

# GEOGRAPHY

Student Textbook  
GRADE 12



FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA  
MINISTRY OF EDUCATION

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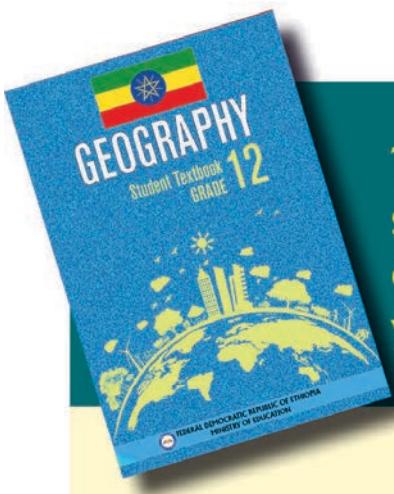
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# GEOGRAPHY

## STUDENT TEXTBOOK

### GRADE 12

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# TABLE OF CONTENTS



## UNIT ONE

### MAJOR GEOLOGICAL PROCESSES ASSOCIATED WITH PLATE TECTONICS

MAJOR GEOLOGICAL PROCESSES ASSOCIATED WITH PLATE TECTONICS.....	1
1.1. Continental Drift Theory .....	2
1.2. Plate Tectonics Theory.....	5
1.3. Plate Movements and Plate Boundaries.....	8
1.4. Major Geological Processes.....	11
Unit Summary .....	32
Review Questions.....	33

## UNIT TWO



### CLIMATE CHANGE

CLIMATE CHANGE .....	34
2.1. Basic Concepts of Climate Change.....	35
2.2. Trends in Global Climate Change .....	38
2.3. Natural and Human Induced Climate Change.....	39
2.4. Consequences of Climate Change.....	46
2.5. Adaptation and Mitigation Strategies to Climate Change.....	50
2.6. International conventions and agreements on climate.....	53
2.7. Pillars of Climate Resilient Green Economy of Ethiopia.....	57
Unit Summary .....	60
Review Exercise.....	61

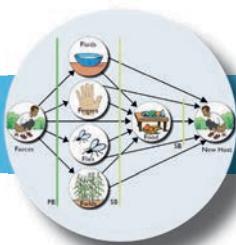


## UNIT THREE

# MANAGEMENT OF CONFLICT OVER RESOURCES

### ISSUES IN SUSTAINABLE DEVELOPMENT I:

MANAGEMENT OF CONFLICT OVER RESOURCES.....	62
3.1. The Concept of Sustainable Development.....	63
3.2. Resource Use Policies and Related Conflicts.....	69
3.3. Governance of Natural Resources.....	81
3.4. Indigenous Conflict Resolution Practices.....	84
Unit Summary.....	89
Review Questions.....	91



## UNIT FOUR

# POPULATION POLICIES PROGRAMS AND THE ENVIRONMENT

### ISSUES IN SUSTAINABLE DEVELOPMENT II:

POPULATION POLICIES, PROGRAMS AND THE ENVIRONMENT.....	92
4.1. Theories on Population Growth and Development.....	92
4.2. Population Policies.....	100
4.3. Measures Taken to Curb Growth of Population.....	102
4.4. Relationship Between Population & Socio-economic Development.....	107
4.5. Relationship Between Population and Environmental Health.....	115
Unit Summary .....	121
Review Questions .....	122



## UNIT FIVE

### CHALLENGES OF ECONOMIC DEVELOPMENT

#### ISSUES IN SUSTAINABLE DEVELOPMENT III

CHALLENGES OF ECONOMIC DEVELOPMENT.....	123
5.1. Multiple Faces of Poverty and Implication to Development.....	124
5.2. The Advantages and Disadvantage of Globalization.....	129
5.3. The Growing Imbalance between Regions and Countries.....	134
5.4. Corruption.....	138
5.5. Global Health Crises.....	145
Unit Summary .....	150
Review Questions .....	151



## UNIT SIX

### SOLUTIONS TO ENVIRONMENTAL AND SUSTAINABILITY PROBLEMS

#### ISSUES IN SUSTAINABLE DEVELOPMENT IV:

SOLUTIONS TO ENVIRONMENTAL AND SUSTAINABILITY PROBLEMS.....	152
6.1. Environmental Problems.....	153
6.2. Sustainability Challenge.....	163
6.3. Environmental Education.....	170
6.4. Environmental Movements.....	174
6.5. Environmentally Friendly Indigenous Practices.....	178
Unit Summary .....	183
Review Questions.....	184



## UNIT SEVEN

### CONTEMPORARY GLOBAL GEOGRAPHIC ISSUES AND PUBLIC CONCERNs

CONTEMPORARY GLOBAL GEOGRAPHIC ISSUES AND PUBLIC CONCERNs.....	186
7.1. Climate Change.....	187
7.2. Desertification.....	190
7.3. Drought.....	200
7.4. Famine.....	209
Unit Summary .....	213
Review Questions.....	214

- 1. Data Collection
- 2. Data Preparation
- 3. Data Input
- 4. Processing /Analysis
- 5. Data output
- 6. Data Storage

## UNIT EIGHT

### GEOGRAPHICAL ENQUIRY AND MAP MAKING

GEOGRAPHICAL ENQUIRY AND MAP MAKING .....	216
8.1. Fundamentals of Research in Geography.....	217
8.2. GIS Data and Map Making Using GIS.....	231
Unit Summary .....	246
Review Questions .....	247

## **GENERAL INTRODUCTION**

Geographers across the world are united by the similar questions they ask and the common set of basic concepts they employ to consider their answers. Of either a physical or cultural phenomenon, geographers enquire: What is it? Where is it? How did it come to be what and where it is? Where is it in relation to other physical or cultural realities that affect it or affected by it? How is it part of a functioning whole? How does its location affect people's lives and the content of the area in which it is found? These questions form the core of the enquiry skills which are, in turn, believed to be the main contribution of Geography to the development of core skills in 21st century.

In the textbook the contents and description are organized and developed based on fundamental and unifying themes in Geography. These mainly focus on physical aspects, human-environment interaction, contemporary Geographical issues, Geographic enquiry and map making. These promote arguments and use of evidence in day-to-day lives in the process of developing knowledge, skill, values and attitudes. Besides, variety of strategies are addressed to create a range of learning opportunities in the topics suited to the need of all learners by following a thematic approach of the study in Geography.

The physical environmental aspects focused on geological processes associated with plate tectonics and resulted land features as well as concept and related basic issues of climate change. The human-environment interaction addresses the issues of sustainable development in relation to natural resource use and management as well as population and socio-economic development. In connection with this, challenges related to economic development and solutions to environmental and sustainability problems are treated in the textbook. Besides, the climate change, desertification, drought and famine topics are addressed as the contemporary Geographical issues. Finally, fundamental of research in Geography as an enquiry and GIS data and map making using GIS are addressed in the textbook.



# UNIT ONE

## MAJOR GEOLOGICAL PROCESSES ASSOCIATED WITH PLATE TECTONICS



### Learning Outcomes:

At the end of this unit, you will be able to:

- explain the theory of continental drift and controversies surrounding it.
- describe the movement of the lithospheric plates over geological time.
- explain the main types of plate boundary and how they interact at triple junctions.
- describe the driving and retarding forces that influence plate motion at different plate boundaries.
- explain how plate movements relate to plate boundaries.
- explain the major geological processes in the formation of continents.
- explain the effects of on the major geological processes on human lives.



### MAIN CONTENTS

- 1.1. Continental drift theory
- 1.2. Plate tectonics theory
- 1.3. Plate movements and plate boundaries
- 1.4. Major geological processes
- [Unit Summary](#)
- [Unit Review Questions](#)

### Introduction

Our planet earth is a home for all living things in general and human beings in particular. It is in a constant motion caused by internal and external forces. Humanity has been ceaselessly affected by these powerful forces of nature such as earthquake, volcanism, tsunamis, fires, and fault ruptures. The location of these forces is frequently associated with plate boundaries where plates diverge, converge and transverse.

Knowledge of the earth's movement and the forces that work behind it is, therefore, highly desirable so as to predict the ground motion and the forces like earthquake and volcanism. Such a knowledge would enable humanity to minimize the damage from moderate forces, and to avoid total collapse during the occurrence of these forces.

We hope that you remember from the previous grades lessons about the geological history of Ethiopia and the formation of the earth's continents. This is a continuation of these lessons on related matters. This unit particularly deals with the theories of continental drift, plate tectonic, geological processes and the landforms caused by these processes.

### **Brainstorming Activity 1.1**



1. Do you remember how the continents were formed?
2. What forces are responsible for their formation?

## **1.1 THE CONTINENTAL DRIFT THEORY**

At the end of this section, you will be able to:

- ➊ identify the continents that constituted Laurasia and Gondwanaland;
- ➋ explain the geological evidences that support continental drift theory;
- ➌ explain why Alfred Wegener continental drift theory was not easily accepted; and
- ➍ describe how continental drift theory and plate tectonics are related.

**KEY TERMS:** Continental Drift, Pangaea, Laurasia, Gondwanaland

The Continental drift theory presupposes that the earth's continents have moved over geologic time relative to each other; thus, appearing to have "drifted" across the ocean bed. The continental drift theory suggests that the present continents were formed from a single continent called PANGAEA. During the Carboniferous period, some 350 million years ago, Pangaea was located around the South Pole.

In the Triassic period of Mesozoic era, Pangaea started to break into several parts. The northern part of Pangaea is known as LAURASIA. The southern part of Pangaea is known as GONDWANALAND. Both continents are further subdivided into the present continents. Through the process of drifting, the continents reached their present location. This process of continental drift as a whole took place over millions of years.

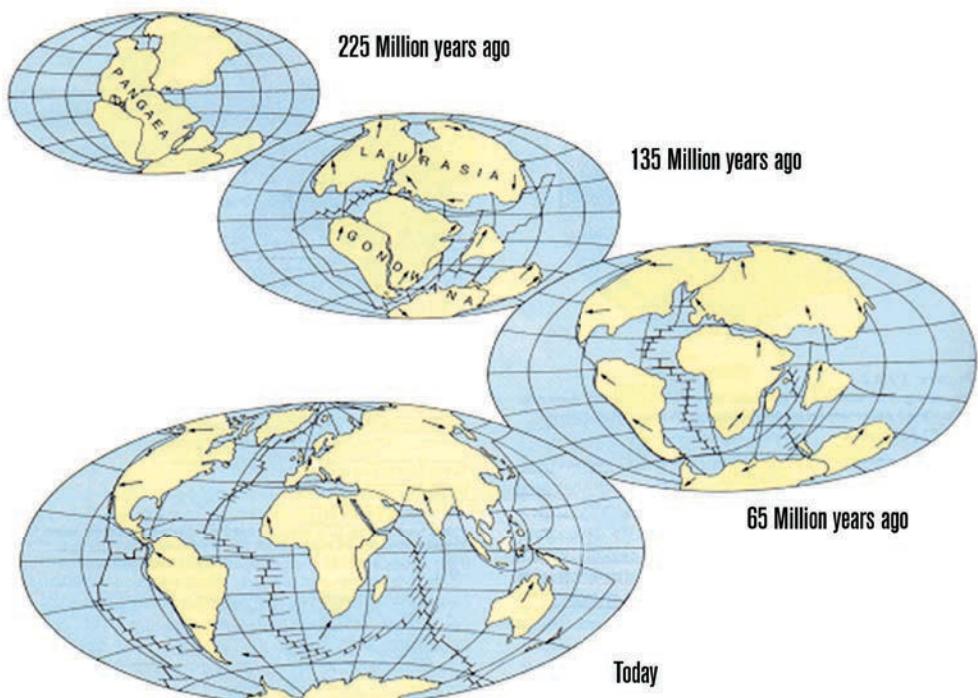


Figure 1.1: Continental Drift

## Geological Evidences Favoring Continental Drift Theory

What evidences are there in support of continental drift theory?

The concept was proposed by a German meteorologist Alfred Wegener in 1912. One of the basic concepts that helped Wegener's continental drift theory the idea of a large united landmass consisting of most of the Earth's continental regions. In his theory, Wegener introduced the supercontinent of Pangaea to explain the ancient climate similarities, fossil evidence and similarity of rock structures between Africa and South America, as well as the outlines of the continents, especially the continental shelves, which seem to fit together (Figure 1.2). Thus, Wegener used the following geological evidence, among others, to support his theory:

**1. Coastline Similarity:** The coastlines of Africa and South America have remarkable similarity in opposite side of the Atlantic Ocean. These coastlines fit together like pieces of a jigsaw puzzle.

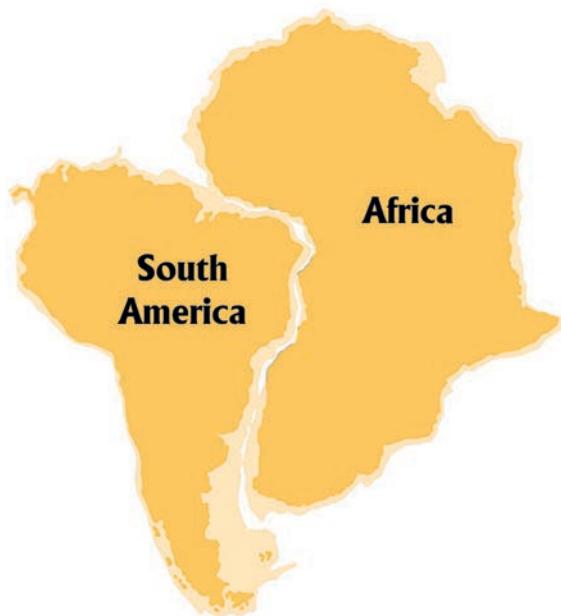


Figure 1.2: Fitting of Africa and South America together

**2. Rock type and structural similarities:** When we fit the continents of Africa and South America “back together again”, we find that:

- ▲ Similar rock types extend from one continent to the other
- ▲ The rocks are also the same age.
- ▲ Moreover, several mountain belts also extend from one continent to the next.

**3. Fossil Evidence:** cases of several fossil organisms had been found on either side of the Atlantic Ocean, implying that the continents were once joined together. Fossils of Mesosaurus are found on both sides of the Atlantic in South America and Africa (green shaded areas Figure 1.3). Mesosaurus was a small reptile that lived about 250 million years ago.

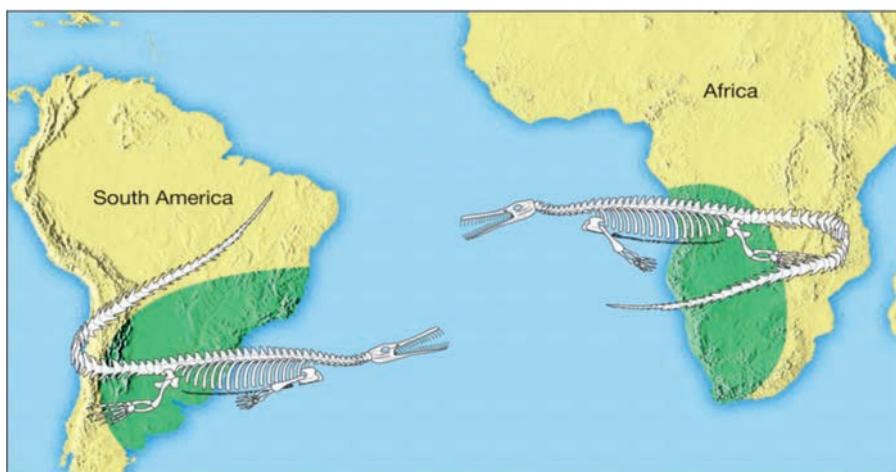


Figure 1.3: Distribution of Mesosaurus

**4. Paleoclimatic Evidence:** similarity of climatic data reconstructed from rock structure are similar in the present continents.

Why was Wegener's continental drift theory not easily accepted? Do you know any other research findings that could be easily accepted by the scientific community?

Wegener's theory of continental drift was rejected by scientific community of the time. The main reasons for this rejection were:

1. Wegener was not a geologist by profession, which of course was most welcome by his opponents.
2. Most influential geoscientists at that time were based in the Northern Hemisphere, whereas most of the conclusive data came from the Southern Hemisphere.
3. Wegener thought that Pangaea did not break up until Cenozoic era, and scientists found it hard to believe that so much continental drift could have occurred in so short a time.
4. The greatest problem remained the lack of direct evidence for the movements of continents and the needed explanation for the mechanism.

Regardless of the controversies mentioned above, perhaps Wegener's most important legacy is to have introduced the idea of lateral mobility of continents, that is, offering a paradigm change from fixism to mobilism to the scientific community and the public. Hence, the theory ignited a new way of viewing the Earth that led some scientists to start searching for an explanation of how continents could move.

### Reflective Activity 1.1



1. Explain the main evidences that support the continental drift theory.

## 1.2 PLATE TECTONICS THEORY

At the end of this section, you will be able to:

- ➊ explain what plate tectonic theory states;
- ➋ identify the major tectonic plates and their boundaries;
- ➌ draw a diagram to demonstrate the movement of plates;
- ➍ identify the major continental and oceanic plates; and
- ➎ explain how geological processes and plate boundaries affect human lives.

**KEY TERMS:** Plate tectonics, Plate boundary, Asthenosphere, Lithosphere



### Brainstorming Activity 1.2

1. What are the factors that contributed to the structural formation of the earth?
2. What are the main oceanic and continental plates?

Since Alfred Wegener's continental drift theory, geologists have developed a better picture of the Earth. According to plate tectonic theory, the layer, called the asthenosphere, allows the uppermost mantle and crust, together called the lithosphere to slide across the top of it. Earth's lithosphere is broken into about a dozen large pieces (plus some smaller ones), called plates (Figure 1.4). These plates move slowly at a rate of a few centimeters per year and change size. Plates may be entirely made up of continental rocks, both continental and oceanic rocks, or entirely of oceanic rocks.

Plate tectonics is a theory developed in the late 1960s to explain how the outer layers of the earth move and deform. The theory has caused a revolution in the way we think about the earth. Since the development of the plate tectonics theory, geologists have had to re-examine almost every aspect of Geology. The theory states that the earth's lithosphere is divided into plates that move around on the top of the asthenosphere. Continental crust is embodied within the lithospheric plate. The plates move in different directions, and meet each other at plate boundaries. Plate tectonics has been proven to be so useful that it can predict geologic events and explain almost all aspects of what we see on the earth.

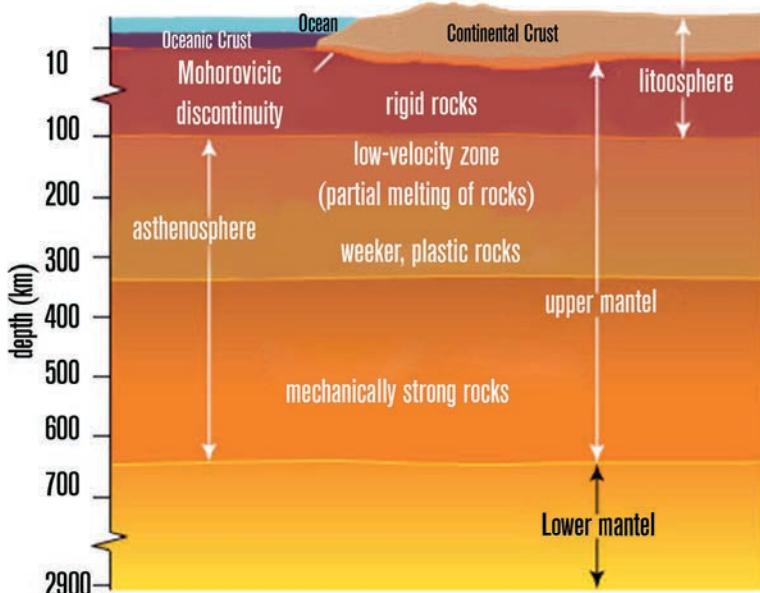


Figure 1.4: Lithosphere and Asthenosphere

Do you think the edge of African plate corresponds to the boundary of the continent? The edges of these plates do not necessarily correspond to the boundaries of continents or oceans. For example, the North American Plate includes the western half of the North Atlantic Ocean's seafloor. (Figure 1.5)

The plate tectonics theory is based on a broad synthesis of geologic and geophysical data. It is now universally accepted, and its adoption represents a true scientific revolution.

Plate tectonic process influences the composition of the atmosphere and oceans. It serves as a prime cause of long term climate change, and makes a significant contribution to the chemical and physical environment in which life evolves.

Today, science has shown that the surface of the Earth is in a constant state of change. We are able to observe and measure mountains rising and eroding, oceans expanding and shrinking, volcanoes erupting and earthquakes striking. Thus, this theory serves as the foundation upon which we understand the geologic processes that shape the Earth.

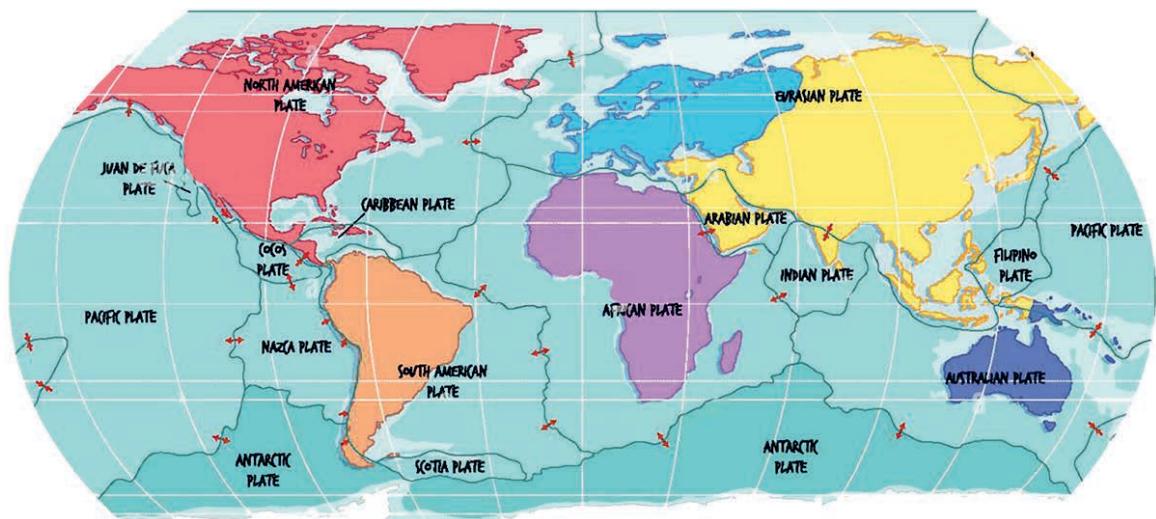


Figure 1.5: The Tectonic plates and their boundaries

The plate tectonics theory provides a framework for understanding many of Earth's features, such as mountains, earthquakes, and volcanoes, as well as the distribution of fossils and the ages of rocks.

### Reflective Activity 1.2



1. Discuss the main idea of plate tectonic theory.

### 1.3. PLATE MOVEMENTS AND PLATE BOUNDARIES

**KEY TERMS:** Convergent, Transform, Divergent, Conservative, Constructive

#### Brainstorming Activity 1.3



1. Which of the tectonic plates do you think are oceanic?
2. List down all the plates and group them as either continental or oceanic?

The way the plates interact at their margins depends on whether the crust forming the top of the plate (at the point of contact) is oceanic or continental. Continental crust, made largely of granite, is less dense than oceanic crust made largely of basalt.

As the plates move, they may:

1. Converge, or come together; forming convergent (Destructive) boundary;
2. Diverge, or spread apart; forming divergent (Constructive) boundary or
3. Slide past each other along fractures called transform (Conservative) boundary.

#### Convergent plate boundaries

These are boundaries where two plates move toward each other. At such boundaries, the denser plate will be forced under, or subducted beneath, the less dense one. The subducted crust is eventually destroyed. This happens when oceanic crust meets continental crust and when oceanic crust meets another oceanic crust. For example, the eastward-moving Nazca Plate, under the southeastern Pacific Ocean, is being subducted under the westward moving South American Plate. The denser oceanic crust is pushed down into the mantle, causing it to melt and produce magma (molten rock). The magma and gases rise to the surface, and are vented through the western crust of South America, forming the volcanoes of the Andes Mountains.

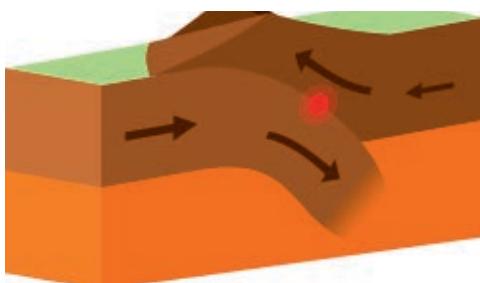


Figure 1.6: Convergence of plate boundary

If two oceanic plates converge, subduction of one under the other may produce an arc of volcanic islands. The Mariana Islands of the western Pacific Ocean were formed this way.

Two blocks of continental crust may converge as well. The resulting pressure can deform the crust. If one block is denser, that block may slide under the other, mainly lifting the other plate rather than sinking too much itself. A good example of this is the convergence of the northward moving Indo-Australian Plate with the Eurasian Plate. Thus, as India met Asia, the collision produced the highest mountain range on Earth: the Himalayas.

### Divergent plate boundary

This occurs where plates move away from each other at oceanic ridges, such as in the middle of the Atlantic Ocean. There, rising magma from underlying asthenosphere intrude and erupt beneath and at oceanic ridge to create a new seafloor. This pushes the plates on either side away from each other in opposite directions.

Undersea volcanoes and crust expanded by heating have produced a long undersea ridge, but with a rift in the middle where the plates are separating. This process is known as seafloor spreading. Shallow earthquakes are common at oceanic ridges.

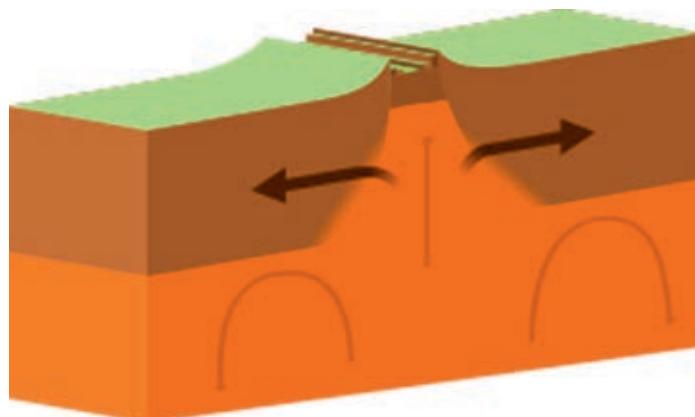


Figure 1.7: Diverging Plates

Divergence can also happen on continents, producing fractures called rift valleys. A modern example is the East African Rift Valley. Over millions of years, the continental crust may separate completely, with the area between flooding with water to become a new ocean.

### Transform Fault boundaries

In some places, plates slide past each other laterally along fractures in the crust. These places are called transform faults. The plates stick and then occasionally slip, producing earthquakes.

Most transform faults are found on the seafloor along the undersea mountain chains called oceanic ridges, but the faults also occur on continents, such as the San Andreas Fault in California.(Figure 1.8). As plates move past each other along transform faults, crust is neither destroyed nor created.

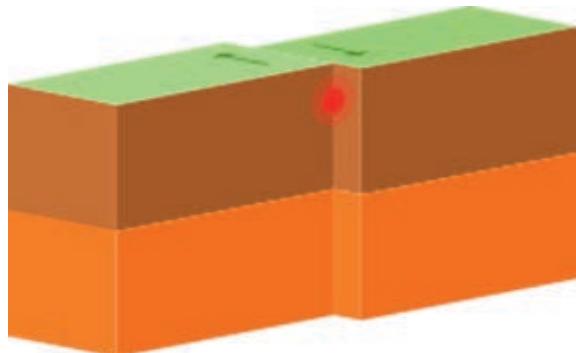
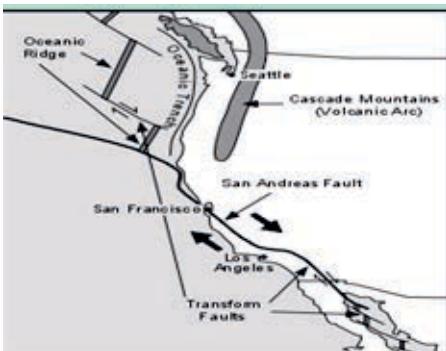


Figure 1.8: Transform Fault

Plate tectonics is driven by the internal energy of the Earth. Although there is some debate among geoscientists as to the exact mechanism, most agree that motion of the plates is ultimately driven by convection currents in the mantle.

Recall that convection is a means of heat transfer wherein the heat moves with the material. It occurs when conduction is inefficient at transporting heat, particularly if the material has a low thermal conductivity, like rocks.

Recall also that the Earth's asthenosphere is ductile, and therefore is likely to flow more readily (it will bend or deform if you apply enough force to it) than the overlying lithosphere.

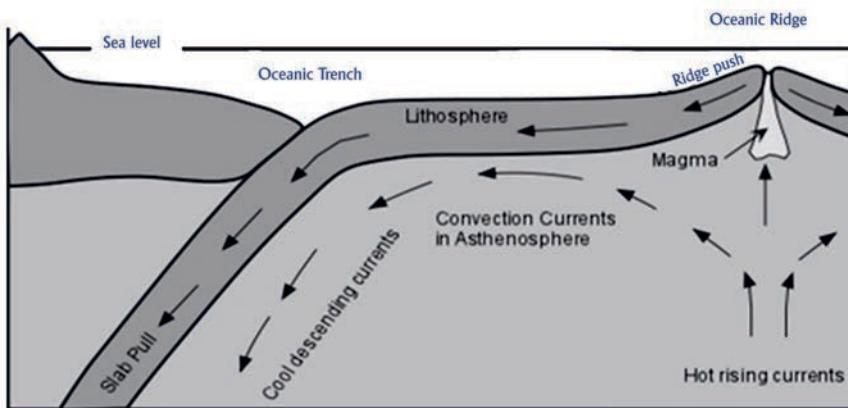


Figure 1.9: Convection currents in the Asthenosphere

Thus, if the asthenosphere moves by convection with the rising currents carrying heat towards the surface at the oceanic ridges, and descending currents sinking at subduction zones after losing heat to the surface, the brittle plates riding on top of the convection cell will be forced to move over the surface, being in a sense, dragged along by the moving asthenosphere.

### Reflective Activity 1.3



1. Discuss the three types of plate boundaries.

## 1.4. MAJOR GEOLOGICAL PROCESSES

**KEY TERMS:** Folding, Faulting, Anticline, Syncline, Vents, Fissures, Craters, Tsunamis

At the end of this section, you will be able to:

- distinguish between endogenic and exogenic forces of the earth;
- explain processes like folding and faulting and their effect on the earth surface;
- draw a map to locate the major young fold mountains of the world;
- draw a diagram to show the formation of horst mountains and rift valleys;
- describe and locate a ring of fire and the countries found around this zone; and
- examine the way in which the various internal and external forces affect the present land surface.

### Brainstorming Activity 1.4



1. How would you define a geological process?
2. What is the difference between endogenic and exogenic forces?
3. Give some examples of endogenic and exogenic forces.
4. What is the difference between folding and faulting?

The Earth is a dynamic planet. Geological processes occur constantly, some of them going on invisible for us; while others causing a great damage. The term "geological processes" describes the natural forces that shape the physical makeup of our planet earth. Plate tectonics, erosion, chemical weathering and sedimentation are all examples of forces that significantly affect the Earth's surface and account for its major features.

The geological processes are closely studied by geologists and earth scientists to:

- ▲ Improve the understanding of the planet's history;
- ▲ Help to locate useful resources, such as metal ores; and
- ▲ Aid the prediction of potentially disastrous events, such as earthquakes, tsunamis and volcanic eruptions.

Some of the geological processes bring about changes on the surface of the earth. The forces that bring about changes on the earth's surface are divided into two. They are:

- 1. Endogenic forces**
- 2. Exogenic forces.**

The forces which derive their strength from the earth's exterior or originate within the earth's atmosphere are called exogenic forces or external forces. The endogenic forces, also called internal forces, are used to describe pressure that originates inside the earth.

#### **1.4.1. INTERNAL (ENDOGENIC) FORCES**

When you go from your home to your school or another area, you find a lot of ups and downs. Have you ever thought as to how these landforms were formed? What are the factors which are responsible for their formation?

Internal forces are forces that come from the inside of the earth. These forces create irregularities or unevenness on the face of the earth. They form ups and downs on the crust of the earth by breaking, bending, or folding the rock. Let us briefly examine some of them: folding, faulting, earthquakes and volcanic eruptions.

#### **FOLDING**

Folding occurs when rock layers are pushed by earth movements sideways. The movement may be only from one direction. It may also be from two directions. When rock layers are pushed from two directions, they are compressed. The rock layers are folded (Figure 1.10). The layers of rock bend up from an upfold or anticline. Those which bend down form a downward arch or syncline.

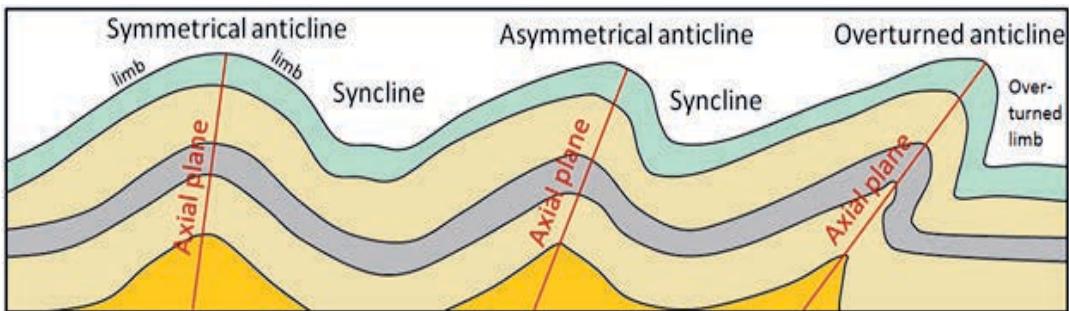


Figure 1.10: Anticline, syncline

If compression continues then simple folds are changed into asymmetrical folds, over folds and over thrust folds. (Figure 1.10)

**Asymmetrical fold:** one limb is steeper than the other.

**Over fold:** One limb is pushed over the other limb.

**Over thrust fold:** When pressure is very great, a fracture occurs in the fold and one limb is pushed forward over the other limb.

### Types of Fold Mountains

The Fold Mountains of the world are grouped into two: They are:

1. Young fold mountains
2. Old fold mountains

### How can we classify Fold Mountains into categories?

During the last 400 million years, there have been three main mountain-building periods. These periods experienced mountain-building processes known as orogenesis. Fold mountains formed during the first and second mountain-building periods are known as old fold mountains. The last and the recent is known as Alpine orogeny. Mountains belonging to this period include the Andes, Rockies, Alps, Himalayas, Atlas and Australian Alps. They are called young fold mountains. The old fold mountains are the oldest, dating back 250 to 300 million years, and they are characterized by lower heights and more weathered. Scandinavian (Calidonian) Mountains, Appalachian Mountains, and the Urals are some examples of old fold mountains.

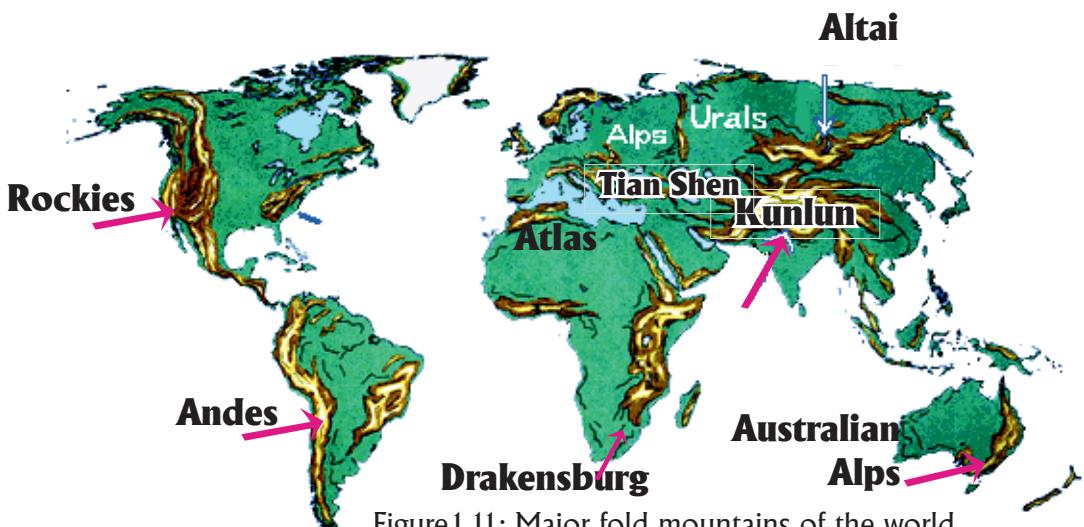


Figure 1.11: Major fold mountains of the world

## FAULTING

What is the difference between folding and faulting? Where are the susceptible areas of folding and faulting in the world?

A fault is a crack on the earth's crust. It is formed by the forces of tension and compression. A fault may occur in the rocks along a single line. When this happens, rocks are displaced either upward or downward.

Usually a series of faults could develop on the surface of the earth. These faults may be roughly parallel to each other. Where parallel faults have occurred, the land in between may sink down or may be forced to move upwards. These movements of the earth will result in the formation of the following landforms:

1. Rift valleys
  2. Block mountains

**Rift valleys:** They are formed when the land between two faults sinks down. The blocks on both sides of the valley form plateaus. For example the East African Rift Valley.

**Block Mountains:** They are formed when the land between two parallel faults is pushed upward. A block mountain is called horst. For example: the Afar Horst. (see Figure 1.12).

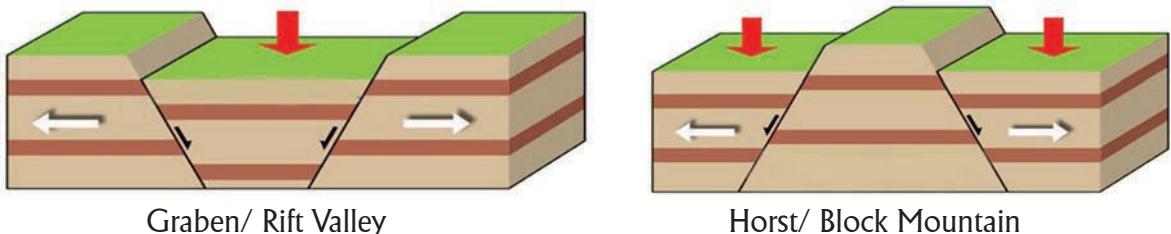


Figure 1.12: Rift valley and Block Mountain

## EARTHQUAKES

The sudden shaking of the ground that occurs when masses of rock change position below Earth's surface is called an earthquake. The shifting of the rock releases a great amount of energy, sending out shock waves that travel through the rock, and cause the ground to shake. These shock waves, called seismic waves by Earth scientists, may be powerful enough to alter the surface, thrusting up cliffs and opening great cracks in the ground. Earthquakes occur most often along geologic faults, which are fractures in the rocks of Earth's crust. Along faults, the rock masses on opposite sides of the fracture strain against each other and sometimes "slip," causing an earthquake.

The major fault lines of the world are located at the fringes of the huge tectonic plates that make up the crust. Earthquakes, called temblors by scientists, occur almost continuously. Fortunately, most of them can be detected only by sensitive instruments called seismographs. A scale is used for reading it. It is called a Richter scale. It gives reading from 0 (no movement) to 9 (extremely severe). The Richter scale measures the effect in a logarithmic scale. The effects of an earthquake increases significantly for each step up the scale. (Figure 1.13).

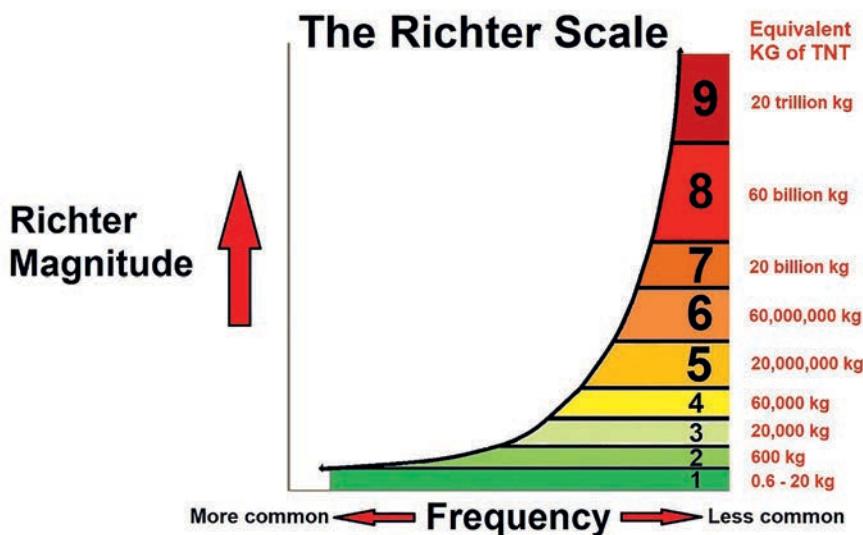


Figure 1.13: Richter scale

(The kilogram of Trinitrotoluene (TNT) is a unit of energy equal to 4.184 megajoules, which is approximately the amount of energy released in the detonation of one kilogram of TNT.)

## Causes of Earthquakes

Most of the worst earthquakes are associated with changes in the shape of Earth's outermost shell, particularly the crust. These earthquakes are generated by the rapid release of strain energy that is stored within the rocks of the crust. The strongest and the most destructive quakes are associated with ruptures of the crust, which are known as faults. Although faults are present in most regions of the world, earthquakes are not associated with all of them.

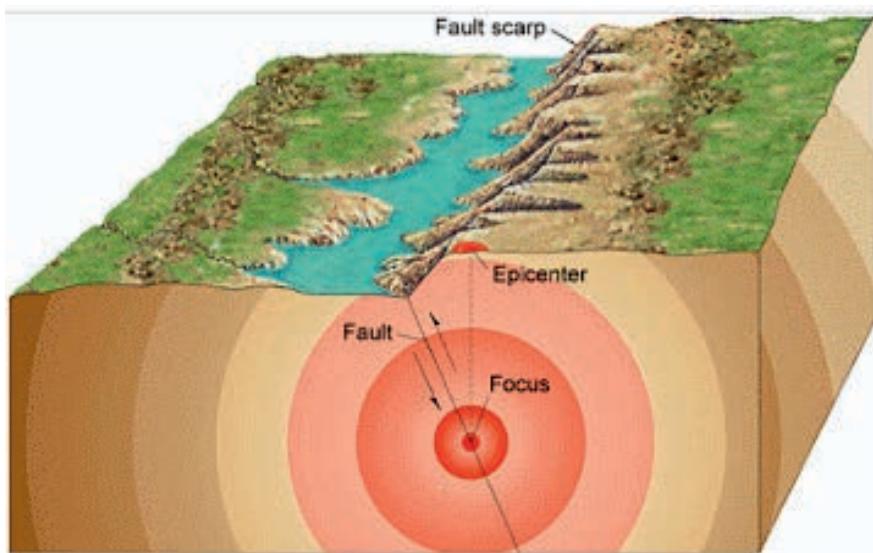
## Shock Waves

The shifting rock in an earthquake causes shock waves called seismic waves to spread through the rock in all directions. In a great earthquake, shocks may be felt by people thousands of miles or kilometers away from the center. Seismographs can pick up the waves on the other side of the world. There are two broad classes of seismic waves:

### Body waves and surface waves.

Body waves travel within the body of the Earth. They include **P, or primary waves** and **S, or secondary waves**. P waves spread in the crust from the point of rupture, which is called the focus of the earthquake. The point of which the wave originates is what we call the Earthquake focus. The point on the Earth's surface immediately above the focus is termed the epicenter of an earthquake. P waves alternately compress and expand the rock through which they pass, and vibrate in the same direction in which the waves travel.

**S waves** vibrate at right angles to the direction of wave travel. These secondary waves are the location of an earthquake many thousands of miles away. After both P and S waves have moved through the body of the Earth, they are followed by two types of surface waves, which travel along the Earth's surface. These are named Love and Rayleigh waves, after the scientists who identified them. Because of their larger amplitude, surface waves are responsible for much of the destructive shaking that occurs far from the epicenter. Surface waves, which travel more slowly than body waves, are the most powerful shake waves.



1.14 Focus and Epicenter of an Earthquake

## Effects of Earthquakes

Earthquakes often cause dramatic changes at the Earth's surface. In addition to the ground movements, other surface effects include changes in the flow of groundwater, landslides, and mudflows. Earthquakes can do significant damage to buildings, bridges, pipelines, railways, embankments, dams, and other structures.

Earthquakes can lead to devastating fires. Fire produced the greatest property loss following the 1906 San Francisco earthquake, when 521 blocks in the city center burned uncontrollably for three days. Fire also followed the 1923 Tokyo earthquake, causing much damage and hardship for the citizens.

Underwater earthquakes can cause giant waves called tsunamis (Figure 1.15). Violent shaking of the seafloor produces waves that spread over the ocean surface in ever-widening circles. In deep water a tsunami can travel as fast as 800 kilometers per hour. By the time a tsunami reaches shore, it has gained tremendous size and power, reaching heights as great as 30 meters. Tsunamis can be catastrophic, with the potential to wipe out coastal settlements.



Figure 1.15: Tsunamis, effects of the earthquake

## Occurrence

Most earthquakes take place on one of the two great earthquake belts that girdle the world. The belts coincide with the more recently formed mountain ranges and with belts of volcanic activity.

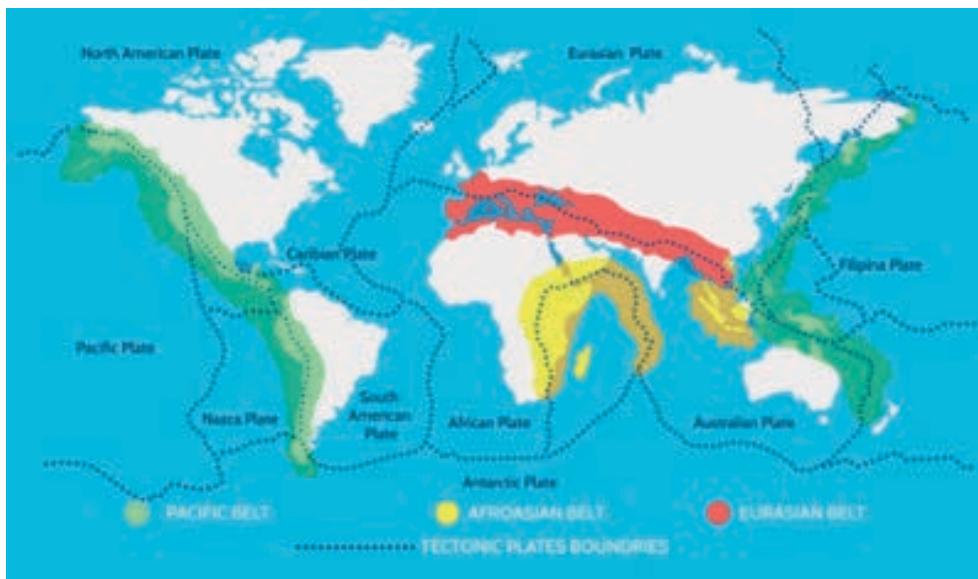


Figure 1.16: The belts of Most earthquakes take place

1. earthquake belt circles the Pacific Ocean along the mountainous west coasts of North and South America and runs through the island areas of Asia. It is estimated that 80 percent of the energy released in earthquakes comes from this belt, which is called the Circum-Pacific Belt or the Ring of Fire (Figure 1.16).
2. less active belt passes between Europe and North Africa through the Mediterranean region. It then runs eastward through Asia and joins the Ring of Fire in the East Indies. The energy released in earthquakes in this belt is about 15 percent of the world total.
3. There are also remarkably connected belts of seismic activity, mainly along mid oceanic ridges including those in the Arctic Ocean, the Atlantic Ocean, and the western Indian Ocean and along the Great Rift Valley of East Africa.

The focus of an earthquake may occur from quite close to the surface down to a maximum depth of about 700 kilometers. More than 75 percent of the seismic energy produced each year, however, is released by shallow focus earthquakes, that is, quakes with foci less than about 60 kilometers deep. Most parts of the world experience at least occasional shallow-focus earthquakes.

About 12 percent of the total energy released in earthquakes comes from intermediate earthquakes, those with foci ranging from about 60 to 300 kilometers deep.

About 3 percent of the total energy comes from deeper earthquakes. The deeper focus earthquakes commonly occur in Benioff zones, which dip down into the mantle at places where two tectonic plates converge (Figure 1.17). A Benioff zone extends down along the plate that is being subducted.

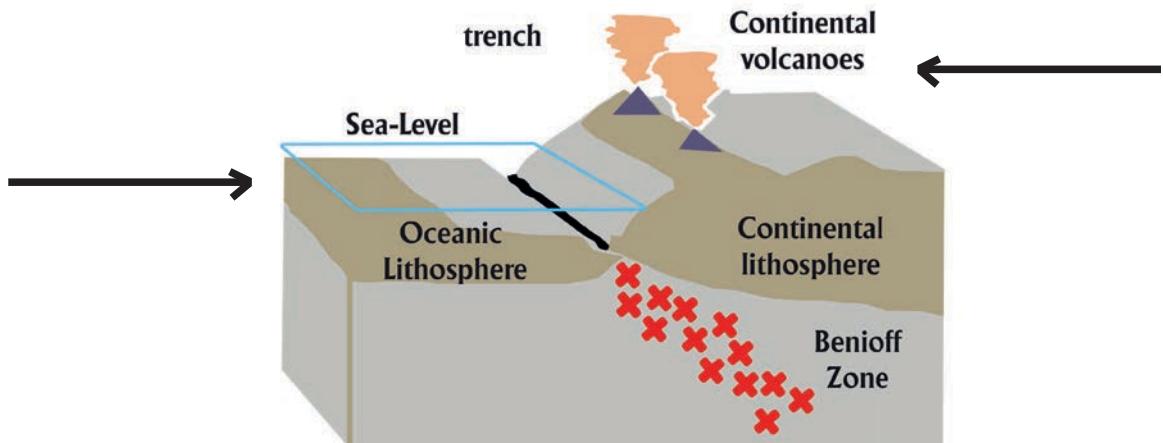


Figure 1.17 Benioff Zone along subducted plate

### **Volcanism:**

Volcanism is the process by which molten rock or magma, together with gaseous and solid materials is forced out on the surface of the earth. This movement could be very slow or sudden. With slow movement, the materials could spread over the surrounding area gently. If the movement is violent, the materials will be thrown high into the sky and then fall back in the surface of the earth. Magma may reach the surface of the earth through two types of openings:

1. Vents and 2. Fissures

Vents are holes or openings like a pipe throw which magma flows out into the surface of the earth. If lava emerges via vent, it builds up a volcano (a cone shaped mound).

Fissures are large and narrow cracks or fractures in a rock. Molten materials may move upward along the cracks and spread out over the surroundings. If the lava emerges via a fissure, it builds up a plateau. During the formation of lava plateau, there is little or no explosive activity through the fissures; lava gently spreads over large area.

### **Volcanoes**

The word volcano refers to the form or structure, usually conical, produced by accumulations of erupted material. In some volcanic eruptions, the molten rock called magma when it is underground and lava when it reaches the surface, flows slowly out of the vent.

### **Occurrence**

Volcanoes occur mainly near the boundaries of tectonic plates. They form along belts of tension, where plates diverge, and along belts of compression, where plates converge. Nearly 1,900 volcanoes are active today or are known to have been active in historical times. Of these, almost 90 percent are situated in the Pacific Ring of Fire (Figure .18).

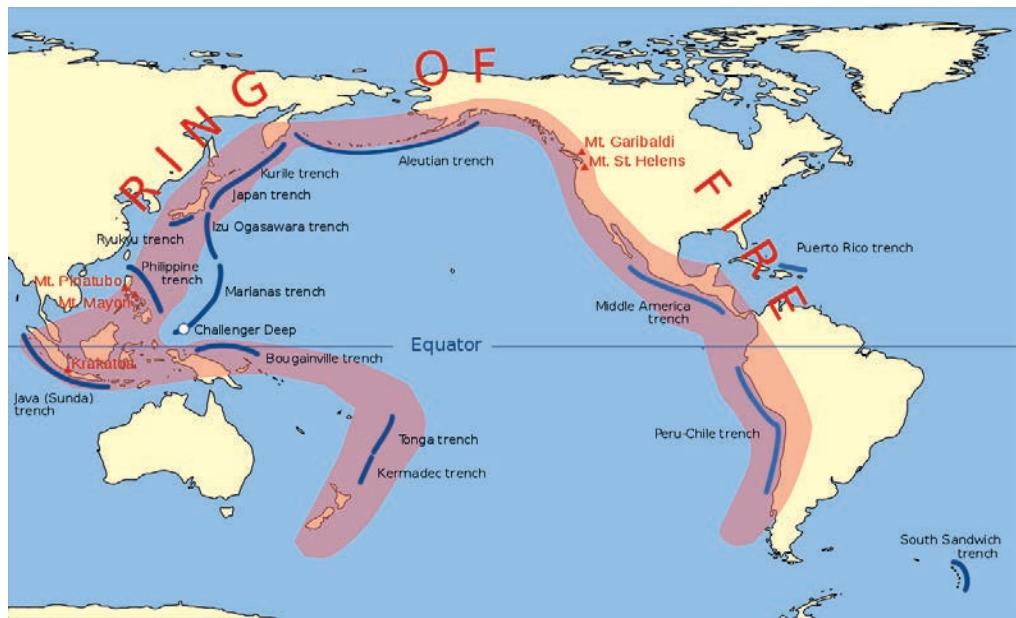


Figure 1.18: Pacific Ring of Fire

The Mediterranean-Asian belt, which accounts for most of the world's earthquakes outside the Ring of Fire, has few volcanoes except the Indonesia and Mediterranean which have more numerous ones.

Oceanic volcanoes are strung along the world's oceanic ridges, while the remaining active volcanoes are associated with the Great Rift Valley of East Africa.

Volcanic activity typically alternates between short active periods and much longer dormant periods.

1. An extinct volcano is one that is not erupting, and is not likely to erupt in the future. Example, Mount Zuqualla, Ethiopia.
2. A dormant volcano is currently inactive but has erupted within historic times, and is likely to do so in the future. Example: Mount Kilimanjaro, Tanzania
3. An active volcano is one that has erupted or thought to have erupted during the last 500 years. Example: Erta Ale, Ethiopia.

Volcanoes are usually classified by shape and size. These are determined by such factors as the volume and type of volcanic material ejected, the sequence and variety of eruptions, and the environment. Among the most common types are

1. Shield volcanoes,
2. Strato volcanoes
3. Cinder cones.
4. Craters, and
5. Calderas

**Shield volcanoes** are volcanoes that have a low, but broad profile created by highly fluid lava flows that spread over wide areas. The lava, usually composed of basalt, cannot build up a cone with sides much steeper than 7 degrees (Figure 1.19). The Hawaiian Islands are composed of shield volcanoes that have built up from the seafloor to the surface some 5 kilometers above.

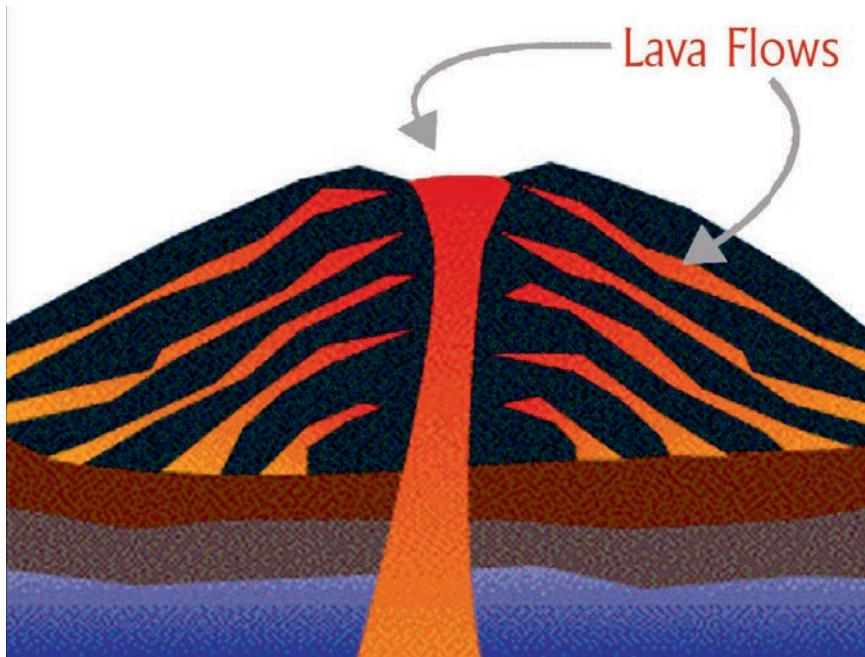


Figure 1.19: Shield volcano

**Strato volcanoes** are the most common volcanic form. They are steep cones composed of alternating layers of lava and pyroclastics, or rock fragments. These volcanoes are characterized by a steep profile and periodic, explosive eruptions (Figure 1.20). The lava that flows from them is highly viscous, and cools and hardens before spreading very far.

