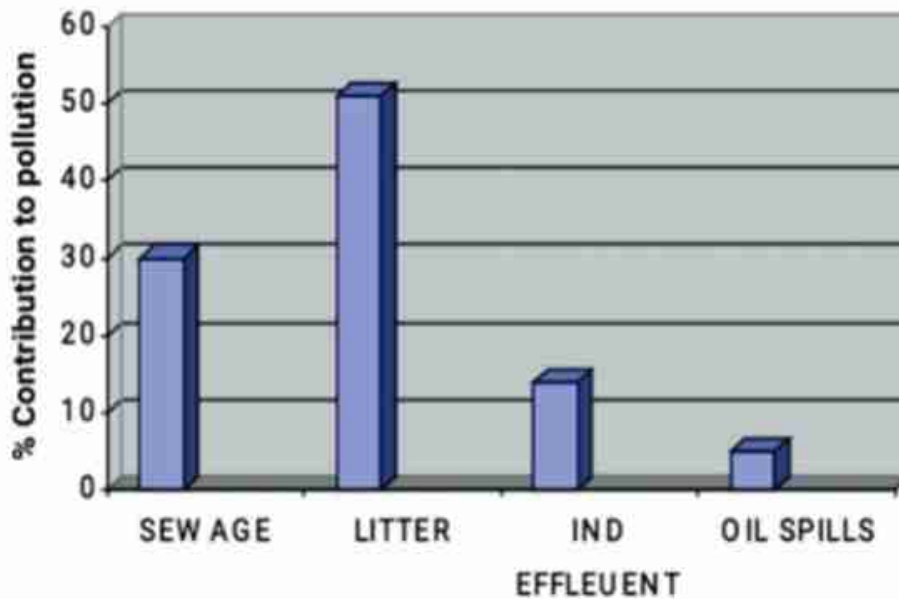


Fig 8.6

The highest and the least cause of land pollution in Bulawayo are----- and ----- respectively

- A. Oil Spills and industrial effluent      B. oil spills and litter  
C. sewage and litter                              D. litter and oil spills

### Structured Questions

7. a) Describe how the following forms of environmental degradation affect the people and environment:

- (i) Land pollution
- (ii) Deforestation
- (iii) Soil erosion
- (iv) Noise pollution (9)

(b) Study fig 8.7 Below and answer the following questions



Fig 8.7

- (i) Identify the nature of environmental degradation shown (1)  
(ii) Describe the causes of the environmental degradation shown (7)  
(c) As a member of the youth support Network organization, suggest ways in which graffiti can be reduced in your area (7)
- 8.(a)(i) What is climate change? (2)  
(ii) Give the advantages and disadvantages of climate change (7)  
(b) Study fig 8.8 Below which shows the effects of climate change



*Fig 8.8*

- (i) Describe the effects of climate change shown in fig 8.8 (6)  
(ii) What do you think should be done to reduce the effects of climate change shown? (7)  
(c) What are the challenges faced implementing measures to reduce the effects of climate change (7)

## AGRICULTURE AND LAND REFORM

**Objectives**

By the end of this chapter, you should be able to:

- identify the dominant farming types in Zimbabwe.
- explain the characteristics of each farming type.
- draw Zimbabwe agro-ecological regions on a map of Zimbabwe.
- describe the characteristics of each farming region.
- explain the farming types of each region.

**Introduction**

Zimbabwe as a country is endowed with vast tracks of arable land found in different ecological regions. Numerous types of farming are shown in different regions the main determinants being the climatic, rainfall, land of growing season and soil conditions. This chapter aims at identifying the dominant farming types in Zimbabwe, explain their characteristics and describe the traits of each ecological region.

**UNIT 9.1 FARMING TYPES IN ZIMBABWE**

Farming types in Zimbabwe can be categorised into two main types of which are communal and commercial farming.

**Communal Farming in Zimbabwe**

Communal farming is also referred to as subsistence or peasant farming. On this type of a farm production is mainly done to meet the dietary needs of the family. Selling of the farm produce is only done if there is surplus. In Zimbabwe before the land reform programme over 50% of Zimbabwe's rural population were communal farmers. However, with the governments' initiative of land reform several families transcended from communal to commercial farming.

**Commercial farming**

This is another dominant type of farming in Zimbabwe. In commercial farming the production of crops and livestock is market oriented thus production is for sale. The main aims of commercial agriculture are to:

- meet the nations dietary needs.
- initiate infrastructural development.
- create employment opportunities to people
- supply agro-related industries with raw materials.

## Communal farming in Zimbabwe



• *Fig 9.1 Communal farming*

Communal farming in Zimbabwe is done in a sedentary basis thus farmers have permanent homesteads and lands on which they cultivate and rear animals. Communal farmers in Zimbabwe practices mixed farming. For example, they grow crops like sorghum, round nuts, groundnuts, rapoko as well as keeping livestock mainly cattle and goats.

Communal farmers in Zimbabwe do not own title deeds of the land which they operate on rather they act like stewards of their lands. In this farming system, resources available for example the land, water, vegetation and pastures are communally owned. Since these belong to all of the community members they do not rightfully belong to anyone.

Communal farmers in Zimbabwe is still very lowly mechanised. Most communal farmers still rely on family labour since to have machines like tractors, planters and combine harvesters is not affordable to them.

In some Zimbabwean communities, farmers organise themselves with the help of traditional leaders to work together in groups. This is of paramount importance since it helps in the acquiring of farm tools as we have highlighted that these farms levels of mechanisation is low.

### Benefits of Subsistence Farming

Subsistence farming has the following benefits.

- By producing food for family consumption, it ensures national food security.
- Since they practise mixed farming their dietary needs one also catered for.
- Resources such as vegetation, water and land are used free of charge.

- Communal farming uses cheap labour and usually it is provided by the family.
- Farmers share ideas and experiences thereby increasing agricultural production.

### Disadvantages of communal farming

Although communal farming has several benefits, it also has the following disadvantages.

- In Zimbabwe, most communal farms are found in regions 4 and 5 which are marginal. These areas characterised by poor soils and unreliable rainfall.
- Communal farming uses cheap labour and usually it is provided by the family.
- Communal farming uses cheap labour and usually it is provided by the family.
- Farmers share ideas and experiences thereby increasing agricultural production.
- Farmers share ideas and experiences thereby increasing agricultural production. Their level of production is therefore low.
- Most communal farmers lack the much-needed capital to fund their agricultural activities. This is so because their lack of title deeds hampers their access of loans from banks because they do not have title deeds which act as collateral security.
- Communal ownership of resources like land and pastures is detrimental to development since when resources are communally owned no individual effort is involved to develop and conserve those resources.
- Due to inheritance laws most of communal farms are fragmented. Land fragmentation leads to shortage of land, over cultivation and mono cultural tendencies

### Exercise 9.1

- (a). Suggest the main characteristics of communal farmers in Zimbabwe (5)  
 (b). Describe the benefits of subsistence farming (5)

## Commercial farming

### Dairying

It is a farming type which majors in the keeping of cows for milk and milk products like cheese, yoghurts, ice cream etc. Dairy farmers keep different dairy cows' breeds known for their differences in their milk yields, diseases, resistance and adaptability. Some of the most common dairy breeds kept are Ayrshire, Friesian, Sussel and Jersey.

### Characteristics of dairy farming

Dairy farms are intensive in nature. This production is also done on relatively smaller pieces of land with high inputs.

Dairying is also labour intensive because a lot of labour is needed to feed and milk the cows. Due to modern developments, most dairy farms now use milking machines to milk and these has managed to lower the labour needed.

Most dairy farms are located near large urban centres. Mainly this is done to ensure that they are closer to markets since milk is a perishable commodity. However, nowadays dairy farms can now be located anywhere because of the introduction of



• Fig 9.2 Dairy Cows



faster modes of transport, cold rooms and refrigerated trucks.

Feeding is supplemented by molasses and cattle cake to increase milk yields.

### Challenges faced by dairy farmers in Zimbabwe

The challenges faced by dairy farmers in Zimbabwe include:

- High cost and shortages of feeds
- Outbreak of notifiable diseases like anthrax and black leg
- Drought also affects dairy farmers by reducing pastures and water availability
- Stock theft
- Shortage of high milk yielding heifers
- Lack of capital
- Low levels of veterinary and extension services

### Solutions

The solutions to the problems faced by dairy farmers in Zimbabwe include:

- Vaccination and continued dipping of cows.
- Use of irrigation to water cattle pastures
- To solve the challenge of low capital base farmers should form co-operatives

### Exercise 9.2

1. Study fig 9.1 below and answer the following questions

(a). Describe the scene in the photography (5)

(b). Explain the possible challenges faced by dairy farmers in Zimbabwe and suggest possible solutions to curb these problems (10).

