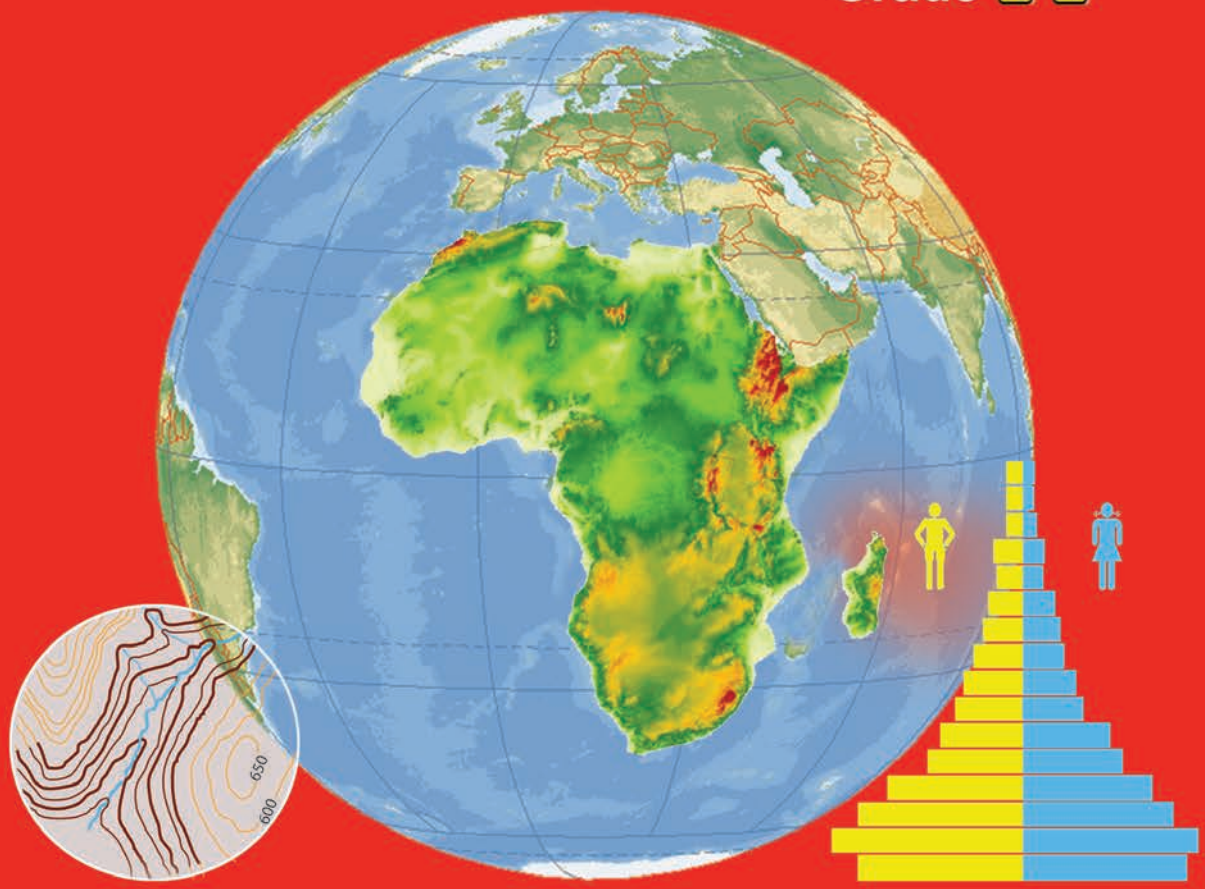
GEOGRAPHY

STUDENT TEXTBOOK
Grade 11



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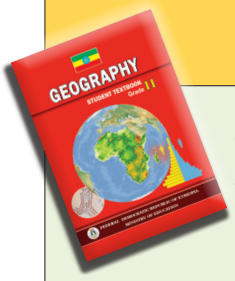

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GEOGRAPHY

STUDENT TEXTBOOK

GRADE 11

Authors, Editors and Reviewers:

Gashaw Gobaw (B.A.)
Solomon Bekele (M.Sc.)
Hari Shankar Sharma (Ph.D., Professor)
Tesfaye Shiferaw (Ph.D.)

Evaluators:

Haftu Araya
Tamrat Fitie
Yitagesu Demsie

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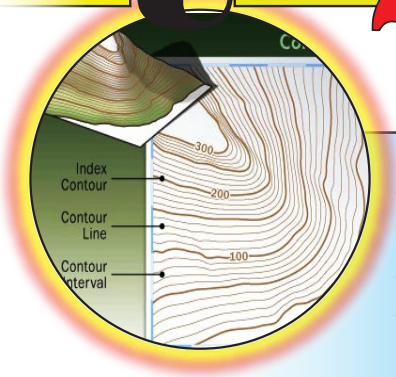

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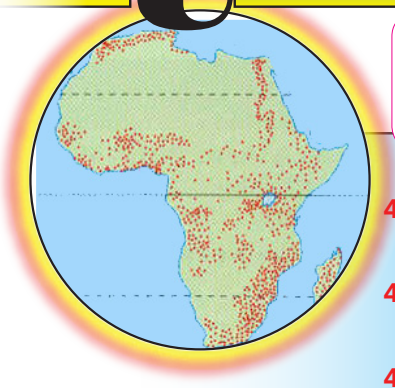


POPULATION, ECONOMY AND NATURAL RESOURCES OF AFRICA 189

Unit 1

THE SCIENCE OF GEOGRAPHY

Unit Outcomes

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

- understand the meaning and basic concept of geography;
- realize the scope of geography and its relationship with other disciplines;
- discuss different approaches of geographic studies;
- realize major schools of thought in geography.

Main Contents

INTRODUCTION

We hope that you remember what you have learned in your previous geography classes. The major topics treated in Grade Ten were the physical characteristics, human backgrounds and economic activities of the world and Ethiopia.

In this grade level, you are going to learn about the geography of Africa. Hence, the topics to be discussed are the physical, social, cultural, economic and political aspects of Africa.

Before we continue studying the socio-economic and political conditions of Africa, you will be acquainted with some basic concepts regarding the nature of geography as a disciplines.

1.1 THE MEANING OF GEOGRAPHY

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

- state the meaning of geography.

Key Terms

- Geography
- Science
- Spatial
- Phenomena
- Interdependence

Brainstorming

1. What is Geography?
2. Is Geography a science?
3. What do we mean by "science"?

Before we define what geography is, it is important to define what science is and to decide whether geography is a science or not.

Science is defined as a body of knowledge that is systematized, organized, experimented and verified. Geography has almost all these characteristics. Hence, it is a science.

Most people think that geography is only a study of certain physical features such as place names, lengths of rivers, heights of mountains, names of countries, and capital cities of countries. Others think that geography studies the physical earth. However, it is much more.

In Grade Nine, you learned about several definitions of geography proposed by different scholars. They enlightened you as to the nature of geography. Ancient Greeks defined geography for the first time. They combined two words:

- *Geo – which means earth*
- *Graphic – which means writing*

Therefore, their definition of geography was *a description of the earth*. Now this definition seems very general when we compare it to the scope of current geography.

Some of the definitions were made by scholars of the nineteenth and twentieth century. These definitions relate to geography's current concerns, interests and focus:

Geography is:

- *"a synthesizing discipline to connect the general with the particular through measurement, mapping, and a regional emphasis." (Alexander von Humboldt, 1845)*
- *"nothing less than an understanding of the vast interacting system between human beings and their environment on the earth's surface." (E.A Acreman, 1953)*
- *«a science that is meant to provide accurate, orderly, and rational description and interpretation of the variable character of the earth's surface.» (Richard Hartshorne, 1959)*
- *"a science concerned with the rational development and testing of theories that explain and predict the spatial distribution and location of various characteristics on the surface of the earth." (M. Yeates, 1968)*
- *"concerned with the locational or spatial variation in both physical and human phenomena at the earth's surface". (Martin Kenzer, 1989)*
- *"the study of the patterns and processes of human-built and environmental (natural) landscapes, where the landscapes comprise real (objective) and perceived (subjective) space." (Gregg Wassmansdorf, 1995)*
- *"the study of the environment of the earth's surface and the relationship of humans to this environment, which includes both physical and cultural geographic features." (Microsoft ® Encarta ® 2008)*

Brain-Storming

1 What do you understand from the above definitions?

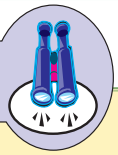
2 Do you see any differences or similarities? Discuss these issues in your group.

As can be seen from the above definitions, geography does not have a single definition that is universally accepted. Nonetheless, most of the above definitions emphasize the fact that geography is a spatial science. Thus, it is possible to synthesize the given definitions and come up with a commonly acceptable definition. Accordingly, geography can be defined as "*the study of the spatial distribution of both physical and human-made things and phenomena on the earth's surface and the two-way interactions and interdependences between natural and human environments.*"

Therefore, geography is the study of:

- ⇨ *The physical world, its inhabitants, and the interaction between the two; The resultant patterns and systems of geographical phenomena;*
- ⇨ *Patterns and processes associated with causes;*
- ⇨ *Relationships between humans and their environment, with emphasis on spatial perspectives at varying scales.*

Focus



In its modern context, *spatial perspective* is concerned with "where" and "why there" questions investigating the forces behind the causes and the patterns manifested as a result.