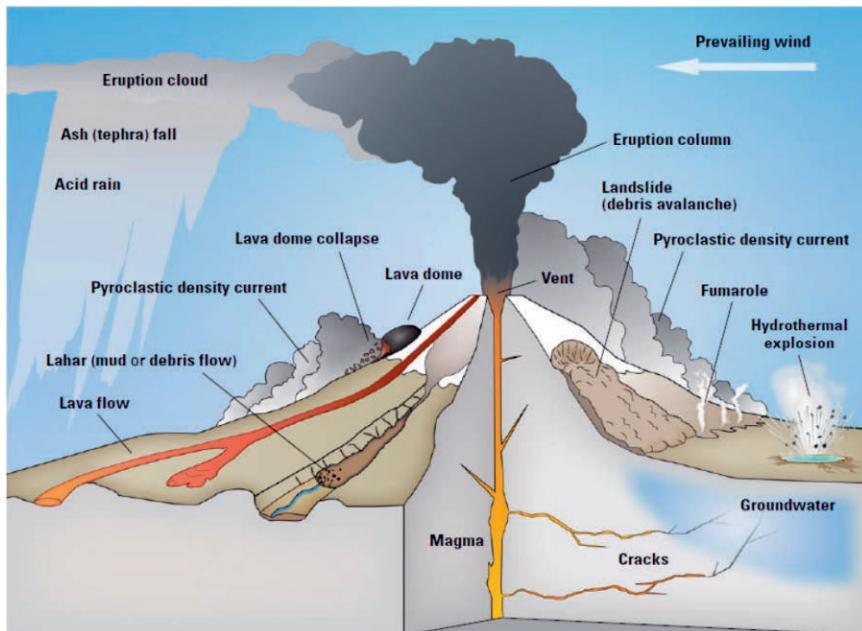


Figure 1.20: Strato volcanoes

Cinder cone volcano is a conical hill of mostly cinder-sized pyroclastics. The profile of the cone is determined by the angle of repose, that is, the steepest angle at which debris remains stable and does not slide downhill (Figure 1.21).

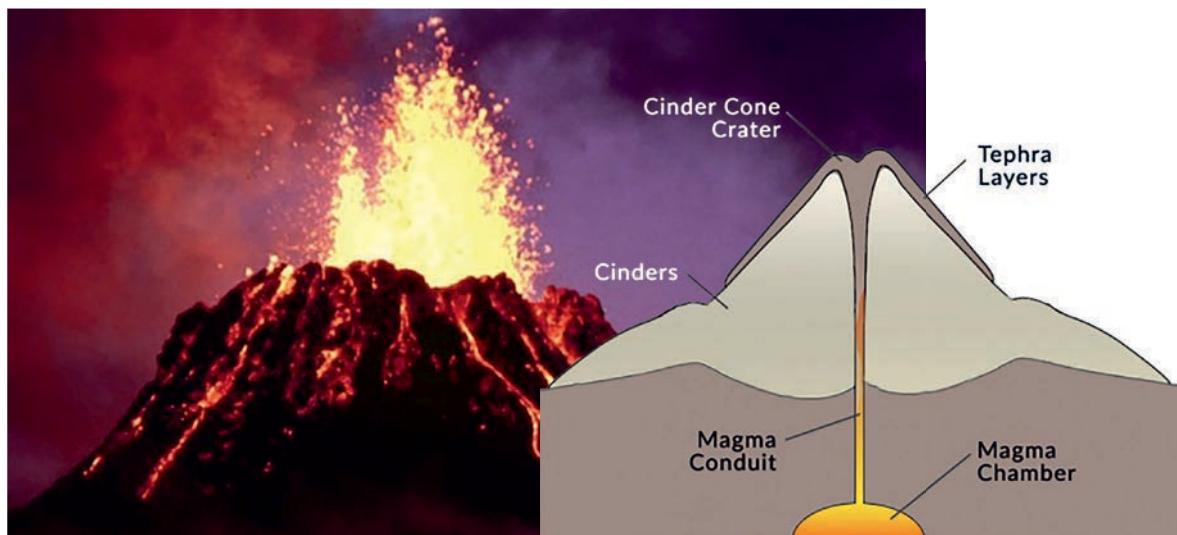


Figure 1.21: Cinder cone volcano

Other landforms created by volcanoes include craters and calderas.

**Craters** are formed either by the massive collapse of material during volcanic activity, by unusually violent explosions, or later by erosion during dormancy. (Figure 1.22).

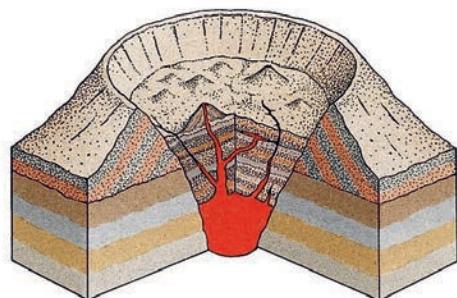


Figure 1.22: Crater volcano

Calderas are large, basin-shaped depressions. Most of them are formed after a magma chamber drains and no longer supports the overlying cone, which then collapses inward to create the basin (Figure 1.23).



Figure 1.23: Calderas; Segara Anakan Crater Lake, Rinjani Mt., Indonesia

When magma cools and solidifies within the crust intrusive or plutonic igneous rocks are formed deep beneath the Earth's surface. Thus, intrusive land forms are the results of part of the magma that solidifies within the crust: Some of the intrusive igneous rocks include batholith, dyke, and sill (Figure 1.24).

**Batholith** is a very large dome shaped intrusion of igneous rock. It is located several kilometers deep in the crust, and extends over hundreds of square kilometers. Sometimes, it forms the core of a mountain.

**Sill** is a near horizontal intrusion of igneous rock between two rock layers. The cooled rock forms a sheet of more or less parallel to the surrounding layers of rocks.

**Dike** is formed as the magma rises up through a near vertical crack. As the magma cools, it forms a vertical sheet of rock or a wall like structure.

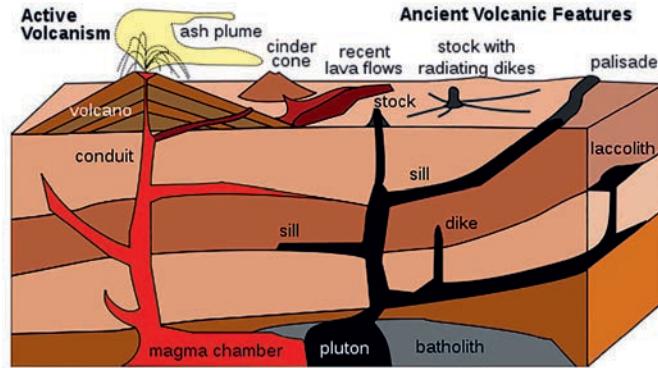


Figure 1.24: Batholith, Sill and Dike

## Volcanic eruptions

Styles of eruption and types of lava are associated with different kinds of plate boundaries. Most lava that comes from vents in oceanic divergence zones and from mid oceanic volcanoes are basaltic. Where ocean plates collide, the rock types basalt and andesite predominate. Near the zone where an ocean plate and a continental plate converge, consolidated ash flows are found. The eruption of Krakatoa (1883) unleashed a tsunami, a large seismic sea wave that swept the coasts of Java and Sumatra and drowned more than 36,000 people.

### 1.4.2. EXTERNAL (EXOGENIC) FORCES

#### Brainstorming Activity 1.5



1. What are the defining characteristics or features of external forces affecting the earth's surface?
2. Can you mention instances of this force and discuss in pair please?

They are forces that act on the surface of the earth from the outside. These forces/agents include running water, wind, moving ice, sea waves, etc. Usually external forces level the up and down of the earth. This process occurs in two ways: 1. Denudation and 2. Deposition

Denudation is the lowering of the land by wearing away the surface of the earth.

Denudation consists of i). Weathering and ii). Erosion

## WEATHERING

Weathering refers to the gradual break down of rocks into pieces. These rocks lie on the surface of the earth. How do rocks break down into small fragments?

Weathering of rocks takes place in two ways. They are:

1. Physical (Mechanical) weathering
2. Chemical weathering

**i. Physical weathering** is the process by which rocks are broken into smaller pieces. Each fragment has similar chemical characteristics like the original. There are three important physical processes that cause rocks to break down into pieces.

They are:

- i). Thermal expansion and contraction
- ii). Frost action
- iii). Plant and animal action

**Thermal expansion and contraction:** In hot and dry areas, temperature brings change on the surface of the rocks. In such areas, at daytime, rocks are heated greatly. This causes the surface layers of rocks to expand. At night temperature becomes low. The same layer which has expanded at daytime contracts at night. Due to this contraction and expansion process, the rock layers peel off and fall to the ground. It is just like peeling an onion. The process of breaking rock layers caused by changes of temperature is called exfoliation (Figure 1.25).



Figure 1.25: Exfoliation

**Frost action:** When water freezes, its volume increases. If water in the cracks of rocks freezes, it expands and pushes the sides of the cracks. Then the cracks widen and deepen.

Frost action is very common in the cooler areas of the world. Due to frost action rocks break up into pieces. Then, the fragments collect around the lower slopes of the rocky outcrops. Such rock collections are called scree.

**Plants and animals action:** The roots of some plants, especially trees, enter the cracks of rocks. When the roots continue to grow, they need more space. Then, they force the cracks and widen them. This leads to the breaking down of the rock. Creatures such as worms, rabbits, moles, make holes in the ground to find food and shelter. While doing this, they break up rocks.

**2. Chemical weathering:** This involves complete changes in the internal structure of rocks. How does the structure of rock change permanently? Chemical weathering can occur because of:

- i. Rain action
- ii. Plants and animals

## Rain action

Water is the most important agent of chemical weathering. This is not true for pure water. But rain water dissolves oxygen and carbon dioxide as it falls through the atmosphere. Therefore, such water is not pure. Some minerals like iron will rust when they become in contact with rainwater that has dissolved oxygen from the atmosphere. Rusting makes iron weak and breakable. Minerals that have carbonates are dissolved when they come in contact with rainwater that has carbonic acid. Limestone is one example.

**Solution** - removal of rock in solution by acidic rainwater. In particular, limestone is weathered by rainwater containing dissolved CO<sub>2</sub>, (this process is sometimes called carbonation). **Hydrolysis** - the breakdown of rock by acidic water to produce clay and soluble salts.

Chemical weathering is most active in limestone. When water flows between layers of limestone, it dissolves and erodes parts of the rock and forms holes. These holes become larger and wider as they continue to be eroded. Finally, very large underground water holes called caves are formed. Rivers that pass through limestone areas often flows underground through caves, e.g. Weyb river in Bale or Sof Omar (Figure 1.26).

In underground cave, water passes slowly through the roof of the cave. Thus, a drop of water (now a solution) hangs to the ceiling of the cave. When the drop of water falls, small amounts of the solution is left as a deposit on the ceiling. After a long time, these small deposits build up to form a limestone column that hangs down from the ceiling. This is known as stalactite. The water drops that falls from the ceiling form small deposits on the floor. These deposits slowly build upward and form other limestone columns from the floor. We call these stalagmites. After a long time, a stalactite hanging down from the ceiling may join with a stalagmite growing upward to form a pillar. Thus, the ceiling and the floor of the cave are connected by such pillars (Figure 1.26).



Figure 1.26: Stalagmites and stalactites in Sof Omar Cave in Ethiopia

How do animals and plants act as agents of chemical weathering?

Bacteria in the presence of water break down certain minerals in the soil. Plants also absorb minerals. Moreover, decaying vegetation produces organic acid which causes a further break down of minerals. All these actions help to weaken and breakup the rocks.

## EROSION AND DEPOSITION

Soil erosion is the movement of soil and rock particles from one place to another. The major agents of erosion include:

- ▲ Running water
- ▲ Underground water
- ▲ Wind
- ▲ Sea waves
- ▲ Glaciers

### **Running water erosion:**

Running water includes all sorts of water that flows on the surface of the earth. Among the external forces, running water is more powerful in shaping the surface of the earth. The ability of running water to erode and transport materials is directly related to its speed. Running water flowing along a steep slope is very powerful. Therefore, it can wear and tear the land surface strongly. As a result, large amount of rock materials are removed from the slope and then transported elsewhere. On the other hand, the rate of erosion by running water also depends on vegetation cover. Areas that have rich vegetation cover are less affected by erosion.

Running water results in different types of landforms (Figure 1.27). Some of them are the following:

**Landform associated with runoff:** they occur by the erosion activity of surface water moving down a slope or across a field. This type of erosion includes:

**Sheet erosion:** It occurs when surface water moves in a wide flow. This moving water erodes top soil evenly. This type of erosion may not be noticeable until much damage has been done.

**Rill erosion:** It occurs when surface water cuts small channels or ditches in the soil.

**Gully erosion:** This happens when floods join together and cut the ditches wider and deeper. Gully erosion can become severe where all or most of the vegetation has been removed.



Figure 1.27: Landforms associated with running water: Sheet, Rill and Gully erosion, respectively from left to right.

**Landform associated with a river course:** various types of landforms are formed along the course of rivers. These landforms grouped as follow:

**Landforms associated with the upper course of a river:** In its upper course, a river is swift and strong. And therefore, it cuts a deep gorge or canyon.

**Landform associated with a middle course of river:** In this part, the river valley becomes wider and larger. The volume of water increases because of the many tributaries that join the main river. The place where a tributary joins the main river is called confluence.

**Landform associated with the lower course of a river:** In its lower course, a river flows slowly. It has a wide and flat-floored valley. Due to the slow movement of the river, most material carried in suspension are deposited. These materials do form different features along the course of the river.

#### Types of upper course landforms

**V-shaped valley:** They are narrow and steep-sided valleys in the upper course of a river. They have the shape of the letter "V".

**Gorge:** It is a valley that is deep and narrow with steep walls. The rock walls are nearly vertical.

**Waterfalls:** They are formed when a river flows over a hard rock which cannot be eroded. The soft rock is eroded fast. Thus, the hard rock will remain hanging over which water flows (Figure 1.28).

**Interlocking spurs:** fingers of land that jut out in to the river valley that stream and rivers are forced to flow around in the upper course. **Rapids:** fast turbulent section of the river where the bed has relatively steep gradient **Waterfalls:** commonly form where water rushes down steep hillside in the upland areas.



Figure 1.28: Landforms associated with the upper course of a river, V-shaped valley, gorge, Interlocking spurs, Rapids and Waterfalls

## Types of middle course landforms

**Meanders:** It is the winding of a river. The river makes zigzag movements (Figure 1.29). The river erodes its way against soft rocks than hard rocks. Whenever the river comes against hard rocks, it is forced to change direction.

**Ox-bow Lake:** It is a crescent-shaped lake occupying a cut-off channel that has been abandoned. It is bent like the shape of the letter 'U' (Figure 1.29).



Figure 1.29: Landforms associated with a middle course of river, Meanders and Ox-bow Lake, respectively from the left to the right

## Types of lower course landforms

**Flood plain:** It is a land surface formed from sediments deposited along the banks of the lower course of a river (Figure 1.30). Flood plain is therefore, a low-lying flat plain along the lower course of a river.

**Delta:** It is a triangular piece of land found at the mouth of a river (Figure 1.30). The name originated from the Greek letter delta.



Figure 1.30 : Landforms associated with the lower course of a river; Flood plain & Delta, respectively from the left to the right.

**Wind action:** It is very powerful in desert and semi-desert areas. Because of the work of wind, different features are formed in these areas. The most common features include:

Sand dunes are little hills of sand (Figure 1.31) formed when sand collects around obstacles, such as rock or bits of vegetation. Barkhan is a hill with the shape of crescent moon or quarter moon. Loess deposits are fertile soils in deserts deposited by wind. There are large loess deposits in North China.

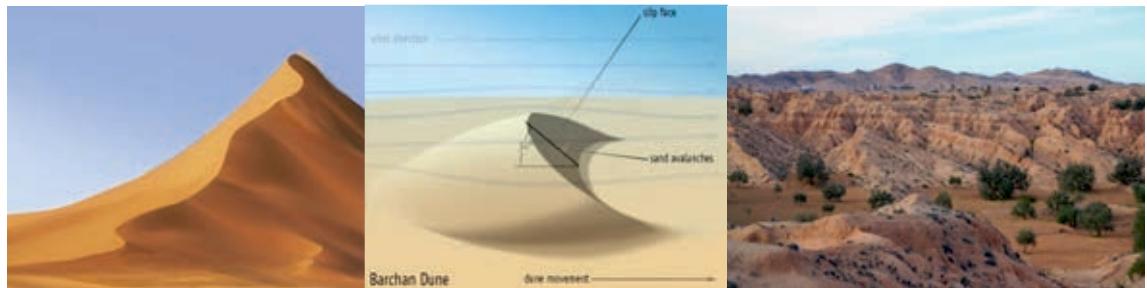


Figure 1.31: Wind action; Sand dunes, Barkhan, Loess de-

**The work of the sea:** the sea water performs both erosion and deposition activities. The most important features formed along the coastlands include:

**Beach** is strip of land along the sea coast covered by varied types of sediments (Figure 1.32).

**Spit** is a low-lying, narrow deposits of sand or silt attached at one end to the land moving deep into the sea in the other end (Figure 1.31).

**Lagoon** is an area of salt water separated from the sea by loose sand banks (Figure 1.31).



Figure 1.32: The work of the sea beach, spit, lagoon left to right

### Mass wasting:

Mass Wasting refers to the down slope movements of rock, regolith, and soil under the influence of gravity. Actual gravity is the controlling factor for mass wasting. There are also other factors. The major ones are:

- Water;
- The angle of the slope, and
- The activities of people.

How do water and the angle of slope cause mass wasting? Let us examine them briefly.

Water: We know that a portion of rain water that falls on land soaks into the ground. Part of the soaked water collects into pores of the sediments. Such water could reduce the cohesion among the particles which results in lack of internal resistance. Subsequently, the materials are set in motion by the force of gravity.

**The Angle of the Slope:** The steepest slope at which materials remain firm varies from 25 to 40 degrees. This depends on the size and shape of the particles. For example, the larger and more angular particles maintain the steepest slopes. If the angle is increased, the rock debris will adjust by moving down slope.

**Activities of people:** People often create favorable conditions for mass wasting along steep and unstable slopes. This happens due to farming and overgrazing of the areas. In different parts of Ethiopia, mass wasting occurred several times. This phenomenon resulted in the destruction of human life and properties.

#### Reflective Activity 1.4



1. What are the resultant effects of the endogenic process of the earth?
2. Discuss the main types of land forms along the course of the river.

## UNIT SUMMARY

The continental drift theory suggests that the present continents were formed from a single continent called PANGAEA.

The breaking of Pangaea was the result of tectonic forces.

Plate tectonics refers to the study of the movements of plates and land forms.

The movements include divergent, convergent, and transform movements.

Movement of continents is understood in line with continental drift theory.

The causes of earth movements include convection current and isostatic movements.

The surface of the earth is changed by internal and external forces.

Plate tectonic process profoundly influences the composition of the atmosphere and oceans, serving as a prime cause of long term climate change, and makes significant contribution to the chemical and physical environment in which life evolves.

Today, science has shown that the surface of the Earth is in a constant state of change.

Earthquakes often cause dramatic changes on the Earth's surface.

A volcano is a vent, or opening, in the Earth's surface through which molten rock, gases, and ash erupt.

Mass Wasting refers to the down slope movements of rock, regolith, and soil under the influence of gravity.

Denudation is the lowering of the land by wearing away the surface of the earth.

Soil erosion is the movement of soil and rock particles from one place to another.



## REVIEW QUESTIONS

### **I. Chooses the best answer for the following questions**

1. Which one of the following is part of the old Gondwanaland?  
A. North America    B. Asia    C. Europe    D. Australia
  
2. Which of the following was proposed by Alfred Wegener?  
A. Plate Tectonics    B. Continental Drift    C. Ocean floor spreading    D. All
  
3. What is the name of the huge sea that existed around Pangea?  
A. Atlantic Ocean    B. Tethys    C. Amazon    D. Antarctica    E. None
  
4. The sudden shaking of the ground that occurs when masses of rock changes its position below the Earth's surface is called:  
A. An earthquake    B. Volcano    C. Magma    D. None
  
5. Which of the features given below is associated with the work of wind action in different areas?  
A. Sand dunes    B. Barkhan    C. Loess deposits    D. All    E. None
  
6. A crack on the earth's crust formed by the forces of tension and compression is:  
A. A fault    B. A fold    C. Volcano    D. All
  
7. Instruments that can detect earthquake waves are called:  
A. Thermographs    B. Seismographs    C. Wind vane    D. None

### **II. Give Short answers to the following questions**

1. Explain the continental drift and plate tectonic theories.
2. Identify the major geological processes and explain associated land features.

# UNIT TWO

## CLIMATE CHANGE



### Learning Outcomes:

At the end of this unit, you will be able to:

- explain basic concepts of climate change;
- distinguish between natural and human induced climate change;
- analyze trends in climate change in Ethiopia and the world at large;
- recognize the major climate change mitigation and adaptation strategies;
- assess the major international conventions and agreements in views of their aspirations and achievements; and
- explain the purpose and Pillars of Climate Resilient Green Economy strategy of Ethiopia



### MAIN CONTENTS

- 2.1. Basic concepts of climate change
- 2.2. Trends in global climate change
- 2.3. Natural and human induced climate change
- 2.4. Consequences of climate change
- 2.5. Adaptation and mitigation strategies to climate change
- 2.6. International conventions and agreements on climate change
- 2.7. Pillars of Climate Resilient Green Economy of Ethiopia change
- Unit Summary
- Review Questions

### Introduction

In the previous grade level you learned about climatic classification and regions of the world, the factors that influences the world climate and indigenous climatic classification of Ethiopia. Climate change is one of the most significant environmental challenges facing humankind today.

Though there are several arguments over the concept of climate change, scientifically speaking, there is no doubt about the existence of global warming and climate change. It is now time to find out what actions will be taken at the political and social spheres to make our world more resilient and fight climate change. Geography has much to contribute to understanding of the complex spatial dimensions of climate change, including the observed and anticipated geographical differentiation in potential impacts and vulnerability. Therefore, this unit addresses about basic concepts of climate change such as global climate change, cause and consequences of climate change, adaptation and mitigation strategies, international conventions and agreements on climate change and finally the climate resilient green economy of Ethiopia

## 2.1. Basic Concepts of Climate Change

At the end of this section, you will be able to:

- define climate change; and
- conceptualize climate change.

**KEY TERMS:** Climate Change, Global warming, Greenhouse gases, IPCC, Carbon dioxide

Recall how climate differs from weather based on your experiences, for example, if you decided what clothes to buy for years, and what clothes to wear in a particular day; these explain climate and weather respectively. Climate refers to the conditions of the atmosphere in a certain place over many years. For example, the climate in Gondar is cold in the winter, and the climate in Gambella is warm and humid all year long. The climate in one area, like the Horn of Africa, is called a regional climate.

### Brainstorming Activity 2.1



1. Imagine that last summer was much hotter than the usual in the place where you live. Is this a sign of climate change?
2. Likewise, say almost every summer for the past decade has been hotter than the usual. Is this a sign of climate change?

The average climate around the world is called global climate. When scientists talk about global climate change, they are talking about the global climate and a pattern of change that's happening over many years.

One of the most important trends that scientists look at is the average temperature of the Earth, which has been increasing for many years. This is called global warming. Rising global temperatures lead to other changes around the world, such as stronger hurricanes, melting glaciers, and the loss of wildlife habitats. This is because the Earth's air, water, and land are all interdependent and prone to the climate change. This means a change in one place can lead to other changes somewhere else. For example, when air temperatures rise, the oceans absorb more heat from the atmosphere and become warmer. Warmer oceans, in turn, can cause stronger storms as shown in Figure 2:1

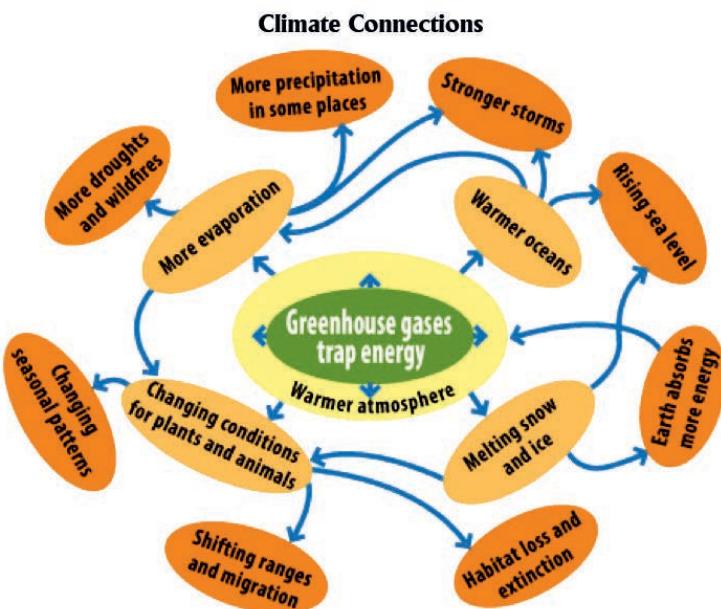


Figure 2:1 Global warming leading to a variety of changes.

According to the Intergovernmental Panel on Climate Change (IPCC), Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate overtime, due to either natural variability or human activities. Thanks to the work of the IPCC and other groups of scientists working on the definition of climate change, we now better understand the consequences of this phenomenon in our lives. In the minds of many, climate change is a relatively distant problem that simply implies that it will get hotter. Nevertheless, the consequences are much deeper and should be taken more seriously.

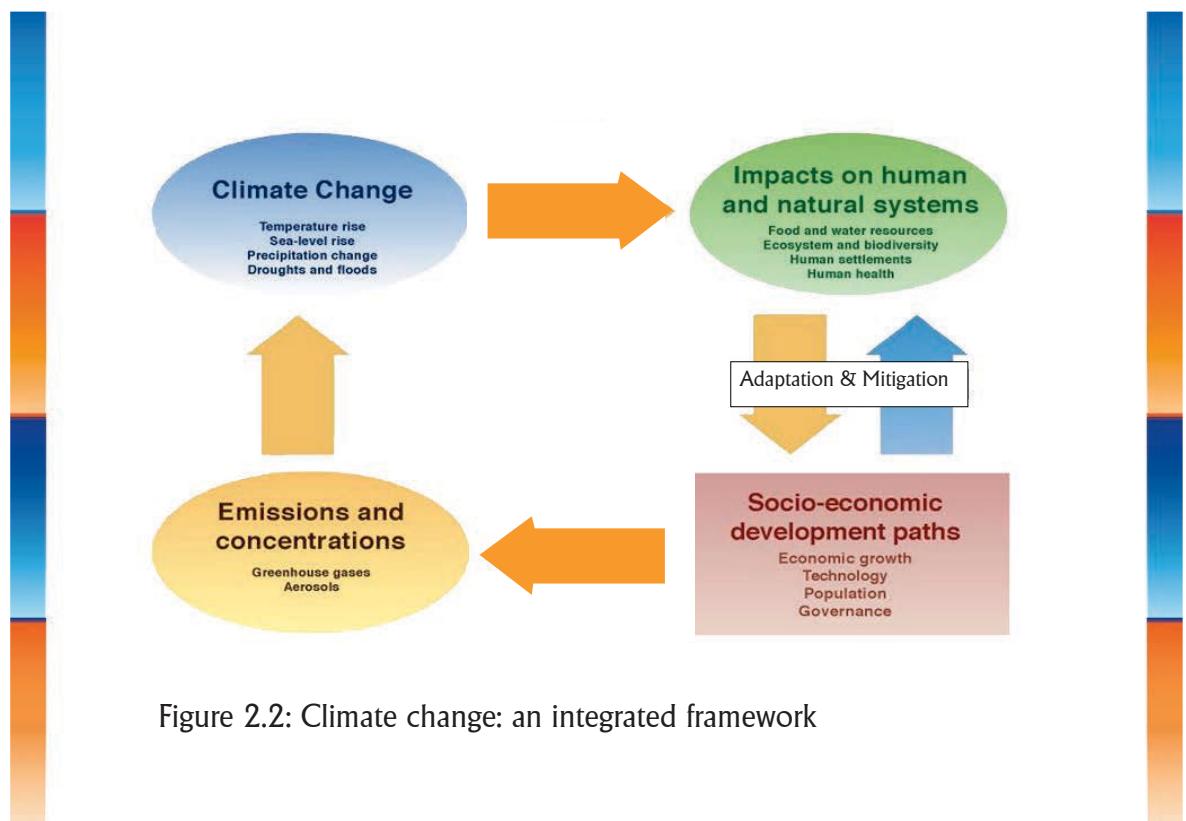


Figure 2.2: Climate change: an integrated framework

### Note:



The yellow arrows show the cycle of cause and effect among the four quadrants in the figure; the blue arrow indicates the societal response to climate change impacts.

Previous assessments have already shown through multiple lines of evidence that the climate is changing across our planet, largely as a result of human activities. The most convincing evidence of climate change derives from observations of the atmosphere, land and oceans. A clear evidence from in situ observations and ice core records shows that the atmospheric concentrations of important green-house gases such as carbon dioxide ( $\text{CO}_2$ ), methane( $\text{CH}_4$ ), and nitrous oxide ( $\text{N}_2\text{O}$ ) have increased over the last few centuries.

**Reflective Activity 2.1**

1. What is the difference between IPCC and other definitions of climate change?

**2.2. Trends in Global Climate Change**

At the end of this section, you will be able to

- explain the global trends in climate change.

**KEY TERMS:** Reducing emissions, Deforestation, Aerosols, Human activities

**Brainstorming Activity 2.2**

1. What do you expect about the climatic condition in your locality in the next 10 or 20 years? Will the temperature and rainfall increase or decrease? Work in pair and share your understanding with your classmate

The Earth's climate has always changed and evolved. Some of these changes have been due to natural causes, but others can be attributed to human activities such as deforestation, atmospheric emissions from industry and transport, which resulted in the storage of gases and aerosols in the atmosphere. They are known as greenhouse gases (GHGs) because they trap heat and raise air temperatures near the ground, acting like a greenhouse on the surface of the planet.

The Intergovernmental Panel on Climate Change (IPCC) pointed out in its 2001 Third Assessment Report on the state of the global climate that an increasing body of observations gave a collective picture of a warming world and other changes in the climate system. The report documented that the 1990s had been the warmest decade worldwide, and 1998 the warmest year since instrumental records had begun in 1861. The report also indicated that the twentieth century was likely to have been the warmest century in the last 1,000 years. Subsequently, the observed evidences revealed that most of the warming experienced over the past 50 years had resulted from human activities. Hence, the implication suggests, human influence will continue to change atmospheric composition throughout the twenty-first century.

Global warming has begun to affect the sea level, snow cover, ice sheets and rainfall. Shifts in regional patterns of climate marked by rising air temperatures are already affecting watersheds and ecosystems in many parts of the world.

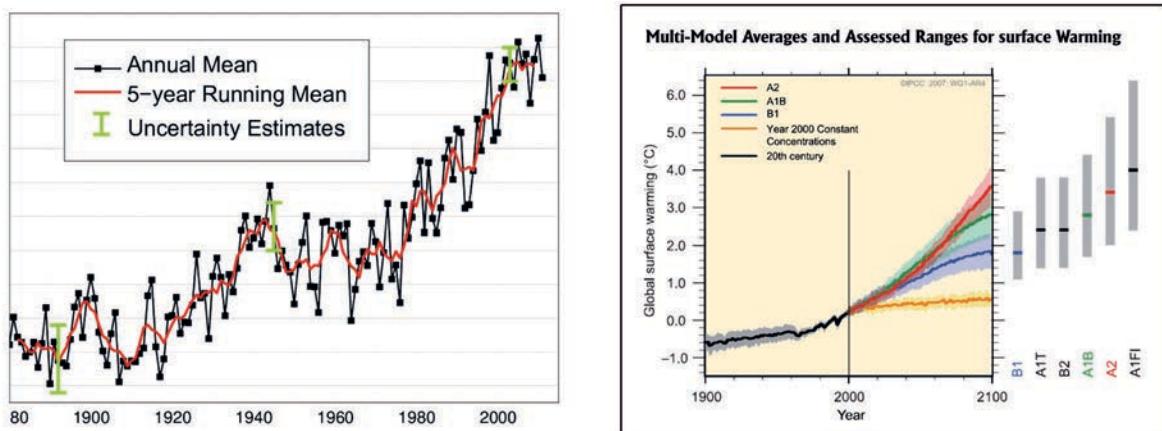


Figure 2.3 Global mean land and ocean temperature variation index, 1880 to present, with the base period 1951-1980.

The average global surface temperature has warmed  $0.80^{\circ}\text{C}$  in the past century and  $0.60^{\circ}\text{C}$  in the past three decades. The IPCC has projected that if greenhouse gas (GHG) emissions, the leading cause of climate change, continue to rise, the mean global temperatures will increase from  $1.4^{\circ}\text{C}$  to  $5.8^{\circ}\text{C}$  by the end of the 21<sup>st</sup> century (IPCC 2001).

### Reflective Activity 2.2



1. What are the main reports of IPCC to 2001?

## 2.3. Natural and Human Induced Climate Change

At the end of this section, you will be able to:

- ▲ describe the natural and human induced climate change by giving examples

**KEY TERMS:** Variations in Solar Output, Climate variations, Milankovitch Theory, Composition of the atmosphere, Incoming solar radiation

**Brainstorming Activity 2.3**

1. What activity of people in your area do you think negatively affect the climatic condition?

One of the great environmental concerns of our time is the climate change now unfolding as a result of greenhouse gases being added to our atmosphere. Glaciers are melting, sea level is rising, precipitation is becoming more intense in many areas, and global temperature is increasing each decade. Climate change, whether driven by natural or human forcing, can lead to changes in the likelihood of the occurrence or strength of extreme weather and climate events or both.

The primary cause of climate changes over the last few decades is human (anthropogenic) activity, mainly the burning of fossil fuels. , Evidently climate has changed in the past, and nothing suggests that it will not continue to change, both globally and locally. As the urban environment changes, its climate differs from that of the region around it. Sometimes the difference is striking, as when city nights are warmer than the nights of the outlying rural areas. Other times, the difference is subtle, as when a layer of smoke and haze covers a city.

In this chapter, we will first look at the evidence for climate change in the past; then we will investigate the causes of climate change from both natural processes and human activity.

IPCC has produced the world's most comprehensive reports on climate change for more than 25 years. It published in-depth climate assessments in 1990, 1995, 2001, 2007, 2013, and again in 2021. The 2013, Fifth Assessment Report, states that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-twentieth century. In the report, "extremely likely" means a probability of at least 95 percent.

### **Climate Change Caused by Natural Events**

What are the natural causes of climate change?

There are three “external” causes of climate change. These are changes in:

1. Incoming solar radiation;
2. The composition of the atmosphere; and
3. The Earth’s surface.

Natural phenomena can cause climate to change by all the three mechanisms, whereas human activities can change climate by the second and third mechanisms.

On the other hand, “internal” causes of climate change, manifested in terms of circulation patterns of the ocean and atmosphere, which redistribute energy within the climate system rather than altering the total amount of energy it holds.

Part of the complexity of the climate system is the intricate interrelationship of the elements involved. For example, if temperature changes, many other elements may be altered as well. The interactions among the atmosphere, the oceans, and the ice are extremely complex and the number of possible interactions among these systems is enormous. No climatic element within the system is isolated from the others, which is why the complete picture of the Earth’s changing climate is not totally understood. With this in mind, we will first investigate how feedback systems work; then we will consider some of the current theories as to why the Earth’s climate changes naturally.

### Variations in the Earth’s Orbit:

A theory ascribing climatic changes to variations in the Earth’s orbit is the Milankovitch theory, named after the name of astronomer Milutin Milankovitch, who first proposed the idea in the 1930s. The basic idea of this theory is that, as the Earth travels through space, three separate cyclic movements combine to produce variations in the amount of solar energy that reaches the Earth. The Milankovitch cycles that combine to produce variations in solar radiation received at the Earth’s surface include:

- Changes in the shape (eccentricity) of the Earth’s orbit about the sun.
- Precession of the Earth’s axis of rotation, or wobbling.
- Changes in the tilt (obliquity) of the Earth’s axis.

What are the Milankovitch Cycles? Natural global warming, and cooling, is considered to be initiated by Milankovitch cycles. These orbital and axial variations influence the initiation of climate change in long-term natural cycles of ‘ice ages’ and ‘warm periods’ known as ‘glacial’ and ‘interglacial’ periods. Our current climate forcing shows we are outside of that natural cycle forcing range.

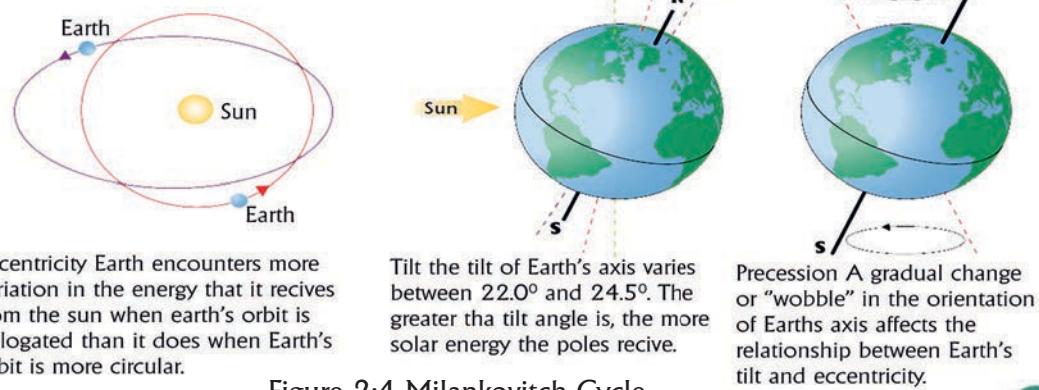


Figure 2:4 Milankovitch Cycle

## Variations in Solar Output

Solar energy measurements made by sophisticated instruments aboard satellites show that the sun's energy output (called brightness) varies slightly by a fraction of 1 percent with sunspot activity. Sunspots are huge magnetic storms on the sun that show up as cooler (darker) regions on the sun's surface. They occur in cycles, with the number and size reaching a maximum approximately every 11 years. The Figure 2.4 illuminates this better.

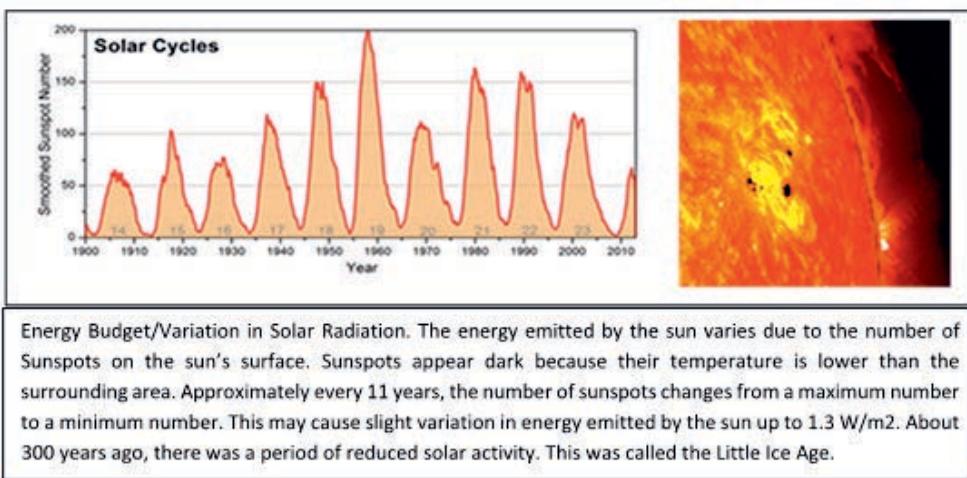


Figure 2.5: Solar cycle

During periods of maximum sunspots, the sun emits more energy (about 0.1 percent more) contrasted to periods of sunspot minimums. Evidently, the greater number of bright areas around the sunspots radiate more energy, which offsets the effect of the dark spots.

## Atmospheric Particles

Microscopic liquid and solid particles (aerosols) that enter the atmosphere from both natural and human-induced sources can have an effect on climate. The effect of these particles on the climate is exceedingly complex, and depends upon a number of factors, such as the particle's size, shape, color, chemical composition, and vertical distribution above the surface.

In this section, we will examine those particles that enter the atmosphere through natural means.

### Particles near the surface:

Particles can enter the atmosphere in a variety of natural ways. For example, wildfires can produce abundant amounts of tiny smoke particles, and dust storms sweep tons of fine particles into the atmosphere. Flaming volcanoes can release significant quantities of sulfur-rich aerosols into the lower atmosphere. Although the effect of these particles on the climate system is complex, the overall effect they have is to cool the surface of the earth by preventing sunlight from reaching the surface.

## Volcanic eruptions

Volcanic eruptions can have a major impact on climate. During volcanic eruptions, fine particles of ash and dust (as well as gases) can be ejected into the atmosphere. Scientists agree that the volcanic eruptions having the greatest impact on climate are those rich in sulfur gases. These gases, when ejected into the stratosphere, combine with water vapor in the presence of sunlight to produce tiny, reflective sulfuric acid particles that grow in size, forming a dense layer of haze. The haze may reside in the stratosphere for several years, absorbing and reflecting back to space a portion of the sun's incoming energy. The reflection of incoming sunlight by the haze tends to cool the air at Earth's surface, especially in the hemisphere where the eruption occurs.

## Human (Anthropogenic) Induced Climate Change

Earlier in this chapter, we saw how variations in atmospheric CO<sub>2</sub> may have contributed to changes in the global climate spanning thousands and even millions of years. Today, we are modifying the chemistry and characteristics of the atmosphere by injecting into it vast quantities of particles and greenhouse gases without fully understanding the long-term consequences. In this section, we will first look at how gases and particles injected into the lower atmosphere by human activities may be affecting climate. Then, we will examine how CO<sub>2</sub> and other trace gases appear to be enhancing the Earth's greenhouse effect, producing global warming.

### Aerosols Injected into the Lower Atmosphere:

In the previous section, we learned that tiny solid and liquid particles (aerosols) can enter the atmosphere from both human-induced and natural sources.

The human-induced sources include emissions from factories, autos, trucks, aircraft, power plants, home furnaces and fireplaces, to name a few.

Many aerosols are not injected directly into the atmosphere, but form when gases convert to particles. Some particles, such as sulfates and nitrates, mainly reflect incoming sunlight, whereas others, such as soot, readily absorb sunlight. Many of the particles that reduce the amount of sunlight reaching Earth's surface tend to cause a net cooling of the surface air during the day.

### Land use changes:

All climate models predict that, as fossil fuels continue to spew greenhouse gases into the air, the climate will change and the Earth's surface will warm. But are humans changing the climate by other activities as well?

Modification of Earth's surface taking place right now could potentially be influencing the immediate climate of certain regions. For example, studies show that about half the rainfall in the Amazon River Basin is returned to the atmosphere through evaporation and through transpiration from the leaves of trees. Consequently, clearing large areas of tropical rain forests in South America to create open areas for farms and cattle ranges, as is happening now, will most likely cause a decrease in evaporative cooling. This decrease, in turn, could lead to a warming in that area at least several degrees Celsius. In turn, the reflectivity of the deforested area will change. Similar changes in albedo result from the overgrazing and excessive cultivation of grasslands in semi-arid regions, causing an increase in desert conditions (a process known as desertification).

### **Increasing Greenhouse Gases Emission**

Carbon dioxide is one of a greenhouse gas that strongly absorbs infrared radiation and plays a major role in the warming of the lower atmosphere. Everything else being equal, the more CO<sub>2</sub> in the atmosphere, the warmer the surface air is. We also know that CO<sub>2</sub> has been increasing steadily in the atmosphere, primarily due to human activities, such as the burning of fossil fuels like coal, oil, and natural gas. Deforestation is also adding to this increase. Through the process of photosynthesis, the leaves of trees remove CO<sub>2</sub> from the atmosphere. The CO<sub>2</sub> is then stored in leaves, branches, and roots. When the trees are cut and burned, or left to decay, the CO<sub>2</sub> goes back into the atmosphere.

Moreover, Nitrous Oxide (N<sub>2</sub>O) and Methane (CH<sub>4</sub>) are greenhouse gases that causes for climate change. These three gases are differ in how they absorb energy (preventing it from escaping to space) and how long the gas stays (life time) in the atmosphere. For example, CO<sub>2</sub> stays for over 100 years while, the others two gases last relatively for short time. NH<sub>3</sub> causes 21 times as much warming as an equivalent mass of CO<sub>2</sub> over 100 years.

#### **Note:**



Naturally, atmospheric GHGs are important to maintain life on earth. The role of water vapor Co<sub>2</sub> and other GHGs play keeping the earth's mean surface temperature higher than it otherwise would be. If the GHGs were absent earth's average atmospheric temperature would be 33°C less. These affects all ecosystem on earth. While, the problem of GHGs effects are increasing in the amount of those gases in the atmosphere due to human causes that resulted for deviation from the natural or normal conditions.

## Global Warming

We have discussed several times in this chapter that the Earth's atmosphere is in a warming trend that began around the turn of the twentieth century. This warming trend is real, as the average global surface air temperature since the late 1800s has risen by about  $1.0^{\circ}\text{C}$ . Moreover, the global average for each decade since the 1980s has been warmer than that of the preceding decade. There are many signs of increasing global warmth other than temperature readings. For example, the amount of water locked in the world's glaciers and ice sheets is steadily decreasing, and sea level is steadily rising.

Global warming might even be apparent where you live. The growing season, for example, may be getting longer, or you may find the changing of the leaf color in autumn tending to happen later than in the past. Global warming in any given year, however, is small, and it only becomes significant when averaged over many years, such as decades. So, it is important not to base global warming on a specific weather event. The main indicators of global warming are shown in figure 2:5.

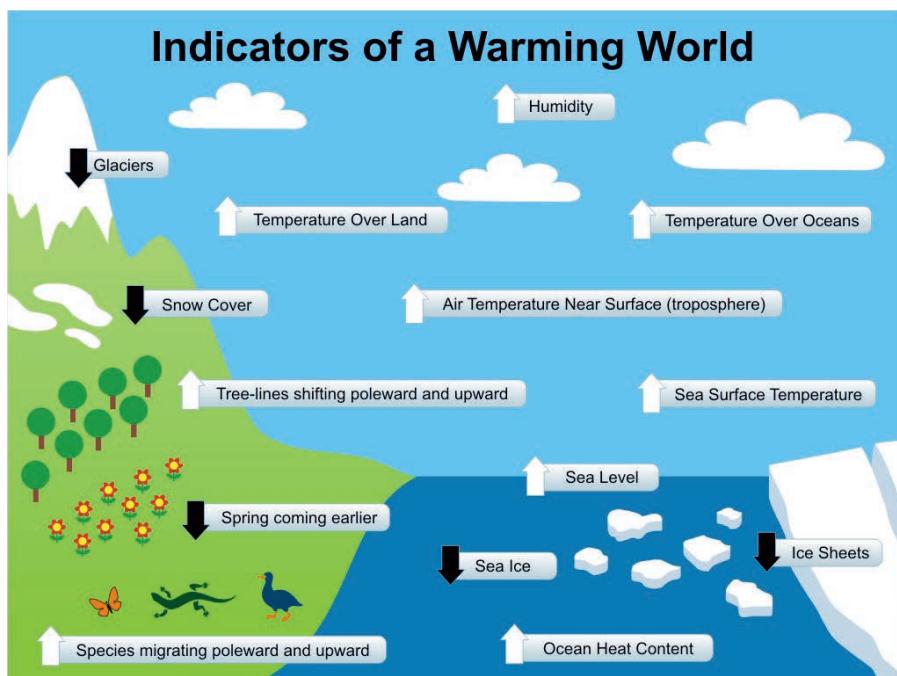


Figure 2:5 indicators of Global warming

### Reflective Activity 2.3



1. What are the main causes of climate change?

## 2.4. Consequences of Climate Change

At the end of this section, you will be able to:

- examine the impacts of climate change on human beings and other life forms; and
- assess the impacts of climate change on the physical features such as water and forest.



If the world continues to warm as predicted by climate models, where will most of the warming take place?

Climate models predict that land areas will warm more rapidly than the global average, particularly in the northern high latitudes in winter. We can see that the greatest surface warming for the period 2001 to 2006 tended to occur over landmasses in the high latitudes of the Northern Hemisphere, as experienced in Canada and Russia. As high-latitude regions of the Northern Hemisphere continue to warm, modification of the land may actually enhance the warming. For example, the dark green boreal forests of the high latitudes absorb upto three times as much solar energy as does the snow-covered tundra. Consequently, the winter temperatures in subarctic regions are, on the average, much higher than they would be without trees. If warming allows the boreal forests to expand into the tundra, the forests may accelerate the warming in that region. As the temperature rises, organic matter in the soil should decompose at a faster rate, adding more CO<sub>2</sub> to the air, which might accelerate the warming even more. Trees that grow in a climate zone defined by temperature may become especially hard hit as rising temperatures place them in an inhospitable environment. These changes in temperature will also affect people in many ways, of course, including direct effects on human health. For example, with heat waves expected to become more frequent and intense, heat-related deaths are expected to increase, although there could be some compensating decrease in cold-related illnesses. In the lower latitude, there are more frequent droughts and unpredictable rainfall due to global warming. Predictions show that global warming will amplify current dangers and introduce new ones, seriously affecting people's ability to support themselves.

### Precipitation

Changes in precipitation and drought may be just as important as changes in temperature over the coming decades. As with temperature, changes in precipitation will not be evenly distributed, as some areas will tend to get more precipitation and others less.

Since the middle of the twentieth century, precipitation has generally increased over the middle- and high-latitude land areas of the Northern Hemisphere, while decreasing over some subtropical land areas. In many areas, there has also been an increase in the intensity of the heaviest precipitation events during the last 50 years or so.

The changes in precipitation adversely affect by placing added stress on agriculture. Even in places where average annual precipitation does not change, it is possible that rainfall and snowfall will be focused in more intense wet spells, with longer dry periods in between. In many parts of the world, observations show that the heaviest one-day rainfall events are already becoming heavier. In addition, warming temperatures will tend to cause soil to dry out more quickly, exacerbating the impact of drought when it occurs.

### Sea Level Rise

Another major consequence of climate change is an increase in sea level, as land-based ice sheets and glaciers retreat, the oceans continue to expand and get warm. During the twentieth century, average global sea level rose by about 17 cm. From 1900 to 2010, globally averaged sea level rose about 19 cm, with the pace accelerating from the 1990s onward. About half of that was a result of melting glaciers and ice sheets, with the other half produced by the expansion of oceans as they warm. Globally averaged sea level has risen about twice as quickly since 1993, roughly 3.4 cm per decade, as it did during the twentieth century as a whole.

Sea level rise will be a growing issue in the coming decades for the many millions of people who live near coastlines around the world. Storm surges will occur atop a higher baseline water level. Rising ocean levels could also have a damaging influence on coastal ecosystems, such as coral reefs. In addition, coastal groundwater supplies might become contaminated with saltwater.



Figure 2.6 Rising Seas:

Figure 2.6 Rising Seas: As sea ice and ice caps at both of the Earth's poles continue to melt at unprecedented rates, rising sea levels can put coastal and island communities like those in the Philippines at risk of flooding and water damage.

## Effects on Polar Regions

In Polar Regions, areas of the world, rising temperatures produce complex interactions among temperature, precipitation, and wind patterns. Hence, in Antarctica, more snow might actually fall in the warmer air. This situation could allow snow to build up across the interior, although it may be counterbalanced by an increase in melting already taking place along the Antarctic coastline. Over Greenland, which is experiencing rapid melting of ice and snow, any increase in precipitation will likely be offset by rapid melting, and so the ice sheet is expected to continue to shrink. Sea ice has been shrinking and thinning rapidly across the Arctic Ocean. During the summer of 2007, and again in the summer of 2012, the extent of Arctic sea ice dropped dramatically to new record lows. If the warming in this region continues at its present rate, summer sea ice may, at times, shrink to cover less than 10 percent of the Arctic Ocean by the middle of this century, or even sooner.



Figure 2.7 Sea ice is frozen seawater that floats on the ocean surface, forming and melting with the polar seasons. Some persists year after year in the Arctic, providing vital habitat for wildlife such as polar bears.

## Effects on ecosystems

Increasing levels of CO<sub>2</sub> in a warmer world could have many other consequences. For example, greater amounts of CO<sub>2</sub> can be expected to act as a “fertilizer” for some plants, accelerating their growth, although this process can slow over time if water, nitrogen, and other nutrients were not plentiful enough to sustain the growth. In some ecosystems, certain plant species could become so dominant that others are eliminated.

In tropical areas, where many developing nations are located, the effects of climate change may actually decrease crop yield, whereas higher latitudes might benefit from a longer growing season and an earlier snowmelt. Extremely cold winters might become less numerous, with fewer bitter cold spells.

However, wildfires may continue to become more prevalent during dry spells in forested high-latitude areas.

Thus, while there will be some “winners” and some “losers,” the most recent analyses suggest that the impact of climate change on agriculture and ecosystems may become increasingly negative by later in this century.

Future impact on our climate system has been summarized from the 2013 Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) as follows:

The primary source of the increased atmospheric concentration of carbon dioxide since the preindustrial period results from fossil fuel use, with land-use change providing another significant but smaller contribution. The atmospheric concentration of carbon dioxide in 2005 exceeds by far the natural range over the last 800,000 years (180 to 300 parts per million (ppm) as determined from ice cores. Climate-driven changes in species distributions affect human well-being both directly (for example, through emerging diseases and changes in food supply) and indirectly (by degrading ecosystem health) see figure 2.8.

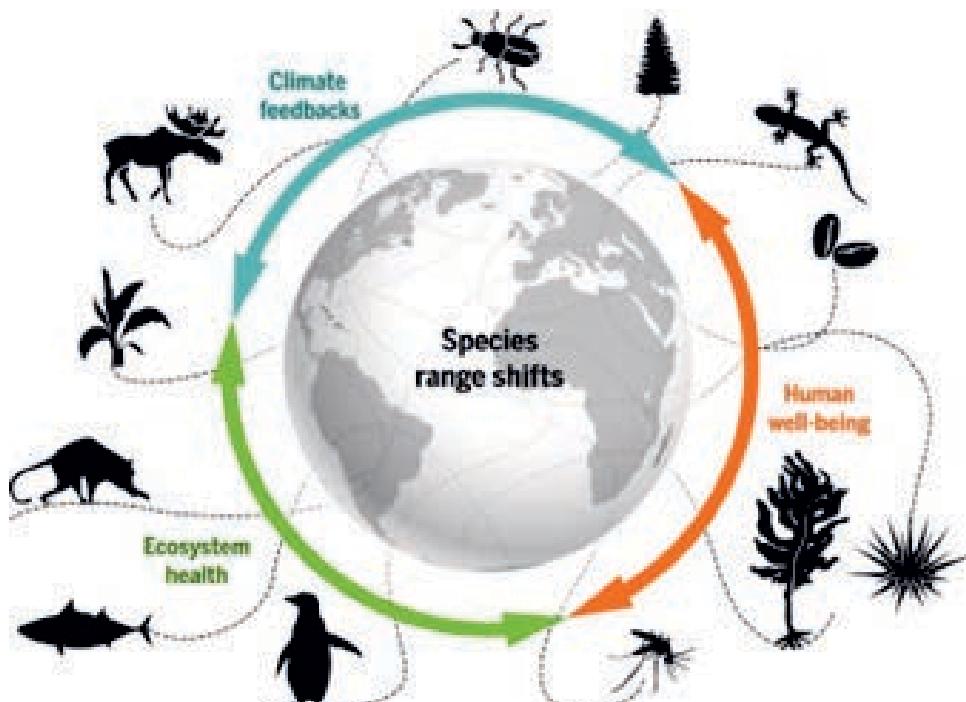


Figure 2.8 Interlinked climate change changes impact on species distributions and human well-being

#### Reflective Activity 2.4



1. What are the main impacts of climate change?

## 2.5. Adaptation and Mitigation Strategies to Climate Change

At the end of this section, you will be able to:

- elaborate the main adaptations and mitigations strategies to climate change;
- describe adaptation to climate change;
- define mitigation to climate change; and
- differentiate between mitigation and adaptation strategies.

**KEY TERMS :** Adaptation, Mitigation, Strategies, Reactive, Anticipatory, Planned, Autonomous

### Brainstorming Activity 2.4



1. What are the common climate change adaptation and mitigation mechanisms peoples adopted in your locality?

Think individually about each issue then discuss in a group of five and report to the class

Climate change is one of the all-encompassing global environmental changes likely to have deleterious effects on natural and human systems, economies and infrastructure. The risks associated with it call for a broad spectrum of policy responses and strategies at the local, regional, national and global level.