### Market gardening

Market gardening is a farming type which involves the intensive cultivation of vegetables, ornamental flowers and fruits for sale.

### The characteristics of market gardening

The characteristics of market gardening include:

- Market gardening is labour intensive thus it requires a lot of labour to operate.
- It is also capital intensive in the sense that huge sums of money are required to



• Fig 9.3 Market Gardening

buy inputs like seeds, herbicides and insecticides.

- It uses a small piece of land where production is done intensively.
- Market gardening is feasible in areas with irrigation facilities since production is done all year round.
- Production of market gardening farm is market oriented and rejects are only consumed locally or used to feed livestock.

### **Problems of market gardening**

Market gardening is a form of commercial farming is faced with several problems. Some of these includes:

- Since it relies on irrigation market gardening is heavily affected by droughts.
- The other main challenge of market gardening is a higher incidence of pests and diseases.
- Market gardens are now losing a considerable amount of their land consumed by urban sprawl.
- Natural hazards like frost and hail storm also affects market gardeners.

### **Solutions to problems of market gardeners**

- The problem of pest and natural hazards can be solved by growing crops in greenhouses. Green houses are buildings with glass or plastic roofs in which crops are grown.
- Crops can be insured against natural disasters like hail storm, droughts and floods.
- Correct use of fertilisers and insecticides may also assist in solving the

**Task: Organising an educational tour**

Organise a trip with your teacher at your school.

Go to your nearest market gardener.

Observe the farming system and identify on the inputs, processes and outputs needed to run a farm.

**Cattle ranching**

Cattle ranching is a farming type which includes the keeping of cattle for beef and beef products. In Zimbabwe, cattle ranching is mainly done in the dry regions 4 and 5. Cattle ranchers keep several breeds of cattle but the most commonly kept are the Brahman Nguni, Tuli and Mashona. Most cattle ranchers have cross bred their stock to make them adapt to climatic conditions in different areas.

In cattle ranching cattle graze freely and they are given supplementary feeds like molasses and cattle cake. Mainly the cattle are kept in paddocks. An example of cattle ranches in Zimbabwe is Tuli range and the Manjere ranges in Zvishavane.



• *Fig 9.4 Cattle Ranche Ngunii Cattle*

### Benefits of cattle ranching

- Cattle ranching provide the protein needed by the people to meet their dietary needs.
- Cattle skins are tanned to obtain skins used in the shoe manufacturing industry.
- Cow dung is used as a source of fertilizer.
- Where it is done on a large scale it creates several employment opportunities to the local people.

### Problems faced by Cattle Ranchers

Just like any other farms this type of cattle ranching has its own challenges. Some of these challenges includes:

- Outbreak of notifiable diseases, for example, anthrax.
- High incidences of stock theft.
- Pest for example tsetse fly are common problems in any hot regions, for example, the Zambezi Valley.
- Lack of properly developed feeding lots and ranching facilities like dip tanks.
- Stock feed are quite expensive to buy such that a few can afford them.
- Scarcity of vaccination measure
- A series of drought which are affecting Zimbabwe, for example, in 1992, 2002, and 2012.
- Lack of support from the Government and Veterinary department.

### Solutions

Some of the solutions to the above-mentioned challenges are:

- Vaccination and dipping of animals against pests and diseases.
- Quarantining animals affected by notifiable diseases and buying or burning affected carcasses.
- Cattle ranchers should pull resources together and form cooperatives to finance their ranching schemes.
- Controlled movement of livestock from one ecological region to another.

### Activity 9.3

- (a). Discuss on the problems faced by cattle ranchers in Zimbabwe (5)
- (b). What can be done to reduce these problems (5)

### Mixed farming

Mixed farming refers to the growing of crops and rearing of animals on the same piece of land for sale. It is quite common in most of Zimbabwean communal farms. It can be done on subsistence or on a commercial basis. Large scale mixed farms are owned by TNCs, Parastatals and rich private owners because they require a huge capital investment.

### Benefits of mixed farming

- Mixed farming ensures food security because when crops fail livestock may survive.
- Waste products of crop products is usually used to feed the livestock.
- Livestock provides manure to crops.
- Crops and livestock are produced all year round
- Farming provides employment opportunities to people

### Plantation agriculture

Plantation agriculture is a large-scale farming type which thrives on the production of one crop in the same piece of land. Crops grown may mature in a season, within a year or in several years. Plantation farms are highly capitalised and mechanised thus they require huge capital investment and modern machinery to operate effectively.



*Fig 9.5: Plantation agriculture (Hippo Valley)*

### Main characteristics of plantation

These are some of the main characteristics of plantation.

- Most of them are owned by Trans National Companies and the government.
- Plantations produce both food crops and industrial raw materials.
- Farm produce from plantations is sold locally but much of it is for exportation.

- They are mono cultural thus they major in the production of one crop.
- Farms are scientifically managed to ensure high productivity.
- Plantation helps nearby farmers to grow and produce the same crop with them. Local farmers are called Out growers they enjoy infrastructure, knowledge and market from the plantation.
- A Plantation farm has most infrastructural facilities like employee houses, recreational facilities, clinics, schools and factories.

### Advantages of plantations

Plantations play a crucial role in the national economy. Some of its benefits are:

- It creates employment for the skilled, unskilled and semi-skilled workers.
- They supply, processing industries with raw material.
- Plantations provide local farmers with knowledge, technology and skills.
- They ensure food security by providing food for the local people.
- They also lead to infrastructural development of an area thereby improving living standards.

### Disadvantages of plantations

Through beneficial plantations have the following disadvantages:

- Their mono cultural tendencies lead to severe soil erosion.
- They utilise large pieces of land whilst the locals are left with small pieces of land to use.
- Since most plantations are foreign owned they facilitate repatriation of profits overseas.

### Irrigation farming

Irrigation farming refers to a farming type which involves the supplying of supplementary water to the soil for agricultural purposes. Irrigation facilities are now very common in Zimbabwe. Some of the most common are those found in Zimbabwe South East Lowveld where sugarcane is produced



*Fig 9..6: Zimbabwe's South East Lowveld irrigation agriculture*

**Advantages of irrigation farming**

- It promotes double and treble cropping so crops are grown all year round.
- It utilised dry areas by supplying water for example the Nyanyadzi Irrigation Schemes and mashanduke in Masvingo
- Where irrigation is done on a large scale, it creates employment opportunities to people.
- It ensures high yields per area.
- Improves standards of living to local people in which they are found.

**Disadvantages of irrigation farming**

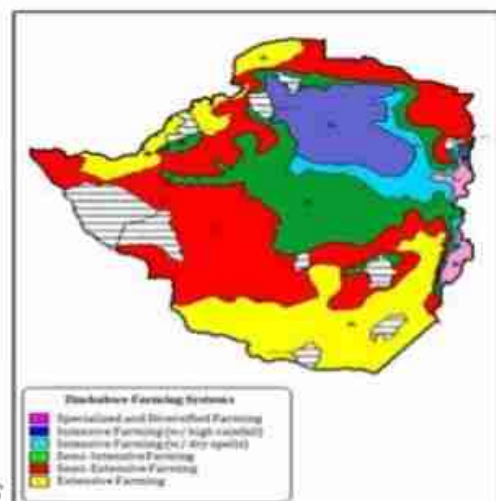
- Often it is done in dry areas, it leads to soil salinisation.
- Flood irrigation often results in leaching of soil nutrients
- Dams constructed facilitate the rapid spread of water storage and fungi diseases to crops.

**Activity 9.4**

- (a). Define plantation agriculture (2)  
 (b). Describe the main characteristics of plantation agriculture (5)  
 (c). Suggest the advantages and disadvantages of irrigation farming (8)

**UNIT 9.2****ZIMBABWE AGRO  
ECOLOGICAL REGIONS**

Zimbabwe was partitioned into different ecological regions. The classification was mainly done on the basis of activities done in an area and variations in soil, altitude and climatic characteristics. Originally five distinctive farming regions with distinctive characteristics were found in Zimbabwe in 1960s. However, changes in climate led to changes in boundaries of farming regions and proposed region 6.



*Fig 9.7 Zimbabwe Agro-ecological regions*

**Natural Farming Region 1**

The natural region 1 is found on the Eastern parts of Zimbabwe. This area receives annual rainfall of over 1000 mm. They are high altitude areas with relatively low temperatures. Their temperature range between is between 15 to 18-degree Celsius.

Region 1 covers 14439 square kilometres that is about 4% of the whole country. The following table highlights some of the agricultural activities done in region 1 and where they are practised.