While making spatial investigations, geographers ask five pertinent questions about the phenomena they study. These are:

- ⇨ *"WHERE are things located?"*
- ⇨ *"WHY are they located where they are?"*
- ⇨ *"WHEN did the things form?"*
- ⇨ *"WHAT things are found where?" and*
- ⇨ *"HOW are they arranged?"*

Activity 1.1

In a small group, discuss what the "where", "why there" and "how are they arranged" questions deal with. Present your results to the class.

The answers to these basic questions are both descriptive and analytical. Answers to the "where" questions are primarily descriptive in nature as they try to describe the places where things and phenomena are found.

Similarly, answers to the "why there" question try to provide logical explanations as to what factors determine the location of the phenomena in the places where they are found.

On the other hand, the "How are they arranged" question is primarily analytical. The answer provides visual explanations of how the studied phenomena are spatially distributed.

Geography tries to provide explanations about our world and the ways in which we live, work, and carry on socio-economic, political, and cultural activities. In short, geography is a science that investigates our cultural and natural environments, how we affect them, and how they affect us.

Consequently, it becomes important to note that geography is not only a study of place names, lengths of rivers, heights of mountains, areas of lakes, capital cities of countries and the like. It is much more than this. Geographer William Hughes proves it by stating the following:

> *Mere names of places... are not geography... knowing by heart a whole gazetteer full of them would not, in itself, constitute anyone a geographer. Geography has higher aims than this: it seeks to classify phenomena (alike of the natural and of the political world, in so far as it treats of the latter), to compare, to generalize, to ascend from effects to causes, and, in doing so, to trace out the great laws of nature and to mark their influences upon humans. This is 'a description of the world'-that is Geography. In a word Geography is a Science-a thing not of mere names but of argument and reason, of cause and effect.*
>
> **William Hughes 1863**

Geography is a systematic observation and study of the world in spatial perspective. It contributes a lot to the understanding of our complex and fast changing world. By doing so, it helps us appreciate the great diversity and complexity of peoples and places and the existing two-way relationships between them.

Content Check

1 Compare and contrast the definitions of geography given by different scholars.

2 Can you justify why the definition which we presented as the collective agreement is appropriate and why it is widely accepted?

3 What differentiates ancient and modern definitions of geography?

1.2 THE SCOPE OF GEOGRAPHY

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

- determine the scope of geography.

Key Terms

- Scope
- Geosphere
- Spatial interaction
- Spatial distribution

Brainstorming

1 Do you remember what you learned in Grade Nine about the scope of geography?

2 What is scope by itself? Please, try to remember.

As you might remember, scope refers to the extent of interest or focus in a certain subject. In other words, it refers to the capacity and limits that an academic discipline treats. In this regard, geography is said to have a greater scope than mere locations. It treats a wide range of phenomena on the planet earth. Generally,

the geo-sphere is considered as geography's scope. The geo-sphere itself is made up of five sub spheres, namely the lithosphere, hydrosphere, atmosphere (troposphere), biosphere and anthroposphere. Do you know what each of these spheres represents? If yes, good! Otherwise, please refer to Table 1.1.

Table 1.1: **The geospheres of the earth**

Geospheres	Description	Geography's related area of study
Lithosphere	The solid part- i.e., the rock layers of the earth	Geomorphology, soil geography
Troposphere	The lower part of the atmosphere where weather changes occur	Climatology
Hydrosphere	The water surfaces of the earth including oceans, seas and lakes	Oceanography
Biosphere	The part of the earth that supports all sorts of life	Biogeography
Anthroposphere	The earth's cultural landscape	Cultural geography, population geography

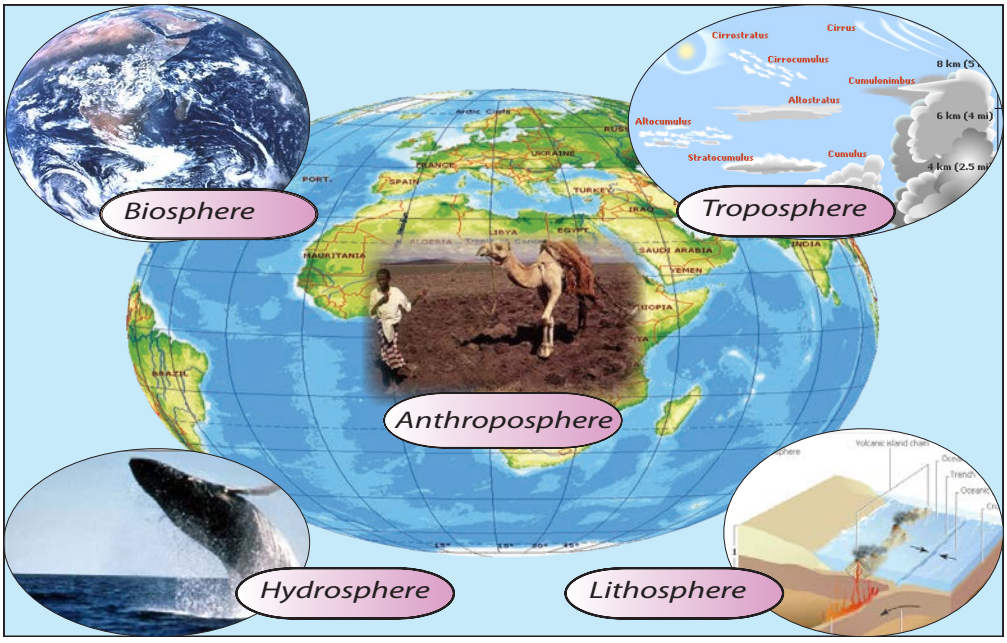


Figure 1.1: **The earth's Geo-sphere**

Brain-storming

1 What do you understand from the above table and figure?
2 Have you seen how varied the area of study of geography is?
3 Do you understand the extent of its scope?

Geography's area of study is very wide and diverse in its nature. The subject deals with from the dry land mass of the lithosphere to the extensive oceans of the hydrosphere, from the earth's crust (surface) high into its atmosphere (troposphere) and from the natural environment to human-related phenomena. Understanding geography is key to understanding and acting effectively in our world. It is a subject that enables people to understand the earth and its environment. It also enables us to appreciate the complex balances of the human and physical elements that bind people to this planet.

Activity 1.2

1 Do you think that the scope of geography is limitless? Why or why not?
2 In your groups discuss the major areas of focus of geographical studies and present your results to your class.

It is true that geography has a very wide scope. However, this does not mean that its scope is limitless.

The major areas that geography focuses on are:

- ⇨ *The earth, its position in the universe and its movements;*
- ⇨ *The different physical features that constitute the earth's surface, the forces that cause them, their variations from place to place and their changes over time;*
- ⇨ *The different relationships between human beings and their natural environment. Also, the interdependence and the impact that each has on the other;*
- ⇨ *The conditions of the lower part of the atmosphere and the subsequent weather and climatic conditions, together with their spatial distribution and variation*
- ⇨ *The materials that make up the earth and its diverse land forms;*
- ⇨ *The major economic activities of humans and the impacts on the environment.*

Therefore, it is possible to conclude that although wide in its scope, geography has certain areas that it focuses upon.

Content Check

1 ***Define:*** geography, spatial interaction, biosphere, and lithosphere.

2 What makes the scope of geography very wide?

3 What are the three questions that geographers ask when they study spatial distributions?

4 ***Challenge:*** Geography focuses on the inter-relationship between human beings and their environment. Can you explain the relationship?

5 Geography's concern is much more than the study of place names. Explain this statement briefly.

1.3 APPROACHES IN GEOGRAPHY

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

- justify the merit and demerit of approaches used to study physical and human environments.

Key Terms

- Approach
- Regional approach
- Systematic approach
- Region

Brain-Storming

1 How do geographers study geography and geographic phenomena?

2 What are the methods and approaches that they employ? Discuss these questions with your friends.

Geographers, like other social scientists, have their own approaches to their subject. The most frequently adopted approaches are:

A Regional approach

B Topical or systematic approach

Activity 1.3

What are the differences between the regional and systematic approaches? What are the weaknesses and strengths of each? Discuss these issue, with your desk mate.

A Topical or Systematic Approach

Unlike the regional approach, the topical or systematic approach applies a specific geographical element or phenomenon over a defined geographical unit. For example, it takes a phenomenon such as climate, land forms or culture, and treats the distribution of the selected element over a country, continent or the world at large.

In short, the topical approach seeks to establish general or common concepts of the phenomena studied, but only in terms of their relationships to distribution in an area.