The United Nations Framework Convention on Climate Change (UNFCCC) highlights two fundamental response strategies: mitigation and adaptation. While mitigation seeks to limit climate change by reducing the emissions of greenhouse gases and by enhancing 'sink' opportunities, adaptation aims to alleviate the adverse impacts through a wide-range of system-specific actions.

Although both mitigation and adaptation measures must be pursued to tackle the climate change problem and to create an effective and inclusive international climate change regime, more attention has been devoted to mitigation in the past, both in scientific research and policy debate. Sensitivity to the issue of adaptation has grown over the last couple of years, particularly after the IPCC Third Assessment Report. Adaptation has now emerged as an urgent policy priority, prompting action both within and outside the climate change negotiations.

## Climate Change Adaptation

According to Intergovernmental Panel on Climate Change, adaptation to climate change refers to, “adjustments in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This term refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change”.

The most commonly identified adaptation strategies in Ethiopia include soil conservation, terracing, water harvesting, crop diversification, changing crop planting date, planting trees and irrigation.



Figure 2.9: Climate change Adaptation using irrigation and planting trees.

## Types of Adaptation

Depending on its timing, goal and motive of its implementation, adaptation can either be reactive or anticipatory, private or public, planned or autonomous. Adaptations can also be short/long term, localized or widespread (IPCC 2001).

In unmanaged natural systems, adaptation is autonomous and reactive, and is the means by which species respond to changed conditions. In these situations, adaptation assessment is essentially equivalent to natural system impact assessment.

## Reactive or Anticipatory Adaptation

Reactive adaptation is the one that takes place after the initial impacts of climate change have occurred. Anticipatory adaptation takes place before impacts become apparent. In natural systems, there is no anticipatory adaptation.

## Private or Public Adaptation

The distinction is based on whether adaptation is motivated by private (individual) households and companies or public interest (government).

## Planned or Autonomous Adaptation

Planned adaptation is consequence of deliberate policy decision, based on the awareness that conditions have changed or are expected to change and that some form of action is required to maintain a desired state. Autonomous adaptation involves changes that systems will undergo in response to changing climate irrespective of any policy, plan or decision

	Anticipatory	Reactive
Natural System		Changing in length of growing season Changes in ecosystem composition Wetland migration
Private	Purchase of insurance Construction of house on stilts Redesign of oil-rigs	Changing in farm practices Change in insurance premiums Purchase of air-building
Human System Public	Early- Warning system New building codes, design standards Incentive for relocation	Compensatory payments, subsidies Enforcement of building codes Beach nourishment

## Climate Change Mitigation

It refers avoiding and reducing emission of heat trapping greenhouse gases in to the atmosphere to prevent the planet from warming to more extreme temperatures. For example, reducing source of heat trapping greenhouse gases the burning of fossil fuels for electricity, heat or transport and enhancing the sinks that accumulate and store these gases (such as the oceans, forests and soil).



Figure 2.10: Climate change mitigation (Forests as sinks and wind power as source of green energy)

### Reflective Activity 2.5



1. What is the difference between adaptation and mitigations of climate change?

## 2.6. International Conventions and Agreements on Climate Change

At the end of this section you will be able to:

- analyse the major international conventions and agreements in view of their strengths and limitations;
- explain the current status of International Conventions and Agreements on Climate Change.

**KEY TERMS:** Toronto Conference, Kyoto Protocol, Buenos Aires Plan of Action, Marrakesh Accords.



### Brainstorming Activity 2.5

1. What are the common aims of the international conventions and agreements on climate change?
2. Why conventions and agreements on climate change is needed at global scale?

Discuss in convenient group sizes and share with your classmates

The First World Climate Conference (1979) identified climate change as an urgent world problem and issued a declaration calling on governments to anticipate and guard against potential climate hazards. A World Climate Programme was set up, directed by the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU). Several intergovernmental conferences on climate change followed.

The Toronto Conference on the Changing Atmosphere (1988) advanced public debate, when more than 340 participants from 46 countries all recommended developing a comprehensive global framework convention to protect the atmosphere. Following a proposal by Malta, the United Nations General Assembly addressed climate change for the first time by adopting Resolution 43/53. This recognized that “climate change is a common concern of mankind, since climate is an essential condition which sustains life on earth”, and determined that “necessary and timely action should be taken to deal with climate change within a global framework ...” The WMO and UNEP established the Intergovernmental Panel on Climate Change (IPCC), to assess the magnitude and timing of changes, estimate their impacts and present strategies for how to respond.

The IPCC published the First Assessment Report on the state of the global climate (1990), which had a potent effect on policy makers and on public opinion. It became the main basis for negotiations under the United Nations General Assembly on a climate change convention, beginning in late 1990. The Second World Climate Conference met in Geneva in November, and, unlike the 1979 Climate Conference, included ministers as well as scientists. On 21 December the United Nations General Assembly established, by Resolution 45/212, the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change (INC) as “a single intergovernmental negotiating process under the auspices of the General Assembly.” The INC met for five sessions between February 1991 and May 1992.

The IPCC finalized its Second Assessment Report in time for COP 2 in Geneva in June 1996. It concluded that on the balance of available evidence, there was indeed a discernible human influence on global climate that posed hazards to human and economic development. It recommended cost-effective steps, consistent with sustainable development and designed to provide “no regrets” safeguards against such risks.

COP 6 (2001) resumed in Bonn in late July and reached an outline agreement – the so-called Bonn Agreements – on an emissions trading system, on a Clean Development Mechanism (CDM), on rules for accounting for emissions reductions from carbon “sinks” and on a compliance regime. It also outlined a package of financial and technological support to help developing countries contribute to global action on climate change and address its adverse effects. Detailed legal texts based on these decisions were on the negotiating table at COP 7, held in Marrakesh in late 2001. COP 7 adopted the respective decisions, the so-called Marrakesh Accords.

COP 8 (2002) , held in New Delhi in November, was the first session after the negotiations under the BAPA had been completed. It marked a new phase of negotiations as the focus shifted to implementation of the Marrakesh Accords and to Convention issues. COP 8 adopted the Delhi Ministerial Declaration on Climate Change and Sustainable Development as well as the New Delhi work programme on education, training and public awareness.

COP 9 (2003) , held in Milan in December, adopted decisions on afforestation and reforestation activities under the CDM.

COP 10 (2004) , held in Buenos Aires in December, the predominant issue was adapting to climate change and one of the outcomes was the Buenos Aires programme of work on adaptation and response measures.

The Kyoto Protocol (2005) came into force on 16 February. The first Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (COP/MOP 1) was held with COP 11 in Montreal in November and December. It was one of the most successful to date, with an important political break-through being the decision by Parties to start a dialogue on strategic long-term cooperative action. In 2006 of a total United Nations membership of 191 nations, 189 countries and the European Community have joined the Convention (and 164 countries and the European Community have joined the Kyoto Protocol). It is therefore clear that the Convention is one of the most universally supported international agreements in existence.

Thus, the international agreement called the Kyoto Protocol was adopted in 1997 and put into force in February 2005. The Protocol set mandatory targets for reducing greenhouse gas emissions in countries that adopt the plan. Although the percent by which each country was to reduce its emissions varies, the overall goal was to reduce greenhouse gas emissions in developed countries by at least 5 percent below existing 1990 levels during the five-year period of 2008 through 2012. For the industrialized nations that participated in the Kyoto Protocol, emissions expected to be dropped by more than 22 percent.

However, the United States did not ratify the protocol, and many developing nations such as China were not required to carry out emission reductions, since they had been responsible for only a small part of the accumulated CO<sub>2</sub> up to that point. As a result, the global total of greenhouse gas emissions actually increased by more than 25 percent from 1990 to 2012.

The Kyoto Protocol has been followed by the Paris Agreement, which was introduced in 2015 and adopted by virtually every one of the world's nations. Under this agreement, each nation set voluntary targets for reducing emissions and will report their progress on a regular basis. (In mid-2017, the United States announced its intention to withdraw from the Paris Agreement. The current regime is trying to reconsider it again.)

In addition, several cities and countries, including Costa Rica, Iceland, and Norway, have pledged to become carbon neutral meaning that all of their greenhouse gas emissions would be offset by activities such as planting trees, so that the country ends up with no net emissions. Many global businesses are also striving to become carbon neutral. This does not necessarily mean that collective response strategies that are effective and efficient have been introduced.

The cutting down on the emissions of greenhouse gases and pollutants has several potentially positive benefits. These are, it:

- ▲ Could slow down the enhancement of Earth's greenhouse effect,
- ▲ Reduce global warming,
- ▲ Reduce acid rain,
- ▲ Diminish haze,
- ▲ Slow the production of photochemical smog, and
- ▲ Produce significant health benefits.

The most obvious way to limit global warming is to reduce greenhouse gas emissions by reducing the use of fossil fuels. Burning natural gas produces less carbon dioxide than burning oil and coal.

Thus, to fight climate change, we must first reduce our greenhouse gases (GHG) emissions. To accomplish this, the first step is to embrace renewable energy that are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat, and avoid creating energy by the burning of fossil fuels.

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For this to happen, we should start to create a worldwide culture of sustainable development, where the energy is used wisely and efficiently, where a circular economy is a strong bet, as well as durable and eco-friendly products. We need to choose responsibly the products we buy because our demand as consumers influences what we are supplied with.

### Reflective Activity 2.6



1. Discuss the major conventions and agreements on climate Chang.

## 2.7. Pillars of Climate Resilient Green Economy of Ethiopia

At the end of this section, you will be able to:

- evaluate the pillars of climate resilient green economy of Ethiopia.

**KEY TERMS:** Climate resilient, Green Economy, Carbon stocks, Energy-efficient technologies



### Brainstorming Activity 2.6

1. What are the pillars of the climate resilient green economy of Ethiopia?
2. What should be done to make the economy resilient?

Students, attempt these questions in pairs and share your answers with others at classroom level.

Ethiopia's plan is to follow a green growth path that fosters development and sustainability. The Climate Resilient Green Economy (CRGE) strategy follows a sectoral approach. Initially it identified and prioritized 60 initiatives that would help the country reach its development goals while emitting less GHG emissions. Ethiopia's green economy plan is based on four pillars discussed below:

**i. Improving crop and livestock production practices for higher farmer income and food security while reducing emissions:**

This pillar recognizes that agriculture will remain a core sector of the economy that provides employment to the majority of the Ethiopian population. Traditional economic development could deliver the required growth required in this sector, but at a cost. The CRGE strategy, however, prioritizes initiatives that limit soil-based emissions from agriculture and limits pressure on forests by limiting expansion of land under cultivation. The strategy also prioritizes initiatives that increase the resource efficiency and productivity of the livestock sector. The prioritized initiatives in the livestock sector have offered the combined benefit of economic growth support, by increasing pastoralists' income and limiting emissions.

**ii. Protecting and re-establishing forests for their economic and ecosystem services including carbon stocks:**

This pillar recognizes that in order to support continued growth in economic and eco-system services as well as growth of the GDP, deforestation and forest degradation should be reversed. The CRGE initiative has prioritized strategies to reduce demand for fuel wood, and increase afforestation, reforestation, and forest management to increase carbon sequestration in forests and woodlands as well as the promotion of area closure, which would result in increased storage of carbon in Ethiopian forests.

**iii. Expanding electricity generation from renewable sources of energy for domestic and regional markets:**

This pillar recognizes electricity as a fundamental enabler of modern economic development for powering cities, fuelling industrial activity and pumping irrigation water for agriculture. Ethiopia which needs to expand its electricity supply at a rate of 14% per annum is endowed in natural resources which can meet this demand. In particular, its plan is to exploit its vast potential for hydro, geothermal, solar and wind power – all of which would deliver electricity at virtually zero GHG emissions. It is worth highlighting here that the generation of clean energy also allows for green development of other sectors of the economy. There is also potential that the projected supply will surpass domestic demand, which offers a possibility of exporting its clean energy to neighboring countries.

#### **iv. Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors and buildings:**

This pillar recognizes the opportunity to gear development of key sectors including transport, and industrial sub-sectors like cement, textile, leather and fertilizer industries, to contribute to the sustainable development pathway. The Ethiopian government aims to promote among other initiatives energy efficiency and the usage of alternative fuels in these subsectors. For the transportation sector, in particular, the strategy introduces initiatives that include introduction of stricter fuel efficiency standards, construction of an electric rail network powered by renewable energy, improvement of modern transport.

The preceding sections pointed out how Government of the Federal Democratic Republic of Ethiopia has integrated climate change objectives in broader national plans and policies through the Climate Resilient Green Economy strategy to prepare and protect the country from the adverse effects of climate change and to build a green economy that will help realize the country's national development ambition of reaching middle income status before 2025. Thus, the CRGE Strategy complements the current homegrown economic reform 6th pillar, which aims to set Ethiopia on a path to become a middle-income country by 2025.

Reflective activities

#### **Reflective Activity 2.7**



1. What are the main pillars of climate change resilient green economy?

**UNIT SUMMARY**

In this unit attempt has been made to analyze a number of ways the Earth's climate can be changed by natural means. Climate change may be attributed to external and internal causes.

The external causes of climate change for instance include:

Changes in incoming solar radiation;

Changes in the composition of the atmosphere;

Changes in the surface of the Earth.

The Milankovitch theory proposes that alternating glacial and interglacial episodes during the past 2.5 million years are the result of small variations in the tilt of the Earth's axis and in the geometry of the Earth's orbit around the sun. Fluctuations in solar output (brightness) may account for periods of climatic change.

Volcanic eruptions, rich in sulfur, may be responsible for cooler periods in the geologic past.

The earth's climate has undergone considerable change during the geologic past.

possible causes of climate change, is extremely complex, as a change in one variable in the climate system almost immediately change other variables.

Climate change can be brought on by both natural events and by human (anthropogenic) activities.

Climate change may also be brought naturally by volcanic eruptions rich in sulfur and by variations in the sun's energy output.

Human activities, such as emitting vast quantities of greenhouse gases into the atmosphere, can produce climate changes worldwide.

Global average temperatures since the late nineteenth century have risen by about 1°C.

Many studies have found that increasing concentrations of greenhouse gases are the primary cause of this warming.

Sophisticated climate models project that, as levels of CO<sub>2</sub> and other greenhouse gases continue to increase, the Earth's surface will warm substantially by the end of this century.

The models also predict that, as the Earth warms, there will be a global increase in atmospheric water vapor, more extreme precipitation events, a worsening of drought impacts, a more rapid melting of sea ice, and a rise in sea level.



## REVIEW QUESTIONS

### I. Multiple Choice Questions

Choose the correct answer from the given alternatives.

1. Which of the following is important greenhouse gas?  
A. Carbon dioxide (CO<sup>2</sup>)    B. Methane (CH<sub>4</sub>)    C. Nitrous oxide (N<sup>2</sup>O)    D. All
  
2. According to the Third Assessment Report of IPCC which decade had been the warmest decade worldwide?  
A. 1990s    B. 1950s    C. 1920s    D. 1970s
  
3. What is a feasible method to reduce the release of the greenhouse gases without decreasing the production of these gases?  
A. Mitigation    B. Adaptation    C. Resilience    D. Exposure
  
4. The type of adaptation that takes place after the initial impacts of climate change has occurred is:  
A. Anticipatory    B. Reactive    C. Planned    D. Autonomous
  
5. Which of the following country had an intention to withdraw from the Paris Agreement in mid-2017:  
A. United States of America    B. Russia    C. China    D. France

### II. Short Answer Questions

1. What is the state of today's average global temperature compared with the average temperature during most of the past 1000 years?
2. Describe the Milankovitch theory of climatic change by explaining how each of the three cycles alters the amount of solar energy reaching the Earth.
3. Do volcanic eruptions rich in sulfur tend to warm or cool the Earth's surface? Explain.
4. Explain how variations in the sun's energy output might influence global climate.
5. How could Climate models predict that increasing levels of CO<sub>2</sub> will cause the mean global surface temperature to rise?



# UNIT THREE

## ISSUES IN SUSTAINABLE DEVELOPMENT I: MANAGEMENT OF CONFLICT OVER RESOURCES



### Learning Outcomes

At the end of this unit, you will be able to:

- recognize the meaning of sustainable development;
- identify the main focuses, goals and principles of sustainable development;
- explain the principles and characteristics of good governance; and
- examine the problem of land management and policy of Ethiopia.



### MAIN CONTENTS

- Introduction
- 3.1. Sustainable Development
- 3.2. Resource Use Policies and Related Conflicts
- 3.3. Governance of Natural Resources
- 3.4. Indigenous Conflict Resolution Practices
- Unit Summary
- Review Questions

### Introduction

The management of land and other natural resources is one of the most critical challenges in developing countries face today. The exploitation of high-value natural resources, including oil, gas, minerals and timber has often been cited as a key factor in causing, increasing or sustaining violent conflicts around the globe. Furthermore, increasing competition over diminishing renewable resources, such as land and water, are on the rise. This is being further aggravated by environmental degradation, population growth and climate change. The mismanagement of land and natural resources is contributing to new conflicts and obstructing the peaceful resolution of existing ones. Thus, this chapter deals with the issues of management of conflict over resources in line with sustainable use of it.

### Brainstorming Activity 3.1



1. What do we mean by sustainable development?
2. What are the three dimensions of sustainable development?

### **3.1. THE CONCEPT OF SUSTAINABLE DEVELOPMENT**

At the end of this section, you will be able to:

- explain the concept of sustainable development;
- elaborate the different dimensions of sustainable development in your local context; and
- discuss the progresses for achieving sustainable development goals globally and in your local context.

#### **The concept of Sustainable Development: Historical Overview**

The concept of “Sustainable Development” has emerged as one of the development paradigms that have given rise to a particularly rich literature, policies and programs by a wide range of international and national governmental and NGOs.

The first United Nations Conference on Environment and Development (UNCED) held in Stockholm in 1972 (known as the Brundtland Report), introduced the notion of “eco-development” and led to the establishment of UNEP with the mission “to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations”

The second UNCED held in Nairobi, Kenya in 1987 introduced the idea of “sustainable development”.

The third conference held in Rio de Janeiro in 1992 (known as the Earth Summit), further developed “Agenda 21” that highlighted the connection between poverty and underdevelopment on the one hand, and the connection between environmental protection and natural resource management on the other.

Agenda 21 states in its Principle 1 that “human beings, the centre of concern for sustainable development, are entitled to a healthy and productive life in harmony with nature”.

The fourth conference known as the “World Summit on Sustainable Development” was held in Johannesburg, South Africa in 2002. This summit placed much more emphasis on the social and economic aspects of sustainable development.

While many and confusing definitions of sustainable development abound, others state that “a development path is sustainable if total welfare does not decline along the path”. Critical to this definition is a realization that sufficient welfare functions through consumption, environmental quality, social equity, and other factors to the quality of life. This definition is broad enough to capture the essence of a pattern of resource use that aims to meet human needs while preserving the natural resources. This is necessary so that these needs can be met not only in the present, but also for generations to come, intergenerational equity so to speak.

Sustainable development as a concept puts the relationship between economic growth and the environment at its core. The term was first used in 1987 by the World Commission on Environment and Development. It is also known as the Brundtland Commission, names after its chair, Gro Harlem Brundtland. In the commission’s report, “Our Common Future,” sustainable development has been defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

It is clear that this definition is rooted in a systems thinking as it stresses the three interdependent and mutually reinforcing pillars of sustainable development: economic development, social development, and environmental sustainability.

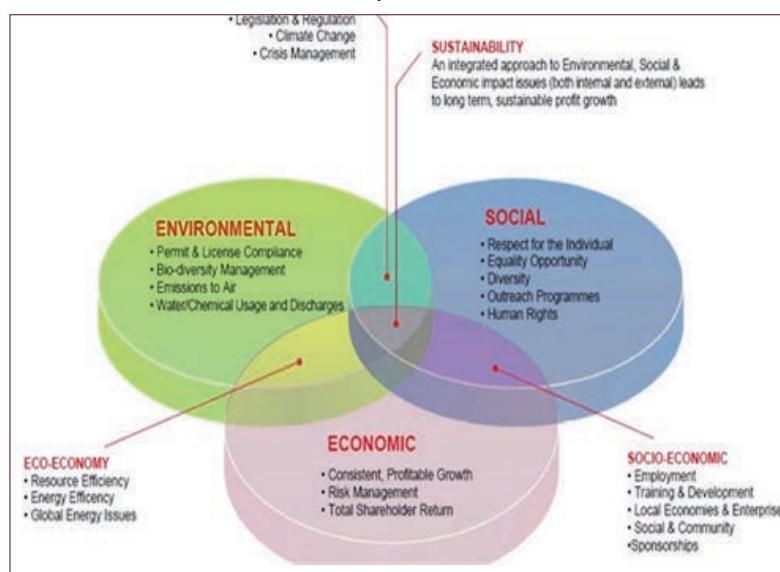


Figure. 3.1: Nested Pillars of Sustainable Development

Sustainable development, therefore, aims to bring the three components together in a balanced way, as three interconnected or nested rings. The nested rings approach insists that the economy is dependent on society and the environment. Human and economic activities take place within the environment and the society, depend on and have an impact on the environment. A key issue for sustainable development is, therefore, the integration of different dimensions of sustainability, taking a holistic view and overcoming barriers between disciplines, ideologies and sectors.

The three essential dimensions of sustainable development are:

- I. Economic: an economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and avoid extreme sectoral imbalances that damage agricultural and/or industrial production.
- II. Environmental: an environmentally sustainable system must maintain a stable resource base and avoid overexploitation of non-renewable resource systems, including maintenance of biodiversity, atmospheric stability and ecosystems services not always looked upon as economic resources.
- III. Social: a socially sustainable system must achieve fairness in distribution and opportunity among all persons with adequate provision of such social services as health, education and gender equity. The social dimension focuses on reconciliation of environment and development, and governance related to provision of social services.

### **The Sustainable Development Goals (SDGs)**

- ◆ The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity
- ◆ The 17 SDGs are integrated, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.
- ◆ Countries have committed to prioritize progress for those who are furthest behind.
- ◆ The SDGs are designed to end poverty, hunger, HIV/AIDS, and discrimination against women and girls.
- ◆ The creativity, knowhow, technology and financial resources from all society are necessary to achieve the SDGs in every context.

The 2030 SDG Agenda comprises 17 goals and 169 targets. The 17 SDGs are:

1. No Poverty
2. Zero Hunger
3. Good Health and Well-Being
4. Quality Education
5. Gender Equality
6. Clean Water and Sanitation
7. Affordable and Clean Energy
8. Decent Work and Economic Growth
9. Industry, Innovation and Infrastructure
10. Reduced Inequalities
11. Sustainable Cities and Communities
12. Responsible Consumption and Production
13. Climate Action
14. Life below Water
15. Life on Land
16. Peace, Justice and Strong Institutions
17. Partnerships for the Goals

### **Integration of the SDGs in the Ethiopian National Development Frameworks:**

In light of implementing the 2030 Sustainable Development Agenda, the FDRE appreciates the meaningful contribution of the SDGs to Ethiopia's aspirations to eradicate poverty and bring about prosperity for its people. The SDG's integration into the Growth and Transportation Plan II (GTP II) was, therefore, made possible by taking into account principal directions from GTP II.

GTP II focuses on creating conducive condition for macroeconomic stability, ensuring fast and sustained economic development, infrastructural development, human resources and technological capacity building, ensuring good governance and democratic systems building, environmental development, building of democratic systems, and in general fulfilling the renaissance journey of Ethiopia. Existing institutional forms and mechanisms have been used in implementing the SDGs and GTP II. SDGs have also a role to accelerate the economic development of Ethiopia in infrastructures development.

Integrated with GTP II, SDGs were implemented across the nation in 2015/16 fiscal year and progresses have been registered. This was made possible through:

1. Ensuring universal (inclusive) access to equitable and quality education (SDG 4).
2. Ensuring availability and sustainable management of water and sanitation for all (SDG-6).
3. Ensuring access to affordable & reliable energy for all (SDG-7)

Good Health and Well-Being was one of the areas that progress has been registered. great progress has been made against several leading causes of death and disease. Life expectancy has increased dramatically; infant and maternal mortality rates have declined and the tide on HIV and malaria deaths have halved.

## Performance of the SDGs

- The national and sectoral policies and strategies of the FDRE focused on eradication of poverty and implementation of development interventions that would have returns satisfying all the nation-wide demands/needs while ensuring inter-generational equity.
- The Climate-Change-Resilient Green-Economy strategy (CRGE-strategy) has been implemented.
- The Paris Agreement on climate change has also been implemented.
- National Policy and strategy on disaster prevention and management has been implemented across the nation.
- The Paris Agreement on climate change has also been implemented.
- National Policy and strategy on disaster prevention and management has been implemented across the nation.

In order to achieve the 2030 SDGs, national development priorities have been identified in the GTP II which is the first 5 years-phase (2015/16-2019/20). As the country made wide governance reform after 2018 the GTP plan was also adopted into homegrown economic reform. The new 10 year development plan of 2021-2030 is also contemplating the SDG main pillars. These include:

- I. Ensuring that the agricultural development sector remains the mainstay of the nation's accelerated economic development;
- II. Expediting change in the economic structure of the nation by transforming the manufacturing industry development;
- III. Enhancing the economy to its full economic capacity through increased focus on competitiveness, efficiency, productivity and quality;
- IV. Correcting the imbalance between overall demand and supply;
- V. Fostering the development of the construction industry and projects' management capacity;
- VI. Institutionalizing urban administration and management compatible with the accelerated urbanization, industrialization and structural changes in the economy;
- VII. Creating enabling environment for the transformation of domestic investors;
- VIII. Providing support to human resources development through building technologic capacity;
- IX. Building climate resilient green economy and
- X. Eliminating rent-seeking behaviors and ensuring the predominance of developmental frame of mind.

## Shortcoming of the notion of Sustainable Development

The Planetary Project criticism of the Concept of Sustainable Development develops in the following directions:

- The incorrectness of the term “sustainable development” and its internal logical contradiction.
- The narrowness of the term and the provocative tendency to confine global problems to the environmental context. Many scholars, politicians, social activists and industrialists believe that environmental protection issues cover the entire sustainable development strategy.
- The absence of a single concept of sustainable development, with multiple concept definitions causing considerable implementation difficulties.
- There is an opinion that the implementation of the concept of sustainable development can only bring benefits to a certain part of humanity rather than to all people.
- The controversial character of several methods used by the Concept of Sustainable Development.
- The diversity in understanding the goals of sustainable development, naturally arising from the different worldviews of the participants implementing a new civilization model, and countries and people representing cultural, social and political diversity.
- Without doubt, The Concept of Sustainable Development goals are aimed at creating a just and balanced world design.

Thus, in any case, both the critics and followers of the concept of Sustainable Development are united in believing that transition to sustainable development requires dramatic transformation of the current civilization, the core of which is the environmentalisation of all major human activities.

### Reflective Activity 3.1



1. Analyze the SDG intents and describe its adaptability to Ethiopian development schemes
2. Debate on the strengths and/or weaknesses of SD

## 3.2. Resource use policies and related conflicts

At the end of this section, you will be able to:

- examine conflicts over resources in your localities along with approaches to address them; and
- analyze the main drivers of conflict over renewable resources.

### KEY TERMS:

Natural Resource, Renewable resource, Resource conflict, Transboundary, Conflict over resource access, drivers of Conflict, Poor Governance, Non renewable resource

### Brainstorming Activity 3.2



1. How could conflict over natural resource arise in an area? Can you give a concrete example of such conflicts in your own area?
2. What would your contribution be in instances of such problems?

### Meanings and Types of Resources

The word resource is a general term, which refers to any element or substance useful for the satisfaction of man's requirement. Natural resources in any environment have varied capacity and rate of regeneration. On the basis of the regeneration capacity, the Natural resources are classified into two broad categories.

- i. Renewable resources
- ii. Non-renewable resources

**Renewable resources** are resources that are recurrent, meaning they can replenish themselves in the foreseeable future. They are also known as flow resources. The renewable resources are replaceable in character, because they regenerate themselves through reproduction or recycling. Renewable resources comprise all living or biotic resources and most of the Non-living or abiotic resources. Biotic resources includes living organisms or animals and plants (vegetation), and abiotic resources such as solar energy, land and soil, water, air, etc.

**Non-Renewable Resources** are resources that do not replace or regenerate by natural processes. This group of resources are also referred to as fixed or fund resources from the human point of view, because they are formed slowly and their supply is limited by nature. Therefore, with use, they are diminished or even last though time, and once they are used up, they are gone forever. This category consists of most mineral resources, such as coal, petroleum, Natural gas, Ferrous and Nonferrous metals, etc.

### **Categories of resource conflicts**

Resource conflicts are typically categorized according to the primary resource involved and to the main conflict driver. Typical resource categories include extractive resources (e.g., hydrocarbons, minerals, gemstones, and timber), land, and water. Of course, many conflicts involve the interplay of more than one type of resource. Indeed, in the majority of cases, one or more of the following drivers are at play: (1) conflict over resource ownership; (2) conflict over resource access; (3) conflict over decision making associated with resource management; and (4) conflict over distribution of resource revenues as well as other benefits and burdens.

### **Unique characteristics of natural resource conflicts**

A number of characteristics associated with natural resource conflicts contribute to their complexity and, in turn, influence approaches to their resolution. The scarcity or abundance of a specific natural resource fundamentally influences the conflict dynamics at play and the mediation opportunities available. Many resources are influenced by a range of natural and social factors leading to a high level of complexity and uncertainty in their availability, quality, and value.

Resource disputes often involve uneven geographic patterns of resource distribution that can be particularly salient when they occur along ethnic, religious, or linguistic lines. Tensions between competing livelihood groups over scarce natural resources often occur in seasonal cycles, which can escalate into violent outcomes following sudden shocks or stresses to the system.

Natural resources can play a number of different roles in the generation and escalation of tensions between stakeholders, ranging from triggering and intensifying conflicts to prolonging them. Resource conflicts can involve a wide range of actors and stakeholders, including nation-states, local governments, ethnic groups, communities, civil society organizations, and private companies.

Natural resources frequently play a key role in the broader political economy, often reinforcing the power of elite actors. Resource disputes are sometimes associated with significant power imbalances and asymmetries between the parties (e.g., international corporations versus local communities, or lack of formal representation of a specific livelihood group in a decision making process). In many situations, natural resources are governed by a combination of customary and statutory institutions, or hybrid political orders.

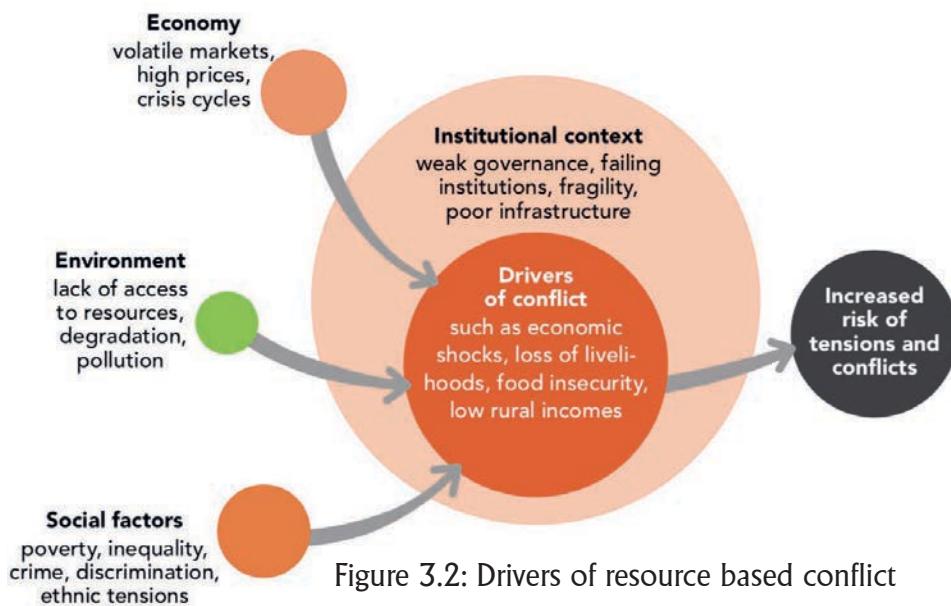


Figure 3.2: Drivers of resource based conflict

### Conflict over resources

Conflicts over renewable resources are essentially political issues concerning who should have access to and control over the resources?. Whose views should count in identifying and prioritizing issues and problems, and, desirable management goals and rates of use?

These key political questions can become sources of tension and division, based on the competing interests of different individuals, groups or countries. Such conflicts can occur at the local, national and transboundary levels as well as involve multiple stakeholders including communities, private sector actors, civil society organizations, local authorities and national governments.

However, conflicts are not in themselves a negative phenomenon. They can be an essential component of change and development. Non-violent resolution of conflicts is possible when the parties have trust in their governing structures and institutions to manage incompatible or competing interests.

Conflict becomes problematic when mechanisms for managing and resolving them break down, and give way to violence. Weak institutions, fragile political systems and divisive social relations can be drawn into cycles of conflict and violence. Preventing this negative spiral, and ensuring the peaceful resolution of disputes is in the core interest of nations, societies and the international community.

There are three main drivers of conflict over natural resources. These drivers, working alone or in combination, have been important factors in contributing to violent conflict when acting alongside other socio-economic, political and security stresses. These are:

1. Competition over increasingly scarce renewable resources;
2. Poor governance of renewable natural resources and the environment; and,
3. Transboundary natural resource dynamics and pressures.

These factors of conflicts over renewable natural resources can occur at many different levels (at the local, subnational, national and transboundary levels) and interact with larger political, economic or security stress factors and vulnerabilities. This is briefly discussed as follows:

### **1. Competition over increasingly scarce renewable resources:**

The concept of “resource scarcity” describes a situation where the supply of renewable resources such as water, forests, rangelands and croplands are not sufficient to meet the local demand. Increased scarcity of renewable natural resources that are needed to sustain livelihoods can increase competition between user groups or between economic sectors. Social responses to rising competition can include migration, technological innovation, cooperation and violent conflict.

There are three main causes for increasing resource scarcity working separately or in combination: These are:

1. Demand-induced scarcity;
2. Supply-induced scarcity; and
3. Structurally induced scarcity.

**Demand-induced scarcity** arises when demand for a specific renewable resource increases, and cannot be met by the existing supply. While a resource such as water or cropland may initially meet all local needs, population growth, increases in consumption rates, and/or the use of new technologies can reduce the per capita availability of the resource over time.

**Supply-induced scarcity** occurs when environmental degradation, natural variation or a breakdown in delivery infrastructure constrains or reduces the total supply of a specific resource. As the supply of natural resources is reduced, options for pursuing productive livelihood strategies are undermined, creating competition between livelihood groups that are difficult to resolve.

**Structural scarcity** occurs when different groups in a society face unequal resource access. While structural scarcity can be caused by poor NRM, it can also exist even in a well-functioning governance structure, as the result of different land use decisions and tradeoffs.

At the same time, it can also be caused by cultural practices as well as social and economic barriers. For example, in many regions of the world, women face restrictions in purchasing land, drilling water wells or harvesting resources.

Similarly, poverty itself can act as a significant barrier to purchasing the equipment needed to access and exploit a natural resource.

## **2. Poor governance of renewable natural resources and the environment:**

Governance of renewable natural resources and the environment refers to the institutions, policies and processes that are established to regulate their management, ownership, allocation, use and protection. In general terms, there are four types of grievances that lead to poor resource and environmental management.

### **The first is unclear, overlapping or poor enforcement of resource rights and laws.**

In many countries, land and renewable natural resources are regulated under a combination of statutory, customary, informal and religious forms of tenure. Disagreements regarding these ‘rules’ as well as uncertainty over resource rights are often at the heart of conflict. The ‘rules’ of resource governance vary from country to country, and even within countries. In many countries in the global South, it is common to find renewable natural resources, including land, regulated under statutory, customary, informal and religious forms of tenure. In many cases, conflicts occur either because specific groups have no rights to the resources on which they depend for their livelihood, or no feasible way to exercise the rights they do have. Similarly, conflict can occur when institutional jurisdictions, mandates or resource management laws are unclear, overlapping or contradictory. A lack of state capacity to extend its presence and authority into rural areas in order to enforce laws and resolve disputes is often a key cause of poor NRM.

**The second is discriminatory policies, rights and laws that marginalize specific groups.** When one group controls access to renewable resources to the detriment of others, natural resource-dependent communities are often marginalized. Violence can occur as individuals and groups seek greater or more fair and equitable access to key resources. The struggle for increased equity can become linked to the recognition of identity, status and political rights, making conflict resolution even more difficult. As discussed above, this can be a key factor causing structural scarcity.

### **The third is unequal distribution of benefits and burdens from development projects.**

Extractive industries, industrial sites or major infrastructure projects can provide multiple benefits to local communities as well as seriously degrade, exhaust or pollute renewable natural resources and become a major source of grievance. The environmental impacts of development projects can create tensions if communities are not compensated for the damage, and do not receive a share of the development benefits, financial or otherwise.

In other words, grievances are caused when the burdens of development exceed the benefits. Major grievances can also occur if specific renewable resources that have important cultural, spiritual or religious meaning are damaged. Such grievances can become highly emotive because they impact upon a people's way of life, or their perception of entitlement or lifestyle.

### **The fourth is lack of public participation and transparency in decision-making.**

Natural resource policies and interventions are often made by the state, in conjunction with private sector actors, without the active participation of affected communities or sufficient transparency and consultation with stakeholders. Where communities and stakeholders are poorly engaged or excluded from the decision making process over renewable natural resources, they are likely to oppose any related decisions and outcomes. Lost access to key resources, eviction without compensation or sudden price increases for renewable resources such as water, can lead to significant tensions between the affected communities, the government and the private sector.

### **3. Transboundary natural resource dynamics and pressures**

The challenges of managing renewable natural resources often extend beyond national borders. This is particularly the case for water, wildlife, fisheries and air quality. Similarly, risks to renewable resources from waste management, pollution, climate change and disasters are often transboundary in nature.

While states have - in accordance with the UN Charter and the principles of international law - the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, they also have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states.

Furthermore, Principle 2 of the Rio Declaration refers to the issues of sharing in the use and management of resources that move across international borders. Yet, transboundary dynamics are often beyond the capacity of a single sovereign state to manage unilaterally, requiring cooperation and co-management with neighboring countries.

There are four main types of transboundary dynamics and pressures that can cause conflicts over renewable natural resources.

First, when the transboundary natural resources, such as water or fisheries are shared between countries, conflicts can arise when one country consumes the resource at higher rates than another, and violates agreed allocations or demonstrates inflexibility when faced with natural variation.

This is often linked to existing power and political economy dynamics, as well as with the bargaining power associated with their geographic location (upstream/downstream).

Second, when the quality or quantity of transboundary natural resources, such as water, fisheries, wildlife and air, found in one country are negatively impacted by infrastructure, industrial development or changes in land use in another country. In particular, pollution generated in one country can easily cross national borders, creating health risks in another. Similarly, changes in land use in one country, including high levels of deforestation and soil erosion, can heighten vulnerabilities to natural hazards in another.



Figure 3.3: Dams on Trans-boundary Waters: GERD, Aswan and Sambangalou Top to down respectively.

Third, while national borders define the sovereign boundary of states, these are often not respected by pastoralists that migrate on a seasonal basis along traditional routes, based on the availability of natural resources, such as water and grazing land. Similarly, wildlife populations commonly migrate across national boundaries, shifting economic opportunities from one country to another. Both situations can be important sources of conflict as user groups face increasing competition and lose their livelihoods. This in turn may result in the loss of indigenous communities and their cultural and spiritual heritage.

Fourthly one, of the emerging threats to the natural resource base of countries comes from illicit activities and criminal groups operating on a global and transboundary basis. Illicit extraction and trade of natural resources deprive resource benefits of local communities which can lead to conflict.

At present, there are 263 rivers that either cross, or demarcate, international boundaries. To date, shared water resources have more often been the stimulus for co-operation than for conflict. Various studies indicate that cooperative interactions between riparian states over the past fifty years have outnumbered conflictive interactions by more than two-to-one. Since 1948, the historical record documents only 37 incidents of acute conflicts (i.e., those involving violence) over water (30 of these events were between Israel and one or another of its neighbors, the last of which occurred in 1970), while during that same period, approximately 295 international water agreements were negotiated and signed.

However, there are important qualifiers to this finding. They go on to observe that 158 of the world's 263 international basins lack any type of cooperative management framework, and that of the 106 basins with water institutions, approximately assisting in the design of co-management plans and institutions. Among these are:

- Iran and Iraq to resolve tensions over the development and conservation of the transboundary Mesopotamian marshlands;
- Iran and Afghanistan to address the degradation and co-management of the Sistan basin;
- Sudan and South Sudan to facilitate coordinated management
- Palestinian Authority and Israel to address water and waste management issues.

## The Nile Basin

Transboundary water management has evolved into a key diplomatic issue in the relationships of the eleven countries that share the Nile Basin. The upstream countries have argued for the unequal allocation of water resource shares and have been claiming for the right allocation. The Nile Basin Initiative (NBI) was formally established in 1999 as an effort to coordinate the management of the basin between the ten river basin states, and to promote peace and security among its member states. The NBI is the first initiative to include the participation of all basin states. Upstream countries usually requesting:

- To reach into agreement on equitable share;
- To undertake sustainable food production through irrigation and water supply;
- A mechanism for facilitating the construction of hydroelectric power; and
- A means of improvement of conservation of soil and water in collaboration with others.

Thus, at the heart of this dialogue is the question of equity. In 2010, five of the upstream states signed the “Nile River Basin Cooperative Framework” to utilize an equitable share of water from the basin, though Egypt and Sudan strongly opposed it.

International law commission (ILCs) article 5, states that water course states shall in their respective territories utilize an International water course in an equitable and reasonable manner. In particular, an international water course shall be used and developed among water course states with the view to attaining optimal utilization. An obligation not to cause significant harm to the river basin state(s) is written in article 7 of ILCs document. Article 8 states about obligation to cooperate; article 9 urges the exchange of data and information between the upstream and downstream states, and article 20 is about protection and preservation of the eco-system i.e., water course states individually and jointly protect and preserve the ecosystem of the international water course.

## Conflict Prevention Strategies

Conflict prevention refers to the set of approaches, methods and mechanisms used to avoid, minimize, resolve and contain conflict in order to prevent a further escalation to violence. Where natural resources are a direct source of conflict, or a contributing factor in a larger conflict context, prevention strategies must take into account the complex inter-relationships between causes, potential impacts and possible interventions. The way that conflicts over natural resources become politicized within the broader conflict and political context is also essential to consider. In all cases, conflicts over renewable resources interact with existing political, socio-economic and security tensions and stress factors, requiring a response on multiple levels, including technical, political and institutional responses.

In other words, there is no “quick fix” to the problem. The “technical side” of NRM cannot be addressed in isolation from the institutional and governance aspects, which together are the main determinants of how users relate to each other, and how competing interests are resolved. Appropriate interventions depend on the mix of conflict drivers, underlying vulnerabilities, livelihood responses, political processes, existing governance capacities and the level of conflict intensity. This could be achieved by implementing sustainable livelihoods and reduce vulnerability to resource scarcity.

### The sustainable livelihoods framework

The sustainable livelihoods framework has been adopted by a number of UN agencies and donors to understand how to reduce poverty at the household level. Sustainable livelihoods framework is a method to understand how livelihood strategies in a specific area compete for the same limited resources, together with the social assets and institutions that are available to prevent conflict.

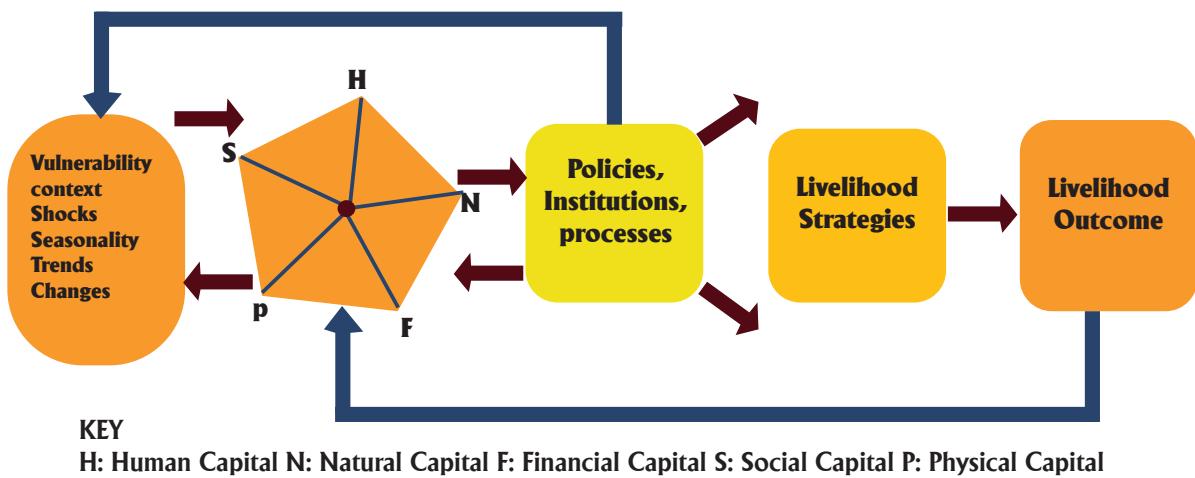


Figure 3.4 sustainable livelihood framework

The sustainable livelihoods framework can be used to inform conflict prevention programmes in three main ways:

First, it can help practitioners understand how changes in the availability of specific natural resources can impact livelihoods and lead to competition.

Secondly, it can help identify the social assets, coping mechanisms and institutions that are utilized to respond to shocks and resolve disputes over scarce resources.

Third, the sustainable livelihoods framework can help to identify specific interventions that can be undertaken to expand livelihood opportunities, reduce vulnerabilities from increasing resource scarcity, and provide access to dispute resolution. A major strength of the approach is that it does not perceive people as vulnerable and helpless, but as dynamic actors able to adapt to trends and cope with shocks.

The sustainable livelihoods approach does not offer a simple solution to the challenge of declining resource access and availability. However, it represents a useful approach to thinking through the problem, by providing a framework that facilitates coherent and structured discussion of differing perspectives. It draws attention to the assets people have rather than what they do not have; the cross-sectorial nature of livelihood strategies; to the vulnerability context; and to the role of policies, processes and institutions.

By encouraging local people to think about a broad range of livelihood outcomes, potential conflicts can be explicitly discussed and prevented.

There are five basic approaches that can be used to increase livelihood opportunities and reduce vulnerability to resource scarcity:

**1. Livelihood diversification aims for livelihoods to become increasingly:**

- a. multi-sectorial, including agricultural and nonagricultural work;
- b. multi-locational, including on-farm, at home, and off-farm (including in towns and cities), and
- c. multi-occupational, including self-employment and working for others. The basic approach with diversification is to make livelihoods less dependent on a single scarce resource in order to reduce vulnerability to reductions in supply.

**2. Improving the efficiency of resource dependent livelihoods and the amount of value added to raw goods: This involves two main measures:**

- d. improving the level of production of resource-dependent livelihoods (e.g., through agricultural extension, inputs, technologies); and
- e. adding more value to existing resources and raw goods (e.g., processing and manufacturing) at each stage in the value-chain.

**3. Livelihood adaptation programmes aim to adapt livelihoods to declines in resource availability from climate change and disasters. In areas where livelihoods are likely to be affected by long-term climate change, adaptation support is essential to prevent livelihood failure.**

For farming livelihoods, this can include: seasonal changes; using different varieties or species; augmenting water supply and irrigation systems; using alternative inputs (fertilizer, tillage methods, grain drying, and other field operations); forest fire management; promotion of agro-forestry; adaptive management with suitable species.

4. In regions where time does not permit livelihood diversification, efficiency improvements or adaptation, the focus should be on protecting livelihoods and preventing the erosion or destruction of livelihood assets, including natural capital. This generally includes: support to food security, income and employment support, market support, and production support. It tries to prevent coping strategies involving the liquidation of natural capital by providing immediate alternative measures.

5. Emergency livelihood support can be provided when livelihoods begin failing. This usually comprises standard life-saving interventions, including general food distribution and selective feeding programs, as well as public health interventions such as water provision, sanitation, shelter and health care.

### Reflective Activity 3.2

Discuss the following questions in your groups and share your ideas to the class.



1. If Ethiopia does not use its rivers, what do you think the consequences will be?
2. Why is Egypt opposing the construction of the Great Renaissance Dam? What have you contributed to the Great Renaissance Dam?
3. Do you think the international laws related to the use of water equally favor developing countries and developed ones?

### 3.3. GOVERNANCE OF NATURAL RESOURCES

At the end of this section, you will be able to:

- explain the principles and characteristics of governance of natural resources;
- appreciate the local indigenous way of protecting natural resource; and
- examine the main principles of good natural resource governance.

**KEY TERMS:** Good governance, Indigenous communities, Natural resource governance, Environmental protection, Social equity, Conservation, Discriminatory policies, Public participation, Unequal distribution

#### Brainstorming Activity 3.3



1. What is natural resource governance and why is it important in conservation of natural resources?
2. What are the qualities of a good governance?

Natural resource governance refers to the norms, institutions and processes that determine how power and responsibilities over natural resources are exercised, how decisions are taken, and how citizens – women, men, indigenous peoples and local communities participate in and benefit from the management of natural resources.

Natural resource governance is increasingly contentious in view of the over-exploitation of natural resources, the environmental degradation that results from excessive farming and mining, and the destruction of livelihoods in localities where such exploitation takes place. Improving natural resource governance, including securing rights and sharing power and responsibilities, can benefit both people and biodiversity, e.g., through improved ecosystem health and human wellbeing.

Land use debates, especially in the arena of conservation, wildlife protection and sustainable development, revolve strongly around natural resource governance because the prioritization, allocation and management of resources exert a direct impact on the environment and its inhabitants. Implicit in such debates is the call for exploitation of natural resources to be carried out in a manner/extent that, “meets the needs of the present without compromising the ability of the future generation to meet their own needs”.

Indigenous communities are particularly affected by exploitation of natural resources such as monoculture farming, industrial fishing, logging, mining and dam construction. This is why a central feature of natural resource governance pertains to indigenous self-determination and tenure rights. Unfortunately, the national legal frameworks of many countries have yet to accord the indigenous people sufficient recognition of their customary lands and the stewardship of their environments.

This is despite the existence of international conventions that advocate indigenous self-determination and self-governance. For example, Article 10 of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) states that indigenous peoples should not be forcibly removed from their lands; and where relocation takes place, it must be with the free, prior and informed consent of the indigenous peoples concerned, coupled with fair and just compensation (United Nations, 2007). Similarly, the Convention on Biological Diversity (CBD) recognises that communities are inextricably linked to their territories, and that the preservation of traditional knowledge is crucial to conservation and biological diversity.

It can be observed that consultation and access to justice are important in the protection of the rights of indigenous groups and any community affected by exploitation of natural resources or competing land use. Where the right to consultation is denied, an effective natural resource governance framework should provide the proper administrative or legal avenues of redress to the communities concerned. In the context of environmental protection, Article 1 of the Aarhus Convention or the UN Economic Commission for Europe (UNECE) Convention on access to information, public participation in decision-making and access to justice in environmental matters advances three pillars of public participation, namely:

- I. The right of access to information,
- II. Public participation in decision-making and
- III. Access to justice, as a means to empower communities in the protection of their own environments.

In sum, natural resource governance should embody principles that, among other things, promote environmental sustainability and recognize the tenure rights and cultural integrity of the communities concerned. To this end, the operational aspects of natural resource governance should foster bottom-up consensus oriented, decision making among multiple stakeholders, premised on trust, shared commitment and common understanding.

## Principles of Good Natural Resource Governance

As has been seen above, good governance is one of the fundamental preconditions for a sustainable development. However, it is challenging to distil common principles of good natural resource governance where multiple stakeholders function at different levels, interacting with culturally diverse communities, against the background of dissimilar geographical landscapes. Factionalism and the consequent competition and clash in priorities are the problems of governance framework in any sector.

Robust laws, institutions, policies and processes can help reduce the vulnerability of populations to renewable resource scarcity, resolve disputes between competing interests and prevent conflicts over resource access, ownership, control and management. It is impossible to prescribe ideal forms of institutions, policies and processes that could effectively manage natural resources and systematically resolve disputes. Given that conflicts over renewable natural resources are highly context dependent, no two governance solutions are ever the same.

There are four main governance challenges often lie at the root of conflicts over natural resources. These include:

- I. Unclear, overlapping or poor enforcement of resource rights and laws;
- II. Discriminatory policies, rights and laws that marginalize specific groups;
- III. Unequal distribution of benefits and burdens from development projects; and,
- IV. Lack of public participation and transparency in decision-making.

As a result, improving the basic governance of renewable natural resources to prevent conflict generally involves five types of interventions:

**First Principle**, there must be legal and institutional changes to clarify resource rights, responsibilities, laws and institutional mandates. This includes clearly recognizing and respecting the rights of poor and marginalized people who are directly dependent on natural resources.

**Second Principle**, at the national level, equitable resource access should be a priority of public policy and one of the outcomes of development programmes. This should include assessing the level of inequitable access to renewable resources and how it relates to socio-economic inequality, poverty and livelihood vulnerability. Based on this analysis, public policies and measures should be adopted to improve equitable resource access linked to sustainable livelihoods and poverty reduction.

**Third Principle**, an important component of any legal framework should include a requirement for conducting environmental and social impact assessments for all major development projects, including infrastructure, industrial sites, and major extractive industries.

Impact assessments should be conducted in a transparent way involving key stakeholders and made publically available.

**Fourth Principle**, another critical component of improved resource governance is to increase opportunities and requirements for public participation in decision-making and resource management. Community-based and collaborative management approaches are often used as a solution.

**Fifth Principle**, even where resource rights are clarified, environmental and social impact assessments are conducted, and public participation in decision making is enhanced, unexpected impacts on renewable resources can emerge as a normal part of the development process.

### Reflective Activity 3.3



1. What are the main principles of Good Natural Resource Governance?

## 3.4. INDIGENOUS CONFLICT RESOLUTION PRACTICES

At the end of this section, you will be able to:

- ➊ discuss the unique values and limitations of indigenous approaches used to address conflict over resources.

**KEY TERMS:** Indigenous, Conflict resolution, Shimagle 'elders', T'eer, Gadaa, Mada'a, Ogaz, Abbaa Gadaa, Kedo Abba



### Brainstorming Activity 3.4

1. What do we mean by indigenous knowledge? Are there any methods unique to your locality which do you think might not be found elsewhere?
2. How could the knowledge in various aspects, such as subsistence agriculture, fishing, forestry and foraging, improving water and resource management, and enhancing ecosystems in rural area is being transmitted from father to his/her son?

Societies world-wide have long used indigenous mechanisms to prevent and resolve conflicts. In every community, systems of indigenous conflict resolution often based on community customs, familial relationships, or embedded in institutional practices run alongside the formal state sanctioned processes. In a society where the majority of the populace is poor with widespread illiteracy culminating in lack of access to justice and the high cost and scarcity of lawyers, traditional conflict resolution stands out as the best method of conflict resolution.

In Ethiopia, many rural and village communities do not refer complaints to the police or prosecuting authorities, but instead deal with them using indigenous tribal processes. To this end, people practice various indigenous conflict resolution mechanisms.

These indigenous conflict resolution mechanisms are deeply rooted in culture and traditions of different ethnic groups. The practices are therefore associated with the cultural norms and values of the peoples and gain their legitimacy from the community values instead of the state. Besides, due to the multi-ethnic composition of the country, indigenous conflict resolution mechanisms of Ethiopia are different from ethnic group to ethnic group. As a result, they do not have uniform application all over the country.

In the ancient days and most especially under the Fetha Negast [law of the kings], conflicts between individuals or communities were encouraged to be settled amicably at local level. Elders-Shimagle - or people appointed on ad-hoc basis to settle disputes played an important role in resolving conflicts. Even today, these mechanisms are widely practiced among the various ethnic groups to settle various conflicts and many other problems. Figure 3.3 showed that elders in the community in Sidama, Ethiopia, and Northern Kenya are looking for a solution to a conflict over land, pasture, and water supplies.





Figure 3.5: Traditional resource conflict resolution vis-à-vis Formal systems (Sidama and North Kenya Ethiopia from up and down, respectively)

For instance, the institutions of Gadaa among the Oromo, the Shimagle by the Amhara and other ethnic groups are used to resolve conflicts. Moreover, even after passing through the procedures and penalties in the criminal court, in some parts of Ethiopia people use the indigenous conflict resolution mechanism for reconciliation and to reduce the acts of revenge. The pastoral community including the pastoralists of Ethiopia has well developed conflict resolution mechanism that involves elders and clan leaders to solve disputes in the context of traditional law. The T'eer of Somali, Gadaa system of Oromo and Mada'a of Afar are some of the indigenous conflict resolution and management systems which are governed by an unwritten law that is transmitted from generation to generation orally.

Although, there have been some minor differences in their practice and implementation, the Somali, Borana and Afar pastoralists do have their own indigenous institutions led by Ogaz, Abbaa Gadaa and Kedo Abba, respectively. These pastoral communities have two types of law, the conflict resolution laws that concern intra-ethnic group disputes, and laws concerning interethnic group disputes.