Agricultural Activity	Areas where it is done
Citrus production	Nyanga
Coffee farming	Honde Valley
Potatoes farming	Nyanga
Beef production	Rusape
Maize production	Chimanimani/ Chipinge



Fig 9.8: Growing tea in Natural Farming Region 1 (Zimbabwe)

### Natural Farming Region 2

The national region 2 is found in the North Eastern Highlands side. These areas receive annual rainfall of about 750-1000mm. Temperature averages 19-23 degrees Celsius in the summer and 16-18 degrees Celsius in the winters. Region 2 covers 29658,62 square kilometres that is about 7,6% of the whole country. These areas are characterised by deep and well drained red clay soils with a fairly flat terrain.

Region 2 is highly dominated by intensive farming of crops like maize, tobacco, sunflower and other, cattle ranching and dairying is also done through on a smaller scale.



### Natural Farming Region 3

Region 3 encompasses much of Midlands Province. The areas receive 650-880 mm annual. It experiences relatively high temperatures of about 23-26 degrees celcius. The area covers about 62829 square kilometres which is about 16,1% of the whole country. Region 3 now includes parts of Mhondoro.

Region 3 is largely suitable for fodder production and livestock rearing. The area mainly produces drought resistant crops like cotton and small grains like millet and sorghum. Most crops are mainly grown under irrigations since rainfall received fail to sufficiently satisfy plant needs.

### Natural Farming Region 4

Region 4 occupies the low-lying area in the North and South of the country. The area receives about 450-650 mm of rainfall, temperatures are generally high averaging 23-26 degrees celcius. The region 4 areas cover 155 707 square km which is about 39,9% of the whole country.

This region is too dry, crops only flourish under irrigation. This farming region is most suitable for livestock production, growing of drought tolerant crops, wildlife keeping and forestry. Small grain cereals like rapoko also thrives in these areas.

### Natural Farming Region 5

This region covers the South East lowveld and the Zambezi Valley. Areas receives less than 450 mm of rainfall annually. They are also characterised by high temperatures ranging between 26 – 32 degrees celcius. They also have deep basalt soils suitable for central production when water is available. Area covers 126,829 km and 32,5% of whole country.

This area is mainly suitable for extensive cattle ranching and wildlife. This area contains Zimbabwe ranches like the Devure ranche and Gonarezhou National Parks. Several productions are also done in these areas. Sugarcane, citrus formed and cotton are grown under irrigation.

### Natural Farming Region 6

Due to changes in climate as argued above, it is now proposed that Zimbabwe has a region 6 ecological region. This region is largely appreciated by rainfall deficiencies of less than 250 per year. These areas are also characterised by extremely high

### Activity 9.5

- (a). State six Zimbabwe agro ecological regions (6)
- (b). Describe the activities done in each agro ecological region (12)

## SUMMARY

- ✓ Communal farming is the growing of crops and rearing of animals for family consumption.
- ✓ Commercial farming is the growing of crops and rearing of animals for sale.
- ✓ Zimbabwe has six farming regions.
- ✓ Dairying and market gardening are intensive forms of agriculture.
- ✓ Mixed farming is the growing of crops and keeping of animals on the same farm.
- ✓ Farming in region 1 is mainly citrus farming, coffee production and beef production.
- ✓ Region 2 is dominated by intensive farming.
- ✓ Region 3 is mainly characterised by animal husbandry.
- ✓ Region 4 and 5 are very dry and suitable for wildlife and cereal production of small grains.

## GLOSSARY

**Altitude-** height above sea level.

**Leaching-** downward movement of soil nutrients carried by water.

**Irrigation-**artificial supply of water for the purpose of farming.

## TEST

## Multiple Choice

- The farming system practised in figure 9.5 is
  - Mixed farming
  - Arable farming
  - Plantation farming
  - Livestock farming
- Which of the following is a characteristic of shifting agriculture?
  - High use of chemicals inputs such as fertilisers, pesticides and herbicides.
  - High yield per hectare
  - Cultivation of permanent crops fields
  - Periodic migration to new areas or to former areas that have re-vegetated.
- Which of the characteristics best describe settled subsistence farming?
  - High use of chemical inputs such as fertilisers, pesticides and herbicides.
  - High yield per hectare
  - Cultivation of permanent crop yields
  - Periodic migration to new areas or to former areas that have re-vegetated.
- Which of the following is the main breed of dairy cows in Zimbabwe?
 

A. Friesland –Holstein	B. Tuli
C. Hereford	D. Braham
- Mixed farming is.....
  - Cattle and crop farming carried out by one farmer on the same farm
  - Crop and livestock farming carried out by one farmer on the same farm
  - Rotating crops on a farm
  - Growing of crops on plantations
- Which of the following is an input in a ranching farm system?
 

A. Pasture	B. Farming
C. Dehorning	D. Hides
- Which of the following is an output in a ranching farm system?
 

A. Pasture	B. Fencing
C. Dehorning	D. Hides



Fig 9.9

## Structured Questions

- Write a short paragraph on the negative impacts faced by communal farmers in Zimbabwe (5)
- Draw a map to summarize the general characteristics of commercial farming (5)
- Draw a flow chart to illustrate the inputs, processes and outputs of a plantation agriculture (9).

## INDUSTRIES

**Objectives**

By the end of this chapter, you should be able to:

- explain factors influence the location of secondary industry
- describe Transnational corporations
- discuss the advantages and disadvantages of transnational cooperation

**Introduction**

The provision of goods and services is achieved through different industries. This shows that industries are important in any economy. The type of industry dominating in a given country shows the country's level of economic development. This chapter looks at the factors influencing the location of secondary industry and Transitional corporations.

**UNIT 10.1 SECONDARY INDUSTRY**

The term secondary industry refers to all industries whose main thrust involves processing of raw materials into finished and semi-finished goods. Secondary industry involves both processing and manufacturing industries to produce finished and semi-finished goods. The term processing involves the initial removal of impurities from a raw materials, for example, in a forestry industry processing includes debarking of the lumbered timber and even planing of poles into planks. Manufacturing on the other hand implies the further step of production to produce end product, for example, the planed planks are assembled into roof trusses, tables benches and other forms of furniture.



*Fig 10.1: The importance of timber*

### Factors affecting location of secondary industries

There are several factors which affects where any industry can be located in Zimbabwe. These factors can be classified into physical, economic, social and political. The location of industries in Zimbabwe are looked at in New Trends in Geography Book 1.

### Physical factors

The physical factors affecting the location of industries include:

- **Raw materials**

Raw materials are the initial factor to consider before locating an industry. Before locating an industry, raw material availability and accessibility should be considered.

Industries which deals with bulk raw materials usually tends to locate near the source of raw material. This is mainly to done to avoid spending huge sums of money transporting raw materials. On the other hand industries which deals with perishable raw materials tend to locate near markets for easy accessibility to the market so that products are sold before they go bad.

The table below shows some of industries in Zimbabwe whose location has been largely influenced by raw materials.

*Table 10.2: Examples of industries and their location*

Industry	Nature of Business
Hippo Valley	Sugar milling
Chisumbanje	Ethanol production
Redcliff (ZISCO STEEL)	Steel production

### Water supplies

Water is a crucial raw material in all industrial operations. Water is used to dissolve industrial substances, cool engines and transport waste products. Most industries tend to locate near perennial streams for a steady and reliable supply of water to execute their industrial processes.

### Land

Land cost and availability is another factor which affects the location of secondary industries. Most processing industries requires large pieces of land which are fairly flat and accessible. This forces most processing industries to locate in areas further away from towns where large tracks of land are found cheaply and in abundance.

## Economic factors

The economic factors affecting the location of industries include:

- **Capital**

The term capital refers to money needed to start a business. The amount of money a company has determines the nature of the business it needs to pursue. Most capital-intensive processing industries are owned by Transnational companies which have a huge capital base.

- **Markets**

Market size and location are of paramount importance when locating industries. Most processing industries tends to locate in areas with a considerable number of people who constitutes the market.

Before the invention of modern gadgets like refrigerated trucks, cold rooms and delivery jets, industries dealing with perishable commodities were forced to locate near markets. This was meant to assist them to sell their products before they go bad. Nowadays an industry can locate anywhere due to technological advancement that is most industries are now footloose.

- **Transport**

All industrial operations are hinged on the transport and the transport system. Transport is crucial in the movement of raw material, labour force and finished products. Industries tends to operate in areas with good transport networks because they help to reduce operation costs and maximise profits. Although some areas are endowed with valuable raw materials they find it had to attract industries because they do not have a vibrant transport system.