Example:

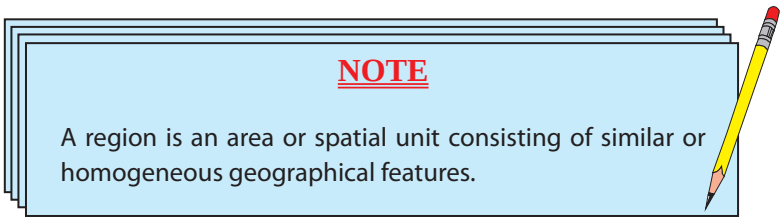
- *The geography of hunger*
- *The geography of climate*
- *The geography of agriculture*
- *The geography of population*

B Regional Approach

A geographic study that uses the regional approach focuses on a region – a defined geographic unit or locality. Within the region, the study examines a variety of geographic features. The region studied could be a subcontinent, continent or a number of countries that share a common geographic factor.

Example:

- *The geography of Africa, Asia, or Oceania, etc*
- *The geography of sub-Sahara.*
- *The geography of the Middle East.*
- *The geography of the Balkans.*

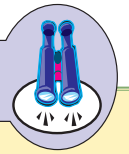


The similarity could be either physical (i.e., climate, landscapes, etc) or cultural-anthropogenic (i.e., religion, language, economic activity, etc.). Regions vary

in area. The size of a region is a function of the study's purpose. Regions called micro are relatively small, and those called macro are relatively large.

Dividing the world into regions is a difficult task. However, we may construct a region on the basis of any one element or interrelated elements.

Focus



Geographical studies can be made with two different basic approaches. These are the **Regional Approach and the Systematic (Topical) Approach**. The REGIONAL approach studies the various characteristics of each region (realm) of the world. It divides the world into regions with each having its own distinct features that make it different from others. This approach then studies each geographic phenomenon in that region.

SYSTEMATIC geography, on the other hand, studies one issue and looks at its spatial variations in all parts of the globe. Although geographers use these two basic approaches, they are not necessarily (regional and systematic), independent of each other. Instead, these approaches are interconnected and overlapping.

Content Check

1 What are the two approaches adopted in organizing geographical knowledge?
2 What are the differences between the systematic and regional approaches?
3 Are the two approaches independent of each other? Why or why not?
4 Which approach would best suit a study of the distribution of coffee cultivation in Ethiopia? Why?

1.4 MAJOR SCHOOL OF THOUGHT IN GEOGRAPHY

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

- compare and contrast the concept of determinism with possibilism;
- show appreciation for the significance of quantitative studies;
- verify the importance of applied geography in solving social and environmental problems.

Key Terms

- School of thought
- Determinism
- Quantitative revolution
- Applied geography
- Possibilism
- Environment

Geography has gone through a series of changes and developments. The 1930's, witnessed major radical changes in the discipline, and were turning points in the history of geography.

The most prominent of these scholars were Alexander Von Humboldt and Karl Ritter. Various schools of thought have emerged with different views regarding the relationship between humans and their environment as well as the interpretation of social problems by human. Different schools of thoughts developed. The main schools are determinism and possibilism.

Since the mid 18th C, we have been observing these two dominant schools of thought that explain relationships between humans and their environment.

Historical Notes

Alexander Von Humboldt
(1769 – 1859)

A German Geographer who traveled for 5 years in South America collecting data in order to identify relationships between the spatial distribution of rocks, plants and animals. He emphasized on the interdependence of peoples, plants and animals with one another within a specific physical setting. He then showed how people have to adapt to and affect their environment.

Sketch of Karl Ritter
(1779 – 1859)

He was the founder of the tradition of regional geography. His approach was to establish a framework for scientific comparisons and generalizations by dividing the continents into regions with distinct characteristics.

Activity 1.4

In a small group discuss how humans and the environment interact and try to answer the following questions.

1 Does the physical environment decide how people live? Why or why not?

2 Can humans adjust their environments in a way that suits their needs? How?

A *School of Determinism*

What is the basis of the philosophy of environmental determinism?

It was the dominant idea up to World War I. It advocated that the physical environment directs or is the master in determining the day-to-day activity of people.

Environmental Determinism is a philosophy that bases its view on the idea that the natural environment is an influencing factor on humans' mode of living. It believes that human activities are controlled by the environment.

It is based on the belief that the physical qualities of geographical conditions are the causes not only for people's physical differences but also for differences from place to place in people's economic activities, cultural practices and social structure. Environmental determinists thus tend to focus on the impact of the physical environment on people, rather than the reverse the influence of people on the environment. This view had strong influences on the geographic writings of the 19th century and its influence penetrated well into the 20th century.

The idea of environmental determinism was laid down by Greek and Roman scholars. They claimed that the elements of the physical environment such as climate, relief, soil and the like determine peoples mode of life. Many scientists agree that the publication of "The Origin of species" by Charles Darwin in 1859 laid the foundation for the concept of the influence of the environment on people and other organisms. In the same way, Demolins (1901 and 1903) postulated that "the flourishment of society is based on the environment."

Furthermore, determinists consider human beings as passive agents where the physical factors determine their attitude and process of decision making. However, this outlook was strongly criticized by geographers who favored a new school of thought known as environmental possibilism. The prominent scholars who supported the school of determinism were: Charles Darwin, Demolins, F. Rutzel, etc.

Activity 1.5

1 Do you agree with the idea of environment conservation? Why or why not?
2 With your friends, discuss why the philosophy of environmental determinism was severely criticized by the proponents of environmental possibilism.

B *Environmental Possibilism*

What do you think of environmental possibilism is? How is it different from environmental determinism?

The school of possibilism was postulated by Febvre. His supporters argue that human beings are masters of the environment and they can judge their benefits. They argued that there are no necessities but only possibilities.

Proponents of this view emphasize that two-way relationships exist between humans and the environment. They state that people can influence the environment to enhance their way of life.

These geographers agree that the environment can potentially affect people's activities, but they believe that we can use our knowledge and skills to regulate these effects. According to possibilists, it is impossible to explain the difference between human society and the history of that society without referring to the influence of the environment. Nowadays, the school of possibilism is becoming widely accepted since it recognizes human's ability to change its environment using the latest or better technologies.

Activity 1.6

In a small group, discuss what humans have done so far to modify environments in ways that enhance their ways of life.

Example: Human beings have been using irrigation to turn barren lands of the deserts into agriculturally productive areas.

C *The Quantitative Revolution*

What was quantitative revolution? How did it affect the significance of geography?

The quantitative revolution was one of the four major changes in the history of geography. The other three were regional geography, environmental determinism and critical geography.

For centuries, geography had been primarily a descriptive science that tried to describe how things are distributed on the earth's surface. The subject focused mainly on the "where" of geographic features. In the early 1950s, however, socio-economic, physical, and political features and processes are spatially organized and ecologically related. The outcomes created by them are evidenced for a given time and place. As a result, a more abstract, theoretical approach to geographical research has emerged, and the analytical method of inquiry evolved this new approach. Used rigorous mathematical formulae, borrowing from the physical sciences. This movement in geography is called the "**Quantitative Revolution**", It began to affect geographers and major geography departments in universities.

What are the contributions of the quantitative revolution to the development of geography?

The revolution was founded by geographers and statisticians in Europe and the United States. With the purpose of bringing 'scientific thinking' to geography, the quantitative revolution led to an increased use of statistical techniques. In particular, it emphasized multivariable analysis and the use of computers in geographical research. The methods adopted included various mathematical techniques that were more precise than the descriptive methods of regional geography.

The quantitative revolution was a response to the crisis in the 1950's. The crisis was the result of the challenges that geography faced during late 1940's and early 1950's. Some of the major challenges were:

- *The shutting down of many geography departments and courses. for example, the geography program at Harvard University was abolished in 1948.*
- *The division between Human and Physical geography was continued-demanding the autonomous subject hood of Human geography.*
- *Geography was seen as solely descriptive and unscientific. As some argued, there was no explanation of why processes or phenomena occur in geography.*
- *Geography was not useful for solving problems. Hence, it was seen as exclusively educational.*

- *Questions regarding the nature of geography persisted, for example, it was unclear to some people whether geography was a science, an art, a humanities subject or a social science.*

The revolution introduced a rapid change in the methodologies used in geographical research. This change led to a shift from ***descriptive geography*** to ***empirical law-making geography***. As a result, disagreement between scholars of different schools such as those who supported quantitative methods and those who favored the descriptive approach arose.

NOTE

The quantitative revolution was driven by the development of the computer and its ability to rapidly process data. Quantitative geographers "went radical" and applied computers, statistics, and mathematical models to the study of geographers.

Some of the techniques that became central to geography during the quantitative revolution were:

- *Descriptive statistics*
- *Inferential statistics*
- *Basic mathematical equations and models, such as gravity models*
- *Deterministic models e.g., Von Thünen's and Weber's location models*
- *Statistical models, using concepts of probability*

The analytical method of inquiry led to the development of logically acceptable generalizations about the spatial aspects of closely defined events under different natural and cultural conditions. Generalizations may take the form of tested hypotheses, models, or theories.