In Afar, the conflicts between different clans are managed by the Mada'a based on their customary law and elders. Elders, of the Madd'a, not representing members in disputes are selected from different clans. The decisions by the council of elders are effective due to the tradition of forgiveness, respect for elders, and the transfer of resources as compensation. Madaa was able to effectively manage conflicts between the Afar people and some of their neighbors in the past.

All Oromo clans have common indigenous conflict resolution mechanisms in which ‘Gumma’ is the known one. Gumma is a conflict resolution technique related to killing, particularly unintentional killing of an individual from other or within the same clan. It helps to avoid grievances and revenge that often follow such a killing.

In the case of the Somalis, there is a well-developed, relatively well-structured conflict management mechanism, where the guurti elders act as judges and jury, and their decisions are largely adhered to and respected by the community. The customary law of the Somali is exercised by the well-experienced elders, and the governing unit is the guurti (the council of elders). The institutions that elders developed are generally respected because elders are seen as trustworthy and knowledgeable people in the community, and are believed to make rational decisions. In addition to solving the conflicts, the elders take measure to prevent conflict through monitoring and punishing individuals who plan to trigger it and through pushing clans to respect the inter clan agreement in place.

Even though different studies underline the importance of indigenous conflict resolution mechanism in achieving sustainable peace and its preference in pastoral areas of the country, indigenous institutions are regarded as an alternative to the formal legal system. The formal legal systems have several weak points such as inaccessibility of the formal court system in the pastoral areas and the lengthy process to achieve justice. There are also instances where the formal legal system returns the cases to be seen by the elders' council, showing that indigenous conflict management and resolution mechanism bridges the gap created by the formal system. Formal conflict resolutions base themselves on a fixed code of law, and are hence unlikely to consider long standing social and economic relations among community members. Besides, government legal set ups often culminate in a zero sum outcome (winner-takes-all) because the main purpose is to serve justice through imposed agreements. They never target reconciliation and peaceful coexistence.

Indigenous conflict resolution and management, on the contrary lead to win-win situations as it takes into account the interest of every party. The disputants acknowledge that they have something to gain and something to lose in the end. Especially, in inter-clan conflict cases, the government legal institutions are regarded as auxiliaries to the local mediation involving elders. Therefore, it is crucial to understand Ethiopian society's potential and actual conflicts in their social context so that the norms, values and beliefs, fears and suspicions, interests and needs, attitudes and actions, relationships and networks are properly taken into account.

### Reflective Activity 3.4



1. What do you think about the Indigenous conflict management practice of Ethiopia?
2. How effective is indigenous conflict resolution compared to the modern approaches?

### The UN Declaration on the Rights of Indigenous Peoples

The Declaration, adopted by the United Nations General Assembly in 2007, makes direct reference to indigenous peoples' rights to land and self-determination – the two issues at the heart of most conflicts affecting indigenous peoples – besides other articles related to violence and conflict resolution.

**Article 7:** Recognizes that indigenous peoples have the collective right to live in freedom, peace and security as distinct peoples and shall not be subjected to any act of genocide or any other act of violence, including forcibly removing children of the group to another group.

**Article 30:** Asks states to undertake effective consultations with the indigenous peoples concerned, through appropriate procedures and in particular through their representative institutions, prior to using their lands or territories for military activities.

**Article 32:** States that indigenous people have the right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources.

**Article 40:** States that indigenous people have the right to access to and prompt decision through just and fair procedures for the resolution of conflicts and disputes with states or other parties, as well as to effective remedies for all infringements of their individual and collective rights.

## UNIT SUMMARY

Natural resources frequently represent an important source of income and power. Land, one of the natural resources in particular, is essential to the livelihoods of millions of people. On the basis of the regeneration capacity, the Natural resources are classified into two broad categories.

- i. Renewable resources
- ii. Non-renewable resources

Renewable resources are resources that can replenish themselves in the foreseeable future. They are also known as flow resources. The renewable resources are replaceable in character, because they regenerate themselves through reproduction or recycling. Non-Renewable Resources are resources that do not replace or regenerate by natural processes. They are also referred to as fixed or fund resources, because they are formed slowly and their supply is limited by nature.

The term “Sustainable Development” was first used in 1987 by the World Commission on Environment and Development. It is also known as the Brundtland Commission. In the commission’s report, sustainable development has been defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The Sustainable Development Goals, also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

When poorly managed, distributed or controlled in an unfair or unequal manner, natural resources can also be a major driver of conflict or instability.

There are three main drivers of conflict over natural resources. These drivers, working alone or in combination, have been important factors in contributing to violent conflict when acting alongside other socio-economic, political and security stresses. These are:

1. Competition over increasingly scarce renewable resources;
2. Poor governance of renewable natural resources and the environment; and,
3. Transboundary natural resource dynamics and pressures.

Conflict prevention refers to the set of approaches, methods and mechanisms used to avoid, minimize, resolve and contain conflict in order to prevent a further escalation to violence.

Where natural resources are a direct source of conflict, or a contributing factor in a larger conflict context, prevention strategies must take into account the complex inter-relationships between causes, potential impacts and possible interventions.

Natural resource governance refers to the norms, institutions and processes that determine how power and responsibilities over natural resources are exercised, how decisions are taken, and how citizens – women, men, indigenous peoples and local communities participate in and benefit from the management of natural resources.

Natural resource governance should embody principles that promote environmental sustainability and recognize the tenure rights and cultural integrity of the communities concerned. The operational aspects of natural resource governance should foster bottom-up consensus oriented decision making among multiple stakeholders, premised on trust, shared commitment and common understanding.

Societies world-wide have long used indigenous mechanisms to prevent and resolve conflicts. In a society where the majority of the populace is poor with widespread illiteracy culminating in lack of access to justice and the high cost and scarcity of lawyers, traditional conflict resolution stands out as the best method of conflict resolution.

In Ethiopia, people practice various indigenous conflict resolution mechanisms. These indigenous conflict resolution mechanisms are deeply rooted in culture and traditions of different ethnic groups

The T'eer of Somali, Gadaa system of Oromo and Mada'a of Afar are some of the indigenous conflict resolution and management systems which are governed by an unwritten law that is transmitted from generation to generation orally.



## REVIEW QUESTIONS

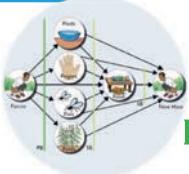
**Multiple Choice:** Choose the best answer

1. The social dimension of sustainable development focuses on:
  - a. Governance related provision
  - b. Maintaining a stable resource base
  - c. Avoiding overexploitation of non-renewable resources
  - d. Avoidance of extreme sectorial imbalances.
  - e. All of the above
  
2. Which one of the following is different from the others?
  - A. Water
  - B. Coal
  - C. Natural Vegetation
  - D. Soil
  
3. One of the following could be the cause of conflict over natural resources:
  - A. Information
  - B. Interest
  - C. Beliefs
  - D. All
  
4. One of the following is not among the main drivers of conflict over natural resources?
  - A. Resource scarcity
  - B. Poor governance
  - C. Transboundary resource
  - D. None
  
5. Which one of the following is a type of scarcity that occurs when different groups in a society face unequal resource access.
 

A. Supply-induced scarcity	B. Structural scarcity
C. Demand-induced scarcity	D. All
  
6. Which one of the following is an indicator of good governance of natural resources?
  - A. Discriminatory policies
  - B. Laws that marginalize specific groups.
  - C. Unequal distribution of benefits
  - D. Public participation and transparency

*Match the Items from Column B for Column A*

<b>Column A</b>	<b>Column B</b>
----- 7 T'eer	A. indigenous leaders resolving conflict in Somali
----- 8 Mada'a	B. Indigenous custom leaders in Borena culture
----- 9 Ogaz	C. Conflict resolution laws in Somali
----- 10 Abba Gadda	D. Customary law in Afar
	E. Dispute settlement custom in Amhara culture



# UNIT FOUR

## ISSUES IN SUSTAINABLE DEVELOPMENT II:

### POPULATION POLICIES, PROGRAMS AND THE ENVIRONMENT



#### Learning Outcomes

At the end of this unit, you will be able to:

- identify major population growth and development theories;
- analyze the impact of population policies on population growth;
- relate population growth to socio-economic development and environmental health;
- recommend strategies aimed at balancing population growth with environmental resources.



#### MAIN CONTENTS

Introduction

4.1. Theories on population growth and development

4.2. Population Policies

    4.2.1. Pro-natalist policy

    4.2.2. Anti-natalist policy

4.3. Measures taken to curb growth of population

4.4. Relationship between population and socio-economic development

4.5. Relationship between population and environmental health

Unit Summary

Review Questions

### 4.1 Theories on population growth and development

After completing this section, you will be able to:

- explain theories on population growth and development.

**KEY TERMS:** Conservative theories, Radical Theories, Malthusian, Neo-Malthusian, Malthusian crisis, Positive checks, Preventive checks

### Brainstorming Activity 4.1



Based on your experience about population dynamic identify the following questions and discuss each in a group of five, and then share with your classmates.

1. What is the contribution of Malthus in population growth?
2. What is the major role of Neo-Malthusian in contemporary population growth debate?

### Conservative vs. Radical Theories

Population size and change play such a fundamental role in human societies that they have been the subject of theorizing for millennia. Most religious traditions have had something to say on these matters, as did many of the leading figures of the ancient world.

#### Conservative Theories

##### 1. Malthusian Theory

Thomas Malthus (1776-1834)- Clergyman, Demographer and Economist maintained the idea that there is a natural law of population growth in which food production increases only linearly (1, 2, 3, 4, 5...etc.) and population rises geometrically (1, 2, 4, 8, 16, 32, ...etc.). Therefore population growth tends to outstrip food supply resulting in poverty and hunger – (a situation often described as the Malthusian crisis). In his 'Essay on the Principle of Population', Malthus (1798) wrote "the cause to which I allude is the constant tendency in all animated life to increase beyond the nourishment prepared for it".

Malthus suggested that a number of 'checks' would serve to keep the population at a level of subsistence (i.e., food supply ceiling). These, are the 'preventive checks' and the 'positive checks'. Preventive Checks: The key preventive check suggested by Malthus was one of 'moral restraint'. Men should attempt to marry late in life as this would give rise to fewer or smaller families.

**Positive Checks:** The positive check, according to Malthus, includes every cause which in any degree contributes to shorten the natural duration of human life. These are diverse and range from poor living and working conditions that might lower resistance to disease, as well as disease itself, wars and famines.

Malthus's pessimistic view of population suggests that human suffering and misery is inevitable, essentially due to population levels exceeding food availability.

Malthus believe that the main cause of high population growth rates lies in the fast breeding of the lower classes that need to adhere to a preventive check.

## **2. Neo-Malthusianism**

One of the most commonly held views in contemporary thinking on population is Neo-Malthusianism as derived from the arguments of Malthus.

The Neo-Malthusians' view follows the thinking of Malthus in that population growth is considered the main cause of poverty. However, unlike Malthus, they see birth control as a means of checking this growth.

Not only do Neo-Malthusians believe that a reduction in population will reduce social problems and alleviate human suffering, but they also see such steps leading to economic growth and improvements in living conditions.

An essential feature of the Neo-Malthusian argument, therefore, is the belief that the size of the population is the main cause of limitations to development, particularly in the less developed countries and that high population growth leads to high natural resource depletion and causes environmental degradation.

This demographic deterministic view of poverty, underlie most debate and discussions on population since the 1960s. It is the 'people versus resources' viewpoint held by many academics, demographers and commentators who all believe that there are too many people for the available resources.

Neo-Malthusians see the rapid rates of population growth in the developing countries resulting in widespread poverty, economic stagnation, environmental destruction, rapid urbanization, unemployment and political instability.

Like Malthus, the Neo-Malthusians see the problem resting with the poor who produce more children, because of their ignorance and lack of foresight. The solution, therefore, lies in persuading (or forcing if needs be) the poor to have fewer children.

It is against this background that the implementation and promotion of family planning programmes by international development agencies gained popularity as an efficient and cost-effective way to tackle the problems of development.

### **Evidence of Malthus and Neo-Malthusian predictions**

Neo-Malthusians would argue that the recurrent famine in countries such as Ethiopia and Somalia is proof of a positive check on population growth.

### **Critics**

Critics of Malthusian and Neo-Malthusian perspective on population have argued that the demographic deterministic view of poverty is fundamentally defective.

First, Neo-Malthusian arguments divert attention from the social and economic causes of poverty. Like Malthus, they simply blame human reproduction. The structure of underdevelopment is ignored, with the reproductive customs of developing countries people considered the main cause of their poverty.

Second, some critics argue that for those who saw the lower classes as a burden to society; Malthus and Neo-Malthusian view provides a perfect excuse not to improve their living conditions. They maintain that it is the failure of successive development strategies to bring about any appreciable improvement in the living conditions of the majority of the people of the world that needs to be discussed and not the productive habits of the poor.

Third, contrary to Malthusian and Neo-Malthusian predictions, world food production has increased more rapidly than that of population. The fact that many countries have stores suggest that it is the distribution of food resources, rather than a lack of, that is the key issue.

Fourth, many developing nations are now challenging the Malthusian and Neo-Malthusian perspectives on population and reclaiming their right to identify for themselves what they perceived their particular population problems are and how to resolve them without pressure from external agencies.

Fifth, there is a growing realization amongst development experts that population growth is NOT the cause of the development problems of the developing countries, but rather a symptom of the problems. New understanding and explanation of fertility rates in economically poor communities suggests that poor people may have many children for logical reasons, such as their economic value, and not just because they are backward-looking.

Sixth, both Malthusian and Neo-Malthusian views on population in relation to development are ethnocentric in nature. They both, implicitly, evaluate the reproductive behavior of people in the developing countries by criteria specific to western Europeans. When the rich nations suffer economic difficulties such as rising unemployment, these are treated as purely economic issues. However, when a developing country experiences obstacles to economic growth, then population pressure is often cited as the cause.

### **Conclusion on Malthusian and Neo-Malthusian**

The Malthusian and Neo-Malthusian view has dominated academic discussion and debate on population since the early 1800s. Their perspective on population and resources has had a profound effect on the way population policy is formulated, especially in the developing world. It has helped in the formulation and implementation of family planning programmes, and helped highlight concern over development problems.

However, the Neo-Malthusian approach which essentially argues for direct population control measures alongside development policies is filled with many difficulties. Not only does it divert academic attention away from arguably the most fundamental causes of poverty in the Third World, it also ignores the unequal distribution of global resources. At best, it fails to address the excessive pattern of resource consumption and waste by the 20% of the world's population who consume 80% of the earth's resources and instead blame the poor for being poor and for having large families.

### **Radical Theories**

#### **Ester Boserup's Hypothesis**

Ester Boserup - a Danish Economist offered an entirely different view on population resource debate. In her book 'The Conditions of Agricultural Growth' published in 1965, Boserup took an empirical approach to the relationship between population growth and food production rather than Malthus's deductive approach (i.e., reasoned by calculations).

Unlike Malthus, she believes that population growth is a major factor determining agricultural developments. According to her, 'population growth stimulates innovation and development in agriculture' thus causing an increase in food production. This is summed up by the following phrase '...Necessity is the mother of invention'. This suggests that an increase in population provides a major incentive for ways to be found to increase food production.

Boserup's main argument can be summarised as follows:

- There is a connection between population and technology. Population change is one of the determinants of technological change, and technological change is a determinant of demographic change.
- The increase in population pressure stimulates changes in the agricultural system. Rising population leads to intensification of farming methods in order to produce the extra food for the extra numbers.
- The pressure to change agricultural production by modifying farming techniques and frequencies with which a plot of land is cultivated come from demand for increased food production
- The sustained growth of population and agricultural output has secondary effects, which will set off a genuine process of economic growth
- All parts of the world have experienced these changes owing to the increase in population density

The conclusion from Boserup's hypothesis is that population growth naturally leads to development rather than being a hindrance to it. Boserup's idea is based upon field studies in SE Asia, and she developed her idea under a number of assumptions

### Critics of Ester Boserup's Hypothesis

Boserup's idea has been criticised for having a rather weak economic basis and her idea applies only to the agricultural production of mainly the developing world where the number of people depends on agriculture. As an area becomes more industrialised and developed, conditions of inadequate food production are much more likely to result in out-migration rather than agricultural innovation.

Her theory, according to some critics, fails to discuss the most recent technological innovations in the highly industrialised societies. Also critics have argue, her idea lacks any universal appeal because it is based on the assumption of an unsophisticated economies and 'closed' communities. In reality, communities are not closed instead; there is constant in- and out-migration. Relatively few communities, if any, operate closed systems producing food only to meet their own requirements. So, it is generally difficult to test her ideas.

Boserup's hypothesis gives no consideration to the qualitative aspects of diet and nutrition. Through the changes in agricultural techniques suggested by Boserup, it is possible that output may increase but the overall quality of diet and nutrition may decline.

Another criticism of Boserup's hypothesis relates to the time that the agricultural adaptation would take place. The innovation in agriculture cannot be presumed to occur immediately. If the population growth is rapid, it may overwhelm the agricultural system in the process of adjustment such that the necessary adjustments do not have time to occur.

It is clear that certain types of fragile environment cannot support excessive numbers of people. In such cases, population pressure may not lead to technological innovation as Boserup suggested.

Boserup herself admits that over-population can lead to unsuitable farming practices which may degrade the land. And she also recognises that in certain physical environments, continuing intensification of production may not be possible with rising population pressures.

In spite of Boserup's hypothesis, two major food problems persist in the world today - massive surpluses in the developed world and famine, starvation and shortage in the developing world. It appears, therefore, that it is not the level of resources which is the main cause of concern but the inability to share and distribute available resources equitably amongst the world's population.

### **Julian Simon - The 'Ultimate Resource' Theory**

Julian Simon (1932-1997), a US economist and statistician, made a significant contribution to the population versus resources debate. Unlike Malthus and Neo-Malthusians, Simon presents a radical optimistic theory to the whole debate.

Simon believes that population growth is not necessarily a bad thing, suggesting the ultimate resource is the people. He believes people are able to innovate to sustain themselves.

According to Simon, "the most important benefit of population size and growth is the increase it brings to the stock of useful knowledge. Minds matter economically as much as, or more than hands or mouths".

Simon believes that despite claims by neo-Malthusians that natural resources are finite with population growth, natural resources are not finite in any economic sense, which is why their cost can continue to fall.

In spite of the 'doom and gloom' of the Malthusian theory, Simon suggested the world food production has increased in both developed and developing countries since the World War II. According to him, the overall trend from 1948-1979 shows there has been an increase in food production per person.

Simon believes that food shortages and famines are caused by politics as the political regime of a country affects food production. According to Simon, any country that gives farmers a free market in food and labor secure property rights in the land and a political system that ensures these freedoms in the future will soon flush with food with an ever diminishing proportion of its workforce required to produce food.

Simon blames the West for destroying the developing countries farmers despite the assistance they give the developing countries in terms of technical shipments of food, by giving subsidies to their own farmers which raise food production artificially and hence reduce the world prices.

Simon believes that subsidies to Western farmers go hand in hand with the policies of African governments which steal from their farmers by forcing them to accept below market prices.

### **The Marxian Perspective**

Karl Marx (1818-1883) maintained that poverty and resource depletion is not a consequence of population growth but of unequal distribution of resources between classes.

Where ownership of and control over resources is confined to a capitalist or land owning class, potential always exists for poverty and hunger. Peasants and working poor have very little bargaining power compared to landlords and capitalists hence poverty and hunger results.

According to Marx, capitalism creates surplus population through: physical separation of producers (peasants, artisans, workers) by landowners from their means of production (land, machinery, tools etc.)

He also suggests that the destruction of traditional methods of farming and production through mechanization and changes in land usage and tenure are ways the capitalist rich class makes the working class poor.

The result is the total reliance on wage labor by the poor to acquire means of consumption (food, clothing, shelter, etc.). According to Marx, poverty occurs, not because of overpopulation, but rather through lack of access to means of gaining subsistence.

### **Reflective Activity 4.1**



1. What did you learn from the preceding population theory explanation?
2. What are the implications of such theories for our context?

## 4.2. Population Policies

After completing this section the student will be able to:

- analyze the effectiveness of population policies in developing countries; and
- examine the different population policies used by different countries.

**KEY TERMS:** Anti-natal, Pro-natal, Policy, Family planning, Contraceptives



### Brainstorming Activity 4.2

1. What is a population policy? Why is population policy formulated in a country?
2. What are the major categories of population policies?

A population policy is a policy that is formulated and implemented by a government in order to plan and control population growth, spatial distribution and structure based on the economic, social, cultural, political, and demographic conditions of the country. It is needed mainly to address population-related problems in a country.

The population policies of countries can be broadly categorized into two groups as: anti-natalist and pro-natalist policies. Both reflect the fact that while individual women and families ultimately control fertility, the state can play a pivotal role in providing or prohibiting access to reproductive health, family planning and other resources associated with fertility behavior. These influences of the state and their policies can directly target fertility or more indirectly shape the broader relational contexts of fertility geographies.

### Pro-natalist policies

What are the major characteristics of a pro-natalist policy? Which countries implement a pro-natalist policy?

Pro-natalist population policy seeks to increase fertility rates, in particular, and population growth rates, in general. Pro-natalists seek to incentivize increased fertility. They have a long historical pedigree and have been adopted by numerous countries, notwithstanding the civil liberties issues they can raise. While no single policy appears most effective, such policies do appear to influence fertility rates.

Within Europe, some countries (notably Germany, France, Sweden, Italy and Spain) had pro-natalist policies in place as early as the 1930s but by the turn of the present century around 88 countries provided incentives for women to have children.

In general, besides explicit exhortation and propaganda, pro-natalism is usually expressed in policies embracing welfare issues. It comes through, for example, in schemes that facilitate women leaving the paid labor force, grant mothers significant maternity pay, or provide substantial support for child caring mothers. For example, the French government worked to increase birth rates through such measures as the 1939 Family Code, provision of social and family benefits such as birth premiums, loans to young married couples, and housing subsidies. Many policies and the socio-cultural environments they support work more indirectly in promoting fertility than explicit pro-natalist policies. For example, acknowledging factors linked to fertility, governments may seek to ensure greater equality within the workplace and a reduction of the burden of family-work responsibilities by creating more flexible working hours, child care assistance, tax incentives, family allowances or low cost housing loans. Such policies can make having a child more economically feasible; highly relevant when noting the high average “cost” of raising a child. In support of this, an Austrian study found increases in parental leave increased fertility.

Pro-natalist policies may also be motivated by concerns about dependency consequences of an ageing society of low fertility. As noted, earlier governments may respond through facilitating immigration. Since much of the world’s population is still young, working-age immigrants from the Global South, in particular, can potentially provide both needed workers for countries with declining populations as well as increased fertility rates on account of their demographic concentration within the child-bearing years. Such policies, however, are likely to be extremely politically sensitive.

### **Anti-natalist policies**

What are the major characteristics of an anti-natalist policy? Which countries implement an anti-natalist policy?

Anti-natalist population policy seeks to lower fertility rates, in particular, and population growth rates, in general. countries may enact anti-natalist policies designed to reduce fertility. In fact, some countries have alternated between pro- and anti-natalist policies.

The most well-known anti-natalist attempt to reduce fertility has been China’s “one child” policy. When the country breakdown the campaign to promote birth control in the 1950s saw China’s TFR shoot up to over 6.0 by the early 1960s.

**Reflective Activity 4.2**

1. discuss the need of population policy for the country.

**4.3. Measures Taken to Curb the Growth Rate of Population**

After completing this section you will be able to:

- analyze measures taken to curb the growth rate of population;
- explain international movements related to population control; and
- discuss the different examples of population control from various cultures.

**KEY TERMS:** Child Tax , Contraception, Infant Mortality Decrease, One-child policies, Family planning, Consumption in wealthy countries, Rapid population growth

**Brainstorming Activity 4.3**

1. How can we control the growth rate of population?
2. What do we mean by effective population control methods?
3. Do you think people in the developed countries are worried about population growth of the developing countries?

In response to the fear of population growing out of hand and outgripping available resources as predicted by Malthus, there had been a number of national, regional and international initiatives aimed at slowing down the world fast-growing population.

In the 1970s, so great was the concern over the world's population expansion that a World Population Conference was held in Bucharest (1974), in which 136 countries agreed to a World Population Plan of Action. This plan highlighted the need "...to introduce family planning programmes and to reduce rates of population growth in order to conserve resources and improve standards of living", particularly in the less developed countries.

Ever since the Bucharest conference, the link between population growth and development has become even more direct. In 1994, there was an International Conference on Population and Development in Cairo which aimed at “linking population more effectively to core development agendas”.

Global population is increasing by about 1.5 percent per year, a growth rate (should it persist) that in less than half a century will double the number of people who live on the planet. On the other hand, modern medical techniques are producing life extension but not healthy life extension, and we are seeing numbers of old and chronically sick or disabled elderly people in increasingly longer economically unproductive retirements, who need consequentially increasing numbers of younger people to support them.

The ability of the Earth to sustain the human population, posed by Malthus over 200 years ago, is a serious question. Dependence on finite resources for energy and water is already threatening international stability. Potentially exponential population growth can only make matters worse. Improving economic development in the most populous countries of the developing world is leading to changing patterns of demand, as people seek more affluent lifestyles. Food and energy demands are increasing faster than had been predicted. Air quality resulting from over-rapid industrialisation is becoming a major problem that will have major public health effects. The likely determinants of climate change, usually attributed to the developed nations, are now spread throughout the developing world, making the ability of nations to achieve the targets signed-up to at Kyoto unlikely to be achieved.

### **International Moves**

In 1994 the United Nations Population Information Network (POPIN) organised an International Conference of Parliamentarians on Population and Development (ICPPD) and an International Conference of Parliamentarians on Population and Development (ICPD) in Cairo. There was a shift in thinking recognised at Cairo, towards viewing population from a more humane and equitable perspective. The consensus document that was produced recognises that consumption in wealthy countries and rapid population growth in poor countries put pressure on the natural environment, both locally and globally.

Rather than simply equating population policy with family planning, the new thinking is that population growth should be stabilised - and development enhanced - by attacking some of the roots of the problem: by improving women's access to education, health care, and economic and political decisions.

Today, more than half of all developing countries have national population policies, and about 130 national governments subsidize family planning services. When polled by the UN in 1994, 91 percent of the countries that lacked national population policies stated that they intended to formulate them in the near future, reflecting a rising global commitment to population-related concerns. But national policy statements do not necessarily translate into program implementation.

Table 4.1. The most important Population control methods

Rank	Population Control Methods
1	Child Tax
2	One-child policies
3	Family planning

**Child tax:** Higher taxation for parents with more children is one of the methods that can be used to control the population. This method of population control ensures that tax payers are entitled to an exemption for a specified number of children (mostly first two) but no other.

**Family Planning:** the idea of family planning highly related to access to safe, voluntary means of planning a family that is taken as human right issue. Family planning is central to gender equality and women's empowerment, and it is a key factor in reducing poverty. Yet in developing regions, women who want to avoid pregnancy are not using safe effective family planning methods. This is because of lack of access to information or ervices and lack of support from their partners or communitie This threatens their ability to build a better future for themselves, their families and their communities.

contraception as one of the family planning mechanisms is the most popular population control method in the world. It is a method used to prevent pregnancy. There are several methods of contraception or birth control. Some of the methods are irreversible while others are temporary.

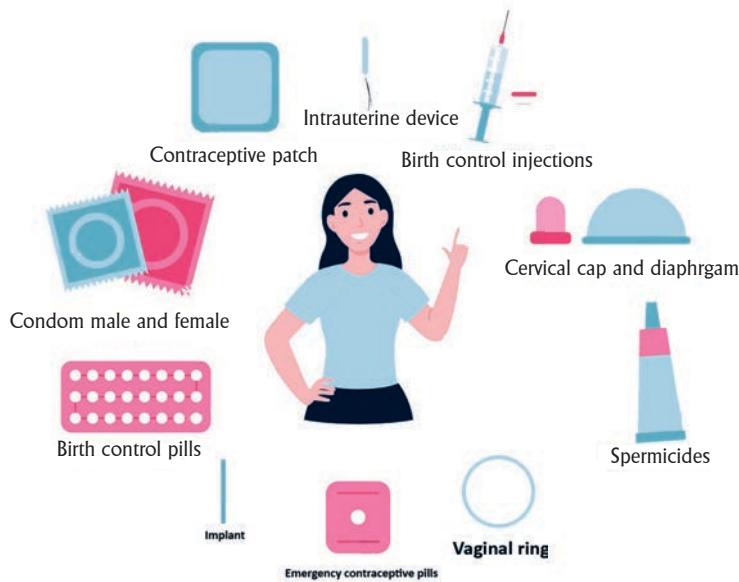


Figure 4.1: Contraceptive Methods

**One child policy:** The one-child policy was an official initiative of the Chinese central government that was implemented in the late 1970s and early 1980s. The initiative's goal was to prohibit the vast majority of family units in the country from having more than one child each. The policy's implementation was justified by the need to slow China's massive population increase. It was announced in late 2015 that the program's execution would end in early 2016.

### Examples from various cultures

China has operated a one-child policy for a number of years, enforced through a system of fines, relaxed after mass bereavements such as Sichuan Earthquake; the focus of China on population control helped to provide a better health service for women and a reduction in the risks of death and injury associated with pregnancy. At family planning offices, women receive free contraception and pre-natal classes. Help is provided for pregnant women to closely monitor their health.

India has greatly increased food production per head over last 20 years, making it better placed to absorb higher numbers. The country's most recent approach to population issues focuses on the advancement of women economically, academically, and socially, as independent women are more likely to have small families.

Africa: birth rates in Africa are the highest in the world. By the year 2050, twenty percent of the world's population will live on the African continent. That will be almost two thousand million people, up from eight hundred fifty-five million people today. Especially large population growth is expected in Nigeria, Ethiopia and the Democratic Republic of Congo.

Other countries likely to have major growth include Burkina Faso, Mali, Niger, Somalia and Uganda. Kenya was the first country in sub-Saharan Africa to view runaway population growth as a serious impediment to economic prosperity, and it became the first, in the late 1960s, to begin developing a national family-planning campaign. The country's official population policy calls for matching population size with available resources, yet leaves decisions on family size up to individual families.

As recently as 1970, Africa was essentially self-sufficient in food. What fostered a breakdown in the continent's ability to feed itself has been a decline of nearly 1 percent per year in per capita grain production since 1968 - in part due to an annual population growth for the continent approaching 3 percent.

The root cause of Africa's crisis is population growth faster than any other continent in history, widespread soil erosion and desertification, and a failure by African governments to adequately support agriculture.

The Millennium Development Goals (MDGs), committed to by all 191 United Nations member states, are rooted in the concept of sustainable development. Although 2007 (midway) reports indicated that programs are under way, unfortunately many countries are unlikely to reach their goals due to high levels of poverty.

The population is often considered as a source of economic, military, and political strength. However, a high population (overpopulation) can also be considered a threat to the environment and resources. However, population growth is a factor that can be managed. Human population planning is a means of intentionally controlling the human population growth rate. The practice may involve increasing or reducing the rate of human population growth.

### Reflective Activity 4.3



1. What is the importance of regulating population growth rate?
2. What sustainable suggestions can be forwarded
3. Analyze the measures Ethiopia takes to manage population growth and report to the class

## Challenges of Population Control

Although population control is largely supported by many people, some of the methods used have been contested. Some religious groups are against the use of contraceptives and other population control methods.

According to the countries' policy direction for regulating population growth, expanding access to high-quality reproductive health care, including for safe and effective methods of family planning, may help reduce fertility and hasten economic and social development. Yet, some of the significant obstacles connected to the execution of policy direction are:

- availability of facilities/equipment
- awareness
- language barrier
- effectiveness of family planning method
- accessibility of family planning services
- cultural acceptance
- religious acceptance
- wife/ Husband's acceptance

### Note



In 2016, China abandoned its decades-old one-child policy in favor of a two-child restriction, which has failed to result in a sustained increase in births.

## 4.4. The Relationship between Population and Socio-economic Development

After completing this section, you will be able to:

- explain the link between population growth and socio-economic development;
- differentiate the economic and environmental implications of population growth;
- explain the relationship and effects of health on development;
- distinguish the widely used measures of economic development;
- investigate the limitations of economic development; and
- examine the social indicators of development.

**KEY TERMS:** Economic development, Per-capita income, Standard of living , Gross Domestic Product

## Brainstorming Activity 4.4



1. What is the relationship between a steady increase in incomes, population growth and environmental quality?
2. What is Development?

## The Concept of Development

What is development? How do you relate sustainability with development?

Development is a difficult concept to define. The term development means different things to different people. Therefore, possible definitions include a wide range of elements (Figure 4.3).

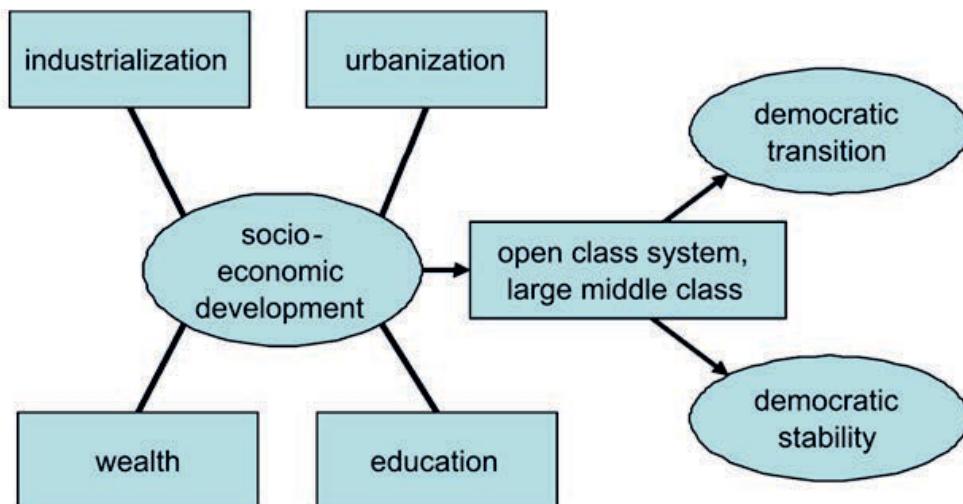


Figure 4.2: Elements of development

What do you understand from Figure 4.2? How do you relate development with the terms noted in each box of Figure 4.2? Despite the complexity of the issue, we have some definitions that can go well with the term development. Development is a process by which members of a society increase their personal and institutional capacities to mobilize and manage resources to produce sustainable improvements in their quality of life.

The most recent definition of development: Development represents the whole package of change by which an entire social system moves away from a condition of life perceived as unsatisfactory towards a situation or condition of life that is materially and spiritually better (Todaro and Smith, 2009:)

What are the main points included in the definition? Can you explain them briefly? What are the main objectives of development in any society?

Development in any society must have at least the following three objectives:

- I. To increase the availability and widen the distribution of basic life sustaining goods, such as food, shelter, health services and clothing.
- II. To raise living standards and levels of income, employment, education and attention to cultural and human values.
- III. To expand the range of economic and social choices.

What should be done to accomplish the above objectives?

Can you mention some of the efforts made in your locality?

Generally, economic development strategies should give due attention to increasing the productive capacities of human wealth and the health of the environment. This is done by concentrating on the following:

- I. Making sure that the nation has a labor force that is ready to work, hardworking and energetic.
- II. Improving the skill and the ability of the working force.
- III. Ensuring the human labor force has adequate medical care (in order to maintain its productiveness).
- IV. Improving the supply, multiplication and distribution of modern and environmentally friendly technology and other inputs.

In addition, in order to ensure sustainable development attention must be given to the environment.

## **Measures and Indicators of Development**

### **Brainstorming Activity 4.5**



1. What are the tools used to measure development?
2. How do we classify countries at different levels of development?

Indicators of development are measures of development in a given country. The most common indicators used to measure countries development are discussed as follows:

### **Gross Domestic Product (GDP)**

The GDP is a measure of the market value of commodities. It is the total value of currently produced final goods and services within a country's borders, usually in a year, irrespective of who owns the outputs. In developing countries, the GDP is not only low, but it is also dominated by primary commodities. On the other hand, secondary and tertiary economic activities contribute to the biggest shares to the GDP in the developed countries.

The GNP is the total value of goods and services produced by a country in a year, including incomes secured from abroad, through varied activities.

### **Per-Capita Income**

How can the per-capita income of a country be measured?

Per capita income or total income measures the average income earned per person in a given area in a specified year. It is calculated by dividing the country's total income by its total population. Per capita income is national income divided by population size. Of course as a measure of peoples' quality of life, it is indicative of their standard of living.

In the same way as the GDP, per-capita income for developed countries is very high and growing. This is the result of ever-increasing GDPs that are based on diversified urban industrial and commercial economies. Developing countries, on the other hand, have low per-capita incomes, whose bases are primary economy that lack diversification.

### **Standard of Living**

Standard of living is the level of income, comforts and services available, generally applied to a society or location, rather than to an individual. Standard of living is relevant because it is considered to contribute to an individual's quality of life. Standard of living is perhaps the best measure of the quality of life of a given society. It is directly related to both the GDP and per-capita income. This is because, as the latter get higher, the former improves, and vice versa. Developed countries have high and constantly growing living standards, while people of the developing world are characterized by low living standards. Based on the above and other indicators of development, countries of the world can be classified and named in different ways such as rich/poor, developed/ developing, north/south, first/second world, and more developed/less developed world. Also, using current development status as a criterion, they can be grouped as: developed, less developed and least developed.

The developed countries are the world's richest nations. This is because their economy is urban-based, industrial and specialized in commercial activities, supported by sophisticated technology and infrastructure (Table 4.2). Less developed countries include the bulk of the world's countries, which are found in Africa, Latin America, and Asia. They have traditional economic systems, largely based on agriculture, mining or a combination of both.

Table 4.2. The richest nations of the world

Country	GDP per capita income (US\$2020)	Adult literacy (%)	Annual population growth rate (%) (2020)	Life expectancy (years) (2020)	Urban population (%) (2020)
USA	63,206.50	No Data	0.57	80	83
Japan	40,193.30	No Data	-0.37	88	92
France	39,037.10	No Data	0.24	85	81
Norway	67,329.70	No Data	0.84	85	83
Germany	46,252.70	No Data	-0.02	83	77
Canada	43,258.30	No Data	0.84	84	82
UK	41,059.20	No Data	0.43	83	84
Switzerland	87,100.40	No Data	0.67	85	74
Italy	31,770.00	99.2 (2018)	-0.17	85	71

The least developed countries, as their name implies, are the poorest nations of the world. By all standards, these countries have the most backward economic and social systems. Hence, mass poverty is a common feature of the majority of the populations of these countries (see Table 4.3).

Table 4.3. Least developed countries

Country	GDP per capita income (US\$ 1) (2021)	Adult literacy (%) (2) (2019)	Annual population growth rate (%) (3) (2021)	Life expectancy (years) (4) (2020)	Urban population (%) (4) (2020)
Afghanistan	461		2.31	65	26
Angola	1798	71	3.22	61	67
Bangladesh	1957	74.6	0.95	73	38
Benin	1277	42	2.68	62	48
Bhutan	3306	68.5(2018)	1.03	72	42
Burkina Faso	809	41	2.82	62	31
Burundi	252	85	3.01	62	14
Central African Republic	479	37	1.97	54	42
Chad	674	40	2.95	55	24

Comoros	1371	58	2.13	65	29
Democratic Republic of the Congo	529	63	3.10	61	46
Eritrea	581	76.5 (2018)	1.69	67	36
Ethiopia	812	49	2.49	67	22

The above mentioned are the common types of measurements, which were used in many literatures. To construct comprehensive indices, it is necessary to incorporate economic, human, social, environmental and other related representative indicators. Based on this the following list of broader concern of development are designated.

These indicators may be broadly categorised as:

- A. Indicators of economic development
- B. Indicators of social development
- C. Health and related indicators

**Economic Indicators:** these are the major type economic measures used at the macro level. some of these indicators are:

- 1. GDP/GNP per capita
- 2. Growth rate of GDP
- 3. Growth rate of different sector of the economy

**Social development** refers to the institutions of societies through which development is enhanced: the ‘soft’ dimensions of development, often invisible and difficult to measure. The following are the commonly used indicators:

- I. Social capital- Institutions = formal and informal social norms that structure behaviour. Formal institutions are created by states and other entities such as laws, regulations, and rules. Informal institutions are behavioural norms, attitudes, beliefs, and the rules of the thumb
- II. Discrimination
- III. Exclusion
- IV. Female and male literacy rate
- V. Enrollment ratio of girls to boys
- VI. Percentage of population living below poverty line
- VII. Percentage of population with access to sanitation

Health and other demographic indicators are:

- I. Life expectancy at birth
- II. Infant mortality rate
- III. Child mortality rate
- IV. Maternal mortality ratio
- V. Percentage of children who are under weight

There are many more indicators depending on the context of study.

### **Factors of Economic Development**

The successful development of a country is not easy and not only the duty of the people in the society. It combines many factors for the success.

#### **Economic factors**

- i. The natural resources: Natural resources mean everything that occur naturally and which can be useful for living and feeding human's need. Natural resources of a country consist of things that happen naturally in the country. They facilitates the country to develop itself.
- ii. Capital expenditure: The capital is an essential factor for economic development in both its size and forms. It is obvious that if a country has more cumulative capital and uses it efficiently for its society and economy, it makes the country gain more advantages than that which lacks the capital.
- iii. Technology: The technology in the production is the measurement on the progress of the production. Therefore, technology is the main factor in the expansion of the production which affects the gross national economy of a country, and plays a role in the development of the economy.

#### **Non-economic factors**

The society: under this factor we have the following components:

- i. The labor force: It is not a simple resource but capital which is called "human capital". It is the most important in the economic development which is planned, implemented and beneficially received by human.
- ii. The Social value: Value of the people in a society comprises social, ethical and political values. It facilitates the rapid development of the economy and makes more progress on the development.

iii. The religion and Tradition: Although any religion teaches people to do good, it also has an impact on the value of people in society which may possibly contribute or block the socio-economy development.

iv. The Political stability: A country of political stability has no antagonistic conflict, no controversy between countries. People contribute to the government policies. Those facilitate the development because the domestic and international investors are interested in the investment which in turn provides the jobs for the people bringing incomes to the country.

### Social implications of population growth

Rapid population growth in less developed countries is linked to many problems, including poverty, hunger, high infant mortality and inadequate social services and infrastructure (transportation, communication etc.).

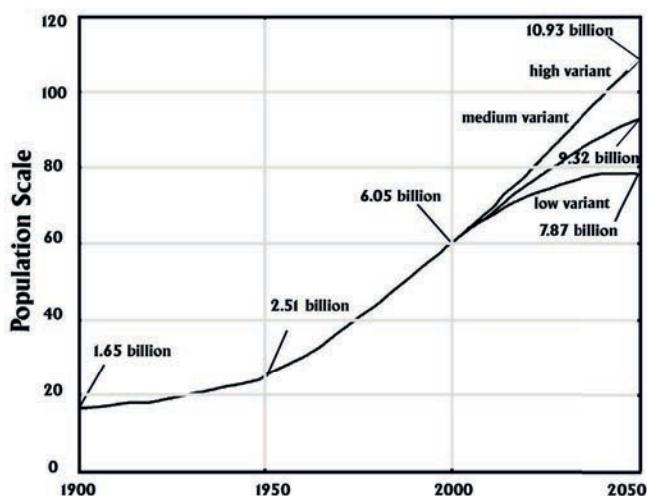


Figure 4.3: Estimated and projected population of the world

Rapid population growth may intensify the hunger problem in the most rapidly growing countries. Population growth can reduce or eliminate food production gains resulting from modernization of farming. Population pressures may also encourage practices, such as over irrigation and overuse of crop lands, which undermine the capacity to feed larger numbers. In some cases population growth is quite directly related to a social problem because it increases the absolute numbers whose needs must be met. For example some less developed countries have made enormous progress in increasing the percentage of children enrolled in school. However, because of population growth during the same period, the number of children who are not enrolled in school also increased because there were insufficient resources to meet the growing need.

Similar observations could be made about jobs and employment, housing, sanitation and other human needs such as water supply, transportation, energy requirement etc. These problems are compounded when large numbers migrate from rural to urban areas and increase the burden placed on already inadequate supplies and services.

### **Population growth and environment**

The relationship between population growth and environmental degradation may appear to be rather straight forward. More people demand more resources and generate more waste. Clearly, one of the challenges of a growing population is the mere presence of so many people sharing a limited number of resources strains the environment.

#### **Reflective Activity 4.4**



1. Discuss the concept of sustainable development.
2. What are the major indicators of development.

### **4.5. Relationship between Population and Environmental Health**

After completing this section you will be able to

- explain the relationship between population and environmental health
- describe the global essence of environmental health
- discuss the principles related to environmental health

**KEY TERMS:** Ecosystem resilience, Environmental Health, Clinical Model, Degradation of the environment, Environmental discrimination, Environmental justice, Racism, Biosafety

#### **Brainstorming Activity 4.6**



1. What do we mean by environmental health?
2. How can the disruption of the environment result in the disruption of human's health?
3. What do we mean by environmental justice?

## Concept of Environmental Health

“In its broadest sense, environmental health comprises those aspects of human health, disease, and injury that are determined or influenced by factors in the environment. This includes not only the study of the direct pathological effects of various chemical, physical, and biological agents, but also the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry, and agriculture.” (Healthy People 2010).

Environmental health can be defined as the interconnection between people and their environment by which human health and non-polluted environment are sustained.

Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.

## Environmental Health: The Global Scene

One of the drivers of the integration of environmental health issues into the overarching notion of sustainable development has been the UN Agenda 21, agreed by governments at the 1992 UN Earth Summit. Chapter 6 of Agenda 21 specifically addresses health issues, with five key target areas all of which related directly to environmental health priorities.

These target areas are:

1. Meeting primary health care needs, particularly in rural areas;
2. Controlling communicable diseases;
3. Protecting vulnerable groups;
4. Meeting the urban health challenge; and
5. Reducing health risks from environmental pollution

The global MDGs and SDGs have given due attention to environmental health in many of their goals and targets. Sustainable Development and SDGs reflect the common understanding that a healthy environment is integral to the full enjoyment of basic human rights, including the rights to life, health, food, water and sanitation, and quality of life.

## Environmental Health Intervention Models

Basic requirements for a healthy environment are clean air; safe and sufficient water; safe and adequate food; safe and peaceful settlements; and stable global environment.

There are 3 different models used to achieve the environmental health outcomes.

The first is **Clinical Model** where interventions focus on treating disease which has already occurred in the population. In most cases, it is an expensive and difficult situation. The second model is, **Public Health Model**, where attempts are made to control disease-causing agents which might already have infested the environment and created public health problems. The third model is the **Environmental Stewardship Model** which tries to address environmental problems from human activities and natural processes (see Figure 4.4.) Each of the above models has its own advantages and limitations.

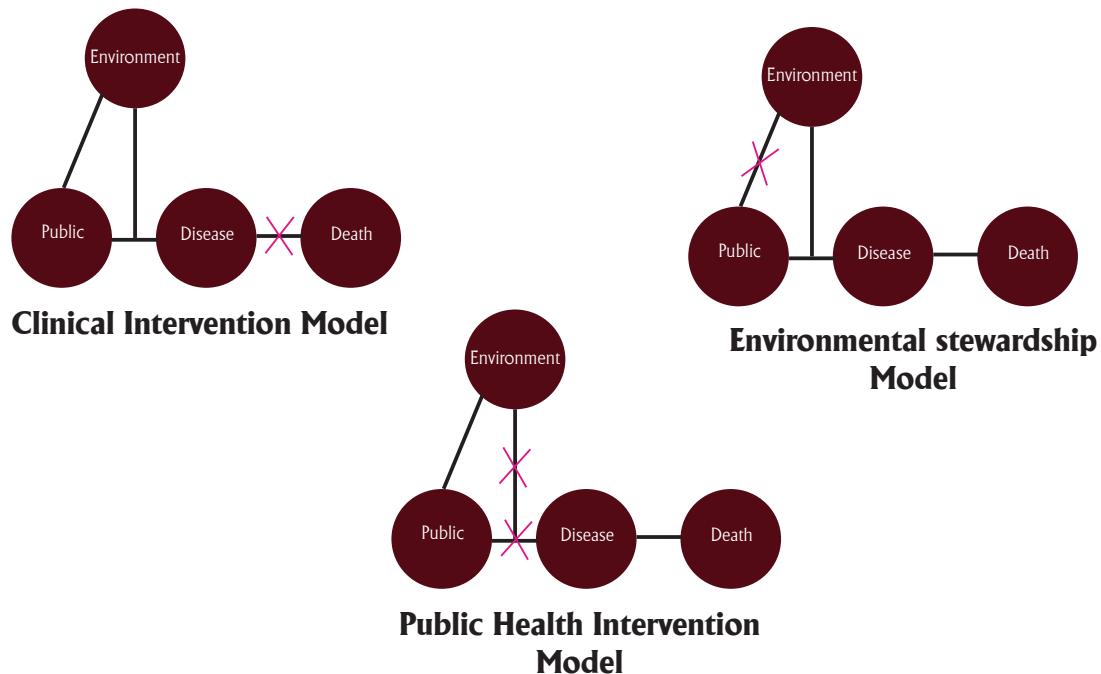


Figure 4.4: Models in improving human health and the environment

## Philosophy and principles related to environmental health:

The philosophical underpinnings and key principles indicate the need to focus on addressing environmental health issues.

Air pollution is the world's largest single environmental risk to health (some 7 million people across the world die each year due to everyday exposure to poor air quality), but it cannot be viewed in isolation.

Degradation of the environment, the air we breathe, the food we eat, the water we drink, and the ecosystems which sustain us is estimated to be responsible for at least a quarter of the global total burden of disease. Environmental degradation is estimated to cause 174-234 times as many premature deaths as occur in conflicts annually. Disproportionate impacts of environmental harms are evident on specific groups: the poor, the young, the elderly, women and migrant workers.

Corona virus (Covid-19), Zika, Ebola, Middle East respiratory syndrome (MERS) , Severe acute respiratory syndrome (SARS), Marburg... new zoonotic diseases (spread from animals to humans) are currently emerging every four months, with the main drivers being exponential population growth, intensive livestock breeding, (there are 36 billion domestic animals on the planet) and concomitantly disturbed environments and biodiversity loss. Strengthening healthy ecosystems is a key to preventing or slowing the emergence of these costly diseases. A key need is for greater investment in integrated surveillance of wildlife, livestock and human health.

The UNEP Healthy Environment, Healthy People report indicates that lack of access to clean water and sanitation causes 58 percent of cases of diarrheal diseases in low and middle-income countries.

There is growing evidence to suggest that exposure to natural environments can be associated with mental health benefits. The 2014 epidemiological study has shown that people who move to greener urban areas benefit from sustained improvements in their mental health. Proximity to green space has been associated with lower levels of stress and reduced symptomology for depression and anxiety, while interacting with nature can improve cognition for children with attention deficits and individuals with depression.

Clean air and water, sanitation and green spaces, safe workplaces can enhance people's quality of life: reduced mortality and morbidity, healthier lifestyles, improved productivity of workers and their families, improve lives of women, children and elderly and are crucial to mental health.

An integrated approach based on evidence of the linkages between poor environmental quality and health, studies identified several priority problem areas for urgent policy attention, including:

1. Unsafe water, inadequate sanitation or insufficient hygiene cause mortality, morbidity and lost economic productivity (Figure 4.5);
2. Nutritionally, poor diet composition and quality, as well as increased physical inactivity, has increased the growth of non-communicable diseases throughout the world; and
3. Degraded ecosystems and stresses to the Earth's natural systems, which reduce ecosystem services that support human health, enhance exposure to natural disasters, food security, and at times give rise to disease outbreaks.

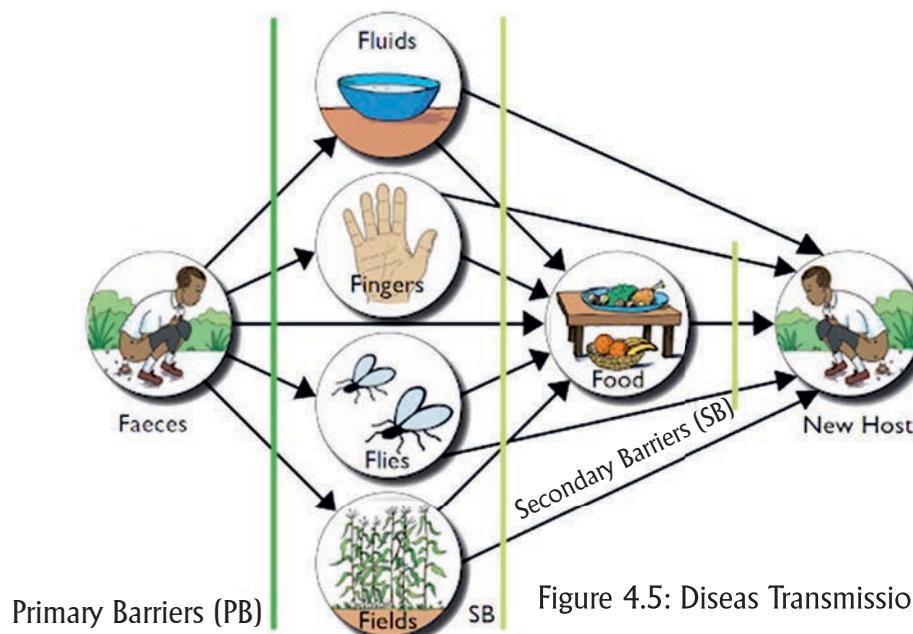


Figure 4.5: Diseases Transmission Method

The findings of reports provide a strong basis for adopting an integrated approach for improving human health and well-being through increased engagement by the health sector in ecosystem management and decision-making. They also identify integrated actions and strategies, such as:

- Reduce resource use and change lifestyles: Use fewer resources per unit of economic output produced and reduce the environmental impact of any resources used in production and consumption activities through more efficient practices.
- Enhance ecosystem resilience and protection of the planet's natural systems: Build capacity of the environment, economies and societies to anticipate, respond to and recover from disturbances and shocks through: agro-ecosystem restoration and sustainable farming systems; strengthening ecosystem restoration, in particular wetlands, dry land vegetation, coastal zones and watersheds, including through reforestation; reducing livestock and logging pressures to increase resilience and mitigate extreme weather conditions of storms, drought and floods.

- Addressing the nexus between environment and human health through delivering on environmental sustainability can provide a common platform for meeting many of the Sustainable Development Goals (SDGs) through multiplier effects that can accelerate and sustain progress across multiple SDGs, and investing in environmental sustainability can serve as an insurance policy for health and human well-being.

#### **Reflective Activity 4.5**



1. explain the essence of environmental health.
2. discuss about the effect of environment on human health.

## UNIT SUMMARY

Population size and change play a fundamental role in human societies that they have been the subject of theorizing for millennia. Most of these theoretical viewpoints have incorporated demographic components as elements of far grander schemes.

Only in a few cases have demographic concepts played a central role, as in the case of the theory of the demographic transition that evolved during the 1930s as a counter to biological explanations of fertility declines that were then current.

Malthus suggested that a number of 'checks' would serve to keep the population at a level of subsistence. These, are the 'preventive checks' and the 'positive checks'.

The Neo-Malthusians' view follows the thinking of Malthus in that population growth is considered the main cause of poverty. However, unlike Malthus, they see birth control as a means of checking this growth.

Unlike Malthus, Ester Boserup believes that population growth is a major factor determining agricultural developments. According to her, 'population growth stimulates innovation and development in agriculture' thus causing an increase in food production.

According to Marx, poverty occurs, not because of overpopulation, but rather through lack of access to means of gaining subsistence.

A population policy is a policy that is formulated and implemented by a government in order to plan and control population growth, based on the economic, social, cultural, political, and demographic conditions of the country. The population policies of countries can be broadly categorized into two groups as: anti-natalist and pro-natalist policies.

Pro-natalist population policy seeks to increase fertility rates, in particular, and population growth rates, in general. Anti-natalist population policy seeks to lower fertility rates, in particular, and population growth rates, in general.

While Governments in developing countries have adopted measures to reduce population growth rates, a growing number of Governments in developed countries have expressed concerns about low rates of population growth.

**REVIEW QUESTIONS****I. Multiple choice Questions**

Choose the correct answer from the given alternatives.

1. Which one of the following is the most popular population control method in the world?  
A. Contraception    B. Child Tax    C. One child policy    D. None of the above
  
2. Which one of the following diseases more related to the African continent?  
A. Zika    B. Ebola    C. MERS    D. SARS    E. Marburg
  
3. The environmental health model which deals with addressing environmental problems from human activities and natural processes is:  
A. Clinical Model  
B. Environmental Stewardship  
C. Public Health Model  
D. None of these
  
4. A condition that occurs wherein certain groups of people can be put at higher risk for environmental hazards and water pollution due to marginalization, economic and political processes is \_\_\_\_\_.  
A. Environmental racism    B. Biosafety  
C. Radiological health    D. None of the above
  
5. Which one of the following is not an environmental health concern?  
A. Food safety  
B. Housing  
C. Hazardous materials management  
D. None of the above



# UNIT FIVE

## ISSUES IN SUSTAINABLE DEVELOPMENT III CHALLENGES OF ECONOMIC DEVELOPMENT



### Learning Outcomes

At the end of this unit, you will be able to:

- identify the major global economic challenges by assessing global risks and priorities;
- analyze the advantages and limitations of globalization to the developing world;
- explain why and how trade imbalance occurs between developing and developed world;
- describe the impact of corruption on economic development;
- explain the major global health issues and problems; and
- recognize the major causes and effects of poverty.