- **Break of bulk**

Break of bulk industries are those which deals with products which loses much weight after the initial stage of processing. Some of these includes timber milling and oil refinery industries. Such industries tend to locate near the source of raw materials. This is done to avoid incurring costs in transporting bulky impurities. One good example of a break of bulk is Feruka in Mutare where crude oil is refined.

- **Power supply**

Industrial operations require the availability of a reliable power source. Most industry now relies on electrical energy. Industries tends to locate in areas where electric energy is accessed easily. Most recently some industries now rely on solar energy for example the Zimbabwean government through the ministry of energy is making frantic efforts to initiate the Gwanda solar energy plant.

- **Agglomeration**

The success of any industry in an area tends to attract some industries dealing with almost the same business. This is called agglomeration. For example, the success of a car assembling industry tends to attract tyre and paint producing industries in the same location.

### Political factors

The political factors affecting the location of industries include:

- **Government politics**

Government have a role to play in the location of industries, they control industrial location through several ways some of them includes offering tax incentives, offering cheap locations, upgrade rural communication and transport infrastructure to attract companies to locater in rural areas

- **Political stability**

Most processing industries prefer to locate their industries in areas with peace and harmony. Industry owners avoid locating their industries in areas without peace and stability.

### Types of Industrial location

Industrial deal with different products, tends to locate in different areas. Industrial location is largely determined by the factors influencing industrial location discussed above.

#### Raw material-based industry

Raw material industries are those that are located near the source of raw materials because they deal with the bulk raw materials.

The raw material index is used to determine where the industry to be located. It is calculated as follows.

$$\text{RM INDEX} = \frac{\text{Weight of raw materials}}{\text{Weight of finished products.}}$$

If the raw material index is greater than 1 the industry will be located near the raw material because it will be dealing with a weight losing raw material.

Examples of raw material-based industries in Zimbabwe are Mutare Board and Paper Mills and Hippo Valley Estates in the South East low veld.

#### Market based industries

These are industries which are located near their markets. Industries usually locate near markets because either the finished product is perishable, their end product

gains weight after processing or their end product is fragile. Market based industries are often established in town, cities of growth points with greater threshold.

Examples of market-based industries includes Beverages like Coca cola and Delta Co-operation, confectionaries like Bakers Inn and Lobels and furniture making companies like Teechers, TV Sales and Home.

### Footloose industries

These are industries which can be located at any point. They are not tied to any location examples includes textiles industries and those dealing with food stuffs.

### Labour based industries

Labour based industries are those which are located in areas with a higher concentration of labourers. Usually they locate in such sites because they are labour intensive. Those that require expertise labour are located in urban areas for example Monarch Industries.

### Power based industries

There are some industries which requires large amounts of energy and power for their operations those individuals aluminium processing so they are located in areas with reliable power supplies.

### Task: Organising an educational tour

Arrange an educational tour with your teacher to a nearby secondary industry. Pay particular attention to the activities done in secondary.

### Exercise 10.1

- (a) Distinguish between footloose and market based industries. (4)
- (b) Explain the physical, economic and political factors affecting the location of secondary industry. (12)



**UNIT 10.2****TRANSNATIONAL COMPANIES**

These are companies with operations in more than one country. For example, the BATA shoe company although it is operated by Canadians it operates in several countries including Zimbabwe, Botswana and Mozambique.

Transnational companies operating in Zimbabwe and other African countries include LONRHO, Uniliver, Nestle, and Heinz

**Characteristics of Transnational companies**

Most transnational companies are similar in terms of their operations and structure. Transnational companies have their headquarters in more economically developed countries. The table below shows some of the TNCs and areas in which their Headquarters are found.

*Table 10.2: Multinational companies and their headquarters*

Company	Country in which the headquarter is found
Bata	Canada
Heinz	Germany
Lonrho	UK
Coca cola	Brazil

Although TNCs operates in several nations most of the profits they realise in their businesses are repatriated back to their mother countries.

Transnational companies' majors in several business enterprises including agriculture for example Hippo valley sugar refinery. Eastern highlands plantation limited, mining for example Rio Tinto. Car assembling, for example, ZIMMOCO operations in TNC are capital intensive ad are done on a large scale. Operations are done in factories with the assistance of the most recent technologies.

**Advantages of Transnational companies**

There are numerous advantages enjoyed by host countries in which TNCs operate in. These advantages can be grouped into two main categories which are economic and social advantages.

### Economic advantages

- TNC creates many employment opportunities to both skilled and unskilled labourers.
- A meaningful amount of foreign currency is generated through operations conducted by TNCs. The foreign currency being generated increases the country's Gross domestic product.
- TNCs also helps in the transferring of new technologies from More economically developed countries to Less economically developed countries since most TNCs have their headquarters in MEDCs the governments of host countries earn some revenue from TNCs through taxation.

### Social advantages of TNCs

- TNCs often leads to the development of infrastructure like roads, schools, clinics, golf courses and football pitches. Expansion in infrastructure increases the accessibility and general standards of living of local people.
- The local people's living standards are also raised through employment opportunities.
- The presence of TNCs also improves the social service delivery systems. They aid people to access social services like education and health easily. For example, companies like Arcturus gold mine and Eastern highlands plantations limited have health centres established in areas where they operate in.

### Disadvantages of Transnational companies

Although host countries of TNCs enjoy several benefits as highlighted above, there also several disadvantages suffered by these host countries.

- The main disadvantage of transnational companies is that they send back huge sums of profits overseas. This results in increased poverty in host country since their economies grows at a lower rate than that in which the headquarters are found.
- TNC in most instances also leads to the destruction of local firms. Due to lack of meaningful venture capital local firms find it very difficult to compete with companies owned by Transnational Corporations.
- The other disadvantage is that they are exploitative in nature. They are exploitive in the sense that the local people are usually given fewer paying jobs whilst top class management posts are reserved for foreigners.
- In some instances, transnational companies prove to be a disadvantage to host countries because they indulge in local politics thereby creating political instability
- TNCs also pays little attention to environmental issues, more so they exploit resources carelessly. Once resources are exhausted they abandon the area and look for other lucrative business to do.

- The other common disadvantage of TNC is enjoyment of product monopoly. For example, no other company except the Peps Cola Company of the US can manufacture Coca Cola beverages. Enjoyment of product monopoly destroys local firms in their infancy.

Most TNCs have a tendency of withdrawing their company from production whenever they feel like doing that. This is disadvantageous in the sense that it causes high rates of job loss and unemployment in the host country.

### Task: Group Work

Get into groups of 5.

Discuss the following questions.

1. a) Define Transnational companies (2)  
b) Describe the characteristics of Transnational companies (2)  
c) Explain the advantages and disadvantages of Transnational companies (10)

## SUMMARY

- ✓ Secondary industries are those which process and manufacture raw materials into semi-finished and finished products
- ✓ There are physical, political and socio-economic factors affecting the location of industries in Zimbabwe
- ✓ Industries are either located near raw materials, markets or in accessible areas to enjoy certain benefits and maximise profits
- ✓ Trans national companies are companies from developed world which operate in more than one nation,
- ✓ The operation of Transnational companies presents both advantages and disadvantages to the host country
- ✓ The main disadvantage of TNCs is that they repatriate huge sums of money to their mother countries
- ✓ Their main advantage is that they create several employment opportunities to the local people

## GLOSSARY

**Agglomeration** – attraction of industries which deal with same materials to the same area

**Industry** - any form of economic activities

**Monopoly** – taking sole control of providing certain goods or services

**Exploitative** – the act of taking advantage and abusing other people.

**TEST****Multiple Choice**

1. Tourism is an example of a:  
A. Primary industry  
B. Secondary industry  
C. High industry  
D. Tertiary industries
2. Which of the following workers work in a secondary industry?  
A. Social worker  
B. Steel worker  
C. School teacher  
D. Fisherman
3. Which of the following is not an advantage of having a transnational company in your area  
a) Creation of employment  
b) setting up and expansion of infrastructure  
c) Enjoyment of product monopoly  
d) Improoves local people standards of living

**Structured Questions**

3. List 4 reasons why industry is so important for Zimbabwe's economy (4)
4. What are the main characteristics of Transnational corporations (5)
5. Transnational companies have been credited with some advantages as well as disadvantages. Clearly show out the advantages and disadvantages of Transnational Companies (10)

# 11

## CHAPTER 11

### SETTLEMENT AND POPULATION

#### Objectives

By the end of this chapter, you should be able to:

- Describe and explain, causes, processes and effects of urbanisation.
- Suggest solutions to the problems of urbanisation.
- Describe and outline the main features of unplanned settlements.
- Describe and explain the location and causes of unplanned settlements.
- Outline effects of unplanned settlements.
- Suggest measures to solve problems of unplanned settlements.
- Identify the main features of disaster resilient infrastructure.
- Describe factors considered when setting settlements.