Adoption of the analytical approach helped geography to become a more law-giving science, and the conception of the discipline as an idiographic field of study became less acceptable. This process began in the 1980s.

D *The Emergence of Applied Geography*

What is Applied Geography? When did it appear as a school of thought?

Geography has been used since human beings appeared on earth. Primitive human and his successors had a good knowledge of the geography of the things

that they needed for survival. However, geographic knowledge had little chance of being used to solve geographic problems.

Another major development occurred in the latter part of the 20th Century in geography. This development was the development of applied geography; geography became a science that we can use to solve socio-economic and political problems.

Applied geography had its roots in the quantitative revolution. The emergence of applied geography increased the applicability of geographic knowledge. Today, many geographers work as urban planners, GIS analysts, environmentalists, cartographers, location analysts, transportation planners, developing-nations specialists, public-transportation planners, highway planners, university-facility planners, transportation logisticians, demographic analysts, etc.

NOTE

Applied geography is the use of geographic analysis in private business, government, non-profit organizations etc. Applied geography solves problems and aids in decision making.

Content Check

1. What is environmental determinism?
2. What is environmental possibilism?
3. What was the quantitative revolution?
4. What is applied geography?
5. Discuss the contributions of the quantitative revolution to the development of geography.

1.5 THE RELATIONSHIP BETWEEN GEOGRAPHY AND OTHER DISCIPLINES

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

- relate elements of geographical study with other fields of studies;
- explain the role of geography in connecting various fields of study.

Key Terms

- Interdisciplinary
- Social sciences
- Natural sciences
- Interdependence

Geography is an interdisciplinary subject. It has strong relationships with various disciplines in both the natural and the social sciences. For instance, human geography is highly linked with social sciences, while physical geography is related to the natural sciences. Knowledge and information in geography and the other sciences are interchangeable and interdependent.

Activity 1.7

What fields of study interrelate with geography? Discuss this question in your group. Please try to remember the lessons you have learned in Grades Nine and Ten.

As you might have noted, many academic disciplines are linked with geography. Among them are: biology, meteorology, geology, astronomy, economics, political science, history, demography, sociology, chemistry, and mathematics.

Can you describe how each of the above disciplines relates to geography? How does each connect to geography's specialized fields of study?

As indicated earlier, geography is closely linked to the social and natural sciences. Geography shares facts with them and explains certain aspects of those sciences. Observe how geography relates to these other sciences:

Biology: is a science that deals with all forms of life, including their classification, physiology, chemistry, and interactions. As biogeography is the study of plant and animal distribution, it is linked with biology.

Meteorology: is the scientific study of the earth's atmosphere, especially its patterns of climate and weather. Hence, it is related to the sub field of geography called climatology.

Geology: is the study of the internal composition of the earth. It examines the forces that change the earth's structure. It also investigates the history of those changes. Geology is linked with such branches of geography as Geomorphology and soil geography.

Astronomy: is the scientific study of the universe, especially of the motions, positions, sizes, composition, and behavior of astronomical objects. Topics about the universe, in particular the solar system, that are taught in geography are borrowed from astronomy.

Economics: is the study of the production, distribution, and consumption of goods and services. As economic geography is concerned with economic activities, it is strongly related to this field.

Political Science: is the study of political organizations and institutions, especially governments. This discipline has strong connections with political geography.

History: is a systematic and organized study of the past socio-economic and political processes of human society. History helps us anticipate the future. As it is concerned with the past, it is strongly linked with historical geography.

Demography: is the study of human populations, including their size, growth, density, and distribution, and statistics regarding birth, marriage, disease, and death. The body of knowledge that we learn in population geography is somehow linked with the subject matter of demography.

Physics: is the study of matter and energy and the effects they have on each other.

Sociology: is the study of the origin, development, and structure of human societies and the behavior of individual people and groups in society. It connects to cultural geography.

Mathematics: is the study of the relationships among numbers, shapes, and quantities. It uses signs, symbols, and proofs and includes arithmetic, algebra, calculus, geometry, and trigonometry. Mathematical geography is linked with this academic discipline.

Activity 1.8

In a small group, list some topics and concepts of geography that are related to the following disciplines:

i Geology
ii Demography
iii Economics
iv Political science

Why do we say that geography is an interdisciplinary subject?

Unit Review

UNIT SUMMARY

In this unit, we have described the nature of geography. We defined geography, discussed its scope, discussed its approaches, examined its major schools of thought and examined its relationship with other sciences.

In summary:

- Geography is a systematic study of the spatial distribution of phenomena on the surface of the earth and of the two-way interaction between the natural and human environments.
- The scope of geography is very wide. It attempts to study many parts of the geosphere: the lithosphere, hydrosphere, atmosphere, anthroposphere and biosphere.
- Geographical studies are conducted based on two basic approaches, regional geography and systematic geography. The first studies all aspects of phenomena found in a region, while the latter investigates a single phenomenon globally.
- Environmental determinism and environmental possibilism are the two dominant philosophies that geographers use when they examine the relationship between humans and their environment.
- The philosophy of environmental determinism is related to the idea that the environment is the factor that determines peoples' mode of living. In contrast, the possibilist philosophy emphasizes the two-way relationship between humans and the environment and the possibility for humans to change the environment.
- The emergence of the quantitative revolution in the 1950s and 1960s contributed a lot to the development of geography. It incorporated different statistical techniques in to geographical studies.
- The emergence of applied geography increased the practical applicability of geography. Applied geography solve, many different socio-economic and environmental problems.
- Geography is highly integrated with other disciplines. It shares a wide range of information with the social and natural sciences.

REVIEW EXERCISE FOR UNIT 1

I *True or False*

1 The fact that deserts can be turned into agriculturally productive areas through irrigation supports the philosophy of environmental possibilism.

2 Geography is less practical in today's world than it was before.

3 According to the determinist approach, human cannot change or influence the environment.

4 Systematic geography is the study of the general characteristic of a region.

5 The facts and principles of the natural sciences can be applied in geography.

II *Matching: match the items given in the box with the statements given below.*

A	Quantitative revolution	F	Demography
B	Febvre	G	Political geography
C	Alexander Von Humboldt	H	Applied geography
D	Topical approach	I	Demolins
E	Regional approach		

6 An ardent supporter of environmental determinism.

7 An ardent supporter of environmental possibilism.

8 A nomethic or empirical law- making geography that occurred in the mid 20^{th} C.

9 A geographic school largely concerned with the structure of the ecological system and other social problems.

10 A geographic approach that emphasizes various aspects of a defined spatial unit.

11 A geographic approach that singles out one or two elements and treats the distribution globally.

12 A branch of geography that deals with the dynamic and static aspects of population.

13 A branch of geography that deals with boundary, communication and activities between countries in relation to political power.

III *Multiple Choices*

14 A Greek philosopher who pioneered the definition of geography was:

A Plato
B Erathosthenes
C Herodotus
D Pythagoras

15 Which of the following opinions do you accept?

A The definition of geography is static.
B Geography is a discipline which does not have one single definition.
C Geography does not have any relationship with other disciplines.
D The definition of geography is not subject to any change.

16 Which of the following statements about geography is correct?

A Physical phenomena are evenly distributed over the surface of the earth.
B There is a one-way relationship between humans and their environments.
C All elements in the natural environment affect the way of life of its inhabitants.
D Human beings are not capable of modifying their environments.

17 The main theme of possibilism is:

A The two-way relationship between human and nature.
B Human beings are not capable of modifying their environments.
C Human society is a passive agent in the man-environment relationship.
D Human beings are always under the influence of their environment.

18 Which of the following reflects the deterministic outlook?

A Self reliance.
B People who live in cold climates are stronger and more courageous than those living in warm climates.
C Human is capable of modifying his environment.
D Analyses social structure in terms of human activities.

IV *Fill in the blank space.*

19 A German geographer who tried to show how people adapt to and are influenced by the environment was _____.

20 The sub field of geography that studies how plants and animals are distributed is called _____.

21 Part of the exosphere that represents the cultural landscape of the earth is _____.

22 A Greek scholar who coined the word 'Geography' for the first time was _____.

23 The use of geography for socio-economic and political problem solving and planning is know as _____.

V *Define the following terms.*

a Lithosphere

b Troposphere

c Hydrosphere

d Biosphere

e Anthroposphere

VI *Answer the following questions briefly.*

24 What is geography?

25 What is the difference between regional and systematic geography?

26 What is the difference between environmental possibilism and environmental determinism?

27 What is applied geography? What is the historical background for its emergence?

28 Discuss the relationship that exists between geography and the other social sciences.

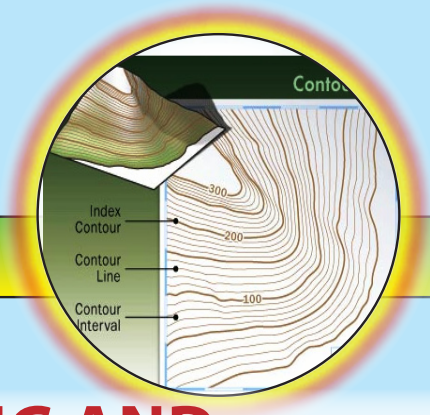
29 What was the quantitative revolution in geography?