### MAIN CONTENTS

- 5.1. Multiple Faces of Poverty and Implication to Development
  - 5.2. The Advantages and Disadvantage of Globalization
  - 5.3. The Growing Imbalance Between Regions and Countries
  - 5.4. Corruption
  - 5.5. Global Health Crises
- Unit Summary
- Review Questions

### Introduction

Sustainable development is a concept that denotes the relationship between economic growth, society and the environment. Sustainable development analysis differs from the standard economics of growth and development by incorporating natural resources as a form of natural capital. This may refer to the value of the existing stock of natural resources such as forests, fisheries, water, mineral deposits, and the environment in general. Natural capital provides goods and services to people, just as do financial capital, manufactured capital, and human capital. Actually, the human capital can be developed by investments in education and health.

There is unequal distribution of resource utilization. Large proportions of the world populations are consuming too little, particularly less developed countries. In 2015, approximately 10% of the world's population (736 million) lived in extreme poverty with incomes of less than \$1.90 per day. In 2017, 821 million people were malnourished, an increase in the number reported malnourished compared with 2016. In addition, rising inequality resulted in increasing polarization of society. Therefore, the weakness of the real world process is complicating the problem and challenging the sustainability of the resource utilization. The welfare of the citizen is also endangered. This unit therefore deals with the related socioeconomic issues such as multiple faces of poverty, globalization, the growing imbalance of regions and countries, corruption, and global health crises. There is an urgent need for further economic development to lift people out of poverty.

## 5.1. Multiple faces of poverty and implication to development

At the end of this section, you will be able to:

- identify the causes of poverty and their link to economic development; and
- explain the relationship between conflict and poverty.

**KEY TERMS:** Absolute poverty, Relative poverty, income security, opportunity, empowerment



### Brainstorming Activity 5.1

Attempt the following question individually and then share with your classmates.

1. How do you express poverty in your local context? What are the main dimensions and indicators of poverty?

#### 5.1.1. Concepts of Poverty

Poverty is generally considered to be a measure of deficiency of the basic needs that a person, household or community required to meet as a basic standard of living. This deficiency can be measured either in terms of a lack of resources such as income, assets, capabilities (e.g. skills, knowledge, technology or both). Basically poverty could be divided into two much known division; absolute and relative poverty.

**Absolute poverty** is when household income is below a certain level, which makes it impossible for the person or family to meet basic needs of life including food, shelter, safe drinking water, education, healthcare, etc.

In this state of poverty, even if the country is growing economically it has no effect on people living below the poverty line. Absolute poverty compares households based on a set of income level and this level varies from country to country depending on its overall economic conditions.

**Relative poverty** is when households receive 50% less than average household incomes, so they do have some money but still not enough money to afford anything above the basic need. This type of poverty is, on the other hand, changeable depending on the economic growth of the country.

- ◆ Relative poverty is sometimes described as “relative deficiency” because the people falling under this category are not living in total poverty, but they are not enjoying the same standard of life as everyone else in the country. It can be expressed in terms of having internet, clean clothes, a safe home (a healthy environment, free from abuse or neglect), or even education.
- ◆ Relative poverty can also be permanent, meaning that certain families have absolutely no chance of enjoying the same standards of living as other people in the same society currently have access to. They are basically “trapped” in a low relative income box.

When the relative approach is used to measure poverty, there is another concept that needs to be explored, namely, persistent poverty. This is when households receive 50 or 60% less income than average incomes every 2 out of 3 years. Since long-term poverty has more impactful consequences on economic and social conditions, persistent poverty is an important concept to bear in mind. There are also other measures of the dimensions of poverty and their indicators used in different researches works (Table 5.1).

Table 5.1. The selected dimensions and indicators

Dimension	Indicator
Income	Net income per capita
Education	Child school attendance & adult illiteracy
Health care	Health service, health status & health insurance
Access to social services	Electricity, drinking water, toilet, cooking fuel, transportation & housing
Social security	Work status, pension insurance, consumer durables & social insurance

### 5.1.2. Causes of Poverty

The causes of poverty is divided into two parts. These are the structural reasons of poverty as well as the behavioral or cultural explanations for poverty.

The structural approach points to systemic reasons for poverty: such things as racial and gender discrimination embedded in our markets and institutions; the profit motive and consequent low wages making it difficult for some families to escape poverty; and the failure to invest sufficiently in education, health care, and social insurance. According to this view, all of these factors reduce opportunity and increase economic insecurity. The failure to correct and accommodate the natural differences between people results in an uneven playing field and promotes the creation of poverty. Structural approaches to poverty point to patriarchy, capitalism, white privilege, and racism as the fundamental causes of most of the poverty in Western economies. Thus, the structural approach has come to be associated with those on the political left.

Behavioral or cultural approach: Without dismissing the fact that our structures, institutions, and systems might help explain poverty, especially the enabling of poverty, there are other researchers who emphasize culture, behavior, and personal differences as the source of much of the poverty that we observe in modern societies. Their argument is that there is a poverty culture or a set of attitudes and behaviors that tends to get passed along from parents to children and tends to perpetuate bad, self-defeating decisions, and hence poverty. Those attitudes (fatalism and the rejection of common societal norms like hard work, rationality, and non-violent dispute resolution) make many of the poor less attractive in the labor and marriage market and less capable parents. This perspective does not suggest that it is easy for low income people to resist these attitudes, but insists that each person has free will and is ultimately responsible for their own life. The behavioral or cultural approach to explaining poverty is typically favored by those who describe themselves as conservative or libertarian. Examining the features emphasized by poor people is one approach to examining the causes of poverty. Some of these features are:

- Lack of income and assets to attain basic necessities food, shelter, clothing, and acceptable levels of health and education.
- Sense of voicelessness and powerlessness in the institutions of state and society.
- Vulnerability to adverse shocks, linked to an inability to cope with them.

To understand the determinants of poverty in all its dimensions, it is helpful to think in terms of people's assets, the returns to (or productivity of) these assets, and the volatility of returns. These assets are of several kinds:

- Human assets, such as the capacity for basic labor, skills, and good health.
- Natural assets, such as land.
- Physical assets, such as access to infrastructure.
- Financial assets, such as savings and access to credit.
- Social assets, such as networks of contacts and reciprocal obligations that can be called on in time of need, and political influence over resources.

As stated clearly in various literatures, poverty mainly caused by labor market issues, education, demographic characteristics (age and family structure), race, poverty-related policies and cultural factors.

### **5.1.3. Relationship between Conflict and Poverty**

There is increasing recognition among researchers, social activists as well as policy-makers that violent conflict and poverty are inter-linked. In some instances, poverty can be identified as a factor directly contributing to conflict and in other instances conflict could be seen as creating poverty. Poverty has traditionally been a concern of development. Violent conflict on the other hand has been considered a peace and security issue. It is only relatively recently that these idea have begun to converge around the issue of violent conflict and poverty.

The literatures on conflict and chronic poverty to examine three hypotheses of relationship:

1. Conflict causes poverty
2. Poverty causes conflict
3. Resource wealth causes conflict

#### **Conflict causes poverty**

There is some consensus around the proposition that conflict causes poverty. Recently however, partly due to the problems of getting reliable data, there have been mainly descriptive accounts of the costs of conflict. The direct impacts including battlefield deaths, disablement and displacement have long-term costs for societies. Chronic poverty is likely to increase due to higher dependency ratios caused by an increased proportion of the old, women and disabled in the population. In a global analysis of conflict affected countries found similar patterns of macro-economic effects including a fall in GDP per capita, food production and exports, a fall in gross investment, government revenue and expenditure. War can lead to entitlement collapse and famine. Drawing upon the literature on famine and conflict, one can distinguish a continuum from vulnerability to external shocks to starvation and death.

Therefore a sole focus on destruction, poverty and people as victims provides only a partial reading of war. But it has outlined the political, economic and social dimensions of conflict which are likely to have an impact on chronic poverty. Moreover, the protracted, collapsed-state conflicts are likely to lead to intergenerational exclusion and chronic poverty.

### **Poverty causes conflict**

The hypothesis that poverty causes conflict is more contentious. Currently, conflicts are multi causal with a range of short term and long term factors coming into play, including a sudden economic slowdown in the face of rising expectations, external shocks and state crises. Isolating and weighting the different ‘risk factors’ is difficult. Is poverty a permissive or causal factor? Is it a structural cause, a trigger or an accelerator of violent conflict? Searching for root causes may have limited value given the capacity of conflicts to mutate over time. Few would argue for a deterministic link between poverty and conflict and the challenge is to understand how poverty may interact with a range of other factors in certain contexts and at certain times to produce violent conflict. A body of empirical work has emerged which examines poverty’s role as one of a number of causal factors behind violent conflict.

### **Resource wealth causes conflict**

Recent research works of the World Bank questions the view that conflicts are driven by grievance. The study also argues that popular perceptions are shaped by the discourse which conflicts themselves generate. War cannot be fought just on hopes and hatreds. Civil wars occur when rebel organizations are financially viable. Therefore it is the feasibility of predation which determines the risk of conflict. Rebellion is motivated by greed, so that it occurs when rebels can do well out of war.

#### **Reflective Activity 5.1**



1. How can you express poverty that isn't based on a monetary indicator? Use a real-life case study from your region to demonstrate this.
2. Arrange a small group discussion in the classroom about how government policies impact a country's increasing pattern of multilayered poverty. Have you noticed any attempts in your area?
3. What criteria do you use to assess it?

## 5.2. The Advantages and Limitations of Globalization

At the end of this section, you will be able to:

- describe the interrelationship of globalization and economic development in developing countries; and
- explain the advantage and disadvantage of globalization.

**KEY TERMS:** Multinational Corporation, mass media, global south, global north

### Brainstorming Activity 5.2



1. Is economic globalization a new form of imperialism, or does it encompass the entire world?

#### 5.2.1. Basic concept of globalization

Globalization has become one of the world's most contentious issues, the idea has been defined in a various ways, but the following is the most common one. Globalization is the process through which the world becomes more linked as a result of greater commerce and cultural interaction. Globalization has increased the production of goods and services. The biggest companies are no longer national firms but multinational corporations with subsidiaries in many countries. Globalization has been happening for hundreds of years, but it has accelerated dramatically in the last half century. Currently the term itself is used to describe the trend towards countries joining together economically, through politics, and education. Countries joining together economically view themselves not just through their national identities, but as part of the world as a whole.



However, a wide range of negative connotations were also given to globalization particularly in the context of developing countries. Local businesses and brands in developing nations can go bankrupt as huge corporations in developed nations can dominate the economy of their country. Local traditions and cultures may change. People in poor counties may no longer wear their cultural costumes as they would want to look like the stars in Hollywood. More and more schools in developing nations are teaching their students how to speak this global language etc. Globalization, thus, has many benefits and disadvantages and they are here to stay. Basically, the developed world has benefited from globalization, as they can sell more goods and products to on the global South.

### **5.2.2. Globalization and Developing Countries**

Globalization in the developing countries is manifested in the following three important fields such as economic and trade processes, education and health systems and culture effects.

**Economic and Trade Processes Field:** Globalization helps developing countries to deal with the rest of the world to increase their economic growth, solving the poverty problems in their country. In the past, developing countries were not able to tap on the world economy due to trade barriers. They cannot share the same economic growth that developed countries had. However, with globalization the World Bank and International Management encourage developing countries to go through market reforms and radical changes through large loans. Many developing nations began to take steps to open their markets by removing tariffs and free up their economies. The developed countries were able to invest in the developing nations, creating job opportunities for the people. For example, rapid growth in India and China has caused world poverty to decrease. However, countries in Africa still have the highest poverty rates, in fact, the rural areas of China which do not tap on global markets also suffer greatly from such high poverty. On the other hand, developed countries set up their companies and industries to the developing nations to take advantages of low wages and this causing pollution in countries with poor regulation of pollution. Furthermore, setting up companies and factories in the developing nations by developed countries affect badly to the economy of the developed countries and increase unemployment.

**Education and Health Systems:** Globalization contributed to develop the health and education systems in the developing countries. We can clearly see that education has increased in recent years, because globalization has a catalyst to the jobs that require higher skills set. This demand allowed people to gain higher education. Health and education are basic objectives to improve any nations, and there are strong relationships between economic growth and health and education systems.

Through growth in economic, living standards and life expectancy for the developing nations certainly get better. With more fortunes poor nations are able to supply good health care services and sanitation to their people. In addition, the government of developing countries can provide more money for health and education to the poor, which led to decrease the rates of illiteracy. This is seen in many developing countries whose illiteracy rate fell down recently. It is true that, living standards and life expectancy of developing countries increase through economic gains from globalization. An important drawback of globalization is, globalized competition has forced many skilled workers where highly educated and qualified professionals, such as scientists, doctors, engineers and IT specialists, migrate to developed countries to benefit from the higher wages and greater lifestyle prospects for themselves and their children. This leads to decrease skills labor in the developing countries.

**Culture Effects:** Globalization affected the developing countries culture in various ways. Not few cultural traits have been enormously changed through globalization, as the people are simply imitating others cultures like America and European countries. On the other hand, many developing countries extreme dependence and emphasis to globalization might lead to destroying of their own culture, tradition, identity, customs and even their languages. It was witnessed in some Arab countries (Iraq, Syria, Lebanon and Jordan) their cultures have been affected negatively. A kind of clothes they wear and a sort behavior they show are totally changed. Furthermore, globalization leads to disappearance of many words and expressions from local languages because many people use English and French words. In addition, great changes have taken place in the family life, young people are trying to leave their families and live alone when they get 18 years old. As a result the extended family tends to become smaller than before. This kinds of changes are also observed in many urban areas of Ethiopia. Figure 5.2 shows the main actors, processes they follow and benefits of globalization.



Figure 5.2. Actors, processes and benefits of Globalization

### 5.2.3. Advantages of Globalization

**Globalization increases free trade:** Globalization has increased the free trade between countries. The increased capital liquidity has allowed investors in well developed nations to invest in developing countries. Huge corporations from developed nations have great flexibility to operate in other countries.

**Global mass media ties the world together:** The increased flow of communication has allowed global mass media to tie the world together. Besides, global mass media has allowed vital information to be shared between corporations and individuals around the world. Globalization has also contributed to greater speed and ease of transporting goods and people.

**Eradicates Cultural Barriers:** Countries joining together economically, through politics and education have reduced and can even eradicate cultural barriers, and increase the global village effect. Globalization has proven to be the medium for the spread of democratic ideals to well developed nations and greater independence to developing countries in the Global South.

**Reduction of War:** Reduction of war between well developed nations is probably one of the primary benefits of globalization.

The following is a list of benefit that could be gained from globalization, both by the countries of global south and north.

- Increased free trade between nations,
- Increased liquidity of capital allowing investors in developed nations to invest in developing nations,
- Corporations have greater flexibility to operate across borders,
- Global mass media ties the world together,
- Increased flow of communications allows vital information to be shared between individuals and corporations around the world,
- Greater ease and speed of transportation of goods and people,
- Reduction of cultural barriers increases the global village effect,
- Spread of democratic ideals to developed nations,
- Reduction of likelihood of war between developed nations, and
- Increases in environmental protection efforts in developed nations.

### 5.2.4. Disadvantages of Globalization

**Decreased environmental integrity:** Globalization has the potential to decrease environmental integrity as polluting corporations from well developed countries can take advantage of developing nations weak regulatory rules.

**The seek for cheap labor:** Globalization increases jobs for non-skilled and skilled peoples of the developing nations as huge corporations of developed countries seek for cheap labor. This condition also creates further inequality between developed and developing countries. Thus the economic trend can also increase the likelihood of economic disrupt in a single nation, which could affect all nations socioeconomic condition, particularly in the impoverished developing nations.

**Limits cultural expressions:** Globalization imposes limits on free expression as most of the mass media tends to be controlled by huge corporations. This means that mass media can be used by handful corporations to pose risks in the cultural heritage of both well developed and developing nations. The following are some of the general disadvantages of globalization.

- Increased likelihood of economic disruptions in one nation effecting all nations,
- Corporate influence of nation-states far exceeds that of civil society organizations and average individuals,
- Threat that control of world media by a handful of corporations will limit cultural diversity,
- Greater chance of reactions for globalization being violent in an attempt to preserve cultural heritage
- Greater risk of diseases being transported unintentionally between nations,
- Spread of a materialistic lifestyle and attitude that sees consumption as the path to prosperity,
- International bodies like the World Trade Organization infringe on national and individual sovereignty, and
- Increase in the chances of civil war within developing countries and open war between developing countries as they vie for resources.

Globalization is a global economic trend that is here to stay. It has advantages and disadvantages, and these things will not disappear. People just need to know how to reap its benefits and reduce its risks. People must understand its impact globally, and work altogether to remedy the problems that may arise in the future. All countries in the Global North and Global South must work altogether to spread its benefits.

**Reflective Activity 5.2**

Critically think back about what you have learned in this unit and complete the following questions first individually and then share with your groups

1. Can you find an element of globalization in your locality?
2. How do you evaluate it? Disuses in your class.
3. Organize the class to undertake a collaborative learning on the impact of globalization on developing countries by taking Ethiopia as an example.

**5.3. The growing imbalance between regions and countries**

At the end of this section, you will be able to:

- demonstrate why and how trade imbalance occurs between developing and developed countries; and
- evaluate the level of countries or regional inequalities.

**Brainstorming Activity 5.3**

Attempt the following question and reflect your idea to the teacher.

1. Is the economy of countries getting more balanced or imbalanced as time passes?

Please explain why you choose each side of your response

**5.3.1. The concept of economic inequality between regions and countries**

The idea of inequality is both very simple and very complex. At one level it is the simplest of all ideas and has moved people with an immediate appeal hardly matched by any other concept. At the same time, is a very complex notion that has been the subject of much research outputs by philosophers, statisticians, political theorists, sociologists and economists. From the ancient period to the present, theories have seen trade as a key instrument in determining the trend of regional and country economic inequality. Both the convergence and divergence hypotheses take it into account with their distinct assumptions and methodologies. The available evidence on trends in global economic inequality comes mainly from two types of studies. Studies of the first type have been concerned with empirically testing the catching-up or convergence hypothesis. This states that less developed countries and regions should be expected to grow faster than more developed ones.

The hypothesis clearly refers to what we have called inter-country inequality and proposes that we should expect this to decline over time. Three main arguments have been advanced in support of the hypothesis.

- First, the latecomers into the world of modern economic growth enjoy an advantage because they can simply adopt and exploit technologies, which the pioneers had to develop through their own efforts.
- Second, assumption reflects there are diminishing returns to inputs factor. This implies less developed economies have an advantage of low production cost because of low labor wage and the price of other factor input. Thus, for equivalent rates of investment, the less developed economies should be able to achieve higher growth.
- Third, the shift of large amounts of labor from farm to industry boosts labor productivity in general. The importance of this source of productivity growth, however, declines with development as productivity tends to equalize across sectors and activities, and fewer and fewer workers remain in low-productivity

Nevertheless, widening income inequality is the defining challenge of our time. In advanced economies, the gap between the rich and poor is at its highest level in decades. Inequality trends have been more mixed in emerging markets and developing countries. Thus, the Second view investigates the divergent trends in inequality developments across advanced economies and developing countries, with a particular focus on the poor and the middle class. The pro-divergent notion primarily highlighted the rationale for this divergence as the countries' current experience. They practically demonstrate a diverging pattern of inequality. The following are some of the evidences that support the greater divergent pattern of inequality.

- Inequality has been exacerbated by technological development and the associated increase in skill, as well as the collapse of various labor market institutions in both advanced economies and developing countries.
- The growing skill premiums are related with expanding income inequalities in advanced nations, whereas financial deepening is associated with rising inequality in developing countries.

### 5.3.2. Cause and effect of trade imbalance

An important indicator of regional and national inequality is measuring the trade balance. A trade imbalance occurs when the cost of a country's imports exceeds the cost of its exports. It is one approach to measure international commerce, and it's also known as a negative trade balance. A country's trade deficit may be calculated by subtracting the entire value of its exports from the total value of its imports. The major causes and effect of this imbalance are stated below.

**Causes:** A trade imbalance happens when a country does not produce what it requires and must borrow from other countries to pay for imports. This is referred to as a current account deficit. A trade deficit also occurs when companies manufacture goods in other countries. The raw materials for manufacturing that are shipped overseas for factory production count as an export. The finished manufactured goods are counted as imports when they're shipped back to the country. The imports are subtracted from the country's gross domestic product even though the earnings may benefit the company's stock price, and the taxes may increase the country's revenue stream.

**Effects:** A trade can enhance a country's standard of living since citizens can access a broader range of goods and services at a lower cost. It can also reduce the threat of inflation since it creates lower prices. However, a trade imbalance may result in more job outsourcing to foreign countries over time. As a country imports more goods than it buys domestically, then the home country may create fewer jobs in certain industries. At the same time, foreign companies will likely hire new workers to keep up with the demand for their exports.

### 5.3.3. Measurement of countries and regional inequalities

Economic inequality, in this context, measures the inequality between a percentage of population and the percentage of resources (such as income) received by that population. Inequality studies explore the levels of resource disparity and their practical and political implications. Though there are number of measures, the most often used metrics for evaluating global economic disparity is per capita GDP. The major characteristics or features that were considered in such assessment are listed below.

- Physical attributes – distribution of natural ability is not equal
- Personal Preferences – Relative valuation of leisure and work effort differs
- Social Process – Pressure to work or not to work varies across particular fields or disciplines
- Public Policy – tax, labor, education, and other policies affect the distribution of resources.

Most people believed that economic disparity in Africa was quite modest and, at best, wasn't a significant barrier to reducing poverty until recently. Mostly because they are all generally impoverished. However, there was a general sense of concern when it was found that inequality in Sub-Saharan Africa was among the greatest in the world. The discrepancy can be seen in both income and non-income circumstances.

Income inequality of sub-Saharan Africa is one of the most unequal, despite low levels of per capita income. Inequalities in non-income dimensions of welfare are also high, particularly between men and women and between regions, and have remained persistent over time. Furthermore, although income inequalities are typically more of an urban phenomenon, asset-based and capability-based inequalities in fact tend to be higher in rural than urban areas. In countries where there is a significant initial income difference, economic growth is less effective at alleviating poverty. Economic expansion and inequality reduction must go hand in hand to significantly reduce poverty. Figure 5.3, which is based on data from the World Bank gathered between 2011 and 2018, shows the level of inequality in a chosen number of sub-Saharan African countries. According to the data, a country's index value rises when levels of economic disparity among its citizens' decline.

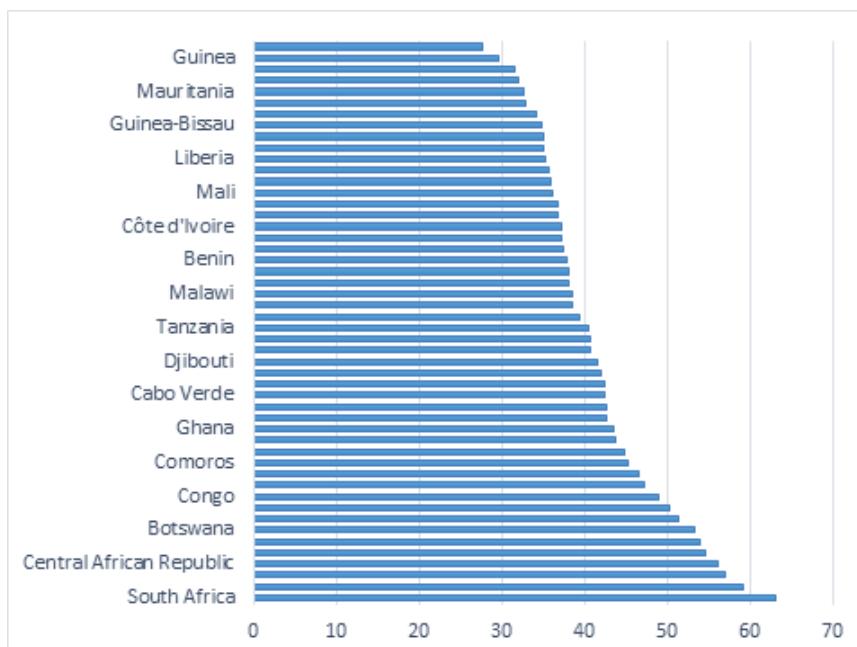


Figure 5.3: Selected Africa Country Ranking in inequality (World Bank estimate of GINI index)

Take for example; countries like S. Africa and Guinea as cases, the inequality that exists in these countries. A Gini coefficient of 0 reflects perfect equality, where all income or wealth values are the same, while a Gini coefficient of 1 (or 100%) reflects maximal inequality among values

#### 5.3.4. The Widening current global imbalance

Measures of inequality based on GINI coefficients of gross and net incomes have increased substantially since 1990 in most of the developed world (see figure 5.8). Inequality, on average, has remained stable in developing countries, Although at a much higher level than observed in advanced economies. However, there are large disparities across developing countries, with Asia and Eastern Europe experiencing marked increases in inequality, and countries in Latin America exhibiting notable declines (although the region remains the most unequal in the world).

During 1990–2012, market income inequality in advanced economies increased by an average of 5<sup>o</sup> GINI points compared to a 3 GINI point increase in the net GINI coefficient.

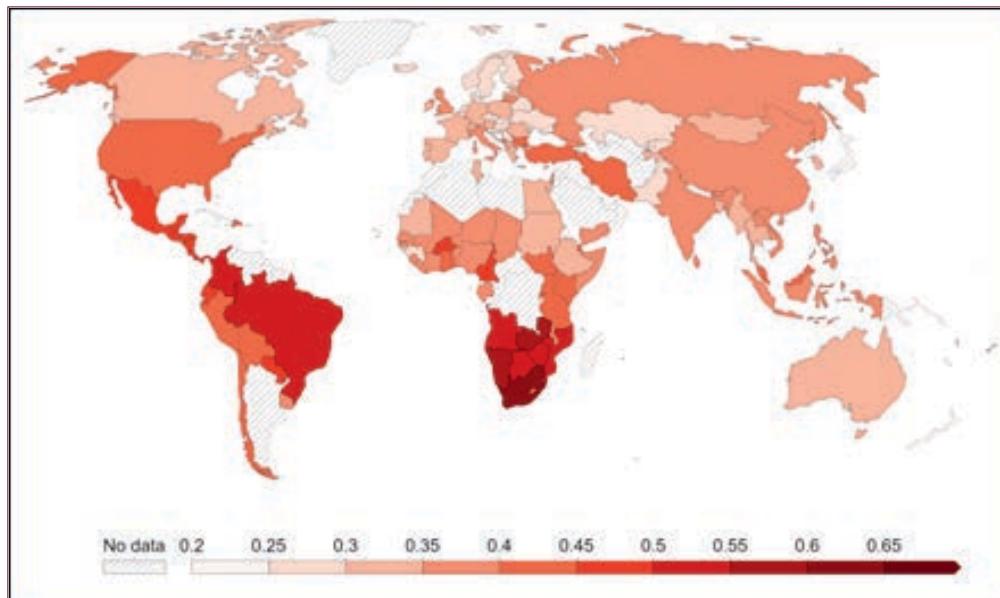


Figure 5.4: Income inequality Gini coefficient of the world 2019

### Reflective Activity 5.3



Arrange a small group discussion in the classroom to look at:

1. Why some countries with abundant natural resources remain destitute, while others are becoming more prosperous while having less natural resources.

Conduct a debate on the role of poor and rich countries in bringing about global trade imbalance.

## 5.4. Corruption

At the end of this section, you will be able to:

- explain the different type of corruption; and
- demonstrate how corruption affects economic development by taking concrete examples.

**KEY TERMS:** Bribery, patronage, petty corruption, grand corruption and Corruption Perceptions Index.



## Brainstorming Activity 5.4

Students, please attempt the following question individual and then share with your classmates.

1. Do you think that corruption is one of the major factors that hamper the growth of your country?
2. Discuss why or why not depending on your response.

### 5.4.1. The Concept of Corruption

Currently critical geography examines corruption as an objective collection of deviant actions predominantly affecting states, particularly in the Global South. It also illustrates how corruption explanations get politicized and interrelated with material, and geographical power regimes. For instance, urban informality is regarded as a significant linked issue in both the North and South.

The term corruption involves a wide range of behaviors differing in their causes and effects in different spatiotemporal contexts. Corruption may be defined in different ways, occurs in varying levels of severity, and takes various forms in time and space, depending on local political cultures and institutional frameworks. There is no one single definition of corruption that can be applied to all circumstances, for example, corruption can be petty or large-scale, systemic or occasional, implicit or explicit, committed by individuals. Similarly, corruption defined as the abuse of entrusted power for private gain. It also more commonly defined as evil, a disastrous personal failing. Legally, however, judicial systems punish acts, not character. In this view, corruption is a source of injustice and inequality.

Corruption is simultaneously a political, economic, legal, and moral phenomenon.

The relationship between corruption and economic growth has been debated. Many studies have found evidence that corruption has harmful effects on economic growth. Corruption shows a negative correlation with economic growth after controlling for institutional efficiency. Furthermore, corruption causes uncertainty for investors and raises investment risk in nations with high levels of corruption.

### 5.4.2. Types of corruption

Corruption can be categorized in various dimensions to facilitate the understanding of how corruption affects economic performance. The concept includes three broad categories of human action; bribery, theft of public assets, and patronage.

**Bribery** is the most familiar among corrupt processes. It consists of payments by individuals or firms to public officials in order to influence administrative decisions under their responsibility. Bribery covers a wide range of administrative decisions, determined by the scope of government regulations and activity. It frequently overlaps with the other two corruption categories through the collusion of briber and bribe.

**Theft of public assets** can occur as unilateral embezzlement by public officials or through the collusion of public officials and private agents. Apart from the illegal transfer of real or financial public assets at below-market prices, it includes evasion of taxes and other legal payments to the public sector, as well as diversion of public funds from their intended use into private pockets.

**Corruption in the form of patronage** (sometimes called favoritism, nepotism, clientelism) consists of the preferential treatment of firms and/or individuals by public officials regarding the compliance with government rules for the allocation of government contracts or transfer payments. The private sector counterpart consists of “special favors” in the form of financial rewards or professional opportunities granted to the public official involved.

Another distinction is that an act of corruption, which can be characterized by the value of the transaction concerned. Although this is a continuous variable, the analytical distinction usually made is between low value (“petty”) and large value (“grand”) corruption. Typically, the larger the value of the corrupt transaction, the higher the position in the public hierarchy of the public official(s) involved.

Various combinations of the characteristics detailed above have given rise to specific types of corruption. Thus systematic theft at a grand scale by high public officials is called “kleptocracy”, while systematic patronage with large stakes has been labelled “crony capitalism” or “government capture”. “Kick-backs” describe acts of bribery that involve theft of public assets or patronage.

### 5.4.3. Geography of Corruption

Corruption has got a geographical essence because social processes are always distributed unevenly across space. The causes, nature, and consequences of corruption differ from place to place, depending on the context of historical, cultural, legal and political organization. The incidence of corruption is difficult to determine empirically because its committers are often adept at keeping it hidden.

Analyses of corruption in different regional contexts rely heavily on the corruption indicator of Transparency International, which is a global nongovernmental organization dedicated to monitoring and combatting public and private sector corruption.

The group is involved in a variety of tangled activities, including measuring corruption, exposing inexcusable cases, offering advice to companies to minimize corruption, and developing tools for combatting it. The organizations produce annual corruption report with Corruption Perceptions Index (CPI) of government misconduct, issued since 1995. The CPI is a composite indicator based on surveys and interviews with public and private sector officials in each country and expert assessments by 13 sources, including the different global, regional and national organizations. A minimum of three of these units contributed to the assessment of corruption in each country. Scores were normalized on an ordinal scale of zero (most corrupt) to 100 (least corrupt).

Table 5.3 provides an overview of how the magnitude of corruption varies over the world. Only a very small number of countries (including Canada, Singapore, Australia, and New Zealand) have relatively uncorrupt governments, with CPI numbers of 80 or higher; however, this group comprises a minuscule 1.7% of the world's population. A secondary tier of slightly corrupt states (indices of 60–79), including several European countries, the United States, Japan, Botswana, Israel, Taiwan, and the United Arab Emirates) includes an additional one-eighth of the planet. Moderately corrupt governments (scores of 40–59) include a diverse array of European, African, Middle Eastern, and a few Asian states such as South Korea. By far the largest group almost three-fourths of humanity consists of very corrupt governments: 82 states with scores ranging between 20 and 39 account for more than 5.2 billion people. By this measure, corruption is the norm in most societies in the world. Finally, a small group of 14 states with scores below 20 may be said to be extremely corrupt; this group includes "failed states" such as Somalia, Afghanistan, and Yemen, which are incapable of delivering basic public services as well as several with long histories of extreme poverty (Haiti), war (Iraq), and totalitarian governments (Uzbekistan, Turkmenistan, and North Korea). Fortunately, this group includes less than 2% of the world's population.

Table 5.3. The world's population distribution by degree of state corruption, 2016

Level of corruption	Corruption index	Population (million)	% of world pop.
Least corrupt	>80	118.6	1.7
Slightly corrupt	60–79	854.4	12.0
Moderately corrupt	40–59	694.2	9.7
Very corrupt	20–39	5210.2	72.9
Extremely corrupt	<20	267.7	3.7
Total		7145.1	100

Figure 5.8 also represents this distribution in more geographically sensitive terms using the categories deployed in Table 5.3. Clearly most countries in the world exhibit moderately high to severe levels of corruption. The worst offenders (scores under 20) are found primarily in Africa and the Middle East; and others like North Korea, and in the Western hemisphere, Haiti and Venezuela. The second-most corrupt group (scores 20–39) include almost all of East, South, and Southeast Asia, with the exceptions of Japan, South Korea, Singapore, and Malaysia as well as most of Africa and a broad swath of Spanish-speaking countries in Latin America. The third most-corrupt group (scores 40–59) includes wealthier countries in the developing world, including Brazil, South Africa, Turkey, Saudi Arabia, and several Balkan states. The fourth-most-corrupt cluster (scores 60–79) includes the United States, Japan, most of Europe, and, notably, Botswana, Africa's least-corrupt country. Finally, the least corrupt (scores 80 and above), and smallest, group includes Canada, the Scandinavian states, Australia, and New Zealand.

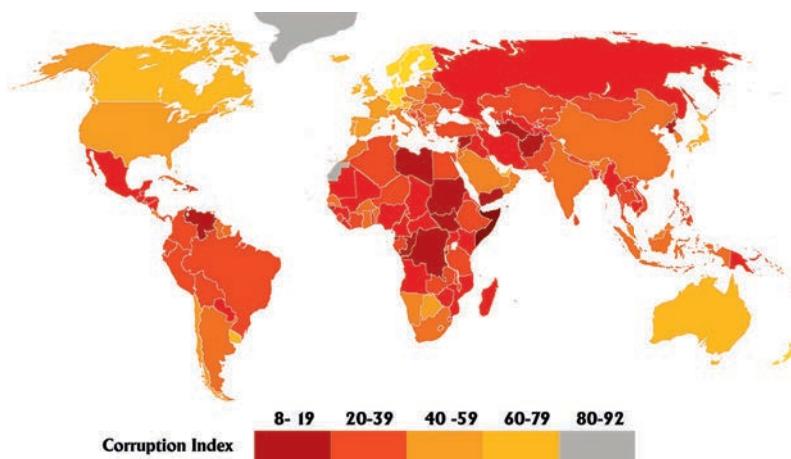


Figure 5.5 Distribution of transparency international corruption scores, 2016

#### 5.4.4. Causes and consequences of corruption

Though corruption differs from country to country, it is possible to identify some of the key common driving forces that generate it. The following are some of the attributes of the most corrupt countries

- ◆ With rare exceptions, they are low-income countries,
- ◆ Most countries have a closed economy,
- ◆ The influence of religion is visible,
- ◆ Low media freedom and,
- ◆ a relatively low level of education.

The effects of corruption were presented in different forms. Some of the very serious impacts of corruption on public finances could be illustrated as follows.

1. Corruption increases the volume of public investments (at the expense of private investments), as there are many options that allow for public expenditure manipulation and are carried out by high-level officials so as to get bribes. That means, as government expenditures increase, opportunities for corruption is also increased.
2. Corruption redirects the composition of public expenditure from the expenditure necessary for basic functioning and maintenance to expenditure on new equipment.
3. Corruption tends to pull away the composition of public expenditure from the necessary fixed assets for health and education, as there is less chance of getting commissions than from other, perhaps unnecessary projects.
4. Corruption reduces the effectiveness of public investments and the infrastructure of a country.
5. Corruption can reduce tax revenues by compromising the ability of the state administration to collect taxes and fees, although the net effect depends on how the nominal tax and other regulatory burdens were selected by the officials, exposed to corruption.

Therefore, the influence of corruption on the economy operates through several factors:

- Through the impact of corruption on investments;
- Through the influence of corruption on the allocation of talents;
- Through the impact of corruption on public spending; and
- Through the impact of corruption on taxes.

### 5.4.5. Remedial measures of corruption

Some ideas and suggestions that have been put forth to fight system level corruption are as follows:

- Leadership: the top leadership must set a good example with respect to honesty, integrity and capacity for hard work. Since fighting corruption will involve taking difficult decisions, the leadership must also display firmness, political will and commitment to carry out the required reforms. But honest and dedicated leaders are a necessity.
- Credibility: The investigation and punishment must start from your group, it doesn't bypass those who are within the leader's party. For success, the offenders both on the demand and supply side of a corrupt deal must be convinced that the government is serious about fighting corruption.
- Involving people: A publicity campaign to create greater awareness on the adverse effects of corruption. Ordinary citizens have a lot of firsthand experience with corruption, they are a good source of information and their help and cooperation should be solicited for the successful launch of an anti-corruption drive. Once people are convinced that a sincere and genuine effort to combat corruption is underway, they will respond and extend their full cooperation in resolving the problem.
- Responsible press: A responsible press to gather, analyze, organize, present and disseminate information is considered vital to create greater public awareness and to provide the momentum for undertaking reforms to overcome corruption.
- Oversight bodies: Views on the effectiveness of anti-corruption oversight or watchdog bodies are mixed. There are instances where they have proved useful. Otherwise, the oversight bodies will be rendered useless or worse, misused for political gain. An unwelcome situation can then arise and the country may have to appoint a watchdog to watch over the watchdog body.
- Improving institutions: This involves such things as improving the legal framework; smoother, less time-consuming and less burdensome ways to conduct business in the functioning of law courts and in the administration of justice; promoting efficiency of the police force; strengthening the auditor general's office; and appointment of a responsible inspector general empowered to investigate and prosecute corruption.

### Reflective Activity 5.4



Students, work in group of 5 to complete the exercise given below.

1. How do you evaluate Ethiopia's degree of corruption?
2. Please use figure 5.9, CPI representation, to elucidate on the Ethiopian instance.
3. Write a detailed visit report, after you go to your local anti-corruption commission office and collect data about what their major duties are, what types of corruption are more common there, and what method they follow in investigating the suspected individual.

## 5.5. Global Health Crises

At the end of this section, you will be able to:

- explain the major crises of global health and their impact on economic development; and
- discuss the causes of global health crises.

**KEY TERMS:** HIV/ AIDS, Covid-19, Ebola and Malaria



### Brainstorming Activity 5.5

Students, please attempt the following questions individual and then share with your classmates.

1. Why are malaria, HIV/AIDS, and Ebola more prevalent in Africa than in any other region?

#### 5.5.1. The Global Context of the Health Crises

Globally, an estimated 2 billion individuals do not have access to basic health services. The result is a shocking level of preventable prevalence. For example, malaria infects more than 500 million people a year and kills more than a million, equating to approximately one death from malaria every 30 seconds. The disease has the greatest impact in Africa, where it is the leading cause of mortality among children and costs the continent around \$12 billion in lost productivity each year.

Also, residents of poor nations must pay the highest proportion of their health-care costs out of pocket, because poor governments lack the financial resources to provide a functional, accessible health-care system. Globally, an estimated 150 million people and 25 million households are unable to pay for health care due to financial constraints. Only 12% of the \$3.2 trillion spent on health care worldwide in 2002 was spent in low- and middle-income nations, which account for 90% of the world's illness burden.

A health sectors aid increased by over 50 percent from 2002 and 2005, reflecting major increases by donor countries, including the United States, and the creation of new financing partnerships like the Global Fund to Fight AIDS, Tuberculosis and Malaria and the Global Alliance for Vaccines and Immunization. Even with these notable increases, the level of funding for global health remains significantly below estimated needs. Faced with these tremendous financing challenges, policymakers are turning to innovative solutions to provide more and more effective aid for health.

### **5.5.2. Historical global health problem**

Basically, in the realm of infectious diseases, a pandemic is the worst case scenario. When an epidemic spreads beyond a country's borders, that's when the disease officially becomes a pandemic. Communicable diseases existed during humankind's hunter and gatherer days, but the shift to agrarian life 10,000 years ago created communities that made epidemics more possible. Malaria, tuberculosis, leprosy, influenza, smallpox and others first appeared during this period. As people got more civilized, they began to establish cities and develop international trade routes to connect with other cities, as well as wage battles with them. As cities in many regions contact each other more, the conditions for the occurrence of worldwide pandemics become more likely.

The Great Plague of Athens in 430BC, during the Peloponnesian War, was one of the key historical times where the first recorded pandemic occurred. After the disease passed through Libya, Ethiopia and Egypt, it crossed the Athenian walls as the Spartans laid siege. As much as two-thirds of the population died. The symptoms included fever, thirst, bloody throat and tongue, red skin and lesions. The disease, suspected to have been typhoid fever, weakened the Athenians significantly and was a significant factor in their defeat by the Spartans.

Following this time and up to the 1918 Spanish Flu pandemic, which was the most famous pandemic in history, around 11 vastly accelerated pandemics were reported. In 1918, Spanish Flu; The avian-borne Spanish flu that resulted in 50 million deaths worldwide, the 1918 flu was first observed in Europe, the United States and parts of Asia before swiftly spreading around the world. At the time, there were no effective drugs or vaccines to treat this killer flu strain. Wire service reports of a flu outbreak in Madrid in the spring of 1918 led to the pandemic being called the "Spanish flu." By October, hundreds of thousands of Americans died and body storage scarcity hit crisis level. But the flu threat disappeared in the summer of 1919 when most of the infected had either developed immunities or died.

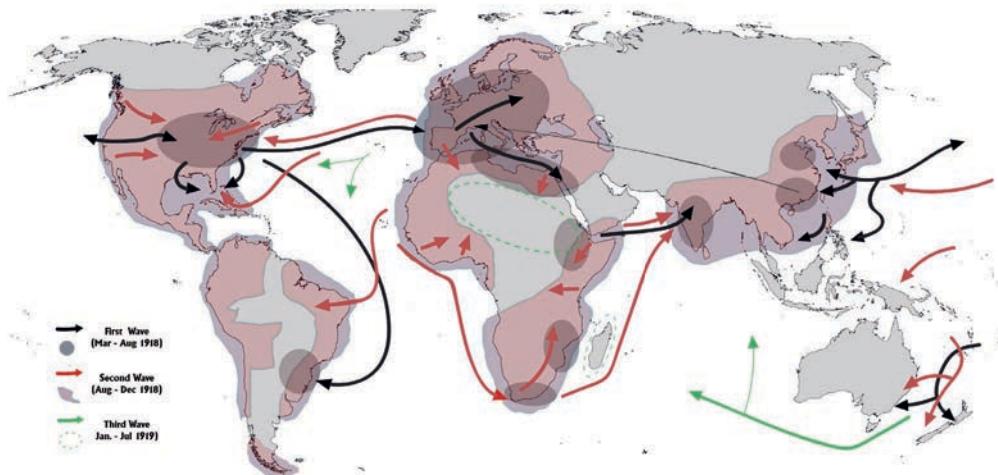


Figure 5.6. The global trajectory of Spanish Flu

### Reflective Activity 5.5



Students, work in group of 5 to complete the exercise given below.

1. Talk about the 1918 Great Ethiopian Influenza (Ye Hedar Beshita) Epidemic and identify which sort of historic health problem it was connected to.

#### 5.5.3. Current experience of global pandemic

Currently, various health crises are occurring in several states, putting country governments and citizens under stress. Among the concerns with wider spatial distribution and deeper socioeconomic consequences include HIV/AIDS, Ebola, and the more recent Covid-19.

**HIV/AIDS:** First identified in 1981, AIDS weakens a person's immune system, resulting in death from illness that the body would typically be able to combat. When symptoms subside, carriers become highly infectious through blood and genital fluid, and the disease destroys t-cells. AIDS was first observed in America. Treatments have been developed to slow the progress of the disease, but 35 million people worldwide have died of AIDS since its discovery, and a cure is yet to be found.

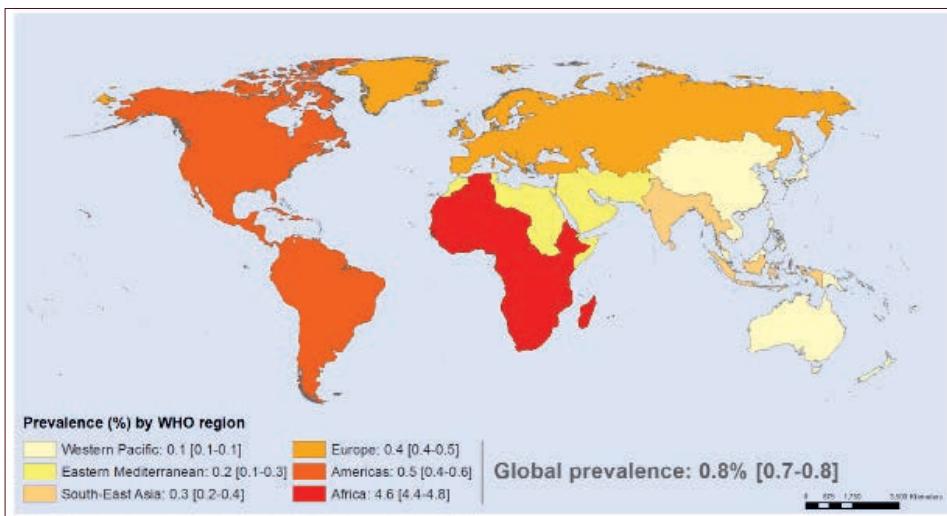


Figure 5.7. Adult HIV prevalence 2011

**Ebola:** The initial case, or index patient, was reported in December 2013. An 18-month-old boy from a small village in Guinea is believed to have been infected by bats. Ebola highlighted the implications for when a country does not have the minimum core capacity to detect, report, and rapidly respond to outbreaks. The three most affected states, Guinea, Liberia, and Sierra Leone had a historically vulnerable public health infrastructure, and were in the aftermath of a civil war that had devastated the healthcare system and access to basic sanitation. While the WHO declared the epidemic to be a Public Health Emergency of International Concern, the impact this epidemic had on the world, and particularly West Africa, is significant. A total of 11,310 deaths were reported in Guinea, Liberia, and Sierra Leone. There were an additional 36 cases and 15 deaths that occurred when the outbreak spread outside of these three countries.

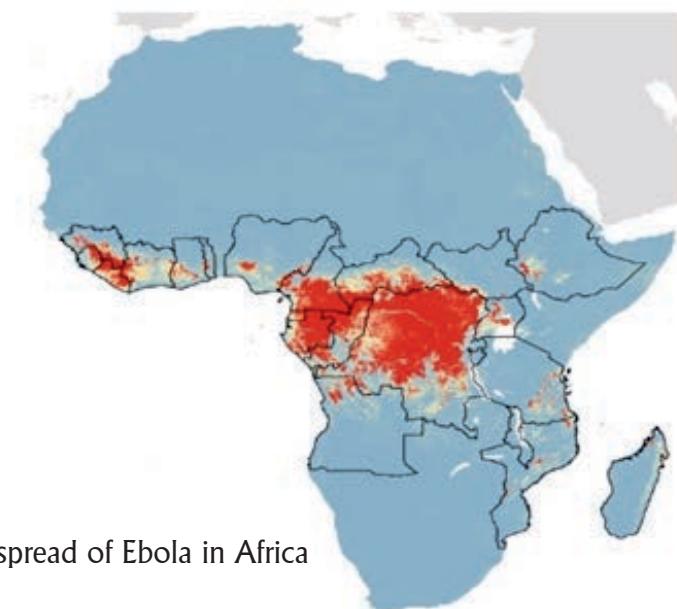
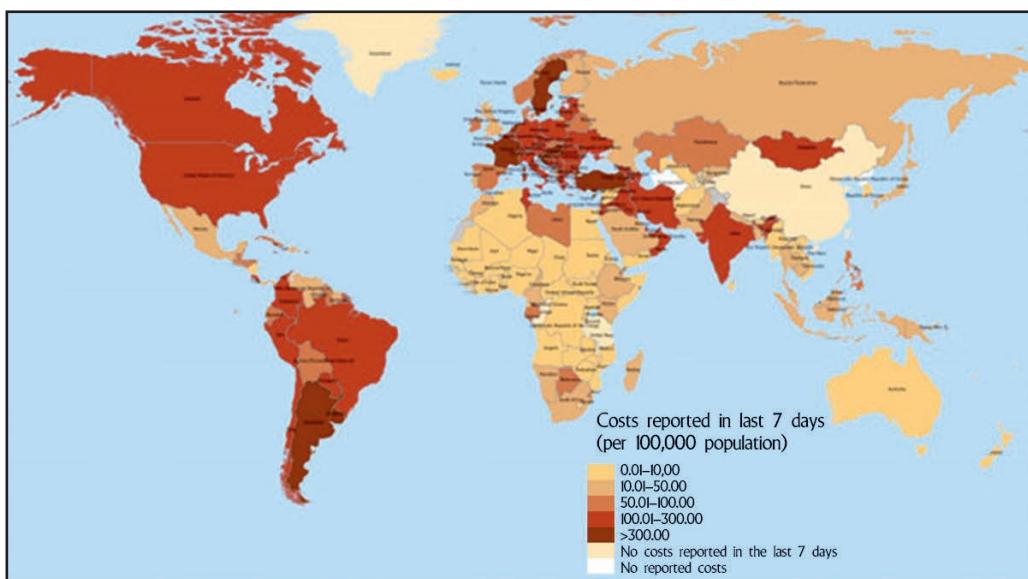


Figure 5.8. The spread of Ebola in Africa

**COVID-19:** On March 11, 2020, the World Health Organization declared the COVID-19 virus to be a pandemic after it infected over 118,000 individuals in 114 nations in three months. And the spread wasn't anywhere near finished. Symptoms include respiratory problems, fever and cough, and can lead to pneumonia and death. It spreads through droplets from sneezes. The first reported case in China appeared November 17, 2019, in the Hubei Province. Without a vaccine available, the virus spread beyond Chinese borders to nearly every country in the world. By December 2020, it had infected more than 75 million people and led to more than 1.6 million deaths worldwide. The number of new cases was growing faster than ever, with more than 500,000 reported each day on average.



Source: WHO (2021)

Figure 5.9. COVID-19 cases per 100,000 population reported by countries, and areas, 2021

### Reflective Activity 5.6



1. Examine the impact of Global health crises on the socio-economic functions of societies.
2. Outline the major global health problems induced by known pandemics and describe their consequences both at international and national context.

## UNIT SUMMARY

The various faces of poverty are observed in the conditions of all types of barrios that maintain an unfavorable change resistant status quo. In this regard, four primary elements of poverty may be identified: economic, cognitive, normative, and power politics.

Globalization is a process that brings together world nations and creates the essence of a global citizen. The notion is a very contentious subject, and both proponents and opponents have claimed their own scientifically verified benefits and drawbacks of it. As a result, when we act as global citizens and Ethiopians, we must weigh the above-mentioned benefits and downsides.

Growing regional/national disparities are a contemporary and pressing worldwide issue. Theoretically, trade should provide a solution, but trade is increasing inequality between nations in the global north and south, owing to current account deficits and import-export imbalances.

Corruption includes a wide range of erratic behavior that is primarily caused by a weakness in the governing structure. Also, it is impossible to establish a single definition of corruption that can be applicable to all situations, whether it is small or grand corruption, systematic or sporadic corruption, implicit or explicit corruption perpetrated by individuals.

Global inequalities, as well as a chronic lack of effective governance, have an impact on countries' capacity to deal with global health problems, particularly in poor countries. Despite the fact that health crises occur in both poor and developed nations, they are dealt with differently, with impoverished countries always suffering more than developed countries. Malaria HIV/AIDS and Ebola are among the most serious instances.



## REVIEW QUESTIONS

**Multiple Choices:** Choose the best answer from the given alternatives for the following statements and questions.

1. Having insufficient income to provide a minimum standard of living is
  - A. Absolute poverty
  - B. Relative poverty
  - C. Both
  - D. None
2. According to UN those countries are considered relative poor where per capita income is less than:
  - A. Four dollars
  - B. Three dollars
  - C. One dollar
  - D. Two dollars
3. Globalization involves...
  - A. A stretching of social, political, and economic activities across political frontiers.
  - B. A growing magnitude of interconnectedness in almost every sphere of social existence.
  - C. An accelerating pace of global interactions and processes associated with a deepening enmeshment of the local and the global.
  - D. All of the answer options given are correct.
4. Which of the following are not negative effects of Globalization?
  - A. Less employment in developed countries.
  - B. Increased air, land and water pollution in developing countries.
  - C. MNC'S gain power in a country and influence decisions.
  - D. Profits made by a MNC's are given to the country where factory is located.
5. Which one of the following is not the cause of trade imbalance in a given country.
  - A. When the country borrows from other countries to pay for imports.
  - B. When a country imports finished goods while exporting raw materials.
  - C. When a country's industrial activity exceeds its extractive activity.
  - D. When the country is in current account deficit.
6. All are the advantage of a Gini Coefficient measure of countries or regional inequalities except:-
  - A. Incorporates all data
  - B. Requires comprehensive individual level data
  - C. Allows direct comparison between units with different size populations
  - D. Attractive intuitive interpretation
7. According to the corruption perception index which country has the highest score?
  - A. Singapore
  - B. China
  - C. USA
  - D. Sudan
8. What is bribery?
  - A. Giving money to someone in exchange for a favor.
  - B. Any fraudulent activity.
  - C. A form of insider trading.
  - D. A legal but unethical activity.



# UNIT SIX

## ISSUES IN SUSTAINABLE DEVELOPMENT IV: SOLUTIONS TO ENVIRONMENTAL AND SUSTAINABILITY PROBLEMS



### Learning Outcomes

At the end of this unit, you will be able to:

- evaluate environmental and sustainability problems at local, national and global scales; and reflect critically on your roles and responsibilities as environmental actors in an interconnected world;
- analyze the historical background of environmental movements, and suggest models worth emulating to address environmental issues and problems in your locality and country at large; and
- discuss indigenous environmental protection knowledge and practices, and assess their strengths and limitations.

### MAIN CONTENTS



- 6.1. Environmental Problems
- 6.2. The Challenge of Sustainability
- 6.3. Environmental Education
- 6.4. Environmental Movements
- 6.5. Environmentally Friendly Indigenous Practices
- Unit Summary
- Review Questions

### Introduction

For several decades now, humans have mistreated and contaminated the very environment that sustains them. But the broad concern for the environment can be so overwhelming that people do not know what to do or where to start making a difference. The achievement of sustainable development necessitates a holistic effort in all areas of society to meet the appropriate criteria. The world is increasingly recognizing that environmental challenges have a significant impact on economies and the people. Economies are under increasing pressure to reduce human and ecological risk factors like resource scarcity.

In addition, the environment stands as highly potent in providing solutions for accelerated socio-economic transformation to solve leading challenges of food insecurity, poverty, unemployment, food waste, migration and implementation of global commitments. To solve leading challenges of food insecurity, poverty, unemployment, food waste, migration and implementation of global commitments. For effective implementation of global commitments and solutions to environmental challenges, there is a need to re-focus our development pathways. If the existing approach continues, countries will not be able to respond to the environmental challenges, thereby undermining the effective implementation of SDGs and other related global commitments. This unit tries to discuss about environmental problems, sustainability challenges, environmental education, environmental movement, and some of environment friendly indigenous knowledge.

## 6.1. Environmental Problems

At the end of this section, you will be able to:

- explain the major environmental problems; and
- identify the major implication of environmental problems.

**KEY TERMS:** footprints, Ozone Depletion, Biodiversity Loss, pollution

### Brainstorming Activity 6.1



1. What are the most serious environmental issues you have noticed in your locality?
2. How do they affect the global environment?

Currently, environmental problems have become globalized in terms of their existence and impacts as well as the socioeconomic factors that generate them. This subsection discusses the nature of environmental problems and their global reach. Yet, while the problems are clearly global and affect human societies worldwide, it is obvious that some societies (and people) have contributed a hugely disproportionate share to our current problems and demands on the global ecosystem. Environmental analysts emphasize that the ecological footprints of poorer nations, and particularly the individual footprints of their citizens, are vastly lower than those of wealthy nations and their citizens.