#### Introduction

Human development has been marked by growth of complex settlements. Both rural and urban settlements bear testimony to a country's level of development. This chapter, looks at aspects of settlements such as urbanization, unplanned settlements, disaster resilient infrastructure and factors considered when setting settlements.

#### UNIT 11.1 URBANISATION

The term urbanisation refers to the process through which a large proportion of a country's population lives in towns and cities. In Zimbabwe an area qualifies to an urban area if it is constituted by a population over 2500 people. Some of the urban centres we have in Zimbabwe are



*Fig 11.1: Examples of urban settlements*

## Causes of urbanisation

There are several factors which causes the proliferation of urban settlements. Some of these includes

- **Discovery of precious minerals**

Areas in which precious minerals are discovered easily develops into urban settlements. This is so because most people will through these areas seeking for employment and enjoying benefits enjoyed in mining towns. A huge inflow of people results in the development of an urban area. Towns like Hwange and Zvishavane have developed due to discovery of precious minerals.

- **Rural to urban migration**

High rates of rural to urban migration also results in urbanisation. This very common in Less economically developed countries in which most youths migrate from rural areas into towns and cities in search of employment resulting in urbanisation.

- **The need for a market**

Urbanisation is also caused by the need to create a market for various commodities. This is the reason why there are several market towns for example Nyanga in Zimbabwe.

- **Merging of transport network**

The convergence of transport routes at a fixed point often leads to urbanisation. In Zimbabwe Gweru is a focal point where main transport routes merge.

- **Manufacturing**

A higher concentration of manufacturing industries in an area often results in urbanisation. The presence of several industries in an area gives people better hope for employment opportunities hence it attracts many people. When huge numbers of people are attracted to an area that area easily develops into an urban area.

## Effects of urbanisation

Any area which supports a large population is bound to experience several effects most of which are negative.

### Negative effects of urbanisation

- Rapid urbanisation often results in the shortage of houses
- High levels of land, car and water pollution.
- Urban setup also causes cultural dilution through mixing of people with different cultural backgrounds.

- If poorly planned urbanisation often causes a strain on social service delivery system hence a decline in people's standards of living. For example, sewage pipes end up bursting if they fail to contain huge volumes of sewage than they are designed to carry
- Traffic congestion is another problem of urbanisation in the main cities. For example, in Harare Zimbabwe.



*Fig 11.2: Burst sewage pipes*

### Exercise 11.1

- Describe the scene in the photography in fig 11.2 (5)
- Describe the factors leading to rapid urbanisation (7)

### Positive effects of urbanisation

- When a large population of people is living in an area they create a fertile ground for trading since they provide a ready market
- Existence of many people in the same locality is also advantageous in the sense that people will share ideas

### Solutions to the problems of urbanisation

Several solutions can be put in place to address the problems caused by urbanisation some of these solutions includes:

- Establishment of growth points in rural area. The establishment of growth points like Hauna, Sadza and Mupandawana reduces the rate of rural to urban migration. This in turn reduces the rapid inflow of people into urban areas and urbanisation related problems.
- Congestion can be solved by creating suburban shopping centres like Highglen in Harare to avoid the inflow of people into town area.

- Creation of ring roads and the use of common public transport can also solve the problem of congestion.
- Land, air and water pollution problems can be solved by education of the people on the need to keep the environment clean

### Urban land use Zones

Different zones or areas within an urban area have their own specific functions. The land use is mainly determined by the values, accessibility and the nature of business being conducted. Businesses with higher profits locate in the CBD whilst those which requires large land to operate on locates on the outskirts. In every functional zone certain activities are concentrated.

### The Central Business District

The CBD is the economic powerhouse of an urban area. It may not be central in terms of physical location. It is a centre of economic activities like retailing, banking and offices.

- It is the economic powerhouse of a town.
- Parking areas are prepaid
- It has the highest volume of traffic and people during the day.
- CBD dies at nights thus there is less movement of people and traffic.
- It has a high concentration of government offices and retail shops.
- It has high rise or tall buildings
- A few numbers of people house in the CBD. Mainly they stay in flats.
- The CBD is the most accessible part of an urban area.
- It has high land values and rentals.

#### **Task: Identifying the characteristics of the CBD**

Visit the nearest city in your province. Identify the main characteristics of the CBD of the city.

### Industrial zones

The other common land use in urban area is industrial land use. Part of this area is where different industries dominate. Industrial land use can be classified into two main groups which are heavy industrial land use and light industrial land use.

#### Heavy industrial land use

This is an area in which several heavy industries are located usually it is found on the western side of an urban area. On the outskirts of a town where land is abundant and cheap. Examples of industrial areas are Masasa and Workington in Harare and Sakubva in Mutare.



### Light industrial land use

These are areas in which most light industries are located on the CBD fringe and they specialise in the production of confectionaries and beverages.

### Residential zones

Residential zones are those areas in which accommodation facilities for urban population is found. A largest chunk of urban land use is residential land use can be divided into three broad categories namely:

- a. High density suburbs
- b. Medium density suburbs
- c. Low density suburbs

### High density suburbs



*Fig 11.3: High density suburb in Harare*

It is a residential area for low income earners. In most towns high density suburbs are found on the Western side of the CBDs near heavy industrial sites. A majority of people living there are employed in heavy industries. Example are Sakubva and Dangamvura in Mutare, Vhengere in Rusape, Mbizo in Kwekwe, Mbare Budiriro and Glenview in Harare. Emalangeneni in Bulawayo. High density suburbs have low quality houses, low land values and areas built on are relatively smaller averaging between 150 and 400 square meters per household.

### Medium density suburbs

This is a residential area constituted by the people of a middle class of an urban population. Houses are of middle class and the residential stands are relatively bigger. Examples includes Palmerstone and Yeovil in Mutare and Marlborough in Harare.



- *11.4 middle density suburbs*

### Low density suburbs



*Fig 11.5: Low Density suburbs*

This is a residential area in which wealthy people live. Low density suburbs are characterised by vast areas to build on, high land values and spacious houses of high quality.

**Task: Identifying the characteristics of suburbs**

Class discussion

Discuss the characteristics of high, middle and low-density suburbs (15)

**Recreational zones**

These are areas in which people get entertainment. Recreational areas include urban parks, golf courses, race courses, stadiums and cinema houses, urban dwellers spend their leisure times in recreational areas with their families, friends and even work mates.

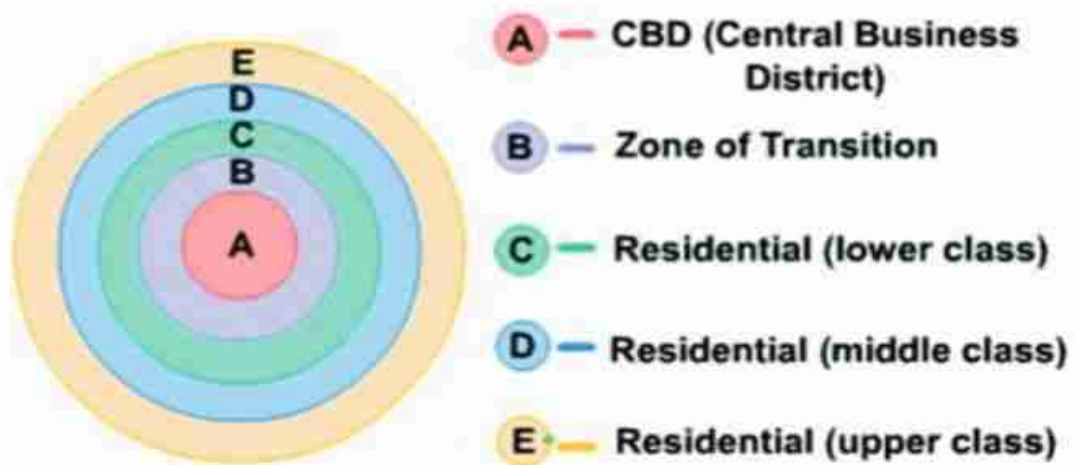
**Urban land use models**

Urban areas display different structures as influenced by the distribution of their land uses. Although there is a variation of land uses from one urban area to another, the morphology of most towns can best be explained using three major land use models which are.

- a) The concentric model
- b) The sector models
- c) Multi nuclei model

**The concentric model**

The concentric model was developed by Burges in 1924. According to him urban land uses develops in circular belts or zones around the CBD. In the concentric model each ring is comprised of a distinct type of land use. Burges also highlighted that every urban area expands outwards from the centre. He devised this model after studying Chicago city.