30 What is the geo-sphere?

31 What are the basic questions that geography addresses in the second half of the 20th C?

32 Geographers argue that "Geography is not solely the study of place names, length of rivers, heights of mountains, etc." State it briefly.

Unit 2



MAP READING AND INTERPRETATION

Unit Outcomes

After completing this unit, you will be able to:

- review the definition and properties of contour lines;
- realize how contour lines are used to represent relief features on maps and types of contours;
- acquire the skills of drawing contour lines, cross-sections and determine intervisibility;
- assess the differences among watershed, river catchment area, drainage patterns and river capture using topographic (contour) maps; and
- discriminate settlement and communication features from contour maps.

Main Contents

INTRODUCTION

The earth's surface is not uniform due to variation in its geological formation. As a result, we observe altitudinal variation between places. The major geologic events that have taken place during the geological history of the earth have left varied landforms such as plateaus, mountains, hills, valleys and plains. These uneven landforms with different heights are represented on maps with the help of contour lines.

The relief features of the earth have three dimensions. These are length, breadth, and height. These three-dimensional features are represented on two-dimensional maps. Traditionally, hachuring, hill shading, layer tinting and form lines used to be used to show the varied landforms of the earth. However, they are no longer in use these days as they are replaced by contour lines.

In this unit, you are going to learn about how relief features, drainage patterns, and human-made features are represented on contour maps. In addition, the unit will try to introduce you to some concepts of Geographic Information System (GIS), including its essence, history and uses.

2.1 RELIEF REPRESENTATION ON CONTOUR MAP

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

- draw contour lines from spot heights, using interpolation;
- construct relief cross-sections to visualize features of the landscape;
- determine the intervisibility of land features by section drawing or contour maps;
- differentiate different landforms on contour maps; and
- identify types of contour lines.

Key Terms

- Relief
- Contour
- Slope
- Spot height
- Ground survey
- Aerial photography
- Satellite imagery
- Stereoscope
- Interpolation
- Clinometer
- Altimeter
- Contour interval
- Profile
- Vertical exaggeration
- Intervisibility

What is relief? What is cartography?

The term relief refers to the way that the earth's surface is arranged. It shows the difference in altitude that exists between different landforms. Relief indicates the variation in the nature of the land surface (i.e., "the lie of the land"). It thus shows the broad features and relative heights of highlands and lowlands such as flood plains, spurs, hills, plateaus etc. As we know, mountains have higher altitudes than hills. Similarly, plateaus are higher in altitude than plains. Such a difference in altitude produces diverse topographic features on the earth's surface. As a result, we have valleys, depressions, plains, plateaus, hills, and mountains constituting the earth's topography. These features of the earth's surface need to be represented by using different techniques while mapping the earth. Currently, the most widely used relief-representation cartographic technique is using contour lines.

Brainstorming

1. *What are contour lines?*
2. *How do they represent different landforms on maps?*
3. *How are contour lines drawn?*
4. *What are the methods and procedures applied to represent landforms on maps?*

Contour lines, also known as isohypses, are imaginary lines shown on a map that connect places of equal altitude above mean sea level. They provide the most accurate way of showing relief on maps. Contours are used to show the different landforms of the earth on two-dimensional maps. They help cartographers to easily show the depressions, valleys, hills, mountains, plains and plateaus by using contours with varying shapes and distances between consecutive contours. For instance, the shapes of the contour lines provide an accurate representation of the shapes of hills and depressions, and the lines themselves show the actual elevations. In addition, while closely spaced contour lines indicate steep slopes, the widely spaced ones indicate gentle slopes.

> ***Contours*** *are one of the several common methods used to denote elevation or altitude and depth on maps. From a contour map, a sense of the general terrain can be determined. Contours are used at a variety of scales, from large-scale engineering drawings and architectural plans, through topographic maps up to continental-scale maps.*
>
> *The term "contour line" is most commonly used in cartography. However, the term "**isobath**" for underwater depths on bathymetric maps and "**isohypse**" for elevations are also used. The process of drawing contours (isohypses) on a map is called isopletion.*

Look at the following contour map and try to identify the general pattern and the arrangement of each contour line.

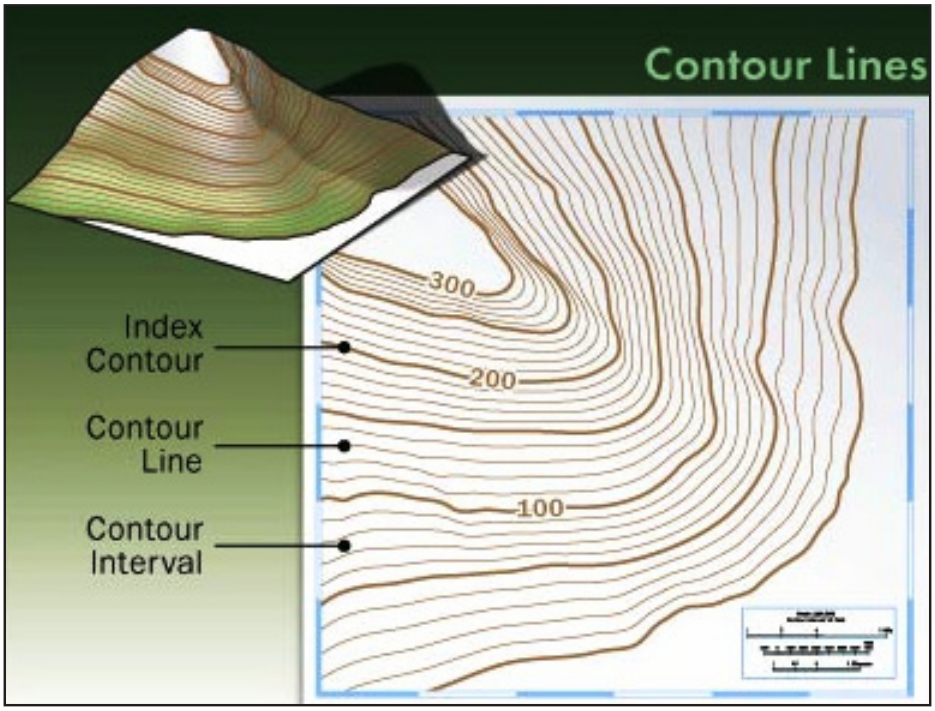


Figure 2.1: **Contour Map**

The different topographic features that characterize landscapes are shown on topographic maps by using contours with various characteristics. The patterns that the contours are drawn with, their spacing and shape indicate the characteristics of the relief of the place. As a result, valleys, spurs, shoulders, plains, plateaus, mountain tops, different types of slope, cliffs, overhanging cliffs, mountain ranges, and depressions are represented by contours of different shapes on topographic maps. For instance,

- *Evenly spaced contours represent a uniform slope;*
- *Contours that are widely spaced indicate a gentle slope;*
- *Contours that are close together near the top of a hill and widely spaced at the bottom indicate a concave slope;*
- *Contours that are widely spaced at the top of a hill and close together at the bottom indicate a convex slope;*
- *Overlapping contours, i.e., contours that merge at a point, indicate a cliff;*

- *Crossing contours indicate an overhanging cliff;*
- *Closed contours with more or less circular shapes, with values increasing towards the center and with the top indicated by a spot height represent mountains or hills;*
- *Closed contours with more or less circular shapes, with values decreasing towards the center represent depressions;*
- *Closed contours with elongated shapes, with values increasing towards the center with no specific tips indicate mountain ranges;*
- *Closed contours with more or less rectangular shapes, with values increasing towards the center with the top being a very wide closed contour represent plateaus;*
- *Contours with "V" shapes, with downward bending and values increasing upward represent spurs; and*
- *Contours with "V" shapes, with upward bending and values increasing upward represent valleys.*

The relief of a place represents the varying heights of hills and mountains, and the depths of valleys and gorges as they appear on a topographic map. Unless the relief is adequately shown, the map does not give a clear picture of the mapped area. In the earliest maps, relief was often indicated pictorially by small drawings of mountains and valleys known as pictorials. However, this method is extremely inaccurate and has been generally replaced by a system of contour lines. The contour lines represent points in the mapped area that are of equal elevations. They are drawn with a contour interval that may be any unit, depending on the amount of relief and the scale of the map, such as 50 or 100 m, and in drawing the map the cartographer joins together all points that are at a height of 50 or 100 m above sea level, all points at a height of 100 or 200 m, all points at a height of 150 or 300 m, and so on. Being drawn in such a way, the shapes of the contour lines provide an accurate representation of the shapes of hills and depressions, and the lines themselves show the actual elevations. The spacing between contour lines also indicates the nature of the slopes.