In both the academic and practical senses, interest in global environmental concerns has grown significantly in the aftermath of the United Nations Conference on Environment and Development in Rio de Janeiro in 1992.

This might be due to the rising strain caused by unsolved issues. More significantly, it might be linked to the realization that even the strongest national environmental policy cannot tackle all of these challenges on its own. The long-term character of the consequences, as well as the possibility of irreversible ecological harm, are to be sought in the diversity of political players, their competing interests, and so on.

Global or universally occurring environmental problems can be approached in entirely different ways. The globally interlinked environmental conditions essentially evaluated as a function of population, consumption and technology and the relationship of these factors often shown by the equation called "environment formula".

$$I = f(P, A, T)$$

Where I is global environmental impacts,  
 P is caused by world population growth,  
 A is increasing affluence /consumption of goods and services, and  
 T is environmentally unsound technology

This formula, in fact, had little effect on the formulation of practical policy, even though it does take into account the demographic, economic, and technological forces driving the degradation and destruction of the global environment (such as the ozone layer, climate, biodiversity, soils, water, and oceans). What has happened instead is that a medial structure of international environmental policy has emerged which more or less markedly integrates these driving forces or the intermedial link.

Some of the major Global Environmental Problems discussed in this section include climate change, ozone depletion, biodiversity loss, air and water pollution, and land degradation.

### **6.1.1. Climate Change**

The environmental problem most discussed at the moment is climate change (see also unit 2 for details). Climate change already has observable ecological and social effects, and its projected impacts could potentially result in profound changes in global mean surface temperature, sea level, ocean circulation, precipitation patterns, climatic zones, species distributions and ecosystem function. The climatically active Green House Gases are disrupting the earth's thermal balance by partially blocking thermal radiation into outer space thus, intensified greenhouse effect. As you learned in Unit 2, governments all around the globe have proposed various mitigation and adaptation measures that have to be practiced by industries and each citizen of them to prevent the devastating impacts of climate change.



Figure 6.1 Climate change, environmental degradation, and human misery

### 6.1.2. Ozone Layer Depletion

The ozone ( $O_3$ ) layer forms a barrier in the stratospheric layer (approximately 15 to 30 kilometers above the Earth's surface) thereby protecting humanity from the sun's damaging UltraViolet (UV) rays. It became clear that the ozone layer is being depleted by ozone layer depletion substances such as chlorofluorocarbon (CFC). When an ozone layer is depleted, harmful ultra violet rays reach the Earth's surface, causing health hazards such as skin cancer or cataracts. Ozone layer is being depleted globally except over tropical areas and the rate of depletion is higher in the highest latitude regions (Please take three and a half minutes to watch the accompanying video, <https://www.youtube.com/watch?v=aU6pxSNDPhs>).

Therefore, by reducing emissions of ozone-depleting substances, the Montreal Protocol has protected both the ozone layer and the climate at the same time. The approach used to reduce ozone depletion substances (ODS) is to replace them with fluorinated gases known as F-gases, which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur-hexafluoride (SF<sub>6</sub>). Despite the fact that they are not ODS, these gases have been recognized as greenhouse gases that contribute to climate change. In reality, F-gases are considerably smaller than CO<sub>2</sub> and are rising in the atmosphere on a regular basis.

### 6.1.3. Biodiversity Loss

The "United Nations Convention on Biological Diversity" was adopted by 154 states during the UN conference in Rio de Janeiro in 1992 and came into effect in December 1993. This conveys the global community's recognition that environmental protection requires a far-reaching paradigm shift. The concept of biological diversity or biodiversity embraces all animal and plant species, including microorganisms, the genetic variability within the species, and the earth's ecosystems in which these species live together.

Despite several international agreements on the conservation and wise use of biodiversity, natural ecosystem degradation and the loss of species linked with it continue rapidly. The main reason no doubt is that the approaches to international protection of nature and species previously adopted do not go far enough; and the situation is exacerbated by the lack of political will and of financial commitments needed to address it. The Biodiversity Convention raises the claim to change this situation.

Table 6.1 Numbers of threatened species by major groups of organisms

		Estimated Number of described species <sup>1</sup>	Number of species evaluated by 2018 (IUCN Red List version 2018-1)	Number of threatened species <sup>2</sup> in 2018 (IUCN Red List version 2018-1)
VERTEBRATES	Mammals	5,677	5,677	1,210
	Birds	11,122	11,122	1,469
	Reptiles	10,711	6,669	1,236
	Amphibians	7,866	6,682	2,100
	Fishes	33,900	16,406	2,385
INVERTEBRATES	Insects	1,000,000	7,908	1,478
	Molluscs	85,000	8,442	2,195
	Crustaceans	47,000	3,180	730
	Corals	2,175	864	237
	Arachnids	102,248	250	171
	Velvet Worms	165	11	9
	Horseshoe Crabs	4	4	1
	Others	68,658	839	146
PLANTS	Mosses	16,236	102	76
	Ferns and Allies	12,000	479	246
	Gymnosperms	1,052	1,012	401
	Flowering Plants	268,000	23,788	12,049
	Green Algae	6,050	13	0
	Red Algae	7,104	58	9

### 6.1.4. Air and Water Pollution

#### Air Pollution

Air pollution is defined as the intrusion of chemicals, particles, or biological elements into the atmosphere that cause discomfort, sickness, or death in people, harm other living creatures such as food crops, or harm the natural or built environment.

Pollutants are divided into two types: primary and secondary. The following are some of the significant air pollutions identified in the given category:

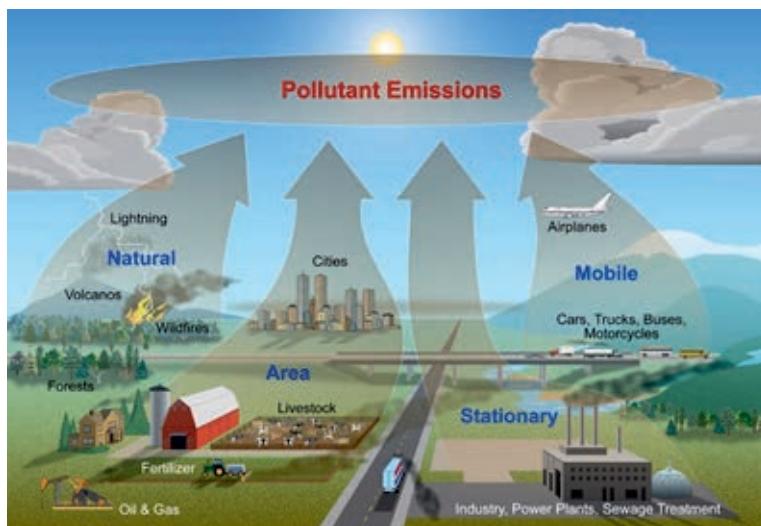


Figure 6.2 Air pollution caused by different actors

**Primary pollutant:** Pollutants that are formed and emitted directly from particular sources.

**Sulphur dioxides ( $\text{SO}_2$ )** is a chemical compound produced by volcanoes and in various industrial processes. Since coal and petroleum often contain Sulphur compounds, their combustion generates sulfur dioxide. The interaction of sulfur with oxygen produces acid rain, which can cause significant environmental harm.

**Nitrogen dioxide ( $\text{NO}_2$ )** are expelled from high temperature combustion, and are also produced naturally during thunderstorms by electric discharge. They can be seen as the brown haze dome above or plume downwind of cities. It is one of the several nitrogen oxides. This reddish-brown toxic gas has a characteristic sharp, biting odor, and it is one of the prominent pollutants.

**Carbon monoxide (CO)** - is a colorless, odorless, non-irritating but very poisonous gas. It is produced by incomplete combustion of fuel such as charcoal, natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide. For example, have you heard of individuals dying or suffering from significant cardiovascular problems as a result of incomplete burning of charcoal in a confined room? This is an important tangible example of the consequences of CO pollution.

**Volatile organic compounds** - VOCs are important outdoor air pollutants. They are often divided into the separate categories of methane ( $\text{CH}_4$ ) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhance global warming.

Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality. Within the NMVOCs, the perfume compounds benzene, toluene and xylene are suspected chemicals and may lead to leukemia through prolonged exposure.

Particulates, alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulates can be man-made or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged over the globe, anthropogenic aerosols currently account for about 10 percent of the total amount of aerosols in our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

**Secondary Pollutant:** Pollutants that are formed in the lower atmosphere by chemical reactions. Particulates are created from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a combination of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and Sulphur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

**Ground level ozone ( $O_3$ )** is formed from NOx and VOCs. Ozone ( $O_3$ ) is a key constituent of the troposphere, it is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel). It is a pollutant and a constituent of smog.

### Water Pollution and Ocean Exhaustion

Water pollution occurs when harmful substances often chemicals or microorganisms contaminate a stream, river, lake, ocean aquifer or other water bodies that damage the quality and

rendering it toxic to humans or other environment. Basically, water is able to dissolve more substances than any other liquid, this is the main reason why it is easily polluted. Toxic material emitted from farmyards, urban areas and industries simply mix with it thereby causing water pollution. When the contaminant is originated from a single source, we call the pollution point source pollution. When the pollutant comes from diffused sources, we call it nonpoint source pollution. Chemicals and heavy materials from industrial and municipal wastewater contaminate water ways as well. These contaminants are toxic to aquatic life most often reducing an organism's life span and the ability to reproduce.



Figure 6.3: Examples of water pollution

Damage and depletion of the marine environment, which covers roughly 70% of the earth's surface and more than 95% of the water system, has a substantial impact on the overall environmental balance. Pollutants from the land along the edge and interior portion of the continent have severely harmed the world's oceans and seas. Though chemicals, fertilizers, and heavy metals are the most common contaminants, plastic debris carried by rivers and winds is also a significant pollutant. Ocean "dead zones" regions of the sea where oxygen is severely or entirely depleted and most forms of life cannot survive are becoming more numerous, and scientists warn that they will continue to increase unless we curb the factors driving global climate change, which is fueling this alarming shift in ocean chemistry. Even outside these near-lifeless ocean regions, rising global temperatures and invasions of nutrient pollution are regulating oxygen levels in the open ocean and in coastal areas, threatening communities of sea life around the world.

Over the past 50 years, the ocean suffered from a loss of about 85 billion tons of oxygen, affecting an accumulated area approximately the size of the European Union. Globally, the amount of zero-oxygen ocean water has quadrupled, while the area occupied by low-oxygen zones has increased by 10 times. In coastal areas and seas that are semi-enclosed, once low-oxygen conditions are established, they can persist for thousands of years, according to some studies.

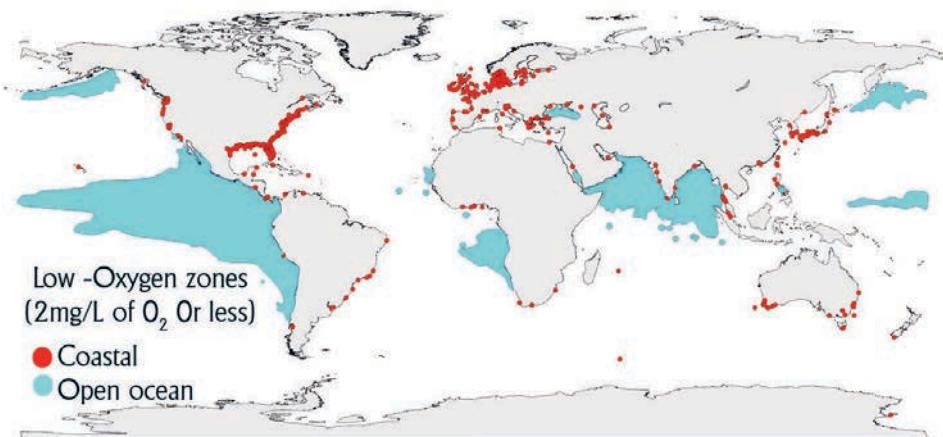


Figure 6.4: Oxygen Zones

In Figure 6.4, the red dots mark coastal locations where oxygen has plummeted to 2 milligrams per liter or less, and the blue areas mark zones with the same low-oxygen levels in the open ocean.

### Reflective Activity 6.1



1. Consider the scope or magnitude of environmental problems confronting human beings then, describe its severity and suggest what is expected from each of us to curb the problem.

#### 6.1.5. Land Degradation and Soil Contamination

Land degradation is defined as a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans. Land deterioration has been associated with mankind since the widespread introduction of agriculture during the Neolithic period, around 10,000 to 7,500 years ago. Land degradation has multiple and complex impacts on the global environment through a range of direct and indirect processes affecting a wide array of ecosystem functions and services.

Land degradation is one of the world's most pressing environmental problems and it will worsen without rapid remedial action. When land is degraded, soil carbon and nitrous oxide is released into the atmosphere, making land degradation one of the most important contributors to climate change. Scientists recently warned that 24 billion tons of fertile soil was being lost per year, largely due to unsustainable agriculture practices.

If this trend continues, 95 percent of the Earth's land areas could become degraded by 2050. Globally, 3.2 billion people are affected by land degradation, especially rural communities, smallholder poor farmers. The world population is projected to increase by about 35 percent to 9.7 billion in 2050, with rising demands for agricultural products including food, fiber, and fuel. As a result, pressure on the global land resource is increasing due to other factors as well, such as agricultural production systems made less resilient, and natural factors such as climate variability and extreme weather events.



Figure 6.5: Views of Degraded land

Soil pollution, on the other hand, is defined as the presence of harmful substances (pollutants or contaminants) at such amounts in a soil to endanger human health and/or the ecosystem. Soil contamination happens as a result of direct infection, such as raw material leaks owing to improper treatment, or indirectly through water pollution or air pollution induced by commercial operations. Once soil is contaminated, hazardous substances are deposited, causing a long-term contamination. In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of the contaminants in soil exceed the levels that should naturally be present.

Soil pollution affects plants, animals and humans alike. Anyone is susceptible to soil pollution or soil pollution effects: however, the susceptibility may vary based on age, general health status and other factors, such as the type of pollutant or contaminant inhaled or ingested. Children, for instance, are usually more susceptible to exposure to contaminants, because they come in close contact with the soil by playing on the ground; combined with lower thresholds for disease, this triggers higher risks than for adults.

Figure 6.6: demonstrates the most common contaminant of soil are dry cell batteries disposed in our locality, in addition to several others



Figure 6.6: Soil contamination by dry cell batteries

The Global Environmental Facility (GEF) is an initiative focused at addressing this type of issue. The GEF is well-placed to help countries implement convention decisions and facilitate coordinated investments in sustainable land management practices. The three GEF Impact Programs form a major component of the GEF delivery towards combating land degradation and deforestation are:

- The Food Systems, Land Use, and Restoration (FOLUR) Impact Program provides the opportunity for an integrated approach to implementing sustainable land management to increase the prospects for food security for smallholders and communities that are dependent on farming for their livelihoods.
- The Sustainable Forest Management (SFM) Impact Program seeks to avoid further degradation, desertification, and deforestation of land and ecosystems in drylands through the sustainable management of the landscapes.
- The sustainable cities impact program will create opportunities for countries to integrate voluntary Land Degradation Neutrality (LDN) target in to urban planning.

### Reflective Activity 6.2

Discuss in small groups, some of the major environmental concerns you've seen in your community.



1. Take a field trip and look at a specific example of a human activity that has an impact on the environment and make a case study on the problem.
2. You can choose an industry, agricultural activity, or forestry if one exists. Write a report that demonstrates the activity's process and how that process contributes to the environmental problem.

## 6.2. Sustainability Challenge

At the end of this section, you will be able to:

- identify the major environmental and sustainability challenges; and
- explain the solutions for environmental sustainability problems.

**KEY TERMS:** Challenges of sustainability, Urbanization, Solar chimney, Green buildings

### Brainstorming Activity 6.2



1. What are the main challenges of sustainability?
2. Can you give a specific example in your locality?

You have well been informed about the essence of sustainability in the first subsection of unit three. Sustainability is making decisions that do not have negative consequences for either current or future generations. Under this broad definition, sustainability impacts on a wide range of ecological and human issues, from the preservation of natural resources to a commitment to human and societal wellbeing. The continuation of current development practices will not be enough to achieve sustainable development, as demonstrated by the following issues:

- a. The impact of climate change threatens to escalate in the absence of adequate safeguards. There is also a need for promoting the integrated and sustainable management of natural resources and ecosystems and take mitigation and adaptation action in keeping with the principle of common but differentiated responsibilities;
- b. Hunger and malnourishment, while decreasing in many developing countries, remain persistent in other countries, and food and nutrition security continues to be an elusive goal for too many;
- c. Income inequality within and among many countries has been rising and has reached an extremely high level, invoking the spectre of heightened tension and social conflict;
- d. Rapid urbanization, especially in developing countries, calls for major changes in the way in which urban development is designed and managed, as well as substantial increases of public and private investments in urban infrastructure and services;

- e) Energy needs are likely to remain unmet for hundreds of millions of households, unless significant progress in ensuring access to modern energy services is achieved; and
- f.) Recurrence of financial crises needs to be prevented and the financial system has to be redirected towards promoting access to long-term financing for investments required to achieve sustainable development.

### 6.2.1. The Challenges of Sustainable Development

The concept of sustainability, as well as its approach, connects social science, environmental science, and future technology. As a result, the issue of sustainability includes a wide variety of explanations and arguments. The sustainability approaches are also severely challenged by a wide range of elements found in various parts of the world. Population expansion, urbanization, energy usage and global warming, water shortages, and waste management are the most serious challenges to the planet's sustainable development. Let us now go through these threats in greater detail.

#### Population Growth

The world population in 2019 was about 7.7 billion with an annual growth rate of about 1.1 percent. To put the recent growth in perspective, the world population in the year 1900 was only 1.6 billion and in 1960 it was 3.0 billion. According to UN, in 2030 the world population will be about 8.5 billion and in 2050 it will be about 9.7 billion. Currently, 80 million people are being added every year in less developed countries, compared with about 1.6 million in more developed countries. Thus, populations are growing more rapidly in places where such growth cannot be afforded in many aspects.

The amount of bio-productive land and sea available to supply human needs is limited. As a consequence of three-quarters of the land area being covered by seas, half of the terrestrial land being desert, and more than a quarter being high mountain ranges, relatively few locations are available for comfortable human settlement. It is believed that just one-eighth of the Earth's surface is suitable for human habitation. Currently, the approximately 11.2 billion hectares of productive earth, divided by the 6.3 billion people who depend on it for their wellbeing, results in an average of approximately 1.8 hectares per person. Collectively, we are currently using approximately 2.2 hectares per person or over 20% more than is produced annually, which means that the population has already exceeded the sustainable limit.

## OVERPOPULATION

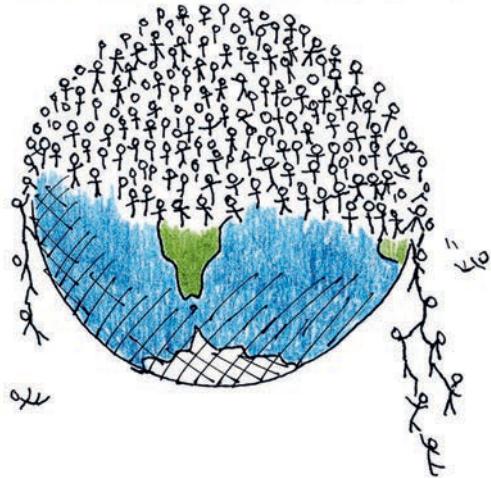


Figure 6.7: Over-population to manage

### Urbanization

In 1950, New York was the only city in the world with a population of more than 10 million. The number of cities with more than 10 million people increased to 5 in 1975 and 17 in 2001, and 21 cities in 2015. The world's urban population reached 2.9 billion in 2000 and is expected to increase by 2.1 billion by 2030. This will make up roughly 60 percent of the world's population.

Population growth coupled with urbanization results in significant impacts on the environment and other problems, which include:

- increased ambient temperature,
- decreased air quality,
- increased water run-off,
- decreased quality of run-off water,
- altered weather patterns,
- loss of natural beauty,
- reduction in farmlands and subsequent food shortage, and
- deforestation.

### Energy use and global warming

There is a broad relation between wealth and energy consumption. Figure 6.8 shows the contribution of various sources to this worldwide power consumption. The energy consumption in India rose threefold, from 4.16 to 12.8 quadrillion but between 1980 and 2001, putting India next only to the US, Germany, Japan and China in total energy consumption.

According to the international energy outlook projections for 2030 of the US department of energy, China and India account for nearly one-half of the total increase in residential energy use in non-OECD (Organization for Economic Co-operation and Development) countries. The OECD brings together 38 Member countries and a range of partners that collaborate on key global issues at national, regional and local levels.

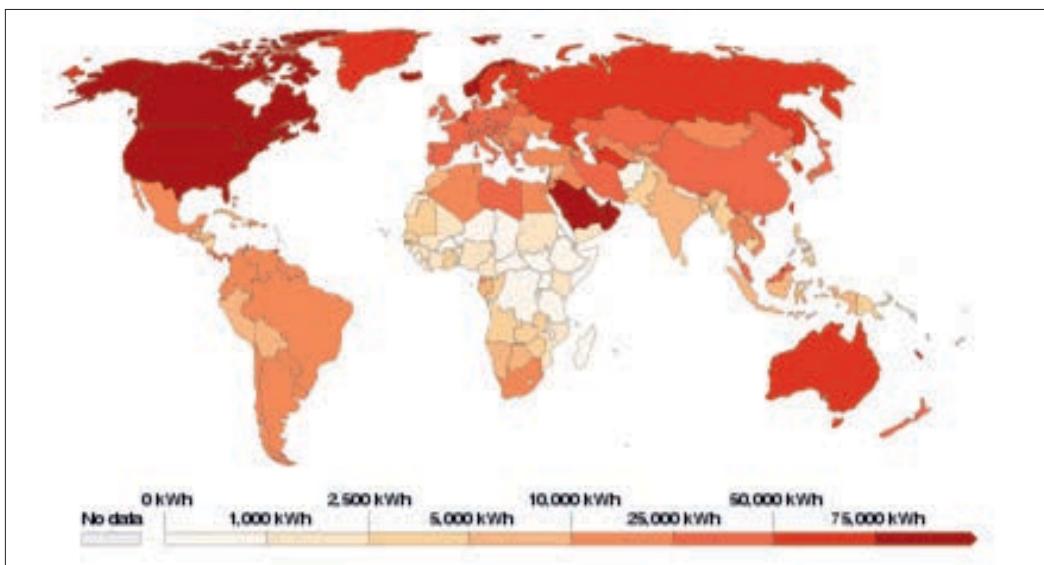


Figure 6.8: Global energy consumption per head (2021)

Though greenhouse effect occurs naturally atmospheric concentrations of some of the gases that produce the greenhouse effect are increasing due to human activity causing global warming. Over one-third of human-induced greenhouse gases come from the burning of fossil fuel to generate electricity. All fossil fuels are made up of hydrocarbons and they release carbon dioxide when burned

### **Water scarcity**

According to the United Nations, one out of every six people do not have access to safe drinking water, and more than double that number do not have access to adequate sanitation. Only approximately 2.5 percent of the Earth's water is fresh water, and three-quarters of it is locked up in glaciers and permanent snow cover. Only 0.3 percent of water is surface water found in rivers and lakes, and therefore easily accessible. Throughout the world, both the ground and surface water is being used at a faster rate than it is being replenished. A country is considered water-scarce when its annual supply of renewable freshwater is less than 1,000 m<sup>3</sup> cube per capita.

## **Waste management**

Waste management is the collection, transport, processing, recycling or disposal of waste materials. The term usually relates to materials produced by human activity and is generally undertaken to reduce their effect on health, aesthetics or as an amenity. Waste management is also carried out to reduce the effect of the material(s) on the environment and to recover resources from them. Waste management can involve solid, liquid or gaseous substances, with different methods and processes for each of them. Various methods are used for waste management which include disposal (landfill and incineration), recycling (physical and biological processing), energy recovery, and avoidance and reduction.

Every year, the globe generates 2.01 billion tons of municipal solid garbage, with at least 33% of that waste not being managed in an ecologically sustainable manner. The amount of garbage created per person every day in the world averages 0.75 kilograms but ranges from 0.11 to 4.54 kilograms. Despite accounting for only 16% of the worldwide population, high-income nations create 34% or 683 million tons of global garbage. The trend also reveals that global waste is predicted to rise to 3.4 billion tons by 2050.

### **6.2.2. Sustainable solutions**

The aforementioned environmental concerns and sustainability challenges sparked arguments regarding the remedial actions that must be implemented to prevent future deterioration of the environment. Despite the fact that scientists and environmentalists have documented the extent and severity of these environmental problems for decades, little progress has been made in meeting the objectives. Aside from that, sustainable solutions to environmental challenges are frequently neglected in favor of technical processes. A number of solutions have been suggested and some have been successfully implemented in the past in several countries to produce clean energy and to maintain sustainability. Some of these solutions are described below.

### **Combating climate change**

Reduction in change of climate and impacts of global warming is urgently required for present as well as the future. Various types of measures are taken for combating climate change and global warming, and microbes have great potential to do the task.

Though there are various mechanisms to control the greenhouse gases, new developments have been observed in biological and more environmental friendly mechanism. For example, oceans are known as the largest carbon reservoir on the earth and consume about one-third of all human carbon emissions. It is reported that about half of the carbon dioxide on the earth is fixed by cyanobacteria and other ocean microbes' mainly through photosynthesis and can be converted into carbon-rich lipids which can be used for biofuel production. Apart from many governmental and non-governmental groups' attempts at GHG (Greenhouse gas Reduction) through institutional reasoning, multiple awareness campaigns and local green moments are also significant. Global warming can also be mitigated by preserving ecologically significant regions, developing environmentally friendly energy and waste management systems, and employing biofuels.

### **Role in sustainable agriculture**

The fertility of soil is a parameter not only confined to availability of nutrients but also the microbial flora flourishing in the soil. Soil microorganisms maintain the fertility of agro-ecosystems, and sustain the crop productivity by maintaining the ecological balance. But the problem is that due to heavy input of chemicals in agro-ecosystems, several of these beneficial microbes are getting depleted or extinct from the soil. Aside from the drawbacks of using chemical fertilizers and pesticides, there is a need to introduce beneficial soil microorganisms into both damaged and unaffected agro-ecosystems in order to increase yields in an environmentally acceptable manner.

### **Renewable Energy**

Though a number of alternative proposals have been given for meeting the growing energy demands of the world, the renewable energy power plant more appealing one is solar. One of these examples is solar chimney. The solar chimney consists of three essential elements - glass roof collector, chimney and wind turbine. Air is heated in a very large circular structure similar to a greenhouse, and the resulting convection causes the air to rise and escape through a tall tower. The moving air drives turbines, which produce electricity. This type of power plant provides enormous amount of energy with no ecological breakdown at minimal cost (most poor countries cannot afford environmental protection), and without safety hazards (unlike nuclear power plants). Above all, there is no depletion of natural resources at the expense of future generations.

Many countries are excessively provided with solar radiation in their deserts. There are also numerous technologies and schemes that have been created using such renewable energy sources or in an environmentally friendly manner, such as solar, wind farm, hydropower, and geothermal, as well as the waste recycling energy process.

## Green buildings

A green/ sustainable building design is one that achieves high performance over the full life cycle, in the following areas:

- Minimizing natural resource consumption through more efficient utilization of nonrenewable natural resources
- Minimizing emissions that negatively impact the indoor and outdoor environment
- Minimizing discharge of solid waste and liquid
- Minimal negative impact on site ecosystem.



Figure 6.9: Examples of green buildings

### Reflective Activity 6.3

In a small group,



1. discuss some of the key problems of sustainability, and attempt to provide evidence with local instances.
2. Identify one of the sustainability issues that you have seen in your community, and provide a solution to the issue that you have highlighted.
3. Make a brief report about it.

## 6.3. Environmental Education

At the end of this section, you will be able to:

- explain the essence and trend of environmental education;
- identify the implication of environmental education; and
- participate actively in the school environmental education protection clubs.

**KEY TERMS:** formal education, informal education, tacit knowledge, Lifelong Learning, Interdisciplinary

### Brainstorming Activity 6.3



Students, try to relate Environmental Education to the problems you studied and attempt the question stated below individually and tell to your teacher.

1. What is the very essence of environmental education?
2. What are the main implications of improving environmental education?

The primary goals of environmental education are to develop an ecologically educated population that is self-assured and motivated to take action on critical environmental challenges ranging from climate change to habitat protection and from endangered species to water shortages. Environmental education is about engaging students, community members, policy makers, the young and the old. It is about empowerment, skills development, and providing opportunities for action. At its best, environmental education represents hope and change. It is a strategy by which people can make proactive, informed decisions that honor ecological, economic, and social integrity as the foundations of sustainability. With its emphasis on instilling these values to guide our individual and communal actions, environmental education allows everyone to work toward a better quality of life.

#### 6.3.1. The Essence of Environmental Education

Most simply, environmental education is education in, about, and for the environment. Environmental education, which researchers have described broadly as an “approach, a philosophy, a tool, and a profession,” is built on the following three goals:

- To foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas;

- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups, and society as a whole toward the environment.

Environmental education has a range of audiences from youth to the elderly, and from families to policy makers and takes place in a range of settings from schools and courthouses to museums to boardrooms. Environmental education is said to be formal or informal (or non-formal), sometimes it could be tacit knowledge where “formal” refers to education that occurs in a traditional school setting and “informal” refers to education in broader public settings such as zoos, aquariums, or community centers and through media outlets such as the Internet or television documentaries. Tacit knowledge refers to learning from the actions of others, or it is a type of information that we may obtain implicitly by living together, contacts or socializing without any teaching.

Environmental education also uses a range of strategies and teaching techniques, which can be used separately but ideally built one upon the other. Education researchers basically describe this continuum as including:

- Information activities, which aim to increase awareness and understanding and are defined as “informal” education.
- Communication activities, delivered in both formal and informal settings, which aim to establish a dialogue between audiences and environmental organizations or agencies for the mutual sharing of experiences, priorities, and planning.
- Education activities, also delivered in both formal and informal settings, which aim to promote knowledge, understanding, an attitude of concern, and the motivation and capacity to work with others in achieving goals.
- Capacity building activities, delivered primarily in informal settings, which aim to increase the capacity of civil society to support and work for environmental preservation.

In practice, environmental education is intended to exemplify sound education principles based on sound pedagogy and sound science. It is hands-on, contextualized, and interdisciplinary, linking natural and social sciences, the arts, and mathematics, among other subjects, to address complex and multifaceted environmental issues.

### 6.3.2. Fundamental Characteristics of Environmental Education

Basically, Environmental Education encompasses the following main characteristics:

**Environmental education is lifelong learning:** Environmental education is a life-long strategy that involves everyone, encouraging them to connect with the natural environment and, when necessary, to take action to safeguard it. While youth undoubtedly represent a critical audience for environmental education, it is equally important to nurture and support environmental literacy among adults whose daily consumer behaviors and political actions can have impressive impacts on the environment and conservation. In recognition of this fact, environmental education involving employees, policy makers, clergy, community activists, parents and grandparents, and members of the media, among others, is on the rise. These groups play important roles in decision-making about environmental conservation both today and in the future. So, in addition to schools, informal settings such as zoos, aquariums, museums, community centers, and parks, as well as media outlets including the Internet, radio, magazines, and newspapers all are important avenues for environmental education.

**Environmental education is interdisciplinary:** The science, notably geography, ecology, and others, give vital foundations for understanding environmental concerns, but environmental education is, by definition, social in nature. Environmental education is about human behavior, focusing on human interactions with the world around us, and encouraging people to engage in productive dialogue and decision-making with an emphasis on positive environmental behavior, critical thinking, and citizen participation. In other words, Environmental education is more about altering people's thinking setups, and they learn more by imitating the activities and performances of certain idol individuals around them.

Within a formal, or school setting, environmental education comprises a variety of subjects. Here, social studies, government studies, and history are as important as geography, biology, chemistry, and physics in addressing today's complex environmental problems. The origins of environmental education may be traced back to the 18th century, when Jean-Jacques Rousseau emphasized the necessity of an environment-focused education. As a result of the Great Depression and Dust Bowl in the 1920s and 1930s, conservation education emerged as a new kind of environmental education.

**Environmental education is a proven strategy:** Most environmental issues characterize complexity and uncertainty. Thus, the policy tools of regulation and market incentives prove insufficient to the task of coping with significant environmental management problems. Managers and policy makers must turn ever more frequently to other policy options, including education, information provision, and voluntary measures. Although increased education does not equate with behavior change, a strong link between the two can often be found, as education plays an important role in increasing knowledge, honing critical thinking skills, and enhancing the capacity and motivation to take action. Thus, supporting environmental education represents an investment in the future. Well-designed environmental education initiatives are built around a theory of change, the idea that a logical series of events may be used to demonstrate how activities in the present may lead to the achievement of goals and objectives in the future. Although it may be easier in the short run to see the direct impact of legislation passed or an acre of trees planted, an environmental-education initiative can make a much longer-term impact on environmental attitudes, knowledge, skills, and action by preparing people to support those policies or become involved in the replanting efforts.

**Environmental education is about critical thinking and citizen participation:** Good environmental education is about teaching people how to think, not what to think. Rather than advocating for specific positions, environmental education contextualizes environmental issues within a complex ecological, social, and economic framework. Environmental education encourages people to take an active role in environmental problem-solving by helping to develop citizen-action skills, then providing opportunities for taking action. But, because education around hot-button issues such as the environment can be controversial, developing high quality standards for both teaching materials and professional training is essential to maintaining the integrity of the field.

#### Reflective Activity 6.4



1. Discuss the function and impact of environmental education in a small group.
2. Write down some of the sources that have helped you build your knowledge on environment issues, as well as compare these sources based on the dependability of their information.

## 6.4. Environmental movements

At the end of this section, you will be able to:

- describe the historical development of environmental movements; and
- participate in or initiate environmental movement aimed at addressing environmental threats caused by human activities at local or national level.

### 6.4.1. The Concept of Environmental Movement

Environmental movement is a type of social movement that involves an array of individuals, groups and coalitions that perceive a common interest in environmental protection and act to bring about changes in environmental policies and practices.

The environmental movements are conceived as broad networks of people and organizations engaged in collective action in the pursuit of environmental benefits. Environmental movements are understood to be very diverse and complex, their organizational forms ranging from the highly organized and formally institutionalized to the radically informal; the spatial scope of their activities ranging from the local to the almost global, and the nature of their concerns ranging from single issue to the full panoply of global environmental concerns. Such an inclusive conception is consistent with the usage of the term amongst environmental activists themselves and enables us to consider the linkages between the several levels and forms of what activists call ‘the environmental movement’.

The movement may also be initiated by any group or individuals from anywhere. For example, Greta Thunberg is a significant young climate change campaigner whose voice has the potential to impact many worldwide decision-making bodies, both governmental and non-governmental (take some about four minutes to watch her emotional and influential speech in one of the international climate action summits <https://www.youtube.com/watch?v=u9KxE4Kv9A8> ).

### 6.4.2. Types of Environmental Movements

1. Free market environmentalism
2. Preservation and conservation
3. Popular environmentalism
4. Dark Greens, Light Greens and Bright Greens

#### Free market environmentalism

The idea of free market environmentalism contends that the free market, property rights, and tort law are the greatest tools for preserving the health and sustainability of the environment.

This is in sharp contrast to the most prevalent modern strategy, which is to rely on legislative government action to avoid environmental devastation. Environmental care is regarded as natural, as is the expulsion of polluters and other aggressors by individual and class action.

### **Preservation and conservation**

Environmental preservation is viewed as the strict setting aside of natural resources to prevent damage caused by contact with humans or by certain human activities, such as logging, mining, hunting, and fishing. It differs from conservation in that conservation allows for some degree of industrial growth while keeping it within sustainable bounds. Regulations and laws may be enacted for the preservation of natural resources. Elsewhere in the world the terms preservation and conservation may be less contested and are often used interchangeably.

### **Popular Environmentalism**

Environmentalist action has recently led to the development of a new subculture. It is mainly composed of the educated middle and upper-class. This subculture often exhibits sustainable consumption patterns, choosing local and organic product over the more conventionally imported products that have been manufactured using chemicals such as pesticides and preservatives. Criticism of this 'green consumerism' comes from some environmentalists who complain of elitism, suggesting that this is nothing more than shopping under the banner of environmentalism without espousing any of its true ideals. Because organic and sustainable items are sometimes more expensive, purchasing them may be perceived as a sign of affluence. It is suggested that this new tendency has diverted attention away from the fundamental issues that 'serious' environmentalists want to tackle. Consumer items offer a deceptively easy, feel-good way to both save the world and one's reputation simultaneously. Others, however, argue that practicing green consumerism does not always imply that these consumers are just trying to save money. Simultaneously, many people believe that the cost of environmentally friendly products should be reduced.

### **Light Greens, Dark Greens and Bright Greens**

Contemporary environmentalists are often described as being split into three groups, 'Light', 'Dark' and 'Bright' Greens. Light Greens see protecting the environment first and foremost as a personal responsibility. They fall in on the reformist end of the spectrum introduced above, but light Greens do not emphasize environmentalism as a distinct political ideology, or even seek fundamental political reform. Instead they often focus on environmentalism as a lifestyle choice. The motto "Green is the new black." sums up this way of thinking, for many. In contrast, dark greens believe that environmental problems are an inherent part of industrialized capitalism, and seek radical political change.

Dark greens think that prevailing political ideas (also known as industrialism) are corrupt and will ultimately lead to consumerism, alienation from nature, and resource depletion. Dark Greens claim that this is caused by the emphasis on growth that exists within all existing ideologies, a tendency referred to as ‘growth mania’.

More recently, a third group may be said to have emerged in the form of Bright Green. This group believes that radical changes are needed in the economic and political operation of society in order to make it sustainable, but that better designs, new technologies and more widely distributed social innovations are the means to make those changes and that we can neither shop nor protest our way to sustainability. Bright green environmentalism is less about the problems and limitations we need to overcome than the “tools, models, and ideas” that already exist for overcoming them.

#### **6.4.3. Environmental Movements in Ethiopia**

Environmental activism or movements are rarely seen in Ethiopia in a well-organized way. In many sociopolitical problems, different trends have been noticed in both contemporary and pre-existing social media and networking that can have significant social and political consequences.

Though several initiatives have been undertaken in various organizations to include environmental problems into the mainstreaming process (such as governmental ministries, religious and other civic organizations), some organizations are particularly concerned with the environment and associated issues only. Lem Ethiopia is an example of a well-known organization in this field.

Lem, the Environment and Development Society of Ethiopia (LEM Ethiopia), was founded in 1992 by 29 prominent Ethiopian professionals working in the fields of environment and development. The Society aims to promote sustainable development, and therefore is involved in areas such as natural resource management and appropriate technology promotion, urban waste management and livelihood security in collaboration with donors, government institutions, local and international NGOs and communities. It engages in capacity building, with special attention given to environmental education and awareness interventions that target school children, teachers, farmers, urban dwellers, men, women and development practitioners to impact climate change and advocate for environmental protection policies.

Some individual based attempts were seen with an ad hoc, and discontinuous patterns. One of such an attempt is the municipal solid waste controlling task of artist Sileshi Demise (Gash Abera Molla) which had great impact in the Addis Ababa community and

it might also be taken as the precursor of the current riparian buffer projects of Addis Ababa. The late Prime Minister Meles Zenawi, as a movement leader, was officially assigned by African countries to represent the Continent in global climate change negotiations, and Ethiopia appears to be leading the 'green economy' movement in Africa, both in ideological and practical terms. Another important individual action that influences majorities of the public concern is the current Prime Minister Abiy Ahmed's Green Legacy and the development of big ecotourism projects in different parts of the country. Over four billion seedlings were claimed to have been planted in the First Green Legacy Campaign, which was conducted in 2019 during the Ethiopian rainy season, and this number was raised to five billion seedlings in 2020, which was a significant accomplishment of his effort. Such an individual's attempt can also trigger a broad based environmental and climate change movement particularly among young population group.

Ethiopian youth are increasingly impacted by environmental and climate related issues, yet their perspectives are largely absent from policy arenas. This lack of the voices of youth, who as citizens of tomorrow will inherit the environment created by adults today, highlights the pressing moral need to include their vital perspectives in the environmental and climate change debates.

change debates. Furthermore, there is a political need to include the voices of amateur people in such debates as these voices inform and contribute to the global activism which in turn forces influential political decision.



Figure 6.10 personalities and the green movement, PM Dr. Abiy Ahmed and LPM. Meles Zenawi and Sileshi Demisse (artist) from left to right.

#### Reflective Activity 6.5



1. Discuss the function of the environmental clubs that have been established at your school in a group setting, and demonstrate your level of involvement, as well as the advantages of being engaged in a club.
2. Take a case of one of your role models who is involved in environmental activities in your community, region, or country at large and write a report about him or her.

## 6.5. Environmentally friendly indigenous practices

At the end of this section, you will be able to:

- identify some environmentally beneficial traditional activities in Ethiopia, as well as their locality; and
- support indigenous practices proven to be effective in mitigating environmental problems.

**KEY TERMS:** indigenous knowledge, folk medicinal knowledge and skills, Terracing,

### Brainstorming Activity 6.4



1. How does indigenous knowledge contribute in combating environmental problems?

#### 6.5.1. Indigenous Knowledge for environmental issues

Indigenous Knowledge can be conceptualized as the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. Indigenous Knowledge as holistic, dynamic and changing community-based knowledge is generated by a process of trial and error through social practice. Some of the most extensive and convincing qualities of indigenous knowledge are listed below.

- Indigenous knowledge is local. It is rooted to a particular place and set of experiences, and generated by people living in those places.
- Indigenous knowledge is orally-transmitted, or transmitted through imitation and demonstration.
- Indigenous knowledge is the consequence of practical engagement in everyday life, and is constantly reinforced by experience and trial and error.
- Repetition is an essential characteristic of tradition, even when new knowledge is added.
- Tradition could be considered as 'a fluid and transforming agent with no real end'. When applied to knowledge its central concept is negotiation.
- Indigenous knowledge is characteristically shared to a much greater degree than other forms of knowledge. As a result, it is frequently referred to as "people's science".

- Although indigenous knowledge may be focused on particular individuals and may achieve a degree of coherence in rituals and other symbolic constructs, its distribution is always fragmentary.
- Despite claims for the existence of culture-wide (indeed universal) abstract classifications of knowledge based on non-functional criteria; where indigenous knowledge is at its densest and directly applicable, its organization is essentially functional.
- Indigenous knowledge is characteristically situated within broader cultural traditions; separating the technical from the nontechnical, the rational from the non-rational is problematic.

There is a global concern to safeguard the increasingly dilapidating environment. Environmental degradation needs to be combated to minimize or eradicate its threats to lessen the limit of the earth to meet social and environmental destinations, and needs. This issues require interdisciplinary and multidimensional approaches, which include the use of cultural construct, herein referred to as indigenous knowledge system.

The application of indigenous knowledge in areas such as:

- Ecosystem and landscape management,
- Water management,
- Soil conservation,
- Biological control of pests and diseases,
- Ecological agriculture and livestock practices, and
- Plant and animal breeding often enhances food security and prevents or alleviates poverty.

### **6.5.2. Practices of Environmental Friendly Indigenous Knowledge in Ethiopia**

Ethiopia is a country with over 80 ethnic groups and a wide range of languages. Ethiopian society has diverse knowledge that helps to cope up with the natural and human built environment. It is possible to draw examples from a wide range of indigenous knowledge. The following are some of the examples.

Practices in wet highland landscape of the West: The practice of indigenous knowledge has been used as an alternative way of protecting natural environment among the Illuababora, Maccaa Oromo. The scope of their indigenous knowledge comprises attitude towards the universe and natural resources around. They practice this knowledge system in the way of promoting and preserving ecosystem.

Specially, their knowledge regarding their folk healing practices to protect the health of their livestock and families is worth mentioning. They have wisdom on identification and classification of medicine and its resources, mode of preparation, mechanism of dose control and spiritual and philosophical aspects of folk medicine. Folk healers and local elders have knowledge on how to protect folk medicinal plants and other sources of remedies from further wiping out and extinction. Folk medicinal practice thus has the great role in keeping natural environment. This includes different conservation measures to cultivating and duplicating folk medicinal animals, plants and other mineral based medicines. The knowledge of community members in general and folk healers in particular is logical and fruitful on conservation of folk medicine in their natural environment.

These days, folk medicine and folk medicinal plants are protected in natural habitats based on their nature. In addition, there is indigenous mechanism to protect the capitals of folk medicine from further damage by planting and growing in their garden in secret. In this sense, local community have original knowledge on protecting folk medicine in their farm land, pilgrimage (ritual sites), scared grooves, around river and home garden.

Furthermore, indigenous beliefs system on folk Medicine shared and exploited grounded on their world view. Culturally, cutting trees and killing animals intentionally will be seen as broken norms and values of the society. Besides, these people can get these medicines so long as they protect their environment.

Practices of dry high land landscape in the south, Terracing: The Konso Cultural Landscape is characterized by extensive dry stone terraces which witnesses hundreds of years of persistent human struggle to harness the hard, dry and rocky environment, which has resulted in the beautifully outlined rows of dry stone terrace. The terraces retain the soil from erosion, collect maximum water and discharge the excess, and create terrace saddles that are used for agriculture. The terraces are the main features of the Konso landscape and the hills are contoured by the dry stone terraces that could reach at some places up to 5 meters high. The dry stone walled towns (Paleta) of the Konso are located on high hills selected for their strategic and defensive advantage. These towns are circled by, between one and six rounds of dry stone defensive walls, built using locally available rock.

The Gedeo people are founded on long-standing regulations (seera) of standards, respect to elders, and oral declarations passed down from generation to generation. Particularly, respect is an important social value among the Gedeo community.

Though this regard is usually limited to old men and humans in general, it is critical to understand the essence of this reverence since the value of respect is targeted at all species, including domestic animals and the surrounding ecosystem. Respect is frequently exhibited in the form of reverence for parts of environmental resources because it is linked with traditions and relationship to humans. For instance, songo sacred trees are often seen as ritualistic trees which are maintained and protected by prohibition systems (taboos) and traditional rules of “seera”.

In the mores of Gedeo, respect is translated into attitudes such as respecting elder person in villages, not cutting songo sacred trees (Dhadacha), not injuring sacred forests, not felling young and immature plants from farms, not cutting grave trees for house uses, killing birds murdering of human-being, defecation in sacred natural sites, degrading the reputation of cultural elders and mass-cutting of trees (degradation) from indigenous cultural landscapes (agroforestry) have been considered as disrespectful deeds and perjuring of ancestral rules of “seera”.

Practices of western lowland dry lands, The Gumuz have special relationships with their lands and the environment. They possess knowledge about their natural resources and environment based on observation and experience.

Indigenous knowledge is important to the Gumuz systems of natural resource management and it can be best understood along with their traditional belief systems. The Gumuz hold the belief that vital natural/land resources are sacred. They believe that natural resources are the ingenuous gift, blessing and creation of Yamba (the supreme deity), which is the source of life and livelihoods to the past, present and future generations. Yamba provided the Gumuz with knowledge of proper use, management and a responsibility of passing the natural resources to the next generation. The different resources have their respective Missa (poly-spirits) that ensure their proper use and management; violations result in severe punishments and revenge from the respective Missa.

Moreover, the Gumuz perceive their natural resources as an ancestral heritage. Ownership of natural resources is vested upon the whole community. The present generation runs a responsibility of trusteeship over the resources. Since natural resources do not belong to only one generation, they cannot be privately possessed or controlled by any single members of the community, only its fruits. Shifting cultivation is an indigenous agro-ecological knowledge used to maintain the complex agro-ecosystem. The fields are shifted to use the nutrients of the natural vegetation-soil complex. Thus, by skillfully maintaining the natural forest and vegetation ecosystem, the other equally important natural resource components such as soil, water and wild animals are managed in a sustainable way.



Figure 6.11: Ecofriendly landscapes of Gedeo, Illubabor and Konso, from left to right

### Reflective Activity 6.6



1. Identify some of the most prevalent indigenous practices for environmental conservation in your area and discuss them in class as a group.
2. Choose one of these ecologically beneficial indigenous practices from your community and describe it briefly.

## UNIT SUMMARY

Environmental problems arise as a result of human activity's harmful impact on the biophysical environment. Environmental protection is a practice of protecting the natural environment on the individual, organizational or governmental levels, for the benefit of both the environment and humans.

The problem of environmental sustainability has proven to be difficult to overcome. The shift to a more sustainable way of life is being hampered by human actions that continue to harm the environment. The modern environmental movement has attempted to solve the problem in a large variety of ways.

Environmental education refers to organized efforts to teach how natural environments function, and particularly, how human beings can manage behavior and ecosystems to live sustainably. It is a multi-disciplinary field integrating disciplines such as biology, chemistry, physics, ecology, earth science, atmospheric science, mathematics, and geography.

Environmental movement, addresses environmental issues via lobbying, education, and activism. It is a broad philosophical, social, and political movement for solving environmental challenges that includes conservation and green politics. Environmentalists fight for just and sustainable resource management and environmental stewardship through public policy and individual behavior changes.

Environmentally friendly indigenous practices describes indigenous and other traditional knowledge about local resources. It is concerned with the interactions between living beings (including humans) and their traditional groups as well as their surroundings. It is important to note that indigenous knowledge is not a universal concept among various societies, but it refers to a set of knowledge traditions or practices that are highly influenced by "location." Such knowledge is employed in natural resource management as a supplement to scientific methods of ecological management or as a substitute for baseline environmental data in circumstances where there is little recorded scientific data.

**REVIEW QUESTIONS**

Multiple Choices: Choose the best answer from the given alternatives for the following statements and questions.

1. Which one of the following is not taken as the world's major environmental problem?
  - A. ozone depletion
  - B. the quality of fresh water
  - C. environmental movement
  - D. waste management
2. Which of the following is true about nitrogen dioxide?
  - A. It is colorless
  - B. it is odorless
  - C. Formed by thunderstorms
  - D. it is an example of particulates
3. All are the primary air pollution agents except:\_\_\_\_\_
  - A. Ground level ozone
  - B. Volatile organic compounds
  - C. Carbon monoxide
  - D. Sulphur dioxides
4. Ocean "dead zones" refers to \_\_\_\_\_
  - A. a water body containing large amount of oxygen
  - B. the ocean part polluted by dead plants and animals
  - C. the ocean part where oxygen is severely or entirely depleted
  - D. all oceanic body having high concentration of salt
5. Which one is not a sustainability challenge?
  - A. population growth
  - B. environmental education
  - C. Urbanization
  - D. Water scarcity

6. All are examples of sustainability solution except:\_\_\_

- A. Waste pollution
- B. combating climate change
- C. Sustainable agriculture
- D. Renewable energy

7. The objective of environmental education is\_\_\_

- A. To raise consciousness about environmental education
- B. To teach environmentally appropriate behavior
- C. To create an environmental ethic that fosters awareness about ecological inter-dependence of economics, society and politics
- D. All of the above

8. Which environmental movement is concerned less about the problems and limitations to overcome environment problems rather focuses on the “tools, models, and ideas” that already exist for overcoming them?

- A. Free market environmentalism
- B. Bright Green environmentalism
- C. Light’ ‘Dark environmentalism
- D. Popular environmentalism

9. Which of the following environmental concerns may not be solved using indigenous knowledge?

- A. Ecosystem management,
- B. Water management
- C. industrial emission control
- D. Soil conservation

10. The traditional belief system that helps the Gumuz people to control their environment as their communal property is \_\_\_

- A. Yamba
- B. Paleta
- C. Maccaa
- D. Gumm



# UNIT SEVEN

## CONTEMPORARY GLOBAL GEOGRAPHIC ISSUES AND CONCERNs



### Learning Outcomes

At the end of this unit, you will be able to:

- explain why climate change is perceived as a contemporary global issue;
- discuss the causes and possible link between draught, desertification and famine;
- describe the major causes and effects of drought;
- identify the major causes and effects of famine;
- explain the key strategies to address desertification, drought and famine.



### MAIN CONTENTS

- 7.1. Climate change
- 7.2. Desertification
- 7.3. Drought
- 7.4. Famine
- Unit Summary
- Review Questions

### Introduction

The study of geography, by its very nature, covers a range of contemporary issues and events. These are the issues and events that are ‘in the news’. They are issues and events that are discussed and debated widely in the community.

Contemporary geographical issues and events have both a spatial and temporal dimensions. This means that they occur in a particular context and time frame. They might, for example, be a local community-based issues (such as a development proposal) that are the focus of peoples’ attention for just a short period of time, or an environmental issues that affect the whole planet (for example, global climate change) which may be of concern for generations.

Because people have different perspectives or points of view on issues, they will often disagree on how they should be addressed. Disagreement is often healthy as long as we respect the rights of others to express their views that we might not necessarily agree with. Being able to identify and evaluate such points of view greatly enhances our own decision-making processes. This is what makes the study of geography so interesting. In this unit, we try to study the issues of climate change, desertification, drought and famine. Actually they are interlinked and sometimes they are of a cause and effect of one another too.

## 7.1. Climate Change

At the end of this section, you will be able to:

- explain why climate change became a global issue and a serious cause for public concern.

### Note



Climate change is a hot issue in academics all around the world. Climate change is fundamentally a spatial phenomenon. As a result, geographers deal with it as well, and Unit 2 has gone through it exhaustively. This section attempts to demonstrate how climate change is a contemporary worldwide pressing issue that must be addressed.



### Brainstorming Activity 7.1

1. What are the primary reasons that climate change has become such a big topic all around the world?

Climate change as one of the most pressing issues of our time, threatens the lives and livelihoods of billions of people. A changing climate requires comprehensive, integrated strategies that simultaneously address social, economic and environmental consequences. At the end of 2015, 195 Parties to the UN Framework Convention on Climate Change endorsed the historic Paris Agreement.

Participants pledged to curb emissions to minimize the rise in temperatures, and strengthen capacities to manage climate risks. The agreement sets the stage for progress in ending poverty, strengthening peace and ensuring a life of dignity and opportunity for all the main tenets of human security. Climate changes mainly caused by human action which have been transpired different socioeconomic and environmental consequences, and more changes still expected. However, if we stopped emitting greenhouse gases today, the rise in global temperatures would begin to flatten within a few years. According to the current estimates, if major actions are not taken to reduce emissions, global temperature is on track to rise by  $2.5^{\circ}\text{C}$  to  $4.5^{\circ}\text{C}$  ( $4.5^{\circ}\text{F}$  to  $8^{\circ}\text{F}$ ). Studies on climate change impacts point out different results with different temperature stabilization scenarios. The findings of this review are summarized in the table below.

Table 7.1: Predicted situations caused by the temperature increase in the global context

Impacted conditions	Within $2^{\circ}\text{C}$	Within $2^{\circ}\text{C}$ - $2.5^{\circ}\text{C}$	$>3^{\circ}\text{C}$
Health	A $1.2^{\circ}\text{C}$ temp. change causes an increase in premature mortality of hundred thousand human race excluding extreme cases of heatwave.	a $2.3^{\circ}\text{C}$ increase of temp. by 2080 may put 270 million people in a risk of malaria	a $3^{\circ}\text{C}$ rise of temp. put up to 330million people at risk of malaria
Ecosystem	A $1^{\circ}\text{C}$ temp. change may causes for a change of 10% ecosystem damage	1- $2^{\circ}\text{C}$ temp. rise causes 15–20% of the ecosystem worldwide	A rise of $2^{\circ}\text{C}$ temp. responsible for a shift of a 20% global ecosystem and a 10% coastal wetland loss
Agriculture	A rise of temp. up to $2^{\circ}\text{C}$ responsible for a decline of crop yield in EU and US	Heat stress caused by $1.7^{\circ}\text{C}$ temp rise affected the agriculture in the tropics	$2.5^{\circ}\text{C}$ temp. increase in 2080 results in 50 million additional people at risk of hunger
Water resource	A $1.5^{\circ}\text{C}$ temp. rise puts many region into the water stress 400800 million people will be in water shortage	2– $2.5^{\circ}\text{C}$ temp. rise cause for 2.4-3.1 billion people in a risk of water shortage	$>2.5^{\circ}\text{C}$ temp. warming effect will put 3.1-3.5billion additional people into water shortage risk
Other major events	A $1.5^{\circ}\text{C}$ temp. rise will cause for the complete melting Greenland ice, which causes 7m sea-level rise	$2^{\circ}\text{C}$ temp. rise may result in various catastrophic events. When the temp. rise ranges $2\text{--}4^{\circ}\text{C}$ it will cause for a sheet of W. Atlantic ice that may rise the sea-level 5-6m	$>3^{\circ}\text{C}$ temp. rise makes all the catastrophic event significant. $4^{\circ}\text{C}$ temp rise increases the probability of thermohaline shutdown up to 50% and above

As a result, climate change has been taken as one of the worldwide geographical concerns, with the following effects:

- Ice is melting worldwide, especially at the Earth's poles. This includes mountain glaciers, ice sheets covering West Antarctica and Greenland, and Arctic sea ice. In Montana's Glacier National Park the number of glaciers has declined to fewer than 30 from more than 150 in 1910.
- Much of this melting ice contributes to sea-level rise. Global sea levels are rising 0.13 inches (3.2 millimeters) a year and the rise is occurring at a faster rate in recent years.
- Rising temperatures are affecting wildlife and their habitats. Vanishing ice has challenged species such as the Adelie penguin in Antarctica, where some populations on the western peninsula have collapsed by 90 percent or more.
- As temperatures change, many species are on the move. Some butterflies, foxes, and alpine plants have migrated farther north or to higher, cooler areas.
- Precipitation (rain and snowfall) has increased across the globe, on average. Yet some regions are experiencing more severe drought, increasing the risk of wildfires, lost crops, and drinking water shortages.
- Some species including mosquitoes, ticks, jellyfish, and crop pests are thriving. Booming populations of bark beetles that feed on spruce and pine trees, for example, have devastated millions of forested acres in the U.S. Climate change is fundamentally a spatial phenomenon. As a result, geographers deal with it as well, and Unit 2 has gone through it exhaustively.