*Fig 11.6: The sector model*

### The sector model

The sector model was devised by Hoyt in 1939. According to him urban areas develop assuming wedge-shaped sectors moving outwards from the CBD following transport routes. Hoyt's model is most applicable in most British cities where transport and communication links determine the formation of various sectors. The sector model resembles the concentric model in the sense that they all have a single CBD from which an urban area expands from.

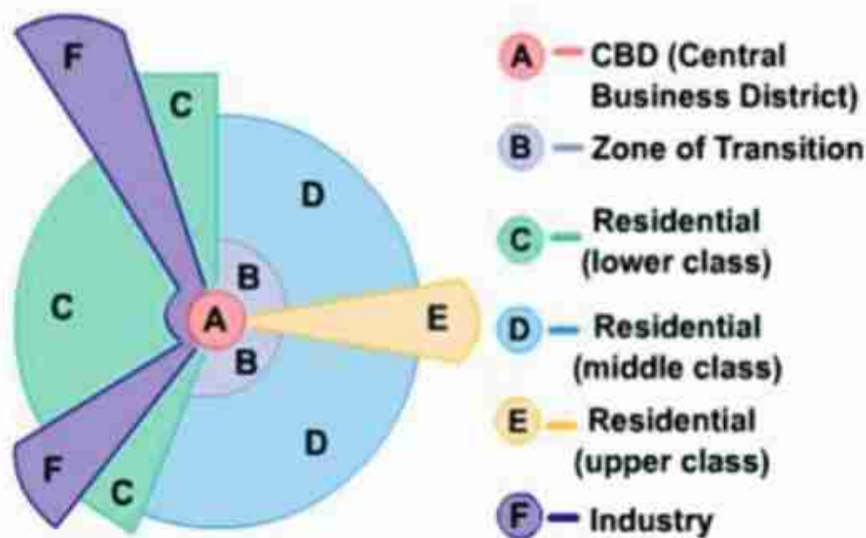


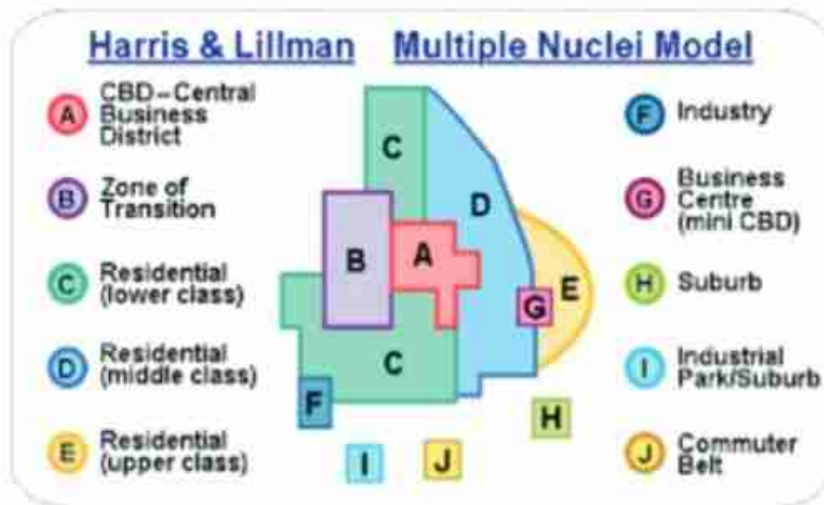
Fig 11.7: Burgess' Concentric ring model

According to Hoyt's model;

- The CBD is at the centre of the town
- Middle and low-density suburbs occupy areas further from the industrial zones which are characterised by noise.
- High density of low-income houses is located closer to industrial zones since most of its population works there.

### The Multi Nuclei Model

This model was devised by Ullman and Harris in 1945. According to them the development of urban areas development occurs not from one CBD but from other smaller nuclei of economic value. To them an urban area has more than one shopping centre from which an urban area spread from.



*Fig 11. 7: Multi nuclei model*

## Exercise 11.2

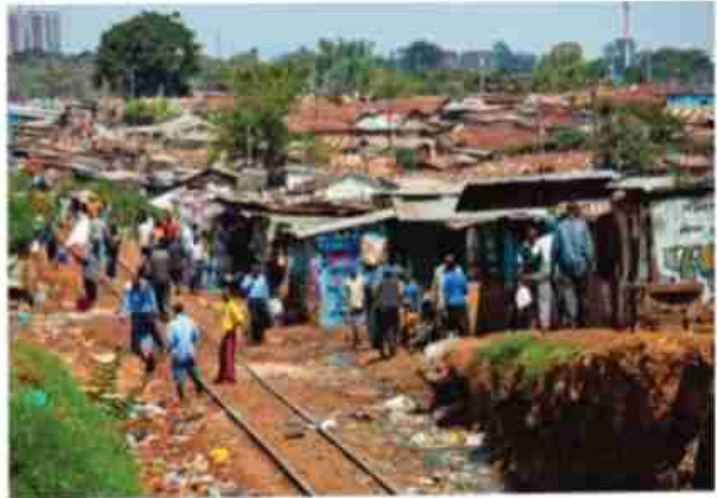
State any 3 urban land use models you know (3).

Draw and describe the following land use models.

1. The sector model (5)
2. The multi nuclei model (5)
3. The concentric model (5)

## UNIT 11.2 UNPLANNED URBAN SETTLEMENTS

Unplanned urban settlement are residential areas which are set up without approval from land owners or urban authorities. All unplanned settlements are illegal they mainly emerge due to a rapid influx of people into urban areas. Illegal settlements have become a common feature in most towns. Some of the common unplanned settlements includes Caledonia, Hopley and Porta farm in Harare, Kilaney in Bulawayo, Flavera in Brazil and Kiberia in Kenya



*Fig 11.8: Unplanned urban settlement*

### Characteristics of unplanned settlements

The following are main characteristics of unplanned urban settlements

- The houses are of poor quality made up of assortment of cheap locally available materials like plastic, wood scrap material, cardboard boxes etc.
- Shortage of basic social amenities like safe drinking water and ablution facilities.
- Unreliable water supply and electricity.
- It is a fertile ground for social vices like drug abuse, murder, theft and prostitution.
- Higher incidences of crimes.
- Heaps of uncollected garbage is common since litter is not collected
- Wood, coal and charcoal are the commonly used fuels since there is no electrical energy
- Areas of unplanned settlements is characterised by very narrow paths between houses and underdeveloped road networks

### Location of unplanned settlements in urban areas

The areas in which most unplanned settlements locates have a resemblance from one site to another. Some of these include

- **Along major rivers**  
Several unplanned settlements locate along major perennial streams. This is so because since such settlements are unplanned there is no water for use hence they rely on water from the streams.

- **Near airports**

Most areas near air ports are always vacant since no other activity can be allocated land nearest to air ports for fear that it disrupts aviation. Squatters often utilise such open spaces to build unplanned settlements.

- **Grave yards**

In some cases, squatter settlements can emerge near grave yards. This is so because usually vast tracts of lands near grave yards are vacant so squatters tend to grab these lands for unplanned settlements.

- **Near dump sites**

Squatter settlements are built near dump sites. Unplanned settlers prefer dumpsites because of their richness in building materials and vicinity so that they can obtain building materials from the dumped refuse.

- **Urban fringe**

Some unplanned settlements are built on the urban fringes. Settlers prefer these areas because they are strategic for fleeing away when city council officials attack them. More so there are vast tracks of land at urban fringes which can be utilised for setting up squatter settlements.

### Causes of unplanned settlements

These are numerous causes of unplanned settlements some of these include:

- Shortage of accommodation in urban areas
- High rentals and rates in towns
- Some people have a very dangerous misconception of thinking that settling in an unplanned settlement paves a way for them to be resettled by the government
- High cost of living in urban areas.
- Large volumes of rural to urban migration
- Poverty among urban dwellers
- Destitution due to loss of employment or loss of parents

### Effects of unplanned settlements on the environment

Unplanned settlements have negative effects on the environment. Chief among the effects are massive deforestation. Unplanned settlements often destroy much vegetation as people clear land for settlements and to obtain wood fuel. Since these settlements lack basic social amenities like running water and toilets they become breeding grounds for pests and rodents making them inhabitable. Since people rely on running water from perennial streams unplanned settlements leads to a higher incidences of water pollution. Land and air pollution are also very common problems. The presence of squatter settlements destroys the natural beauty of an area thus the aesthetic value is lost.