Activity 2.1

1 Define the following terms:
   a relief b contour c isobath
2 How do we differentiate steep slopes from gentle slopes and plains from plateaus?
3 In what situations do we use a small vertical interval (V.I.) on a contour map?
4 Describe the type of land feature formed by the following contour lines:
   a evenly spaced contours
   b contours that are widely spaced
   c contours drawn one over the other/ merging contours
   d contours crossing one another.

2.1.1 Drawing Contour Lines from Spot Heights

Brainstorming

1 How are contours drawn?
2 How is spatial information concerning the area being represented by contour maps obtained?
3 Do you think that aerial photographs/images taken by aircraft and artificial satellites can be used in contour mapping? How?
4 How do cartographers draw contour lines from spot heights?

Contours are drawn on maps based on the spatial data that is gathered through different techniques. This is to mean that before preparing the contour map of an area, surveying the area to obtain spatial data about the relief of the place is important. The collection of spatial information that is vital for contour mapping can be done through **ground survey**, **aerial photography** or **satellite imagery**.

When the surveying is done by using aircraft and satellites (through aerial photography/imagery), the aerial photograph of the landscape has to be mapped through aerial photogrammetry, which uses an instrument called a ***stereoscope***. **Photogrammetry** is the science of taking measurements from aerial photographs or satellite images to make maps, including topographic maps. **Photogrammetrists** use photographs taken by a special camera on an airplane or

by spacecraft satellites. To minimize distortions, the pictures are corrected using a stereoscopic device called a **stereoplotter**, which creates a three-dimensional image by combining overlapping pictures of the same terrain taken from two different angles. Contours, roads, and other features are then traced from the three-dimensional image to form a map base.

The photographs with horizontal and vertical information of the area will then be reconstructed into stereo models for drafting true-scale maps. In this method, precise cameras and precision-mapping equipment are required to show true elevations for all points in the mapped area. Elevations on topographic maps are shown chiefly by use of superimposed contour lines connecting points of equal elevation, to give a readable picture of the terrain.

A stereoscope is an optical instrument through which one may view photographs of objects not merely as plane representations, but with an appearance of solidity, and in relief. The stereoscope is an instrument in which two photographs of the same object, taken from slightly different angles, are simultaneously presented, one to each eye. Each picture is focused by a separate lens, and the two lenses are inclined so as to shift the images toward each other and thus ensure the visual combination of the two images into one three-dimensional image. Stereoscopic aerial photography permits three-dimensional representations, which can be used in the preparation of contour maps.

On the other hand, when spatial information is gathered through ground surveys, surveyors must physically be present in the area being mapped and take measurements of the relief and keep records of their measurements of height. Then, the gathered data will be recorded on paper or stored in a computer by using spot heights, with each spot height representing the measured altitude of the specific point. Then, the cartographers/map-makers will connect all points of equal altitude to draw the contours with the contour interval that they choose based on the nature of the landscape and the scale of the map.

Drawing contours from spot heights is tiresome and time-consuming. However, it is important for producing contour maps in situations where advanced technologies of contour mapping are not adequately available. Contours are drawn from spot heights by using the method called **interpolation** to determine the height of places between successive spot heights. Spot heights represent individual heights of places at varying points as obtained through ground surveys

by using **clinometers**, which are hand held surveying instruments for measuring angles of slopes, and **altimeters**, instruments to measure the elevations of places.

Activity 2.2

Discuss the following questions with your friend and try to answer them collaboratively.

1 How can you determine the points at which each contour line with a 100 m contour interval passes?

2 How do cartographers obtain spatial data for their mapping?

Interpolation can be done in any one of the following ways.

- **Estimation method:** *This technique is used to locate contour lines by rough estimation. It should be applied in areas where the ground is quite regular and when very simple and small-scale work is done. It does not necessarily need great accuracy.*
- **Calculation method:** *This is the most accurate method of interpolation, whereby the exact altitude of the contour will be determined by measurement and subsequent calculations. Despite its accuracy, the calculation method is time-consuming and laborious.*
- **Graphical method:** *This is the quickest and the most accurate method of interpolation of contours. In the graphic method, a graph is prepared on tracing paper.*

Methods of Depicting Relief on Maps

How are different relief features represent on maps?

Map makers use several methods to depict relief of the terrain.

a **Layer Tinting:** Layer tinting is a method of showing relief by using different colours or different intensities of the same colour. Each shade of colour, or band, represents a definite elevation range. To understand the relief, a legend is printed on the map margin. However, this method does not allow the map user to determine the exact elevation of a specific point. It only shows the range of elevation.

b **Form Lines:** Form lines are not measured from any datum plane. As a result, they have no standard elevation. They only give a general idea of

relief represented. Form lines are represented on a map as dashed lines and are never labeled with representative elevations.

c **Shaded Relief:** Relief shading is a method that indicates relief by a shadow effect achieved by tone and colour that results in the darkening of one side of terrain features, such as hills and ridges. The darker the shading, the steeper the slope. Shaded relief is sometimes used in conjunction with contour lines to emphasize these features.

d **Hachures:** Hachures are short, broken lines that are used to show relief. They are sometimes used with contour lines. Hachures do not represent exact elevations, but are mainly used to show large, rocky outcrop areas. Hachures are widely used on small-scale maps to show mountain ranges, plateaus, and mountain peaks.

e **Contour Lines:** A contour line represents an imaginary line on the ground, representing altitude above or below mean sea level. Contour lines are the most common method of showing relief and elevation on a standard topographic map. All points on a given contour line are at the same elevation. The elevation represented by contour lines show the vertical distance above or below mean sea level. Cartographers use three types of contour lines while representing relief on topographic maps.

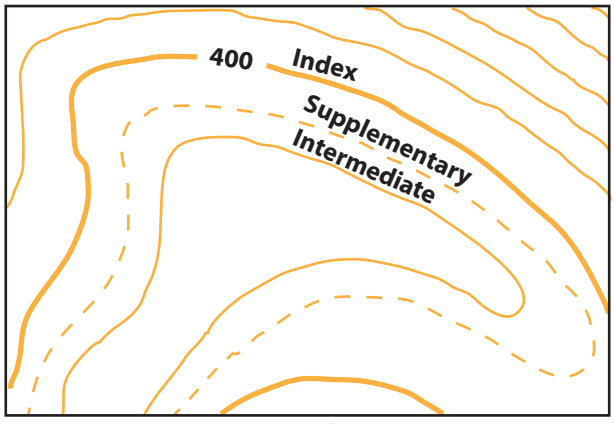


Figure 2.2: **The three types of contour lines**

The three types of contour lines used on a standard topographic map are the following.

1 ***Index Contour:*** Starting from zero elevation or mean sea level, every fifth contour line is a heavier/darker than the other contour lines. These heavier contour lines are called **index contour** lines. Commonly, each index contour line is numbered at some point. This number indicates the elevation of that line.

2 ***Intermediate Contour*:** The contour lines falling between the index contour lines are called intermediate contour lines. These lines are finer/thinner than the index contours. They do not have their elevations given. In most cases, there are four intermediate contour lines between index contour lines. Their value is decided by dividing the difference in altitude between two consecutive index contours by five, if there are four intermediate contours.

3 ***Supplementary Contour:*** These contour lines resemble dashed or broken lines. They show changes in elevation of at least one-half the contour interval. These lines are normally found where there is very little change in elevation, such as on fairly level terrain.

Contour lines are generated from spot heights. A spot height is a statistical point that represents the specific altitude of a place at that particular point. Drawing contours from spot heights is not hard or difficult. However, it needs a lot of practice and patience, as well as a lot of time, to make a good-looking contour map.

Contouring is started by plotting the spot heights with their specific altitudes on the paper on which you want to draw the contour map. The elevations of the spot heights can be obtained by ground survey and associated measurement of altitude of points on the surveyed area. Figure 2.3 shows you an area in which the altitudes of the selected points are shown by using spot heights.

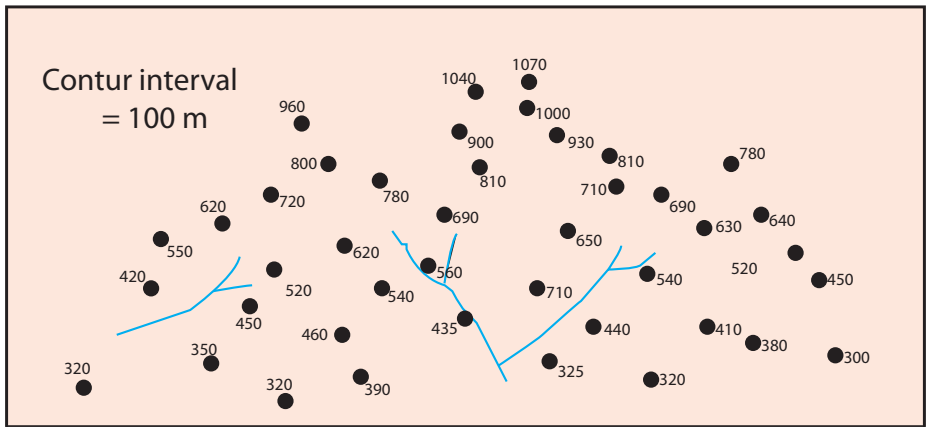


Figure 2.3: **Spot heights indicating elevations of selected points of an area to be mapped**

As you can see from Figure 2.3, the altitudes of a number of places have been collected through ground survey and the altitude of each point is presented by using mathematical calculation.