### Reflective Activity 7.1



1. Discuss in a group how climate change affects the current socioeconomic conditions of Ethiopia.

## 7.2. Desertification

At the end of this section, you will be able to:

- explain the causes and effects of desertification;
- describe the major human induced and natural causes of desertification; and
- explain the consequences of desertification taking a concrete example from East African countries.

**KEY TERMS:** desertification, land degradation, dryland, landscape, human induced.

### Brainstorming Activity 7.2



1. What are the main causes of desertification?
2. How does desertification affect our physical and socioeconomic environment?

#### 7.2.1. Definition of Desert and Desertification

Deserts are defined as areas of the Earth that get a little or no rain, often 250mm or less per year which is different from the idea of desertification. Desertification does not concern natural deserts, and can only occur on land which is vulnerable to the desertification process. The phenomenon known as desertification has received widespread attention recently, as witnessed in the United Nations Conference on Desertification in Nairobi in 1977, mainly as a result of the impact of extended drought in the West African Sahel in the early 1970s. Today, the UN definition of desertification is that it is 'human induced land degradation in dry and sub-humid regions' (UNCCD: United Nations Convention to Combat Desertification). By definition, human induced land degradation, refers to how desertification is caused by the actions of people that have a negative impact on the condition of the environment.

According to IPCC special report on climate change and land, desertification is land degradation in arid, semi-arid, and dry sub-humid areas, collectively known as drylands, resulting from many factors, including human activities and climatic change.

The range and intensity of desertification have increased in some dryland areas over the past several decades. Drylands currently cover about 46.2% of the global land area and are home to 3 billion people. The multiplicity and complexity of the processes of desertification make its quantification difficult. Desertification hotspots, as identified by a decline in vegetation cover, extended to about 9.2% of drylands in between the 1980s and 2000s, affecting about 500 million people in 2015. The highest number of people affected are in the South and East Asia, the Sahara region including North Africa, and the Middle East.

Desertification, even if viewed as a subset of the general land degradation problem, has undoubtedly proved to be controversial, especially since the 1977. The term has been seen as confusing, as it is grouping together a range of environmental processes and because of the images it presents, an inappropriate images of desert advance through sand dunes encroaching upon productive land.

### **7.2.2. Characteristics and Surface Area of the World's Drylands**

The dry lands are comprised of arid, semiarid and sub-humid areas, the difference being in their degree of aridity. Aridity is the result of the interaction between various climatic factors (rain, temperature, wind) and evapotranspiration. These elements combine together to determine the growth of plants and the capacities of animals or humans to live fittingly in a harsh natural environment. Almost half of the terrestrial land surface, equal to 6.45 billion hectares, is made up of drylands (47% according to the World Atlas of Desertification, UNEP 1997). They are distributed among all the great regions of the planet. One billion hectares is hyper-arid; these are real deserts such as the Sahara.

Generally, 5.45 billion hectares of land are arid, semi-arid and sub-humid areas. Desertification occurs in these parts of the planet. These areas are inhabited by one fifth of the world's population or 1.2 billion inhabitants in the year 2000. It is here where the soils are fragile, vegetation is sparse and the climate is difficult that helps to expand desertification. Land degradation occurs everywhere, but can only be defined as 'desertification' when it occurs in the drylands. Some 70% of the 5.2 billion hectares of drylands used for agriculture around the world are already degraded. Thus, desertification now damages practically one quarter of the total land surface area of the world and it also affects about two-thirds of the countries of the world.

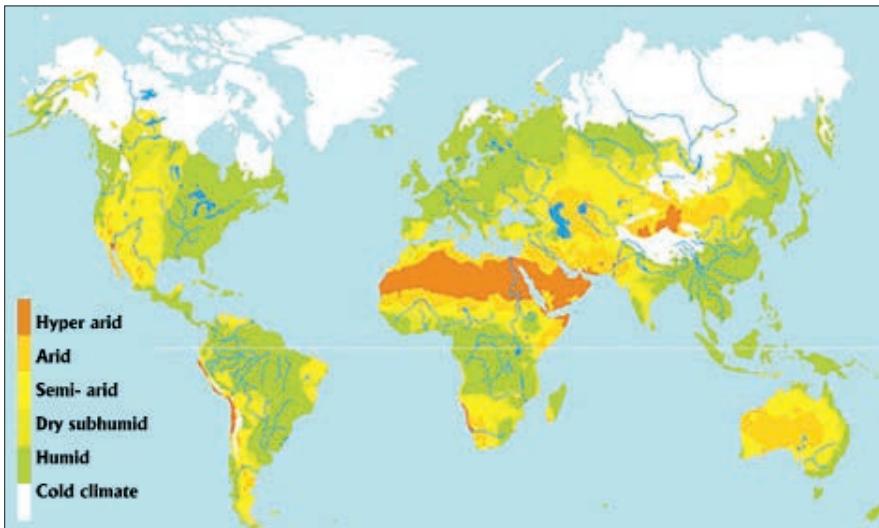


Figure 7.1. World Map of Aridity Zones

The world's drylands are particularly affected by desertification as they have the following fundamental features:

- Low precipitation that is infrequent, irregular and unpredictable;
- Large variations between day and night temperatures;
- Soil that is poor in organic matter;
- Lack of water for consumption; and
- Plants and animals adapted to climatic variables (heat resistance, lack of water).

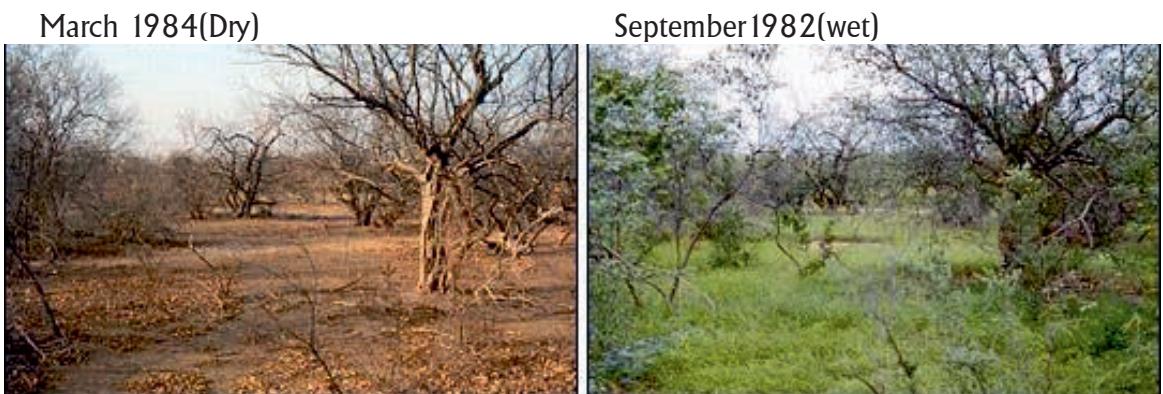


Figure 7.2 The process of desertification

### 7.2.3. Causes of Desertification

An obvious starting point when considering the causes of desertification is the increase in the human population from about 1 million in the Stone Age to 1 billion in 1850 and 6 billion in the 1990s.

Desertification and land degradation have emerged as a significant and seemingly permanent issue as a result of the combined effects of technology, human population expansion, and cultural shifts. Therefore, man is one of may be the 3 million species but today consumes far more food than all of the other land animals put together. Ever since people started to use fire to improve grazing and domesticate crops and cattle, land degradation and desertification occurred, and this happened everywhere. Some of the factors that contribute to desertification are discussed in a greater depth in the following sections :

#### Brainstorming Activity 7.3



1. Students, discuss in your group how a desertification occurs?

#### a. Population growth

Since the middle of the 20<sup>th</sup> century many countries have experienced significant population growth (a greater number of children are born while infant mortality decreases slightly, but also people tend to live longer). As a result, the rate of population growth is often high when it is between 2% and 3% per year.

That means in certain countries, the population will double within the next 20 to 30 years. As a result, such fast population increase makes it impossible to feed them using traditional methods of production. Increase in agricultural pressure on land, with the added effect that the soil in the drylands is not given sufficient time to recover, leads to an eventual drop in productivity. Basically human action, ironically, is necessary to restore damaged areas. That means, people have the potential to devastate the environment as well as the ability to heal and rehabilitate it.

### b. Over-exploitation of natural resources

Due to the lack of alternative survival strategies, farmers tend to relentlessly exploit natural resources (food crops, water for drinking and washing, firewood) to the point that they are often over-exploited and cannot regenerate naturally. Soil nutrients and organic matter begin to diminish as intensive agriculture removes quantities of nutrients greater than the soil's natural regeneration capacities. As a result, the soil does not recover as quickly as it does during fallow periods. This traps it in a vicious cycle of environmental deterioration and poverty, both of which are major contributors to desertification.

Over-cultivation exhausts the soil, overgrazing removes the vegetation cover that protects it from erosion. The causes are multiple and interact in a complex manner. The principal causes exacerbating land degradation derives from the farmers' determination to maximize soil productivity, which include:

- Crops cultivated in areas at high risk from drought.
- Shortening of crop cycles and the reduction of fallow periods.
- Insufficient use of fertilizer after harvesting.
- Inadequate crop rotation or worse, monoculture.
- Intensive labor.
- Intense breeding and overgrazing with pressure on vegetation and soil trampling by livestock.
- Separation of cattle rearing and agriculture, eliminating a source of natural fertilizer or organic matter (cattle dung) used to regenerate the soil.
- Deforestation.
- Bush and forest fires.
- In mountainous regions, crops are cultivated along the downward sloping face rather than following the natural contour lines of the mountain.
- Deterioration of terraces and other soil and water conservation techniques

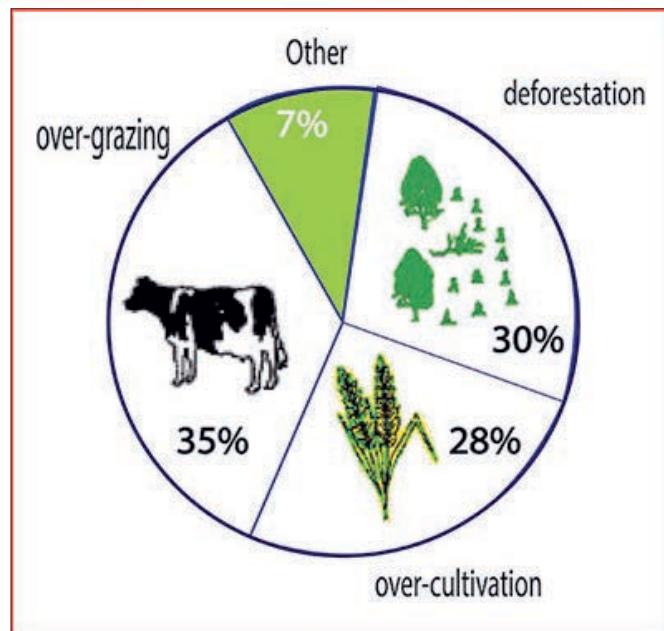


Figure 7.3: Causes of worldwide land degradation and Desertification

### c. Deforestation and energy

The use of firewood is one of the principal causes of desertification. In tropical arid areas, wood is the principal source of domestic energy for cooking and lighting both in rural and urban areas, and it is also used for construction. In this way, large tracts of forest are destroyed. Due to the lack of water in the drylands, forest regeneration is very slow, reducing the dynamic growth of vegetation.

However, allowing for rest periods from grazing and increasing fallow periods, generally have spectacular regenerating effects on the forest. In the drylands, this regeneration is very slow because of water scarcity. Thus, deforestation is a major cause of desertification. To limit the need for deforestation, only renewable sources of energy (hydraulic, wind, solar) and gas and petrol should be encouraged as it can replace wood consumption



Figure 7.4. Example of Deforestation in Liberia

#### d. Do climate change and deforestation cause desertification?

The climate of the planet has changed over the course of history (see Chapter Two). Variations in arid and humid climates have been observed in most regions of the world. Thus, a desert today could have been a humid and fertile zone in the past, and is still in the process of evolving. Moreover, today's forests originally developed from low-lying vegetation made up of grasses and shrubs. However, if humans continue to over-exploit forest resources and influence the climate by gas emissions, who knows what will remain of the forests in the next few decades.

Global and regional variations in temperature at the ocean surface are directly linked to rain cycles. This is the case of the phenomenon known as 'El Nino' whose persistent and devastating rains affect the eastern coast of the Americas, Asia and even Africa. As a result of this situation, the area may be warm by at least several degrees Celsius. Deforestation, Overgrazing and over cultivation on grass lands in semi-arid areas cause similar changes in albedo, leading to an increase in desert conditions, a process known as desertification.

#### 7.2.4. The Consequences of Desertification

Billions of acres of the world's range and cropland, along with the welfare of millions of people, have been affected by desertification in recent decades. One of the main causes is believed to be overgrazing, although over cultivation, poor irrigation practices, and deforestation also play a significant role. Some of the major effects of desertification is given below.

Desertification decreases the resilience of the land to natural climatic change. Thus, soil, vegetation, freshwater supplies, and other resources' efficiency and viability are all affected. Soil becomes less productive as a result of topsoil erosion, which can be blown away by wind or washed away by rainstorms. When pastures are overgrazed, edible plant species may go extinct, and non-edible plant species may invade the area. Some of the consequences are caused by people who live outside of the impacted areas. Downstream flooding has resulted in decreased water quality due to sedimentation in rivers and lakes, silt sediment in reservoirs and navigation channels, dust storms, and sand drifting, are a few instances. Food production will suffer greatly if desertification is not prevented and the area's food yields are not restored. Many of the nations impacted by desertification, malnutrition, hunger, and disaster are all conceivable results. Desertification often adds to famine in regions where there is also poverty, civil disturbance or conflict. Drought and land degradation often help to trigger a crisis, which is then made worse by poor food distribution and the inability to buy what is available. Desertification has huge societal consequences, including land degradation, drought, population migration, wars, and conflict over freshwater.

Desertification has a significant economic impact; it is estimated that the annual income lost in desertification-affected regions is over 42 billion USD. However, some of the most significant consequences of desertification are listed below.

- Farming becomes next to impossible;
- Decrease in crop yields;
- Hunger;
- Flooding;
- Poor water quality;
- Poverty;
- Biodiversity loss;
- Endangerment and extinction of species;
- Destruction of habitats; and
- Migration.

### **7.2.5. Desertification in Eastern Africa**

Essentially, two-thirds of Africa is classified as dryland, with 319 million hectares of land considered to be vulnerable to desertification. These areas are concentrated in Sahelian region, Horn of Africa and Kalahari in the south. Increasing concentration of poverty in the drylands of sub-Saharan Africa has been documented, where 41% of the total population lives in extreme cases. This is mainly because of desertification. Thus, desertification is one of the most severe concerns and risks to Africa's long-term development.

The sub-region of East Africa lies between  $21^{\circ}$  North latitude and  $11^{\circ}$  South latitude in the Tropics. It includes nine countries Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, South Sudan, Uganda and the United Republic of Tanzania. The Sahara Desert has a significant influence on this region, making it relatively dry. Desert covers more than 1 million square kilometers, including all of the northern Sudan. The climate is characterized by high temperatures and low precipitation (less than 200 mm). Very arid and semi-arid climates are also found in Somalia, Djibouti and along the coast of Eritrea, with annual rainfall ranging between 400mm and 750 mm. Most of Ethiopia and the mountains of Kenya have mountain climates with higher rainfall and lower temperatures. Uganda and the coast of the United Republic of Tanzania are mostly characterized by a very humid climate with high temperatures and a very short dry season. The rest of Tanzania, Kenya and Uganda have typical tropical climate with a long dry season.

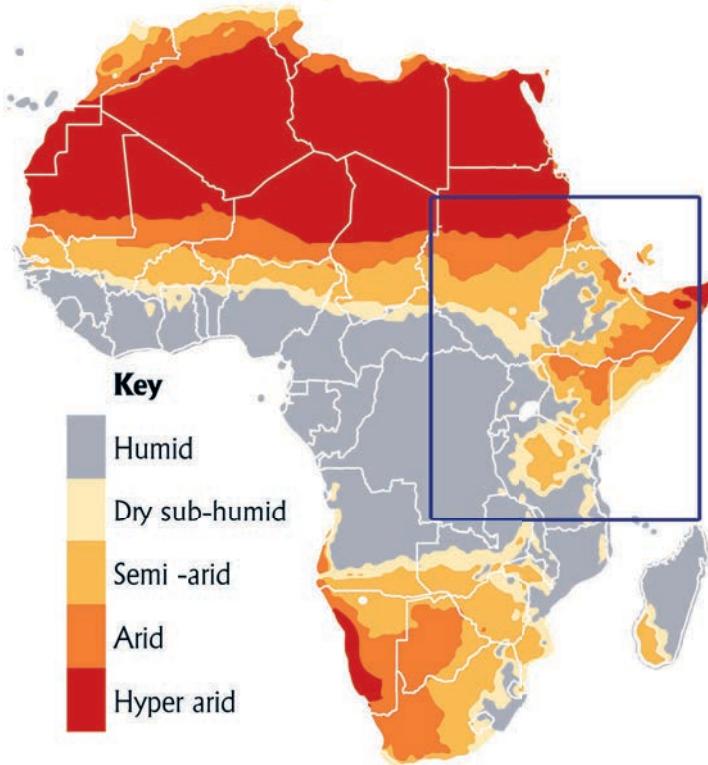


Figure 7.5. The extent of desertification particularly in Eastern Africa

Rapid population increase, widespread deforestation, and the building of large-scale projects that damage the environment are all contributing to desertification in semiarid East Africa. Desertification has already proven to be one of the key challenges affecting the livelihoods of the poor people of the region. Most of the people in this region are living predominantly in rural areas where their lifestyles are traditional peasants relying heavily on land for livelihood. The governments have to try and export little to earn foreign exchange which is used to import much needed machinery,

Mineral fuels, manufactured goods, chemicals, etc. Little revenue is therefore left to be used in developing and providing the needs of the growing population. It is in this context that the population of East Africa is seen as growing faster than their economies can provide for.

### **Features of desertification in Eastern Africa**

This section provides a few examples of desertification process in eastern African countries and the consequences thereof. In Tanzania, population pressure from both man and animal is causing moderate to high land degradation. Along with that, roughly 45 percent of the country's entire territory has already been impacted, with another 35 percent under threat. The semiarid Sukumaland Sindiga, Gogoland and Masai steppe are the most affected areas that are taken as an example.

In Sudan, overpopulation demanding large amounts of millet cultivation, and tree cutting for various domestic needs are the main causes of desertification. Accordingly, each household in a settled situation uses about 200 trees or bushes a year. They indicate that the introduction of agriculture in the 450-650 mm rain zone has accelerated desertification in the Western Sudanese region.

In the case of Ethiopia, the experience is the same as that in Sudan particularly in the north, northeast and southeast areas but the condition is aggravated by lack of political stability and recurrent war in its marginal areas. Uganda, which is known as the "Pearl of Africa," has seen significant forest loss, causing environmental destruction. One of the major causes of this is rapid population growth. Kenya is also threatened by desertification especially in its grazing marginal lands which cover 85% of the country. The worst hit are the Kerio Valley Development Authority areas, much of Eastern and North Kenya and Kajiado areas of South Kenya. Severe sedimentation in manmade dams, notably along the Tana River, threatens the usefulness of these hydropower plants. This is one of the major causes of climate change and destruction of natural vegetation.

### **Attempts to combat desertification in Eastern Africa**

**National efforts to combat desertification:** They include the recent creation of Presidential Commission on Soil Erosion and Afforestation in Kenya. The starting of a tree nursery in each district of the countries, particularly Kenya and Ethiopia and the designation of a day as a national tree planting day. Thirdly, the local agricultural extension officers are to be more active in encouraging proper agricultural practices. Ethiopian 'green legacy' is a typical example in this respect.

**International projects:** Though it is no longer active, UNESCO's Integrated Project on Arid Lands began in 1976 in Kenya as a pilot project of research, training, and demonstration. Its primary task was to find direct solutions to the more urgent environmental problems associated with desert encroachment and ecological degradation of arid lands. It was then to develop new strategies for pastoral land management and regional development. This program's task is to find scientific management principles to the environment and to use these findings to improve living conditions of the people. The principal objective of it is to enhance production in the agricultural and forestry industries, followed by increased productivity and stress tolerance.

### Reflective Activity 7.2



1. Discuss in group about the causes and effects of desertification with concrete example around your environment.
2. Explain the nature of desertification in the east African context.

### 7.3. Drought

At the end of this section, you will be able to:

- define the essence of drought;
- distinguish different types of droughts and their causes; and
- explain the major causes and effects of drought taking some countries as examples.

**KEY TERMS:** Drought-Prone Regions, Dryness Ratio, Meteorological Drought, Hydrological Drought, Agricultural Drought



### Brainstorming Activity 7.4

1. What do you mean by drought?
2. What are the most essential factors to consider while determining drought?

#### 7.3.1. Definition of Drought

Desertification, drought, and famine are all linked, as stated in the preceding section. When evaluating the concept of drought, the first thing we will ask is where the deserts and their borders are; where the drought-prone zones are, and the places where there is a lack of rain. Quantitatively, the dryness ratio or indices can be used to calculate a rainfall deficit in places that are dry on a regular or seasonal basis. Drought and aridity are clearly related phenomena. A permanent rainfall deficiency causes aridity. Drought is the absence of regular rainfall over an extended period of time. The Sahelian and Sudanese ecosystems in Africa are the most often drought-affected areas.

A generally accepted definition of drought is a ‘temporary reduction in water or moisture availability significantly below the normal or expected amount for a specified period.’ The key assumptions of such a definition are:

1. The reduction is temporary (if the reduction were permanent then terms such as “dry” and “arid” would be more appropriate).
2. The reduction is significant.
3. The reductions is defined in relation to a “norm” i.e. normal expectation.
4. The period taken as the basis for the norm is specified.

It is crucial to understand how the “norm” is defined. To provide more explanation for assumptions 3 and 4. The “norm” may be defined either:

- Technically: a reduction of water availability might qualify as a “drought” when it falls below about 80% of the average availability over the preceding 20 years, or
- Culturally: in terms of the level of water availability the society has come to expect. Thus, after a run of ten years with above average rainfall a society may have become used to the wetter state and perceive the first year of average rainfall as a drought.

### **7.3.2. Location of Drought-Prone Regions**

Our planet has five main diagonal zones of drylands:

1. In northwest Mexico the Sonoran Desert and its extension in the dry basins of the southwestern United States.
2. The Atacama Desert, running along the western foot of the Andes from south of Ecuador to Central Chile. The belt crosses the Andes at the latitude of Antofogasta and extends eastwards into Patagonia.
3. The vast diagonal running from the Atlantic Ocean to China, including the Sahara, the Arabian Desert, the Rajasthan Desert of Pakistan and India, the deserts of Iran and the former USSR, and, in China and Mongolia, Taklamakan and Gobi.
4. The Namib-Kalahari and its surroundings in Southern Africa.
5. Most of the Australian continent.

These belts are divided into:

- Arid zones with rainfall below about 100mm-150mm per year, insufficient to support cropping,
- Drylands with rainfall below about 200mm-250mm, where vegetation can be sufficient to support pastoralism,
- Semi-arid zones with rainfall between 250mm-300mm and 600mm per year where cultivation of drought-resistant crops is possible, and
- Dry-sub humid zones as defined by Nelson (1988) as with 600mm-1200mm of rainfall and a maximum of 6 months growing season.

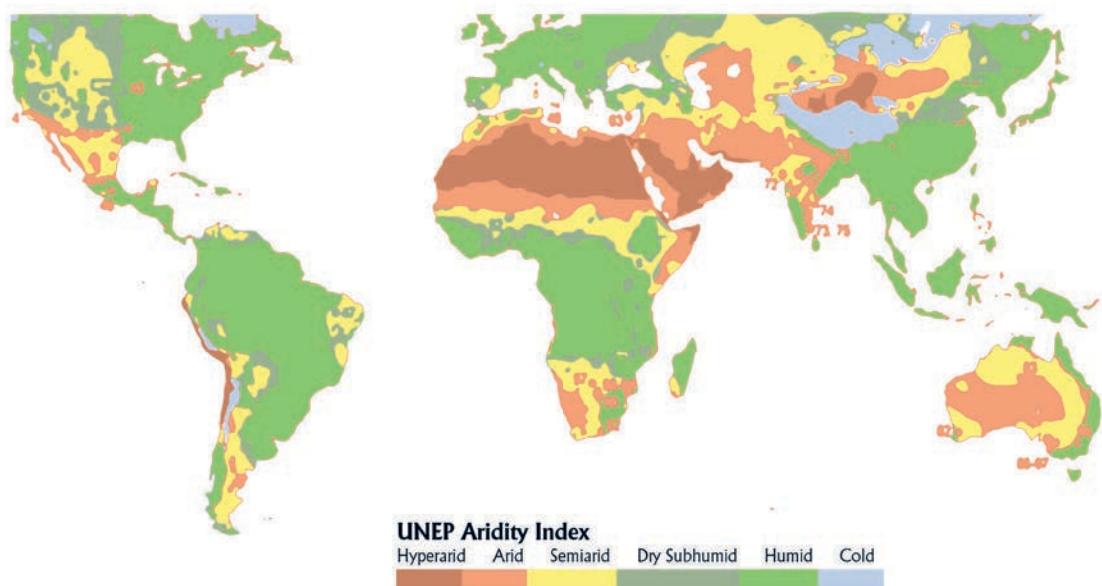


Figure 7.6: Distribution of Aridity in the world

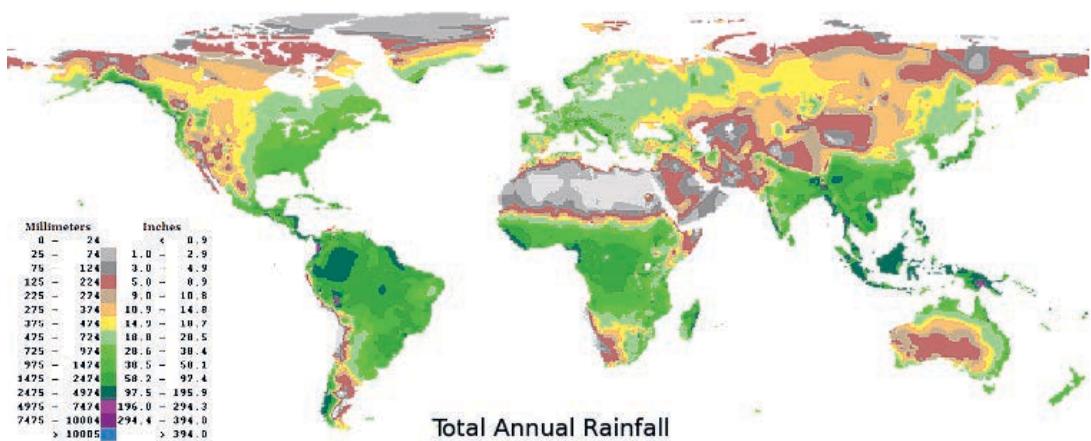


Figure 7.7: Distribution of Annual Rainfall in the world

### **7.3.3. Types of Drought**

It is a common practice to distinguish between three forms of drought; meteorological, hydrological, and agricultural droughts. These categories are usually, but incorrectly, viewed as synonymous.

#### **a. Meteorological Drought**

It describes a situation where there is a reduction in rainfall for a specified period (day, month, season, or year) below a specified amount – usually defined as some proportion of the long term average for the specified period of time. Its definition involves only precipitation statistics. Care needs to be taken in utilizing and aggregating rainfall data.

The word “drought” is most commonly used to refer to meteorological drought. Efforts have been made to design a universal definition of meteorological drought that would fit all localities and situations. These definitions reflect climatic abnormalities, and are based on a deficit of rainfall from a conversion long-term average. That means Meteorological drought occurs when precipitation is significantly below expectations. Its definition involves only precipitation statistics and depends on the time of year and on location.

#### **b. Hydrological Drought**

It involves a reduction in water resources (stream flows, lake levels, groundwater, and underground aquifers) below a specified level for a given period of time. Its definition involves data on availability and offtake rates in relation to the normal requirements of the system (domestic, industrial, irrigated agricultural) being supplied.

The distinction between the two types can often be blurred as hydrological droughts may be caused by reductions in precipitation anywhere within the catchment area of the river or aquifer system. Thus, irrigated agricultural areas alongside the River Nile in Egypt may experience a hydrological drought as a result of a meteorological drought in the Ethiopian Highlands regardless of the levels of rainfall within Egypt itself. In the case of rivers fed by snowmelt, irrigated areas downstream may experience reduced water availability as a result of reduced snowmelt caused by below normal temperatures during the summer months.

Areas drawing water from underground aquifers through wells and boreholes may experience hydrological drought as a result of geological changes which cut off parts of the aquifer. Overutilization of the aquifer may also result in its exhaustion.

### c. Agricultural Drought

Agricultural drought occurs when the water supply necessary for agriculture becomes scarce. An agricultural drought depends on the amount of rainfall expected and the use to which water is put, hence a shortage of water is felt because of human activity, whereas a meteorological drought creates stress on plant life unconnected with people and their needs. Sometimes agricultural drought defined in terms of soil moisture deficit and state that it occurs when there is a consistently high soil moisture deficit over the growing season.

In human terms, agricultural drought is a moisture deficit on a sufficient scale to cause disruption of the rural economy. In an extreme agricultural drought, crops fail, and animals and perhaps people die. A shifting drought threshold shows how changes in population pressure and crop rotation may affect the drought threshold. Thus, agricultural drought is analyzed as a substitution of maize, a more water demanding cash crop than millet, a traditional dry area crop that affect the Kenyan landscape.

#### 7.3.4. Ratio and Indices Drought

A number of different indices have been developed to quantify a drought, each with its own strengths and weaknesses. Most commonly used indices are:

- Palmer Drought Severity Index (PDSI)
- Crop Moisture Index (CMI)
- Satellite Vegetative Health Index (VHI)
- Percentile of Normal precipitation
- Standardized Precipitation Index (SPI)

**Palmer Drought Severity Index:** The PDSI was the first index developed in the United States. (1965).

It is a soil moisture algorithm based on precipitation and temperature data, as well as the local available water content of the soil. From the inputs, all the basic terms of the water balance equation can be determined. Negative values depict drought (range -6 to 6).

- ◆ Strengths: it is very comprehensive, it places current conditions in an historical perspective, and it is best for long-term drought and homogeneous area.
- ◆ Limitations: it can be slow to respond, it does not consider snowpack, and there is a need to know the state of the climate.

**Crop Moisture Index:** The Crop Moisture Index was also developed by Palmer (1968), and is a simple water balance index. The CMI responds more rapidly than the Palmer Index and can change considerably from week to week, so it is more effective in calculating short-term abnormal dryness or wetness affecting agriculture.

- ◆ Strengths: it reflects quickly changing the soil conditions for agricultural applications.
- ◆ Limitations: it is useful only during the growing season, and is not a useful tool for a long-term drought monitoring .

**Satellite Vegetative Health Index:** The Satellite VHI is a combination of the chlorophyll and moisture content in vegetation combined with surface thermal changes. A Vegetation and Temperature condition Index (VT) is produced, with values from 0 to 100 characterizing change in vegetation conditions from extremely poor (0) to excellent (100).

- Strengths: it provides good spatial coverage of vegetative health for agricultural applications; it is useful for early drought detection; it is not adversely affected by bad surface observations.
- Limitations: It is useful only during the growing season.

Percent of Normal Precipitation: it is calculated as;

$$\text{PNP} = (\text{Actual precipitation}) / (\text{Normal precipitation}) \times 100$$

- Strengths: it is very easy to calculate, regularly generated by various climate software packages, and is generally useful and easy to be understood by media and public.
- Limitations: it is often misunderstood as precipitation has a non-normal distribution, which is not taken into account. A station or climate division must have a long record of observations from which a normal can be computed.

**Standardized Precipitation Index:** The SPI calculation for any location is based on the long-term precipitation record for a desired period.

This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero (half of the precipitation amounts are below the median, and half above) (Edwards and McKee, 1997).

The SPI is negative for drought (index ranges from -2 to 2).

- Strengths: It is not as complex as the PDSI; it can provide early warning of both the onset and end of drought; and it captures the various time scales of drought.
- Limitations: Precipitation is the only input –temperature and soil moisture are not included, and it is based on preliminary data.

Based on this index for 12-month we can get the following level of drought

Table 7.2: the standard drought index

Level	Measurement
Extremely wet	2.0+
Very wet	1.5 to 1.99
Moderately wet	1.0 to 1.49
Near normal	0.99 to 0.99
Moderately dry	-1.0 to -1.49
Severely dry	-1.5 to -1.99
Extremely dry	-2 and less

### 7.3.5. Causes of Drought

Droughts are primarily caused by changing weather patterns, which manifest as an excessive accumulation of heat on the earth's surface, as well as meteorological changes that result in less rainfall and lower cloud cover, all of which result in higher evaporation rates. Basically, droughts in Africa are caused by a combination of natural and human factors.

The most important natural factor responsible for the prevalence of drought is El Nino and La Nina effect. In Africa it occurs most frequently during the warm El Nino period. In fact, this does not happen always as there are many other local and global factors influencing the drought phenomenon. In Southern and Eastern Africa regions, droughts have occurred during cold La Nina time. In some cases, a powerful La Nina event was the primary cause of the drought in the Horn of Africa in 2010–2011.

The recent severe droughts in Sahel region were caused by the ocean warming (southward warming gradient of the Atlantic ocean and steady warming of the Indian Ocean), southward shift of Inter Tropical Convergence Zone (ITCZ).

Regarding the anthropogenic factors, the land - atmosphere feedbacks through natural vegetation and land cover change are also important factors. Anthropogenic contribution in land use change altering the land surface feedback mechanisms is also seen as a factor. Furthermore, human induced greenhouse gas emission is also considered as a contributory factor to oceans warming. Although it is generally true that lower rainfall results in lower crop yields, the following factors have an impact on the strength of the connection and on the severity of drought in many African nations:

- The proportion of production which is irrigated;
- The moisture retention capacity of the soil;
- Timeliness of the rainfall (the normal growing season rainfall occurring during the cycle);
- The adaptive behavior of farmers; and
- a standard operational definition of drought.

### **7.3.6. The Impact of Droughts**

Of all the natural hazards, droughts are potentially those having the greatest economic impact and affecting the greatest number of people. Earthquakes and cyclones may be of enormous physical intensity but are invariably of short duration, and are geographically limited. By contrast droughts affect large geographical areas, often covering whole countries or parts of continents and may last for several months and, in some cases, several years. Of the main natural disasters, droughts are unique in terms of the length of time between the first indications from, for example, rainfall monitoring, that a drought is developing and the point at which it begins to impact significantly upon the population of the affected area. Droughts, almost or virtually always, have a direct and significant impact on food production and the overall economy. The impact on a particular population is related to the severity and nature of the drought, but equally, and occasionally more importantly, to the nature of the economy and society in the affected area.

First, consider an extreme example. Two semi-arid countries experience a 50% reduction in annual rainfall. Country X is a high income economy where agriculture contributes only 10% of the total Gross Domestic Product (GDP) and water for industry, agriculture and domestic use is drawn from reliable underground aquifers. Country Y is a low income economy where agriculture is primarily rainfed and contributes 50% of total GDP.

Clearly the drought impacts on Country X are likely to be negligible whereas for Country Y they are likely to be severe. The scenario becomes more interesting if the assumption about the reliability of the underground aquifers in Country X is altered so that water is drawn from rivers and reservoirs whose catchment area is affected by the reduction in rainfall – a hydrological drought. Likely impacts include reduced agricultural and industrial production, increased unemployment, domestic water rationing, increased cost of living, and increased investment in the exploitation of alternative water resources, and so on.

Bearing in mind the variations between economies and societies noted above, the following list of potential economic and social impacts of an agricultural drought may be helpful. The list is neither exhaustive nor comprehensive but is intended to illustrate some of the possible outcomes of drought. Potential information sources on the impacts are noted in brackets.

- Reduced income for farmers and agricultural laborers (household income and expenditure surveys undertaken by statistics departments, ministries of agriculture, university researchers, employment offices).
- Reduced spending locally on agricultural inputs and equipment and non-agricultural items and services like travel and non-subsistence foods.
- Decrease in price of livestock as farmers are forced to sell because of increases in the cost of pasture and purchased feeds.
- Increased price of staple foods.
- Inability of certain groups within the population to afford increased food prices results in their:
  - ▲ Switch to cheaper and sometimes less preferred foods;
  - ▲ Reduction in overall food intake;
  - ▲ Borrowing to maintain food intake;
  - ▲ Selling assets to raise funds;
  - ▲ Engaging in alternative income earning activities locally;
  - ▲ Migrating in search of employment opportunities; and
  - ▲ Migration to where relief food is being distributed.
- Reduced food intake leads to deterioration of nutritional status and reduction in ability to resist infection.
- Difficult and scarce availability of water results in a general increase in diarrheas and other water/hygiene-related illnesses.
- Increased stress and morbidity (disease and illness) results from migration journey.
- Drying-up of water sources leads to reduction in water quality, the need to travel further to collect water and possibly migration to better water.

- Increased competition for access to remaining water sources may lead to increased incidence of local disputes/conflict.
- Loss of education due to reduction in school attendance by children lacking energy and/or money for fees, plus the need for them to assist other family members in water collection and income generating activities.
- Social costs of migration, e.g. break-up of communities and families.

### Reflective Activity 7.3



1. Why defining drought is a difficult task?  
What things have to be considered in defining drought?
2. Describe the major causes and consequences of drought by taking some concrete example from your locality.
3. Why the three types of drought are understood as synonymous

## 7.4. Famine

At the end of this section, you will be able to:

- explain the major causes and effects of famine; and
- analyze the mechanisms to cope up the effects of famine.

**KEY TERMS:** food availability, food security, entitlement to food, incidence of famine

### Brainstorming Activity 7.5



1. What distinguishes famine described in news reports from the actual circumstances that exist in the society?

#### 7.4.1. Definition

For many, the word famine is defined by images of mass starvation, where whole communities are literally starving to death. Indeed, this is the power of the modern media that some tend to define famine in terms of the horrific, and the widely screened film of the feeding camps in Ethiopia and southern Sudan are specific cases of this.

However, to accept that famine is a process rather than a single clearly identifiable event that creates problems for those trying to differentiate famine from other more prevalent conditions such as chronic hunger. It affects as many as a one-third of the world's population and causes the premature death of many among the world's poor. The following is the safest method of defining famine. Famine results from a sequence of processes and events that reduce food availability or food entitlements causing widespread and substantially increased morbidity and mortality.

Over the last two decades, the concept of food security has emerged as a definitional scheme that considers the relationships between food production, distribution and consumption. It is now widely used by governments and donor agencies, and it is helpful to locate famine within this framework. The most widely used definition of food security is that outlined by the World Bank (1986):

Food security is access by all people at all times to enough food for an active, healthy life. Its essential elements are the availability of food and the ability to acquire it. Food insecurity, in turn, is the lack of access to enough food. There are two kinds of food insecurity: chronic and transitory.

Chronic food insecurity is a continuously inadequate diet caused by a household's persistent lack of ability to buy or to produce enough food.

Transitory food insecurity is a temporary decline in a household's access to enough food. It often results from instability in food prices, declining food production or household incomes – and in its worst form produces famine.

#### **7.4.2. Incidence of Famine**

Famines have occurred periodically in most, if not all, societies throughout history. Chronicles of ancient civilizations in India, Egypt, Western Asia, China, Greece and Rome record famines in these and other parts of the world. In the Middle Ages, famine was a frequent occurrence in Europe. For example, historians estimate that during the 900 year period from the 10th C to the 18th, there were 89 "general" famines in France and hundreds more "local" famines. Since then famines in Western Europe have become markedly less frequent as a result of agricultural innovation and the Industrial Revolution, though the 1846-51 "Great Famine" that occurred in Ireland was possibly one of the most catastrophic.

The most recent "famine" to occur in Western Europe developed in the Netherlands during the winter of 1944 when a military stalemate between the advancing Allied Forces and the retreating German Army created severe food shortages in the main urban areas and significantly increased mortality.

Estimate of the total deaths directly attributable to a particular famine are notoriously poor, often prone to exaggeration, and frequently a matter of dispute. In modern history, Ethiopian Famine of 1984 - 1985 is the most disastrous one.

### **7.4.3. Causes of Famine**

Famines are caused by either or both of the following factors:

- A decline in food availability; and
- A reduction in people's access to, or their ability to acquire, food.

Declines in food availability may be caused by a range of "natural" and human-induced factors. These are the factors that may precipitate a food crisis and indicates early symptoms.

Among the "natural" factors are:

- Agricultural drought;
- Floods;
- High winds;
- Unseasonable cold spells /frosts;
- Crop disease; and
- Pest invasion (e.g. locusts, army worms and quelea birds).

Among the human-induced factors are:

- Conflict preventing farmers from planting, weeding, harvesting, and selling or possibly, involving the physical destruction of standing crops.
- External economic shocks, e.g. sudden increases in the price of imported oil or fertilizers or a sudden decline in the value of a country's exports thereby limiting its capacity to import items normally necessary for agricultural production.
- Internal macro-economic mis-management, e.g. poor agricultural pricing policies discouraging farmers from growing surpluses, the overtaxing of export commodities so that the country's foreign exchange earnings fall, and it becomes less able to import vital commodities such as oil and fertilizer.
- Forced procurement of farm produce by state organizations over-export of foods which reduces the amount available nationally to below required levels.

A reduction of people's ability to acquire food may also be caused by a range of "natural" and human-induced factors which affect supply and ability to purchase.

#### **7.4.4. Measures to Maintain Food Security**

The overall objective of short term relief measures should be to protect people's access to food through:

1. Ensuring the availability of food in the affected area, and
2. Protecting the entitlements of all groups within the affected population.

Some of the principal measures for maintaining food security include:

- Price stabilization;
- Food subsidies;
- Employment creation programs;
- General food distributions;
- Supplementary feeding programs;
- Special programs for livestock and pastoralist populations;
- Complementary water programs; and
- Complementary health programs.

#### **Reflective Activity 7.4**



1. How are desertification, drought and famine related?
2. Identify the elements that show their similarities.
3. Write an essay about Ethiopian famines which occurred at different times by asking elderly people in your community.

## UNIT SUMMARY

Climate change, desertification, drought, and famine are some of the major global issues that are causes of concern among many people.

Deforestation is a type of land degradation that happens in arid, semiarid, and dry subhumid environments (drylands) as a result of varieties of reasons, including human activities and climate change. Desertification received a lot of attention in the 1970s as a result of the consequences of a long term drought in Western African Sahel. As a result of the United Nations Conference on Deforestation, the United Nations Convention to Combat Desertification was formed. As to eastern African desertification condition, the dryland of the region is representing about 65% of the total area of the region that is highly vulnerable to desertification. Rapid population growth, widespread deforestation and the construction of large-scale projects cause land degradation in this arid and semiarid area of eastern Africa. Various attempts were made to combat desertification by promoting afforestation programs.

Drought is the absence of regular rainfall over an extended period of time. There are five dry lands identified in the world. These include Sonoran desert, Atacama, the vast diagonal area extending from Atlantic to China, Namib-Kalhari, and most Australian area. Three different types of drought are identified: these are metrological, hydrological and agricultural. These category are usually but incorrectly viewed as synonymous terms though they are essentially different. There are different types of ratio or indices of droughtness. The most commonly used are: palmer drought severity index, crop moisture index, satellite vegetative health index and standard precipitation index. The major causes of drought are categorized as natural and manmade. El Nino, La Nina and warming ocean that affects the shift of Inter-Tropical Convergence Zone (ITCZ) are taken as natural. Also, land cover change, greenhouse gas emission are some of the manmade factors. Drought affects large geographic area. It always has a direct and significant impact on food production and the overall economy.

Famine is not a single easily identifiable phenomenon, it is rather a process that is difficult to differentiate from critical hunger. A more precise definition of famine is that it is the result of a process reducing food availability or food entitlements, and causes widespread and substantially increased morbidity and mortality. Famine is mainly caused by either or both of a decline in food availability and a reduction in people's access to or their ability to acquire food. To maintain food security, it is necessary to take measures in protecting people's access to food through ensuring the availability of food in the affected areas, and protecting the entitlements of groups with the affected population.

**REVIEW QUESTIONS**

**Multiple Choice:** Choose the best answer from the given alternatives for the following statements and questions.

1. Which of the following is a cause of desertification?  
A. Deforestation    B. Drought    C. Overgrazing    D. All of the above
2. An effect of desertification is:  
A. Food shortages                                  B. Strong economies  
C. Growth of new plant life                      D. all of the above
3. Which factor is not responsible for the spread of desertification?  
A. Soil erosion                                        B. Deforestation  
C. Climate change                                    D. Conservation of water
4. Which of the following is describing the meaning of overgrazing?  
A. Allowing herds to drink water in the grasslands  
B. Traveling from place to place  
C. Excessive grazing which causes damage to grasslands  
D. Leaving herds unattended
5. Which one of the following expressions best describes the essence of droughts?  
A. Prolonged period of normally low rainfall, leading to a shortage of water  
B. Prolonged period of abnormally low rainfall, leading to a shortage of water  
C. Prolonged period of abnormally low rainfall, leading to abundance of water  
D. All of the above
6. Which types of drought is expressed in terms of soil moisture deficit?  
A. Agricultural,  
B. Hydrological,  
C. Meteorological  
D. All of the above
7. Which one is a human component that causes drought in the Sahel region?  
A. Rain failure  
B. La Nina  
C. Over cultivation  
D. Lengthy wet and dry season

8. One of the following term is referring the idea of food security. Which one?
- Related to efforts to prevent terrorists from poisoning food supplies
  - ensuring everyone's access to food
  - Food surpluses with distribution
  - Shortage of water for agriculture
9. A famine is something that happens when a large group of people don't have \_\_\_\_\_.  
 A. Enough to eat  
 B. shelter from the cold  
 C. Enough fresh water to drink  
 D. enough money
10. Which one is denoting entitlements to food?
- The term refers to social welfare programs, e.g. the Fair Price food shops.
  - It means the pathways through which people access food, whether by production, purchase, social protection programs or other means.
  - When countries enact right-to-food legislation, then people are entitled to food.
  - The term is a reference to agrarian reform programs that provide farmers with land titles.

### **Give short answer for the following questions**

- What made the definition of desertification controversial after 1970s?
- What are the main factors that make drylands easily exposed to desertification?
- Compare and contrast the types of drought.
- What are the major natural factors that cause decline of food availability?



# UNIT EIGHT

## GEOGRAPHICAL ENQUIRY AND MAP MAKING



### Learning Outcomes

At the end of this unit, you will be able to:

- acquire the basics of research knowledge and skills to undertake geographic research;
- select and use different approaches in geographic research; and
- make different types of maps and interpret them.



### MAIN CONTENTS

- 8.1. Fundamentals of research in Geography
  - 8.1.1. The Purpose of Undertaking Research
  - 8.1.2. Features of Geographic Research
  - 8.1.3. Research Approach and Methodology
  - 8.1.4. Basic Elements of Research
- 8.2. GIS Data and Map Making Using GIS
  - 8.2.1. Gathering Data for GIS
  - 8.2.2. GIS Data Analysis
- Unit Summary
- Review Questions

### Introduction

Geographical enquiry as a method of scientific study involves the learners' active participation. Geographical enquiries at the 21<sup>st</sup> century should encompass all the essential skills related to the subject matter of Geography. Besides, new thinking, skills and strategy are essential to solve local and global environmental and socioeconomic challenges. Among these are Geographic Information System (GIS), Remote Sensing, sophisticated statistical approaches, and an aspect of ICT related to study of Geography. Current understanding of the process of scientific and mathematical investigations make the study of first-hand data through fieldwork or the investigation of second hand data or both manageable and workable.

Therefore, equipping students with contemporary skills and technologies enables them to investigate and understand the following issues:

- Dynamics of spatial and non-spatial characteristics of physical and human environment,
- Interaction and interdependence between people and their environment, and
- The causes and effects of a wide range of ecological, cultural, social, and temporal dynamics.

Learners of geography can address these issues by using skill of making of small research on their localities with some basic tools. The newest skill and technology of map making or GIS also helps to locate their place and navigate some routes in their research project.

This unit will, thus, enable learners to develop the abilities and attitudes pertaining to basic research method so that they become the future researchers in the field. Furthermore, it introduces students to one of the 21<sup>st</sup> century skills and technology of map making that we refer to as GIS and remote sensing.

## 8.1. Fundamentals of research in Geography

At the end of this section, you will be able to:

- explain the notion of research; and
- identify the main components that help to understand the concept of research in Geography.

**KEY TERMS:** Research; research method; scientific enquiries; objective search



### Brainstorming Activity 8.1

1. How do you explain the meaning of research?
2. Have you ever tried to do some research in your class?

Research is the process of using a collection of skills and knowledge that you have acquired to take the most in-depth look at a problem you are confronted with. But does research have a universal meaning? The answer to this question seems NO. Different writers particularly in the field of geography define research differently while the following main elements are the most common components used to define the concept research:

- An inquiry to obtain dependable and useful information,
- a scientific approach to study a problem, and
- a systematic and objective search for reliable knowledge.

Therefore, one could define research as a scientific method of seeking a solution for the problems identified. It is basically a systematic inquiry into causes or the discovery of new facts through planned and organized effort that requires time, money and skill. Generally, research is the search for knowledge through objective and systematic methods of finding solutions to problems.

Figure 8.1. A diagram showing research as target-full work linking various tools, expertise and peoples view with various perspective and method to approach the given problem.



Figure 8.1. Social Research

### 8.1.1. The Purpose of Undertaking Research

At the end of this section, you will be able to:

- identify the significance of research in addressing the environmental and socio-economic issues.

**KEY WORDS:** exploration; explanation; description; understanding

#### Brainstorming Activity 8.2



1. Why do we conduct research?

Governments and private companies have been investing huge amount of money for conducting research to meet their own purpose. As developed countries have investing vast resources for research, they are proving to be sources of new knowledge and innovation. Research capability and the extent to which this capability is directed into action are two significant variables that influence a country's development. As sometimes good researches don't always reach their intended audience, it's critical to make researches accessible to the appropriate institutions, among other things, so that they may be used to take action.

In general, most professional researchers base their research upon the following five main motivations:

- Exploration: includes investigating little understood phenomena, identify/ discover important variables, generate questions for further research, etc.
- Explanation: includes explaining why forces created the phenomenon in question, identifying why the phenomenon is shaped as it is.
- Description: includes documenting and characterizing the phenomenon of interest.
- Understanding: includes comprehending processes and interaction of phenomenon and people.
- Prediction: includes predicting future outcomes for the phenomenon and forecast the events and behaviors resulting from the phenomenon.

### Reflective Activity 8.1



1. Discuss the main elements that make a research report different from other news and fiction written in books and journals.
2. Can you elaborate the contribution of a certain research for science and applied actions? Please use some reference books or the internet to get the material.

### 8.1.2. Features of a Geographic Research

At the end of this section, you will be able to:

- elaborate the typical nature of geographic research ; and
- compare the characteristics of geographic research with other subjects.

**KEY TERMS:** theoretical paradigms, geographical inquiries, spatial distribution, formation of patterns

Geography as a subject provides a conceptual and practical overview of the diverse research methods for learners. The techniques that geographers use in their work are not developed in a vacuum. They are developed to address specific problems and, thus, reflect the focus of the discipline at particular times. These techniques reflect the conscious decisions of geographers about the kinds of information that are important to collect; the spatial scales at which information should be collected, compiled, analyzed, and displayed; data sampling strategies and experimental designs; data representation; and methods for data analysis. The methodologies for empirical research vary as theoretical perspectives shift. Thus, advancement of the discipline goes hand in hand with the development of new and improved techniques for collecting, analyzing, and interpreting information.

Geographers undertake research for all the reasons/ motivations mentioned above often in combination with each other. For instance, in your study, you may start with some exploratory investigations to determine which variables or factors are important. Next, you might try to describe the phenomena and how they are related. You may follow this by seeking to explain what caused the phenomena, and to make a prediction about future outcomes.

for example, if we were interested to investigate why people migrate to a new and relatively unknown area, the four approaches could be linked in the following way:

- Explore why people might want to relocate from their current location to a new one,
- Describe the patterns of migration based upon the factors found during exploration,
- Explain the patterns of migration identified when describing the exploratory factors, and
- predict possible future migrations based upon the explanations of current

Any research project has the following three components:

- A subject matter (what is being studied?),
- Methodology or Approach (how it is being studied), and
- Philosophical bases (ontology, epistemology...).

The whole procedure of your research job is determined by your geographic knowledge. Geography is one of the few subjects that may easily link the social sciences, biophysical sciences, and humanities. Though various definitions exist, Geography can be regarded as a science concerned with the rational development, and testing of theories that attempt to explain and predict the spatial distribution and location of various characteristics on the surface of the earth. For geographers, research is the process of trying to gain a better understanding of the relationships between humans, space, place and environment which leads them use scientific methods.

Geography has a long history of research that spans to 2000 years. It has always welcomed new technology, research methodologies, teaching methods, skills, and material as a scientific subject. The scope and technique of geography have developed over time as a result of technological advancements and the accumulation of knowledge. Traditionally, geographical research is related to the locations of places and people. In the eighteenth century, geography's focus shifted to the physical and human characteristics of places in our world. In the mid-twentieth century, geographical research focused mainly on:

- ▲ The spatial distributions of phenomena and things,
- ▲ The resulting patterns and interactions, and
- ▲ The forces responsible for the formation of the patterns.

Teaching geography is all about getting students to grasp today's concerns, such as population, land use, urban, economic, and health problems, as well as natural hazards. The 21<sup>st</sup> C teaching geography requires scoping, systems thinking (such as climate, watersheds, and energy systems), and critical thinking. Geographical studies, thus, have recently begun to address environmental concerns such as hunger, global warming, poverty, and the long-term evolution of our ecosystem. Changes in the discipline's tools and techniques have firmly positioned geography in the space era on a worldwide scale. At the personal level, the smartphone and global positioning system (GPS) have proven to be significant academic drivers and active players in the digital revolution. Geographers continue to adjust their perspectives on the world by employing both conventional and newly emerging technologies, such as mapping and GIS, respectively.

### 8.1.3. Research Approach and Methodology

At the end of this section, you will be able to:

- distinguish the difference and similarity between research approach, methodology and method; and
- differentiate between qualitative and quantitative methods.

**KEY WORDS:** research approaches, research method and methodology, qualitative and quantitative approach

#### Brainstorming Activity 8.3



1. What is the difference between research approach, methodology and method?



Figure 8.2. Research methods as the different ways to reach the intended target and the way of integrating diverse tools and sources

### a. Research approaches

The general way of treating a certain research problem is referred to as a research approach. Basically, research approaches are classified as quantitative and qualitative. Some literature may add a third alternative called mixed research approach. The following subsections discuss these three different approaches.

#### Quantitative approach

Quantitative research includes designs, techniques and measures that produce discrete numerical or quantifiable data, and data analysis is mainly statistical (deductive process). That means, we use the quantitative approach when trying to verify a given geographical theory. We translate the concepts of the theory into variables that can be measured with statistical techniques. The benefit of this method is that the quantitative technique used by one researcher may be utilized by another researcher for other purposes or to expand on the same data.



Figure 8.3 quantitative data representation are more of numeric

Examples of issues that show the application of this approach have been given as follows:

- Temperature decreases as one travels from lowland to highland areas;
- Land value increases as one moves from city periphery to the city center.

These examples basically discover the difference in variables that occur as a function of altitude and distance measured from a designated place for example, from lowland to highland and from periphery to the city core.

Thus, elevation and distance are the variables that determine the changing spatial patterns of temperature and land value, respectively.

The major subdivisions of quantitative research approach have been presented below.

- ▲ Statistical/Correlational Analysis,
- ▲ Experimental, and
- ▲ Quasi-Experimental.

## **Qualitative Approach**

A qualitative research is concerned with methods, procedures, and measurements that do not yield discrete numerical data. It involves extensive descriptive data in order to gain insights into phenomena. Data analysis includes the coding of the data and production of verbal synthesis (inductive process). This method does not examine any already held theories or hypotheses. There are no quantitative approaches used. As a result, other researchers will be unable to replicate the findings. Data are utilized to explain a new hypothesis in the qualitative method. Some of the major types of qualitative research approaches include the following:

- ◆ Historical/Narrative research,
- ◆ Ethnographic research,
- ◆ Case study,
- ◆ Action research.