### Socio economic impacts of unplanned settlements

The effects of unplanned settlements are that:

- Social problems like prostitution and drug abuse are rampant
- Illegal settlements are hives of illegal dealings because they harbour criminals.
- Due to their poor sanitary conditions illegal settlements are health bombs since they promote spontaneous outbreak and spreading of hygienic diseases like cholera and typhoid.

### Methods of dealing with the problems of unplanned settlements

Some of the ways which can be employed to solve the problems of illegal settlements are:

- The government with the help of local authorities should mobilise resources to upgrade squatter settlements. Collectively they can develop the crucial infrastructure like road, schools, and health centres illegal settlements which cannot be upgraded should be demolished for example in Zimbabwe it was done by the government in 2005. Recently in January 2019 the authorities also cleared slums around the Robert Mugabe airport area.
- Building of low-cost houses for the poor is another way of solving problems caused by unplanned settlements.
- Land owners and authorities should give squatters title deeds to own the land illegally possessed. This will act as an incentive to help the unplanned settlers to upgrade their places of residence with minimum assistance from the government and the local authorities
- Massive rural to urban migration should be curbed by the establishing growth points in several rural areas

### Exercise 11.3

- (a). Describe and explain the location and causes of unplanned settlements (5)
- (b). Outline the effects of unplanned settlements (5)
- (c). Suggest measures to reduce the effects of unplanned settlements (5)



## SUMMARY

- ✓ Urbanisation is a condition in which a larger proportion of people will be living in urban areas
- ✓ Urbanisation is caused by rural to urban migration, discovery of minerals and industrialisation
- ✓ Urbanisation has both positive and negative effects
- ✓ Urban land uses industrial, residential, recreational and the CBD
- ✓ Unplanned settlements are common in Zimbabwe, they lack proper social amenities like safe drinking water and road networks
- ✓ Squatter settlements usually locate along major streams, near airports, near grave yards and on any open spaces
- ✓ Unplanned settlements result in several economic and environmental problems some of these includes outbreak of hygienic diseases and an increase in social vices and crime rates
- ✓ Disaster resilient infrastructure are structures which can withstand natural disasters like floods, earthquakes, typhoons etc.
- ✓ There are physical social and economic factors which should be considered when siting settlements

## GLOSSARY

**Unplanned settlements-** these are settlements built on illegal ground

**Dump sites** – it is an area in which refuse or garbage is dumped

**Water pollution-** processes through which water is contaminated

**TEST****Multiple Choice**

1. The following are the causes of urbanisation except
  - A. Discovery of precious mineral
  - B. The need for market
  - C. Rural to urban migration
  - D. Need for warehousing
2. Urbanisation refers to:
  - A. The process through which a large proportion of a country's population lives in towns and cities
  - B. movement of people from rural to urban centres
  - C. The development of town and cities
  - D. The area that qualifies to an urban area.
3. The following factors are effects of urbanisation except
  - A. Rapid urbanisation often results in the shortage of houses
  - B. High levels of pollution
  - C. Cultural dilution
  - D. employment creation

**Structured Questions**

4. List factors that can be considered when setting settlements (5)
5. Describe the characteristics of CBD (8)

## TRANSPORT AND TRADE

**Objectives**

By the end of this chapter, you should be able to:

- explain trade
- describe trade patterns in Zimbabwe, SADC, Africa and the world
- outline characteristics of domestic and foreign trade
- differentiate domestic from foreign trade

**Introduction**

From time immemorial trade has been an integral part of the human race since it facilitated the exchange of goods and services. Advances in technology and global interaction has led to development of complex trading patterns. This chapter looks at what is trade, trading patterns in Zimbabwe, SADC, Africa and the world.

**UNIT 12.1 WHAT IS TRADE?**

The term trade refers to the purchasing and selling of goods and services locally or internationally. Trade involves the exchange of goods and services for money. Before the invention of money goods were exchanged for goods and that was referred to as barter trading. Although this type of trade has been affected by the proliferation of monetary economy, it should be noted that barter trading still exists in some Zimbabwean communities.

Trade occurs in a form of a chain. The diagram shows the trade chain.



*Fig 12.1: The chain of distribution*

### Trade patterns in Zimbabwe

Zimbabwe's trade patterns are largely controlled by the nature of its location thus it as a land locked country. In the pre and post-independence era in the history of Zimbabwe trade remain an integrate part in the national economy.

Trade patterns in Zimbabwe shows that although trade deficits prevailed since 1980, it was exporting considerable amounts of goods. Economic policies such as the Economic Structural Adjustment Programme (ESAP) in the late 90s grossly affected Zimbabwe's trading patterns. Companies downsized and Gross Domestic Product (GDP) fell leading to gross trade deficit. From 2000 internationally, Zimbabwe suffered negative publicity. In 2008 the economic meltdown led to closure of companies, high unemployment and gross trade deficit. In 2009 Zimbabwe's trading position was revived due to dollarization and liberalisation of the economy. During this period onwards, exports quantities grew at an average rate of over 30%. Minerals played a significant role in promoting trade. Diamonds, platinum and gold are Zimbabwe's major foreign currency earner. Although agricultural production fell, tobacco is still a major foreign currency earner.

Today Zimbabwe depends on imports for most of its needs such as fuel and foods stuffs. In November 2018 Zimbabwe recorded a trade deficit of US\$157.60 million ([www.tradingeconomics.com](http://www.tradingeconomics.com)). Zimbabwe's balance of trade averaged - US\$253.18 million from 1991 to 2018, reaching an all-time high of US\$293 million in December of 2000 and a record low of - US\$3957.75 in December 2009. Zimbabwe is a net importer of fuel and capital goods. Main export is tobacco (23% of total exports), nickel (20%), diamonds and platinum. Zimbabwe's main trading patterns are South Africa and China.

### TRADE PATTERNS IN SADC

The Southern African Development Community (SADC) is a trading bloc formulated to facilitate trade between countries in Southern Africa. This trading bloc and other are covered in more detail in New Trends in Geography Book 3. An analysis on trade in the SADC region shows that South Africa has large trade surpluses with most SADC countries. South Africa also dominate in the trade of this region.

In SADC trade exports are mainly comprised of minerals and agricultural commodities which in most cases are exported in their raw state. The most commonly traded agricultural products are tobacco, tea, maize, sugarcane and timber. There is also trading of industrial products like clothing, paper and petroleum fuels.

Most notably trade in SADC is highly fluctuating with an increase in the trading of non-food consumer goods. Fig 12.3 shows the different trading blocs formed and these trading blocs play a significant role in influencing trading patterns for SADC and the entire African continent.