As shown in the Figure 2.3, the contour interval is 100 m. This means that contours are drawn for every 100 m altitude. The lowest point indicated by the spot heights in the figure is 300 m above sea level. Hence, the contour line with the lowest value is the 300 m contour. By starting from that line, contours have to be drawn for every additional 100 m altitude. Accordingly, you are expected to draw contours for 400 m, 500 m, 600 m, and the like up to the highest point indicated, which is 1070 m. In this case, the last contour line should have a value of 1000 m as the contour interval given is 100 m.

The second step in drawing contours from spot heights is determining the approximate points through which the contour lines with every 100 m value pass. This can be done by using the method called interpolation. Interpolation is a method of estimating the values of points lying between two points that have defined values. By using this method, we can scientifically guess the approximate altitude through which each contour line with an additional 100 m altitude passes. Interpolation involves some kind of mathematical measurement. To determine the points at which the contour is to be drawn and pass through, we have to connect points between which the contour lines of every 100 m additional value pass by using straight lines. Then, the length of the straight line is measured by using a ruler to obtain the distance on the map between the points. Once the distance on the map between the points is acquired, we have to apply a cross-multiplication system to get the point at which the required contour with a 100 m contour interval should pass. We apply similar procedures to plot all the points for each specific contour line.

To better understand the procedures that we apply while interpolating points, you can study the following figure and the associated description. The figure shows you the procedures that we need to follow while determining the points at which the 400 m contour line passes. To do so, follow this procedure.

1 Identify all the points between which the 400 m contour line passes. In this case, they are all the points that lie between the following spot heights.

- ⇨ *320 m and 420 m*
- ⇨ *350 m and 420 m*
- ⇨ *350 m and 450 m*
- ⇨ *320 m and 460 m*
- ⇨ *390 m and 460 m*
- ⇨ *390 m and 435 m*
- ⇨ *325 m and 435 m*
- ⇨ *325 m and 440 m*
- ⇨ *320 m and 440 m*
- ⇨ *320 m and 410 m*
- ⇨ *380 m and 410 m*
- ⇨ *380 m and 450 m*

2 Connect all the points identified above by using straight lines as shown in Figure 2.4. The lines are drawn connecting those spot heights between which the 400 m contour line is expected to pass. To draw the whole map, you should connect all the spot heights between which a contour line with a 100 m contour interval would pass.

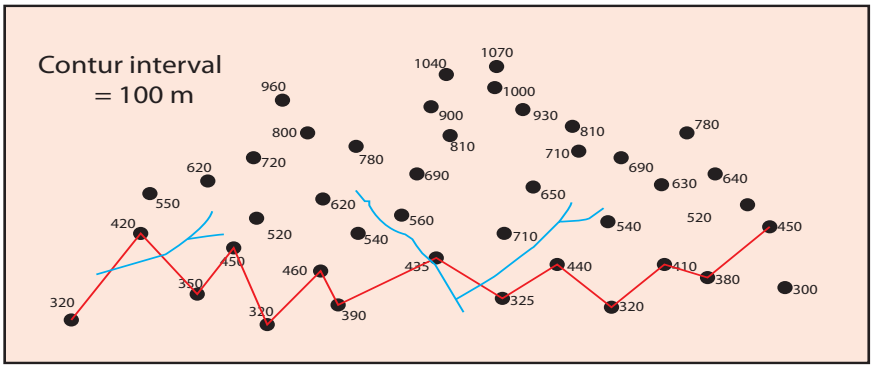


Figure 2.4: **Drawing contour line using interpolation**

3 Measure the length of each line connecting two spot heights to determine the distance on the map between the two points and see the height it represents (the difference in altitude between the two spot heights). For example, the distance on the map between the 320 m and 420 m spot heights is measured and is found to be 1.5 cm. This means that the 100 m altitudinal difference between the 320 m and 420 m spot heights is represented by a 1.5 cm straight line.

4 Determine the point at which the 400 m contour line passes. This can be done by using the cross-multiplication method. For example, if the 1.5 cm represents 100 m between the 320 m and 420 m spot heights, then the length of line that represents 80 m from the lowest spot height, i.e., 320 m, would be 1.2 cm.

5 Put a point at a distance of 1.2 cm from the 320 m spot height along the line that connects the 320 m and 420 m spot heights to identify the point along which the 400 m contour line passes.

N.B: Apply the procedures above to determine the points at which each contour line with a 100 m contour interval passes between two spot heights.

6 Connect all the identified points of a certain contour line with the given contour interval by using curved lines to draw the contours. While doing so, please consider the shapes and patterns that different features such as rivers have when they are represented on contour maps. This will help you to better represent the features on your map.

7 Label the map and add all the required information. For example, write the values of the contour lines to indicate the contour interval and add a title to the map.

When you finish drawing all the contour lines, you will have the following contour map.

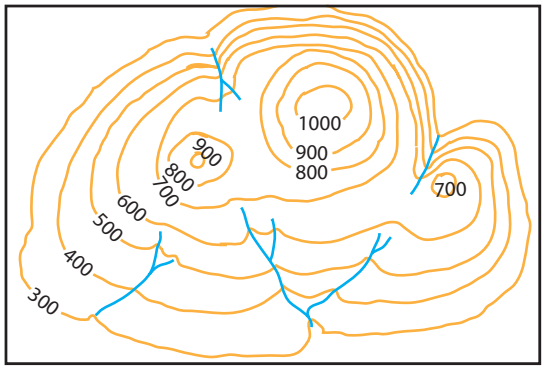


Figure 2.5: **Contour lines drawn with the help of interpolation**

Activity 2.3

With the help of your teacher and friends, prepare a contour map from the following data (Figure 2.6). While drawing the contours, consider the following.

1 The values indicated by each spot height are given in meters.

2 Use a contour interval of 100 m for your map.

3 Do not forget to consider the shapes and patterns that contours would have when they depict different relief features.

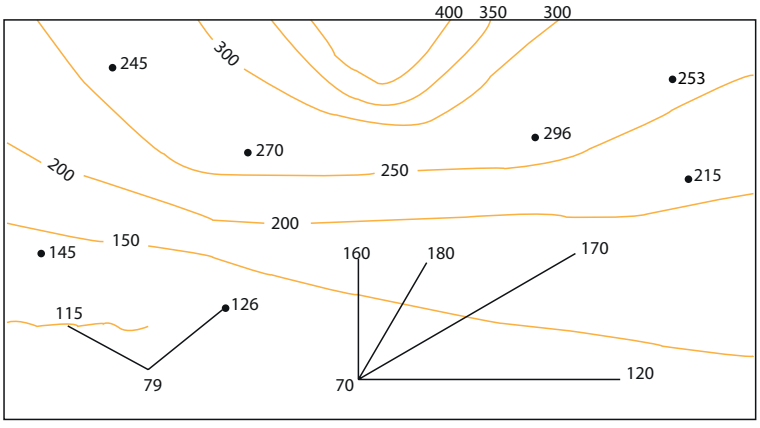


Figure 2.6: **Spot heights**

2.1.2 Drawing Relief Cross-Section (Profile)

Brainstorming

1 What is a cross-section?
2 How are cross-sections drawn?
3 Why are cross-sections drawn?

As we have seen so far, contouring is the standard method of representing relief on topographic maps. For a given contour map the vertical distance between adjacent contour lines – the contour interval – is fixed. Examining the horizontal distance between succeeding contour lines helps the reader to visually estimate the difference in slope of parts of the terrain. Thus, the way the contours are arranged, their shapes and spacing shows the diverse relief features of the area mapped. While closely spaced contour lines represent steep slopes, widely spaced contours show gentle slopes.

However, a more precise method of determining the variation in slope is to construct a profile or cross-section through the topography. This is done by marking off the horizontal distance between contour lines along a base line and then plotting the elevation or altitude of these points. By doing so, a profile can be drawn showing the gradient of slope and shape of the topography along the line of section.

Cross-section drawing is one of the simplest ways of acquiring skills in reading contour maps. A cross-section helps us to acquire a better view of the nature of the slope and other relief features drawn on the contour map. When we draw the cross-section of a map, we can have a better understanding of the nature of the landscape and can tell whether two points are intervisible or not.