## **Mixed Methods Research**

In the actual world, the data types that our study deals with are interlinked and difficult to separate. There are also a number of social and environmental issues, all of which are complexly interrelated. Therefore, the third research strategy is being developed in modern research activities. That is a mixed research approach. Mixed methods research is research in which quantitative and qualitative techniques are mixed in a single study. It is the third major research paradigm/perspective, adding an alternative (when it is appropriate) to quantitative and qualitative research approaches. According to proponents of the method, the following two elements should be considered while using the mixed research approach.

- ◆ The issue of harmony and the idea of how quantitative and qualitative methods are interrelated to use both in a single research.
- ◆ Flexible outlook that researchers should use the approach or mixture of approaches that works the best in a real world situation.

**b. Research method and methodology**

The terms research method and research methodology are interchangeable, although they have difference in terms of scope. A research work is mostly an investigation of a problem. The researcher's motivation might stem from his or her curiosity as well as a clear objective to solve the challenge. However, the use of research results as a guide is required in many business, social, intellectual, and other issues.

Research methods fundamentally include all those techniques/methods that are adopted for conducting research. Some of the main methods incorporated in the research works are:

- ◆ The collection and organization of data necessary or related to the problem,
- ◆ The use of statistical parameters to treat and interpret the organized data, and
- ◆ The evaluation of the accuracy of the result obtained.

Research methodology, on the other hand, refers to a way of systematically solving the research problem. It is a science of studying how research is conducted scientifically. Thus, the concept of research methodology is much broader than the method and it considers:

- Why the study is undertaken (its significance at various levels);
- How the research problem is identified;
- What assumptions or hypotheses are formulated;
- What type of data are collected; and
- Why a particular method or technique of analyzing the data is chosen.

In short, research methodology has wider dimensions than research method or technique. It is the philosophy or logic behind the research.

Study of basic geographic research methodology is therefore expected to give you knowledge and skills in areas indicated below:

- ▲ Gathering materials and data, and arranging them,
- ▲ Participating in field work,
- ▲ Preparing questionnaires, interviews etc.,
- ▲ Using statistical techniques, and
- ▲ Interpreting and reporting results of the study that you have designed or proposed.

**C. Research Design**

The development of a research project design, also known as "Research Design," is a difficult undertaking that follows the job of defining the research problem. Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design.

A research design is an arrangement of circumstances for data collection and analysis that combines the relevance, study goal and procedural efficiency. In reality, the research design is the conceptual framework for doing research, and it serves as the blueprint for data collection, measurement, and analysis. That is, the study design reflects a flowchart of what the researcher would do, from hypothesis development through operational implications and data analysis.

A research design must, at least, contain:

- A clear statement of the research problem;
- Procedures and techniques to be used for gathering information;
- The population to be studied; and
- Methods to be used in processing and analyzing data.

### Reflective Activity 8.2



Organize yourselves into smaller groups to undertake a collaborative learning on approaches and methods of geographical research. Using Encarta or Internet or other possibly accessible materials, conduct a group discussion on the different concepts related to research technique and methodology.

1. Elaborate the different research approaches, and write some examples illustrating local problems observed around your school or home area.

#### 8.1.4. Basic Elements of a Research

At the end of this section, you will be able to:

- identify the major elements of research and the information they contain.

**KEY TERMS:** Background of the study, statement of the problem, literature review, conclusion and recommendation.

The research process consists of a number of closely related activities necessary to effectively carry out a research. The diagram below depicts the major components of a research project, the information that they manage and the process.

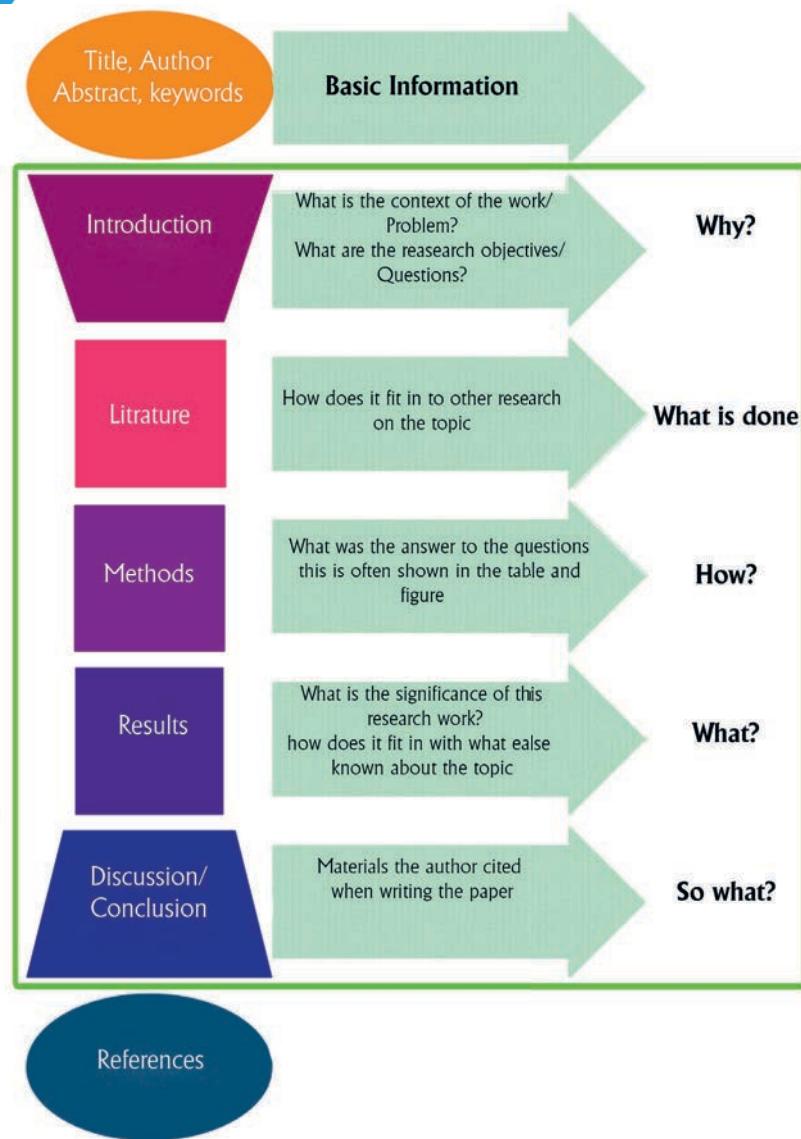


Figure 8.4. Components of Research Project

### Research Problem: Identification and Formulation

This involves the identification of a general topic and formulating it into a specific research problem. It requires a thorough understanding of the problem and rephrasing it in meaningful terms from analytical point of view. The understanding of the problem needs:

- Discussions with colleagues or experts in the field (brainstorming); and
- Examining conceptual and empirical literature on the topic.

**Problem Statement:** The problem statement describes the context for the study, and it also identifies the general analysis approach. Some of the important sources of research problem are:

- Professional experience the researcher's own experiences in the field;

- Inference from theory;
- Professional literature reports, bibliographies of books, and articles, periodicals, abstracts, etc.;
- Technical and social changes - new developments may bring forth new problems for research.

## Objectives

The objectives of a research project summarize what is to be achieved by the study. Objectives should be closely related to the statement of the problem. The general objective of a study states what researchers expect to achieve by the study in general terms. It is possible (and advisable) to break down a general objective into smaller, logically connected parts. These are normally referred to as specific objectives. Specific objectives should systematically address the various aspects of the problem as defined under 'Statement of the Problem' and the key factors that are assumed to influence or cause the problem. They should specify what you will do in your study, where and for what purpose.

The formulation of objectives will help to:

- Focus the study (narrowing it down to essentials);
- Avoid the collection of data which are not strictly necessary for understanding and solving the problem you have identified; and
- Organize the study in clearly defined parts or phases.

Properly formulated, specific objectives will facilitate the development of your research methodology, and will help to orient the collection, analysis, interpretation and utilization of data.

## Research Questions

Research question may be drawn from the statement of the problem. The purpose of the research question is to make the research focused. Thus, it points a research study in a particular direction. A good question should have the following attributes.

- It is stated as a question,
- It is specific,
- It includes key terms and / or variables to be investigated,
- It can be operationalized, and
- It is written in a simple and precise form.

## Literature Review

The purpose of the literature review is to situate your research in the context of what is already known about a topic. It need not be exhaustive, it needs to show how your work will benefit the whole. It should provide the theoretical basis for your work, show what has been done in the area by others, and set the stage for your work. It should probably move from the more general to the more focused studies; it need not be exhaustive, but has to be relevant. Sometimes the literature review is incorporated into the introduction section. However, most scholars prefer a separate section, which allows a more thorough review of the literature.

The literature review serves several important functions, for instance, it:

- Ensures that you are not "reinventing the wheel".
- Gives credits to those who have laid the groundwork for your research.
- Demonstrates your knowledge of the research problem.
- Demonstrates your understanding of the theoretical and research issues related to your research question.
- Shows your ability to critically evaluate relevant literature information.
- Indicates your ability to integrate and synthesize the existing literature.
- Provides new theoretical insights or develops a new model as the conceptual framework for your research.

## Preparing the Research Design

After formulating the research problem, you prepare a research design. The research design is the conceptual framework within which the research could be conducted. It helps you collect related evidence. It also helps you to limit required time, effort and expense. The what, where, when, how much, and by what means of your research project and its subject are answered by a research design.

## Determining the sample

Conducting a study on the entire population is tough, and our project may be too vast to be feasible. The population refers to the total group of people with whom the study will be conducted. Sometimes, the entire population will be sufficiently small, and the researcher can include the entire population in the study. This type of research is called a census study. Usually, the population is too large for the researchers to attempt to survey all of its members. A small, but carefully chosen sample can be used to represent the population. The sample reflects the characteristics of the population from which it is drawn. Sampling methods are classified as either probability or non-probability.

**Probability Sampling:** Probability sampling is also known as ‘random sampling’ or ‘chance sampling’ in which each member of the population has a known probability of being selected. Probability methods include random sampling, systematic sampling, stratified sampling and clustered sampling.

**Non probability sampling:** Here members are selected from the population in some non-probability manner. These include convenience sampling, judgment sampling, quota sampling and snow ball sampling.

## **Data Collection**

Data collection is a time-consuming and costly part of the research process. There are two basic sources of data, these are primary and secondary source.

**Primary Data source:** A primary data source is an original data source, that is, one in which the data are collected firsthand by the researcher for a specific research purpose or project. This type of data collection is original in character. The research produces the data, rather than relying on existing data. There are several ways of collecting primary data.

- Experimental data,
- Survey questionnaires,
- Interview,
- Personal observations,
- Focus group discussions,
- Satellite imageries, metrological data.

**Secondary data source:** Secondary data is data which has been collected by individuals or agencies for purposes other than those of our particular research study. For example, if a government department has conducted a survey of, say, family food expenditures, and then a food manufacturer might use this data in the organization’s evaluations of the total potential market for a new product. Similarly, statistics prepared by a ministry on agricultural production will prove useful to a whole host of people and organizations, including those marketing agricultural supplies. Some of the secondary data could be grouped as published and unpublished:

### **The Published data source include:**

- Publications by governments and NGOs
- Journals
- Magazines and newspapers
- Reports by universities, scholars, etc.

**Unpublished data include:**

- ▲ Diaries
- ▲ Letters
- ▲ Unpublished biographies, etc.

**Data analysis and interpretation**

The methods used to analyze data will depend on the type of research, qualitative or quantitative research, which is again influenced by personal and methodological preference and educational background. For quantitative data analysis, issues of validity and reliability are important. Thus, the researcher must make sure that their measurements are stable and consistent and that there are no errors or bias present. For quantitative data, the analysis can be left until the end of the data collection process.

For qualitative data, the researcher might analyze as the research progresses, continually refining and reorganizing in light of the emerging results. It is useful to produce an interview summary form or a focus group summary form which you complete as soon as possible after each interview or focus group has taken place. This includes practical details about the time and place, the participants, the duration of the interview or focus group, and details about the content and emerging themes. The method you use will depend on:

- Your research topic,
- your personal preferences, and
- the availability of time, equipment and finances.

**Results**

The results are actual statements of observations, including statistics, tables and graphs. The following are some of the guidelines useful for presenting the results of a study:

- Mention negative as well as positive results.
- Do not interpret results - save that for the discussion.
- Present sufficient details so that others can draw their own inferences and construct their own explanations.

Break up your results into logical segments by using subheads

**Discussion**

The discussion section should be a brief essay in itself, answering the following questions and caveats:

- What are the major patterns in the observations? (Refer to spatial and temporal variations.)

- ◆ What are the relationships, trends and generalizations among the results?
- ◆ What are the exceptions to these patterns or generalizations?
- ◆ What are the likely causes (mechanisms) underlying these patterns resulting predictions?
- ◆ Is there agreement or disagreement with previous works or studies?
- ◆ Interpret results in terms of background laid out in the introduction:
  - ▲ What is the relationship of the present results to the original question?
  - ▲ What are the things we now know or understand that we didn't know or understand before the present work?
- ◆ Include the evidence or line of reasoning supporting each interpretation.
- ◆ What is the significance of the present results: why should we care?

## Conclusions

What is the strongest and most important statement that you can make from your observations? If you met the reader at a meeting six months from now, what do you want them to remember about your findings? The following are a few guides for writing this part:

- ◆ Refer back to problem posed, and describe the conclusions that you reached from carrying out this investigation;
- ◆ Summarize new observations, new interpretations, and new insights that have resulted from the present work; and
- ◆ Include the broader implications of your results;

## Recommendations

This section may include remedial action to solve the problem; further research to fill in gaps in our understanding; and directions for future investigations on this or related topics. That means, the recommendations you make in your research paper are critical to the strategies you have in place to further your field of study.

## 8.2. GIS Data and Map Making using GIS

At the end of this section, you will be able to:

- construct statistical diagrams using generated data from various sources;
- make administrative, topographic, and watershed maps; and
- interpret different type of maps.

**KEY TERMS:** digital data processing, GIS, Geo-data base, mapping skills

### Brainstorming Activity 8.4



1. Can you recall the definitions of geospatial information or GIS you learned in previous grades?

In grades 10 and 11 you have learned about the basics of Geographic Information System (GIS). GIS is a tool for capturing, storing, manipulating, analyzing, managing, and presenting various forms of geographic data. This technology's essential term is geography, which indicates that the main part of the data is spatial. That is to say, the information used in it is linked to a specific location.

Just as we use a word processor to write documents and deal with words on a computer, we can use a GIS application to deal with spatial information on a computer. As indicated above the acronym GIS stands for 'Geographical Information System'. It consists of the following basic elements:

- **Digital Data** – the geographical information that you will view and analyze using computer hardware and software.
- **Computer Hardware** – computers used for storing data, displaying graphics and processing data.
- **Computer Software** – computer programs that run on the computer hardware and allow you to work with digital data. A software program that forms part of the GIS is called a GIS Application.

With a GIS application you can open digital maps on your computer, create new spatial information to add to a map, create printed maps customized to your needs and perform spatial analysis.

**Case study** Let's look at a simple example as to how GIS can be useful. Imagine you are a health worker and you make a note of the date and place of residence of every patient you treat. You may use GPS measurements to help your reporting and make your patient's location more specific for your supervisor or substitute worker.

As the continuation of your previous grade lessons, the following sections discuss the GIS data type and use, and the method of data analysis.

### 8.2.1. Gathering Data for GIS

At the end of this section, you will be able to:

- identify the major source of GIS data;
- explain the different ways of data representation and its effect on map interpretation; and
- construct statistical diagrams using data from various sources.

**KEY TERMS:** spatial data, map data generalization, measurement scale, Map data dimensionality.

#### Brainstorming Activity 8.5



1. Do you have any idea as to how to create or obtain data for your GIS work?

GIS is made up of five fundamental components. These are Data, Software, Hardware, People, and Methods. Data is one of the most essential aspects of it. GIS data is basically a spatial data that can be mapped. Spatial data can be obtained from various sources. It might be data obtained directly from the ground or data gathered by others for their own purposes. The first segment may include field survey data and remote sensing photos. The second part includes paper maps and current digital data sets. Therefore, GIS data may be categorized into primary and secondary type, as we saw in the research method section.

#### a. Data generalization

To collect, symbolize and represent, the GIS data has to pass through the process of abstraction or generalization. Two key factors must be addressed while collecting, representing, and symbolizing GIS data. These are selecting the level of measurement (nominal, ordinal, interval, and ratio) and choosing the dimensionalities of the features (point, line, area, volume).

#### Level of measurement

In nominal measurement, the numerical values just “name” the attribute uniquely with no ordering of the cases implied. For example, jersey numbers in basketball are measures at the nominal level. A player with number 30 is not more of anything than a player with number 15, and is certainly not twice whatever number 15 is.

In ordinal measurement the attributes can be rank-ordered. Here, distances between attributes do not have any meaning.

For example, on a survey you might code Educational Attainment as 0 = less than high school; 1 = some high school; 2 = high school degree; 3 = some college; 4 = college degree; 5 = post college. In this measure, higher numbers mean more education. But is the distance from 0 to 1 the same as 3 to 4? Of course not. The interval between values is not interpretable in an ordinal measure.

In interval measurement the distance between attributes does have meaning. For example, when we measure temperature (in Fahrenheit), the distance from 30-40 is the same as the distance from 70-80. The interval between the values is interpretable. Because of this, it makes sense to compute an average of an interval variable, whereas it does not make any sense to do so for ordinal scales. But note that in interval measurement ratios do not make any sense 80 °c is not twice as hot as 40°c (although the attribute value is twice larger).

Finally, in ratio measurement there is always an absolute zero that is meaningful. This means that you can construct a meaningful fraction (or ratio) with a ratio variable.

Weight is a ratio variable. In applied social research most “count” variables are ratio, for example, the number of clients in the past six months. Why? Because you can have zero clients and because it is meaningful to say that “...we had twice as many clients in the past six months as we did in the previous six months.”

### **Features of dimensionality**

Mapping Features Conceived as a Point: Many mapped phenomena exist at points, are referenced to as points in reality, or conceived as points for mapping purposes. Such a feature has a locational attribute (X, Y coordinate) that specifies its position on the earth. It might be measured in both quantitative and qualitative ways.

Mapping Feature Conceived as Line: Symbols portraying attributes of features conceived as lines are easy to find on the maps. Examples of these symbols include coast line, rivers, administrative boundaries, roads, rail ways and flow and movements between locations. Line features also represent qualitative and quantitative information/data.

## Nominal Data

<b>Point</b>	airport 	town 	mine 	capital 
<b>Line</b>	river 	road 	boundary 	pipeline 
<b>Area</b>	orchard 	desert 	forest 	water 

Figure 8.5: Mapping feature conceived as point, line and area at the nominal scale

Mapping features conceived as area: climate and soil are examples of attribute values collected at a point but conceived as areas and mapped by area symbols. To represent area symbol, we use visual variables associated with patterns (texture, arrangement, and orientation) for mapping features conceived as areas.

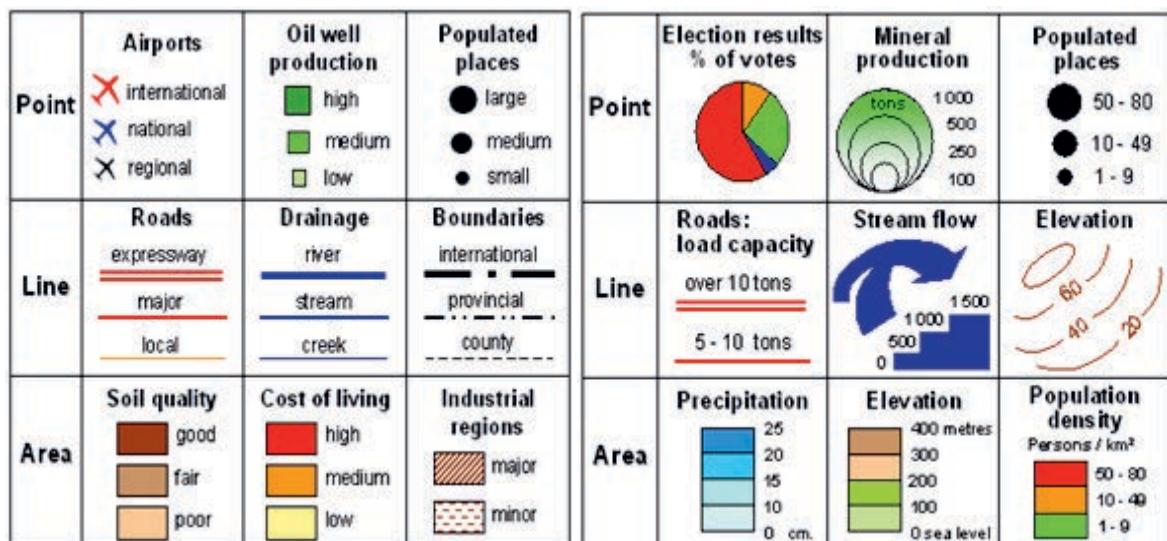


Figure 8.6: Mapping features conceived as point, line and area at the ordinal and ratio scale

Symbolizing features Attribute as Volume: The statistical surface is one of the most important cartography related to volume. It exists for any distribution that is mathematically continuous over an area, and is measured on an ordinal, interval or ratio scale measurement. Dot Maps, Choropleth Maps and Isarithm map are the main examples for portraying features attribute value as volume.

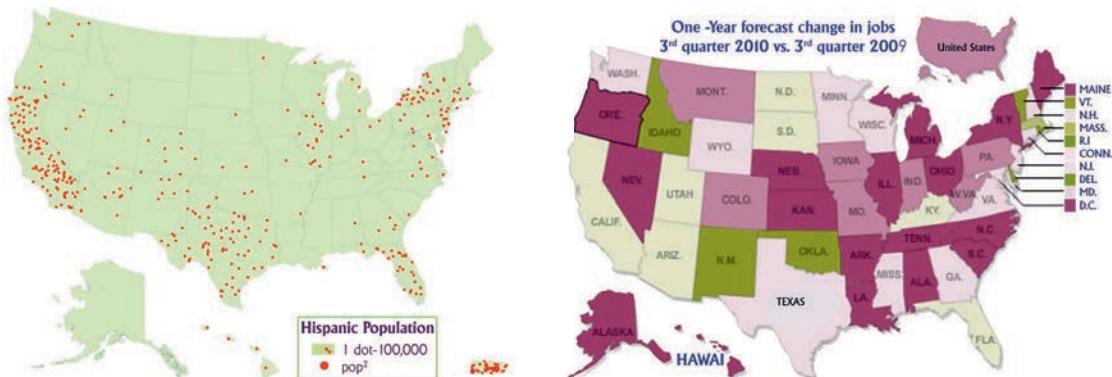


Figure 8.7: Features representation as volume with dot mapping and Choropleth

After viewing the above two considerations of the mapping feature and its attribute data, it is possible to make good data generalization. Why do we need to generalize data? It is helpful to distinguish between important and unimportant phenomena or events, and enhance map communication. Thus, each selected feature and its attributes should contribute to the effective communication of information. Some the major elements of data generalization in map making are stated below:

**Classification** – ordering, scaling and grouping features by their attributes and attribute values.

**Simplification**- determining important characteristics of the feature attributes, and eliminates unwanted details.

**Exaggeration** – enhancing or emphasizing important characteristics of the attributes.

**Symbolization**- the graphic coding of information and thereby placing it into a map context

### b. Data representation

Proper representation of data is an important requirement in GIS work. In a GIS environment, there are four basic ways of representation of data in a choropleth maps that all look different. Map readers may likely draw different conclusions from those maps. In those maps data values, which are given below, are grouped into five classes using different data classification methods. You can compare data classification methods by referring to a histogram and noting where classes are divided in the histogram.

The natural break / Jenk's method divides data into the most homogeneous five classes. Notice that the fifth class (53950–105350) in the natural break map, is internally homogeneous, and is distinct from the other classes.

Breaking points are determined through a clustering algorithm that maximizes similarity with class and difference between classes. The default option for data classification in many GIS software is natural break because natural break organizes data in itself, and works in most (if not all) cases.

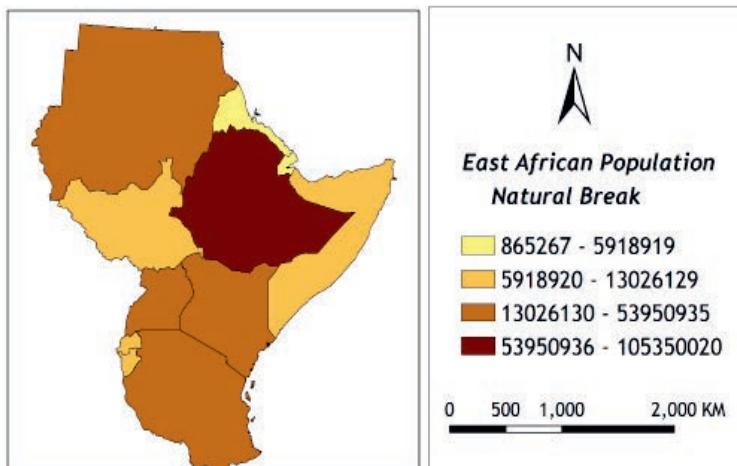


Figure 8.8: Natural break Jenk's representation of Eastern African countries population, 2017

In an equal interval map, the data values are divided into five classes with equal intervals. To determine the intervals, you divide the range (maximum value minus minimum value) by the number of classes. Classes are equally divided at the interval.  $105350-865=104485$ ; thus, when we divide  $104485/5=20897$ . The fifth class has the range 84453-105350 in an equal interval map. While the equal interval method is easy to understand, it does not fairly represent data when the data is highly skewed. For example, in the equal area map in Figure 8.8, the fourth and fifth classes are overrepresented despite the low frequency of the data.

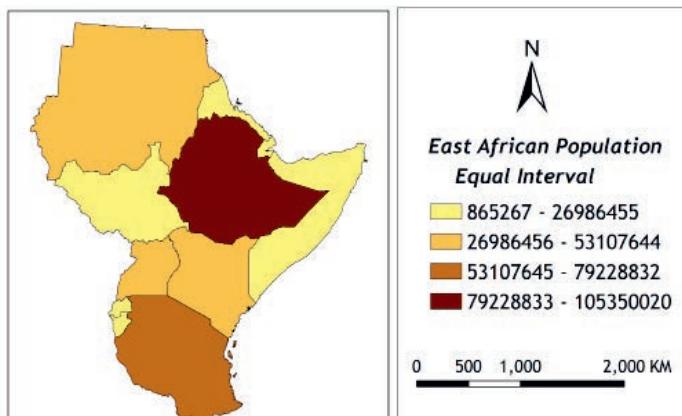


Figure 8.9: Equal intervals representation of Eastern African countries population, 2017

A quantile map divides data in terms of percentiles. If data is grouped into five classes, the first class (865–11031) represents the 0–20th percentile, the second class represents the 20–40th percentile, and the fifth class (47615–105350) represents the 80–100th percentile. In a quantile map, an equal number of ordered cases (units of observation) is placed in each class.

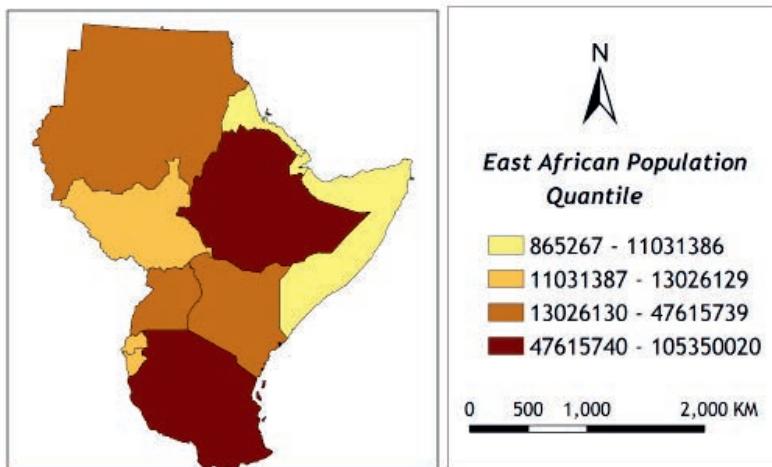


Figure 8.10. Quantile method representation of Eastern African countries population, 2017

Standard deviation calculates the mean and standard deviation from data, and determines breaking points by subtracting multiples of standard deviation from the mean. The standard deviation method is useful when it is important to convey how much data deviates from the average for each areal unit. In contrast to the equal interval and quantile method and natural break, standard deviation takes into account the frequency distribution of data.

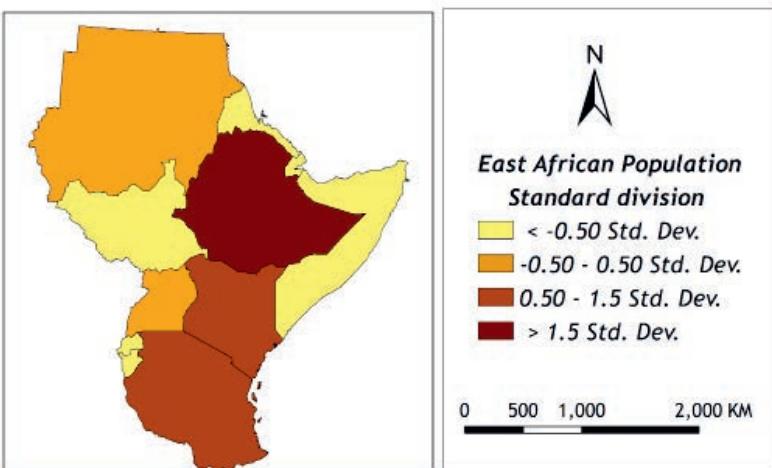


Figure 8.11. Standard deviation method representation of Eastern African countries population, 2017

Using GIS software, you can also set your own breaking points to meet map requirements. For example, it would make sense to group data into classes manually when you need to visualize income data by population size and countries.

Data should be normalized as needed before mapping. Data normalization is intended to facilitate comparison of data values that are often measured in different units. For example, if you are studying how prevalent obesity is in a community, it would be more useful to look at obesity rates than the number of obese persons because variations in base populations across communities make it hard to compare obesity prevalence equally. Examples of normalized data include mortality rate, rate of population change, and median household income.

### Reflective Activity 8.3



1. Discuss, in a small group, what the major properties of GIS data are, how we represent them on a map, and what key conditions must be addressed in representation. Please take the population of a district or 'woreda' in a region where you reside, and attempt to classify it by using natural break/Jenk's method, equal interval, quantiles and standard deviation methods. Your geography teacher will provide you a list of 'woredas' in your region, along with its total population.

### 8.2.2. GIS Data Analysis

At the end of this section, you will be able to:

- identify the main method of GIS data analysis;
- describe steps to conduct simple spatial analysis using GIS software; and
- interpret maps developed by different GIS based analysis.

**KEY TERMS:** spatial analyst, structured query language, proximity analysis, buffering, overlay analysis, Network analysis.



### Brainstorming Activity 8.6

1. Can you state some of the problems in your locality that could be addressed by applying GIS techniques?

We discussed some of the basic sources and methods of data collection and generalization in the previous section. As shown in Figure 8.11, the GIS work process includes six key phases or steps. However, this part mainly focuses on the fundamentals of data processing and analysis.

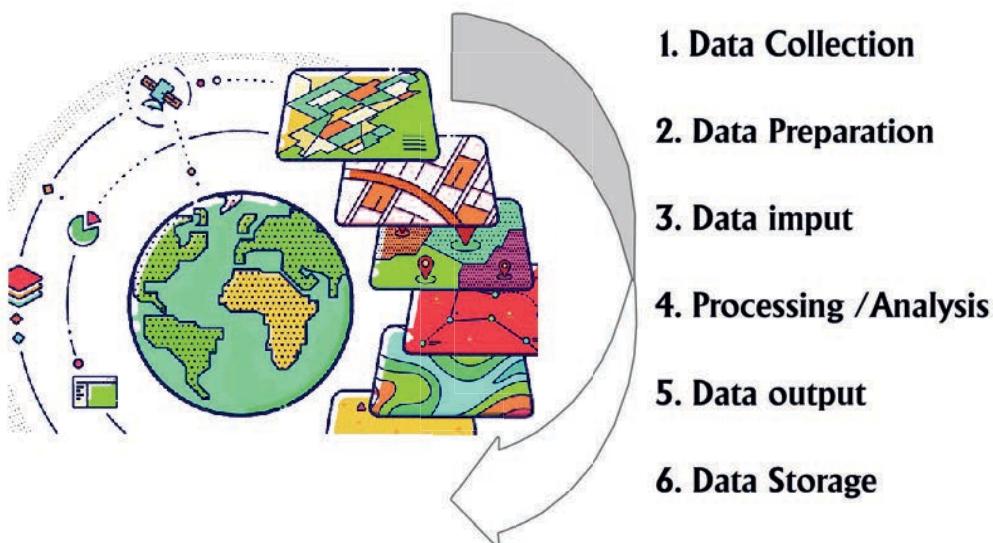


Figure 8.12. The major steps the GIS project follows

A GIS enhances the data analysis process by providing tools. This can help to create meaningful sequence and show new relationships within or between data sets. Thus, it increases understanding of real world. This is done by integrating data from many sources and analyzing multi-parameter data to offer answers and solutions to a given problem. Spatial analysis is the vital part of GIS. Its operation can be grouped into two, the first one deals with no new data generation that includes Attribute Query and Spatial Query or generally called querying. The second one is concerned with generating a new data including proximity or buffering, overlay and network analysis.

### a. **Querying**

**Attribute Query:** It's a process of selecting information by asking logical questions. Example: From a database of a city parcel map where every parcel is listed with a land use code, a simple attribute query may require the identification of all parcels for a specific land use type. Such a query can be handled through the table without referencing the parcel map. Because no spatial information is required to answer this question, the query is considered an attribute query. In this example, the entries in the attribute table that have land use codes identical to the specified type are identified.

**Spatial Query:** Involves selecting features based on the location or spatial relationships, which requires processing of spatial information. For instance, a question may be raised about parcels within one mile of the freeway and each parcel. In this case, the answer can be obtained either from a hardcopy map or by using a GIS with the required geographic information.

## b. Analysis to generate new data

Students, let us take this spatial analysis concept a step further.

- ▲ Have you ever tried to figure out how to go from your house to your school in the least amount of time?
- ▲ Have you ever had trouble getting to the nearest health facility from your home?
- ▲ Assume your family has an ice cream parlor, a fruit market, a bakery, and so on.

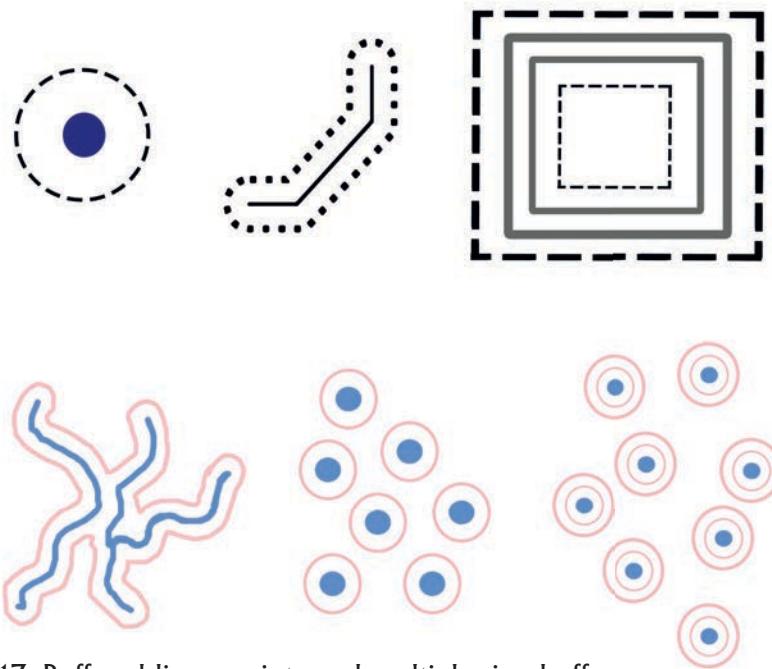
Has your family had difficulties in obtaining a new branch business center?

GIS has a method to tackle these your problems.

### Proximity analysis

Proximity analysis is an important function in GIS as it covers a wide range of topics that help in answering many spatial issues. One of the most basic questions asked of a GIS is “what is near to what?” Proximity tools can be divided into two categories depending on the type of input the tool accepts, namely, features or raster. Therefore, there are two forms of proximity analysis: feature/ vector based proximity analysis and raster based proximity analysis.

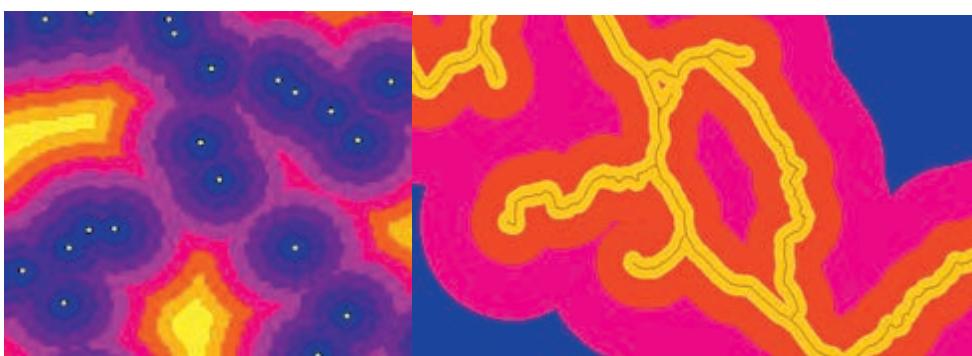
**Feature (vector) based proximity analysis:** For feature data, the tools found in the Proximity toolset can be used to discover proximity relationships. Buffers are usually used to delineate protected zones around features or to show areas of influence. For example, you might buffer a school by one Kilometer and use the buffer to select all the students that live more than one Kilometer from the school to plan for their transportation to and from the school. You could use the multi-ring buffer tool to classify the areas around a feature into near, moderate distance, and long distance classes for an analysis. Buffers are sometimes used to extract data to a given study area or to exclude features within a critical distance of something from further consideration in an analysis. You might use Near tool to find the closest stream for a set of wildlife observations or the closest bus stops to a set of tourist destinations. The tool will also add the Feature Identifier and, optionally, coordinates and the angle toward the nearest feature.



8.13. Buffered lines, points and multiple ring buffers

Raster-based distance tools: The ArcGIS Spatial Analyst extension Distance toolset contains tools that create raster showing the distance of each cell from a set of features or that allocate each cell to the closest feature. Distance tools can also calculate the shortest path across a surface or the corridor between two locations that minimizes two sets of costs. Distance surfaces are often used as inputs for overlay analyses. For example, in a model of habitat suitability, distance from streams could be an important factor for water-loving animals. You might use Euclidean Distance as part of a forest fire model, where the probability of a given cell igniting is a function of distance from a currently burning cell.

Euclidean distance is straight-line distance for a given set of input features, the minimum distance to a feature is calculated for every cell. The figure shown below is an example of the output of the Euclidean Distance tool, where each cell of the output raster has the distance to the nearest feature.

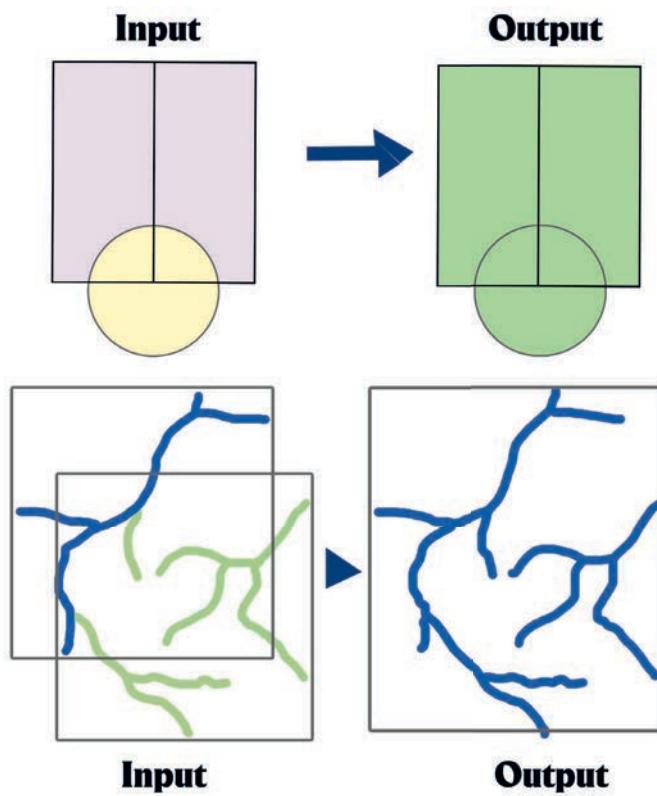


8.14. Euclidian distance raster representation

## Overlay analysis

Overlay analysis is an age-old technique of deriving new information from two or more layers of data covering the same area. It is arguably the most powerful function of a GIS. Any mapped area of the earth's surface can be subdivided (classified) into any number of different thematic "layers". Thus, a typical map will conventionally show rail lines, the road network, forested areas, urban areas, the river network, the coastline, etc., and each of these themes can be mapped separately. Based on the input data used in the process, there are two kinds of overlay analysis. These are raster and vector overlay.

**Vector Overlays:** The first type of overlay operations we are going to discuss in this subsection is vector overlay. A vector overlay involves combining point, line, or polygon geometry and their associated attributes. All overlay operations create new geometry and a new output geospatial data set. You should be cautioned that with certain overlay operations, very large attribute tables may result if the overlay operations combine many layers, and each layer has a very large attribute table. Additionally, it might be possible that the combined attribute tables would cause duplicate attribute fields to exist. In these cases, you should consider reducing the number of transferred attributes to the minimum required, and renaming duplicate fields so that there is no ambiguity. The vector overlay has also three functions. These are clip, intersect and union.

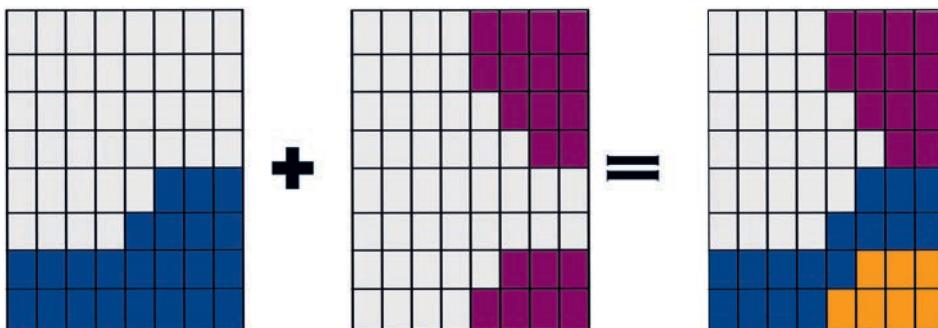


8.15. Union vector overlay function and output

Raster overlay: in this part we will discuss the raster overlay. Just like with vectors, we can perform overlay analysis with raster sets using a different series of tools. As vector tools only work with vector layers, raster tools only works with raster layers, and with the exception of a vector layer designating an extent in some raster tools, there are no tools which combine vector and raster data sets for geoprocessing. By “overlaying” one raster over another, we can examine the cell values from one raster to another and find relationships.

A faster way of performing an overlay is to use raster data. If both raster layers are of the same resolution and their pixels are aligned, then an overlay operation is merely matching corresponding pixels from both layers and combining their attributes to form a new pixel in the composite layer.

This involves no geometrical calculations and no creation of new polygons. Unless the layers are extremely large, overlay analysis involving raster layers can be done interactively. To process the raster overlay analysis, we may utilize a variety of functions. In general, we utilize spatial analysis, overlay tools for one thing, and map algebra for the other.



8.16. Simple map algebra function for raster overlay analysis

## Network analysis

In the context of GIS, a network is defined as a set of interconnected linear features through which resources can flow. Common examples of networks include highways, railways, city streets, canals, rivers, transportation routes etc. through which different vehicles and water can flow.. There are many spatial problems that require the use of network analysis for their solution. These include:

- ◆ To find the shortest path (in terms of physical distance or least cost) that can be followed to visit a series of features in a network, known as pathfinding,
- ◆ To assign one or more portions of a network to be served by a facility or business location, called allocation,

- ◆ to find all portions of the network that are connected with the movement of a particular feature (e.g., city transport), known as tracing,
- ◆ To depict the accessibility of a location and the interactions that occur between different locations (based on a technique known as gravity modeling). This is widely used in economics, geography, engineering, and urban planning, known as spatial interaction,
- ◆ To generate a distance matrix between different pairs of locations in the network, known as distance matrix calculation, and
- ◆ To determine simultaneously the locations of existing and planned facilities, as well as the allocation of demand to these facilities, known as location-allocation modeling

#### Reflective Activity 8.4



Discuss, in small groups, how you might utilize the GIS function to tackle a current problem in your surroundings.

1. Use the Google Maps application on smart phone, tablet, or other device to plan your journey to a cafeteria, market place, shop, or any other place from your house. Your geography teacher can show you how to accomplish this in the classroom.

## UNIT SUMMARY

Research is a scientific method of investigating answers for the problems identified.

Development in any country depends, among other things, upon its research capability.

There are two basic approaches often used in geographical research works. They are quantitative and qualitative approaches. Current researchers developed a new approach what they call it mixed approach that incorporate both the quantitative and qualitative approaches. Their difference lie mainly in the attributes considered to be measured and the techniques chosen to be used.

Geographical research works are different from the research work of other disciplines/sciences. They are very much concerned with spatial distributions and organizations of things and phenomena in time bound. They also consider the forces that results in determine the distributions.

In the study and analysis of spatial aspects, geographical research procedures and techniques with other sciences. For example, identifying the research problem, defining the objective and significance of the research, reviewing literature related to the study, formulating a working hypothesis, etc.

Several GIS data sources are available, including various geoportals that provide information sets utilized in GIS and spatial databases for geospatial analysis and mapping. To make map interpretation and visualization easier, the data must be simplified, classified and symbolized in various way as necessary.

It is difficult to perform geographical quality research today without the use of geospatial technologies. But the use of the most modern GIS techniques is only meaningful when a specific geographical problem is posed with its basic attributes such as location, distribution, regionalization, systemic interaction between physical environment and human action, and its impact on the landscape and land uses, ecological footprint, sustainability, etc. In most cases, the advanced geospatial analysis and representation techniques correspond to complex models of geographic information processing, because they investigate complex models of spatial organization.



## REVIEW QUESTIONS

**Multiple Choices:** Choose the best answer from the given alternatives for the following statements and questions.

1. Research is:-

- A. Searching again and again
- B. Finding solution to any problem
- C. Working in a scientific way to search for truth of any problem
- D. None of the above

2. A research paper is a brief report of research work based on

- A. Primary Data only
- B. Secondary Data only
- C. Both Primary and Secondary Data
- D. None

3. Which of the following is not the major component of a research paper?

- A. Problem statement
- B. Publisher
- C. Research question
- D. Discussions

4. Which of the following is a measured quantitative variable?

- A. Weight in kg
- B. Height in cm
- C. Domestic violence
- D. Income in Birr

5. Which of the following statements is not true about the capabilities of GIS

- A. Data capture and preparation
- B. A system of data vending
- C. Data manipulation and analysis
- D. Data presentation

6. By spatial data' we mean data that has

- A. Complex values
- B. Positional values
- C. Graphic values
- D. Decimal values

7. All are referring to features dimensionality except:-

- A. Polygon
- B. Volume
- C. Line
- D. Interval

8. Which of the following is not an element of map data generalization?

- A. Description
- B. Classification
- C. Exaggeration
- D. Symbolization

9. A process of selecting information by asking logical questions from a given data table is known as

- A. Attribute Query
- B. Spatial Query
- C. Fuzzy analysis
- D. Statistical analysis

10. GIS Methodology that can solve the problem effective school bus routing monitoring and management support scheme is -----

- A. Proximity analysis
- B. Network analysis
- C. Overlay analysis
- D. Structured query

## GLOSSARY

**Absolute poverty:** A type of poverty that is the same regardless of location and that occurs when the resources required for minimum physical health are lacking, typically defined by limited access to food, clothing, and shelter.

**Agricultural Drought:** links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapo-transpiration, soil-water deficits, reduced groundwater or reservoir levels, and so on. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

**Biodiversity Loss:** Biodiversity loss, also called loss of biodiversity, a decrease in biodiversity within a species, an ecosystem, a given geographic area, or Earth as a whole.

Biodiversity, or biological diversity, is a term that refers to the number of genes, species, individual organisms within a given species, and biological communities within a defined geographic area, ranging from the smallest ecosystem to the global biosphere.

**Bribery corruption:** an attempt to make someone do something for you by giving the person money, presents, or something else that they want.

**Bright Greens Environmentalism:** emerged as a group of environmentalists who believe that radical changes are needed in the economic and political operation of society in order to make it sustainable, but that better designs, new technologies and more widely distributed social innovations are the means to make those changes and that society can neither stop nor protest its way to sustainability.

**Corruption Perceptions Index:** refers to an index that scores countries on the perceived levels of government corruption by country. Scores range from zero to 100, with zero indicating high levels of corruption and 100 indicating low levels. The CPI is published annually by Transparency International, an organization that seeks to stop bribery, fraud, and other forms of public sector corruption.

**Covid-19:** a potentially severe, primarily respiratory illness caused by a coronavirus and characterized by fever, coughing, and shortness of breath. In some people, the disease also damages major organs, as the heart or kidneys.

**Dark Greens Environmentalism:** believe that environmental problems are an inherent part of industrialized, capitalist civilization, and seek radical political change. Dark greens believe that currently and historically dominant modes of societal organization inevitably lead to consumerism, overconsumption, waste, alienation from nature and resource depletion.

**Desertification:** the process by which fertile land becomes desert, typically as a result of drought, deforestation, or inappropriate agriculture.

**Drought-Prone Region:** is defined as one in which the probability of a drought year is greater than 20%. A chronic drought prone area is one in which the probability of a drought year is greater than 40%.

**Dry land landscape:** are arid, semi-arid, and dry, sub-humid areas<sup>3</sup> that receive less precipitation than the evaporative demand, and plant production is thus water limited for at least a substantial part of the year. Water scarcity has shaped dryland ecosystems, their biodiversity, and human cultures.

**Ebola:** Also called Ebola fever, Ebola hemorrhagic fever, Ebola virus disease, a usually fatal disease, a type of hemorrhagic fever, caused by the Ebola virus and marked by high fever, severe gastrointestinal distress, and bleeding.

**Empowerment:** the process of gaining freedom and power to do what you want or to control what happens to you, example female/youth empowerment.

**Environmental activism:** refers to the coming together of various groups of individuals and organizations that work in collaboration in social, scientific, political, and conservational fields with the main purpose of addressing environmental concerns.

**Environmental footprints:** the effect that a person, company, activity, etc. has on the environment, for example the amount of natural resources that they use and the amount of harmful gases that they produce.

**Folk medicinal knowledge:** consists of the healing practices and ideas of body physiology and health preservation known to some in a culture, transmitted informally as general knowledge, and practiced or applied by anyone in the culture having prior experience.

**Food security:** is the measure of the availability of food and individuals' ability to access it. According to the United Nations' Committee on World Food Security, food security is defined as meaning that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

**Formal education:** usually takes place in the premises of the school, where a person may learn basic, academic, or trade skills. Small children often attend a nursery or kindergarten but often formal education begins in elementary school and continues with secondary school.

**Free market environmentalism:** is an approach to environmental problems that focuses on improving environmental quality using property rights and markets.

**Gini Coefficient:** The Gini index, or Gini coefficient, is a measure of the distribution of income across a population developed by the Italian statistician Corrado Gini in 1912. It is often used as a gauge of economic inequality, measuring income distribution or, less commonly, wealth distribution among a population. The coefficient ranges from 0 (or 0%) to 1 (or 100%) depending on the process of becoming urbanized

**Dryness Ratio:** is defined as the ratio of the mass of actual dry steam to the mass of steam containing it (246 to 1 or 100%), with 0 representing perfect equality and 1 representing perfect inequality. Values over 1 are theoretically possible due to negative income or wealth.

**Global north:** Global North refers to those technically and socially well-developed countries, basically located in North America and Europe

**Global south:** a term often used to identify lower-income countries on one side of the so-called global North-South divide; it refers to the poorest and least industrialized countries, which are mainly in the southern part of the world.

**Grand corruption:** is the abuse of high-level power that benefits the few at the expense of the many, and causes serious and widespread harm to individuals and society. It often goes unpunished.

**Green buildings:** is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment.

**HIV/ AIDS:** human immunodeficiency virus, retroviruses that infect and destroy helper T cells of the immune system causing the marked reduction in their numbers that is diagnostic of AIDS. AIDS acquired immune deficiency syndrome a diseases caused by HIV

**Human induced:** are caused entirely or predominantly by human activities and choices.

**Hydrological drought:** refers to a persistently low discharge and/or volume of water in streams and reservoirs, lasting months or years. Hydrological drought is a natural phenomenon, but it may be exacerbated by human activities. Hydrological droughts are usually related to meteorological droughts, and their recurrence interval varies accordingly.

**Income security:** is about the level of income (absolute and relative to needs), assurance of receipt, expectation of income adequacy now and improvement or deterioration in the future, both during a person's working life and in old age or disability retirement. Income security is about actual, perceived and expected income.

**Indigenous knowledge:** refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life.

**Informal education:** may be a parent teaching a child how to prepare a meal or ride a bicycle. People can also get an informal education by reading many books from a library or educational websites.

**Interdisciplinary:** involves the combination of two or more academic disciplines into one activity (e.g., a research project)

**Land degradation:** is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land. It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable. 247

**Lifelong learning:** is a form of self-initiated education that is focused on personal development. While there is no standardized definition of lifelong learning, it has generally been taken to refer to the learning that occurs outside of a formal educational institute, such as a school, university or corporate training.

**Light greens environmentalism:** see protecting the environment first and foremost as a personal responsibility. They fall in on the transformational activist end of the spectrum, but light greens do not emphasize environmentalism as a distinct political ideology, or even seek fundamental political reform. Instead they often focus on environmentalism as a lifestyle choice.

**Lorenz curve:** Lorenz curve is a graphical representation of the distribution of income or wealth within a population. Lorenz curves graph percentiles of the population against cumulative income or wealth of people at or below that percentile. Lorenz curves, along with their derivative statistics, are widely used to measure inequality across a population. Because Lorenz curves are mathematical estimates based on fitting a continuous curve to incomplete and discontinuous data, they may be imperfect measures of true inequality.

**Malaria:** Pathology. any of a group of diseases, usually intermittent or remittent, characterized by attacks of chills, fever, and sweating: formerly supposed to be due to swamp exhalations but now known to be caused by a parasitic protozoan, which is transferred to the human bloodstream by a mosquito of the genus *Anopheles* and which occupies and destroys red blood cells.

**Mass media:** the means of communication that reach large numbers of people in a short time, such as television, newspapers, magazines, and radio.

**Meteorological drought:** is defined on the basis of the degree of dryness, in comparison to a normal or average amount, and the duration of the dry period. Definitions of meteorological drought must be region-specific, since the atmospheric conditions that result in deficiencies of precipitation are highly region-specific.

**Multinational corporation:** has facilities and other assets in at least one country other than its home country. A multinational company generally has offices and/or factories in different countries and a centralized head office where they coordinate global management. Some of these companies, also known as international, stateless, or transnational corporate organizations, may have budgets that exceed those of some small countries.

**Ozone depletion:** The ongoing reduction of ozone in the stratosphere. Ozone ( $O_3$ ) is present in 1 ppm in the upper stratosphere, and it absorbs virtually all of the UV radiation from the sun.

**Patronage corruption:** type of corruption or favoritism in which a party in power rewards groups, families, or ethnicities for their electoral support using illegal gifts or fraudulently awarded appointments or government contracts

**Petty corruption:** is the lowest form of corruption, typically involving low-level public servants, or managers who abuse the limited authority of their positions for personal gain. Petty corruption frequently involves the abuse of entrusted power in exchange favors or small sums of money.

**Pollution:** the action or process of making land, water, air, etc., contaminate, dirty and not safe or suitable to use industrial practices that have caused pollution of the air and water.

**Relative poverty:** is when households receive 50% less than average household incomes, they do have some money but still not enough money to afford anything above the basics. This type of poverty is, on the other hand, changeable depending on the economic growth of the country.

**Solar chimney:** A natural draft drive device that uses solar radiation to provide upward momentum to a mass of air, thereby converting the thermal energy to kinetic energy, which can be extracted from the air with suitable wind machines.

**Tacit knowledge:** Knowledge gained from personal experience. The knowledge possessed by your team members is one of your organization's most valuable assets.

**Trade balance:** the difference in value over a period of time between a country's imports and exports.

**Urbanization:** the quality or state of being urbanized or the process of becoming urbanized.



**THANK YOU !**