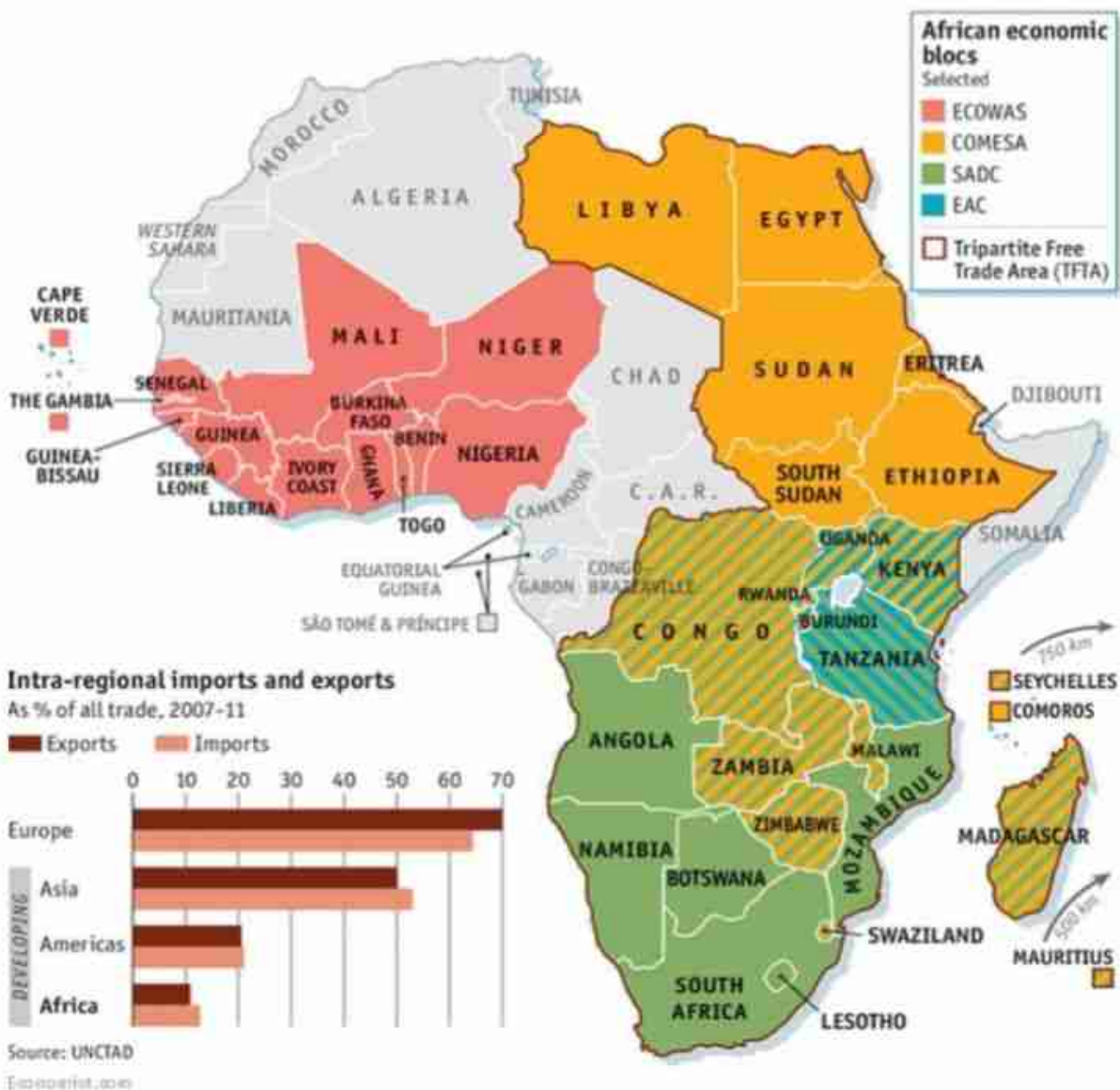


Fig 12.2: Africa trading patterns from 2007 to 2011  
 Source: www.economist.com

The trading blocs in African include Southern African Development Community (SADC), Economic Community of West Africa States (ECOWAS), Common Market for Eastern and Southern Africa (COMESA) and Preferential Trade Area (PTA) as shown in fig 12.3 above. SADC comprises of countries on the southern part of Africa which include Zambia, Angola, Namibia, Botswana and Zimbabwe. Refers to New Trends in Geography Book 3 for more information on how this trading bloc facilitates trade amongst member state. Fig 12.3 also shows the exports and imports as percentages between 2007 and 2011. For SADC countries the percentage of export and imports for SADC is low.

### Exercise 12.1

- (a). Define the term trade (1)
- (b). Explain why most African countries exports unprocessed raw materials. (7)
- (c) Describe the factors which have influenced Zimbabwe's trading patterns since the late 1990s (7)

### World Trading Patterns

Recent technological developments like faster and efficient transport systems and improved ICT development have shaped the whole world into a global village. Trading transaction can be done even in the comfort of one's office or home. The need to visit areas you intend to do business with that been relegated into oblivion.

World trade fell by 3% in 2016. The year 2015 also recorded a 13% decline in trade so trade growth in the world remained negative. It maintained a steady increase in trade. Whilst Asia and North America suffered a decline in trade of 3 and 4% respectively. In the whole world trade. The Middle East dominates in trading involving services which includes IT services, transport and tourism.

In world trade Africa recorded a sharp decline in trade. The United States remain the world's leading trader of which UK and China also dominates in the world markets.

## UNIT 12.2 DOMESTIC AND FOREIGN TRADE

There are two forms of trade which are foreign trade and domestic trade.

### Domestic Trade

Domestic trade refers to the buying and selling of goods and services within the same country. For example, a sugar producing company in Hippo Valley may trade its products with Wholesale and retailers in Harare.

#### Characteristics of domestic trade

- Domestic trade occurs within the same political boundaries.
- It involves the use of the same local currency for example South Africa use the Rand in their transactions whilst Mozambique uses the Metical.
- Domestic trade involves the trading in both goods and services.
- Transport costs are relatively lower in domestic trade.
- Domestic trade has less risk of incurring losses.

### Foreign trade

Foreign trade refers to the exchange of goods and services beyond political boundaries. For example, the trade which occurs between Zimbabwe and China. In

simple terms foreign trade refers to trade between countries. Trade between two countries is called bilateral trade whereas trade amongst more than two countries is called multilateral trade.

### Characteristics of foreign trade

- It involves the trade between countries within the same continents and those beyond.
- Foreign trade involves the use of foreign currencies since countries trading uses different currencies.
- Foreign trade is also characterised by relatively higher transports costs. This is so because at times transportation is done by aeroplanes.
- Foreign trade usually occurs in trade blocks, for example, Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA).

### Differences between domestic and foreign trade

Trade occurs in different forms as highlighted above. Domestic trade refers to all trade operations which occurs within the same political boundaries whilst foreign trade involves the crossing of international boundaries. There are several differences between domestic and foreign trade some of these includes:

- **Use of different currencies**  
In countries with stable economies using single currencies domestic trade thrives on the use of the same currency. On the other hand, foreign trade involves the use of different currencies.
- **Transport Costs**  
Transport costs incurred in domestic trade are relatively lower than those incurred in foreign trade. For example, it is cheaper to transport tea produced in any Zimbabwe in area to any market in Zimbabwe. Transportation of the same tea products to foreign markets attracts a higher transport cost.
- **Level of control in trade**  
Levels of control on foreign trade are higher and stiff than those in domestic trade. This is the case because foreign trade is governed by two different political unites whereas domestic trade is governed by one government with the same vision.
- **Risks involved**  
Domestic trade is characterised by lower levels of risk whilst foreign trade has great risks inherit in it. Risks are high in foreign trade because business is done with foreigners so some clients may default in their payments.

## Exercise 12.2

- (a). Distinguish between domestic and foreign trade (4)  
 (b). In table form outline the differences between domestic and foreign trade. (10)

## SUMMARY

- ✓ Trade refers to the exchange of goods and services between individuals and countries.
- ✓ Trade patterns in Zimbabwe shows that there was an improvement in trade in the year 2009 due to dolarisation of the economy.
- ✓ In the SADC region South Africa has high trade surpluses.
- ✓ Trade exports in the SADC region is mainly comprised of minerals and agricultural products.
- ✓ Europe and China are among the best performing countries in the world trade.
- ✓ Domestic trade involves the use of the same currency in trade transactions.
- ✓ Foreign trade involves the use of foreign currencies in trading transactions.

## GLOSSARY

**Bilateral trade:** it is buying and selling between two countries

**Multilateral trade:** it is buying and selling amongst more than two countries

**Trade:** exchange of goods and services.

**SADC:** Southern African Development Communities.

**Trading blocs:** involves two or more countries joining together to facilitate trade amongst the member states.

**Trade surplus:** a condition in which the value of exports is more than that of imports.



## TEST

## Multiple Choice

1. Trade is the --
- The donations from richer to poor countries
  - Expatriation of profits.
  - Exchange of goods and services.
  - Movements of people and goods
2. The parts marked X and Y in the distribution chain below are--

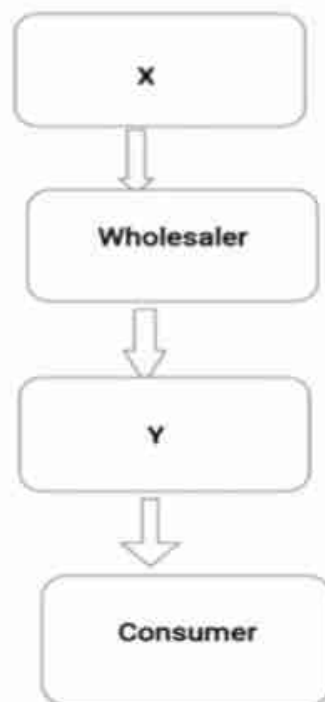


Fig 12. 3

	X	Y
A	Producer	Wholesaler
B	Wholesaler	Producer
C	Retailer	Producer
D	Producer	Retailer

3. When different countries trade it is referred to as ----
- Multilateral trade
  - Forex trade
  - Barter trade
  - Multiple currency

4. Domestic trade has fewer risks than foreign trade because -----
- A. The distance travelled are short
  - B. There is use of foreign currency
  - C. There is less paper work
  - D. There is no smuggling of goods
5. Which of the following countries is not a member of SADC?
- A. Namibia
  - B. DRC (Congo)
  - C. Zambia
  - D. Ethiopia

### Structured Questions

6. (a) What is trade? (2)
- (b) (i) What might be the causes of fluctuating trading patterns for Zimbabwe since 2000? (6)
- (ii) Outline the characteristics of domestic trade (6)
- (c) (i) Describe the difference between domestic and foreign trade (6)
- (ii) How can Zimbabwe promote international trade? (5)