In order to draw a cross-section from a given contour map, we need to have a vertical scale in addition to the horizontal scale of the map. Horizontal scale is the normal scale of any given map. On the other hand, vertical scale is the scale which is used to show the nature and type of relief on the contour map. It shows the degree of exaggeration made while the cross-section of a relief feature is prepared from its contour map.

The vertical exaggeration/vertical scale of the cross-section is determined by considering the scale of the map and the nature of the terrain. Although the decision

concerning the extent to which a cross-section should be exaggerated is in the hands of the one who prepares the cross-section, the widely accepted approach to use is defined by these guidelines:

- ⇨ *higher vertical exaggeration for flat terrain; and*
- ⇨ *small or no vertical exaggeration for rugged (rough) terrain.*

Table 2.1: **Relationship between relief and vertical exaggeration.**

Relief type	Amplitude	Approximate vertical exaggeration to scale			
		1:20,000	1:50,000	1:100,000	1:250,000
Mountainous/ very hilly	700 m	No	2	4	5
Undulating/ dissected	150-350 m	2	4	8	8 or 16
Plains and plateaus	About 150 m	4	8	15	20

To draw a cross-section of a relief feature from the following contour map, we need to follow the next procedure.

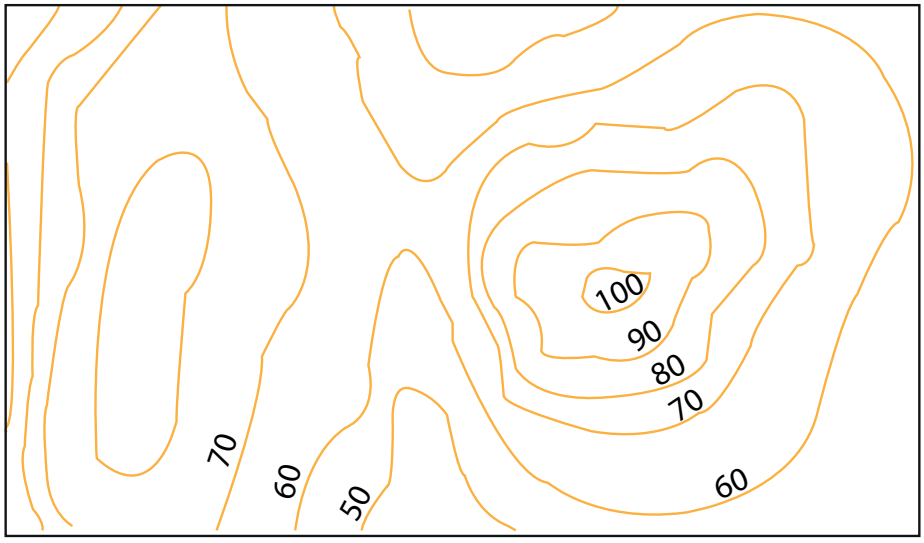


Figure 2.7: **A contour map of an area**

1 Draw a cross-section line across the above contour map between the two points along which you choose to draw the cross-section.

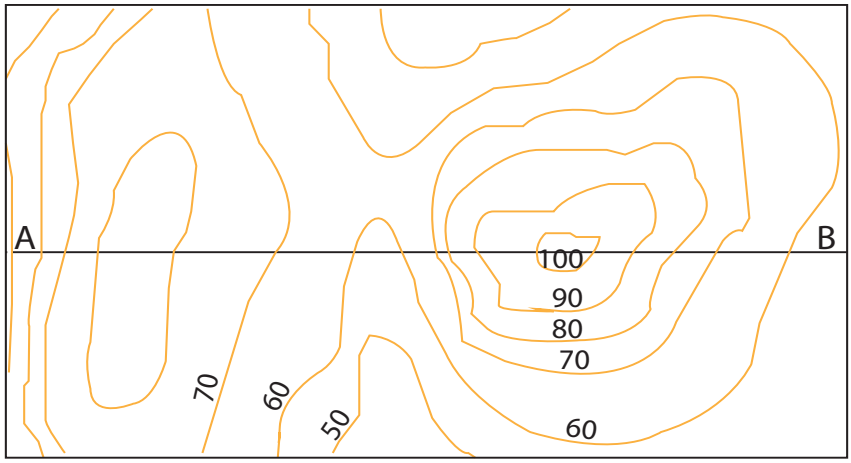


Figure 2.8: **A cross-section line drawn between points A and B**

2 Place the edge of a strip of straight-edged paper along the cross-section line which you have drawn along points A and B.

3 Mark the places where the contour lines disappear under the straight edge and note their heights.

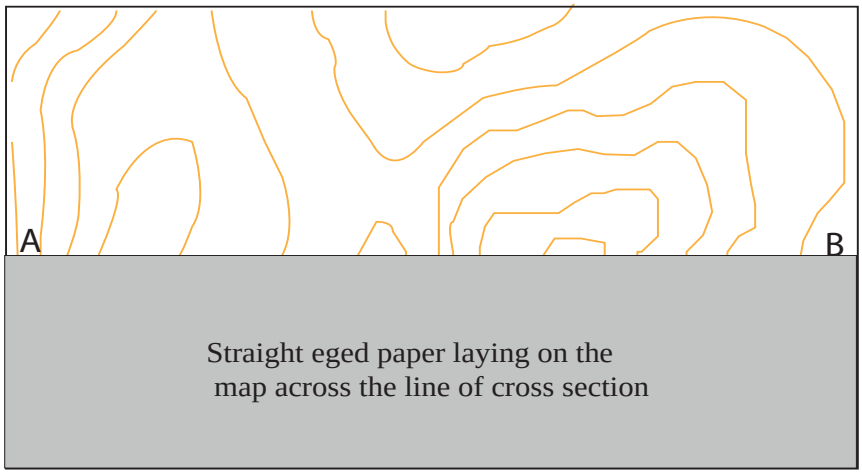


Figure 2.9: **A straight-edged paper whose edge has been placed on the face of the map to mark the points where the contours intersect with the cross-section line**

4 Draw a cross-section outline with vertical scale.

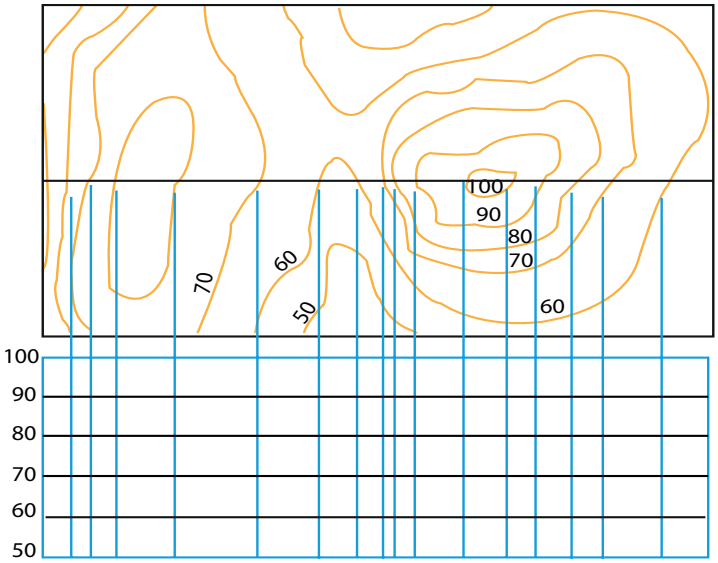


Figure 2.10: **A cross-section outline with vertical scale**

5 Place the strip of paper along the top and mark the height points on the outline.

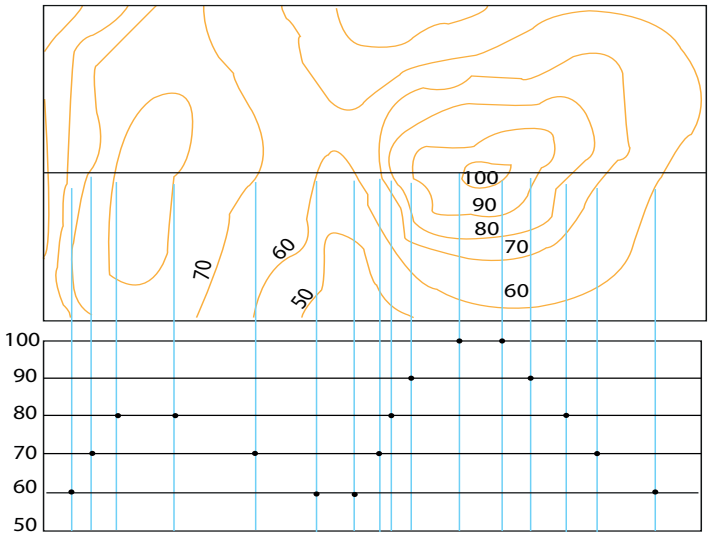


Figure 2.11: **Markings of height points on the cross-section outline**

6 Join the points with a curving line.

7 Shade the bottom of the diagram.

8 Add labels and titles.

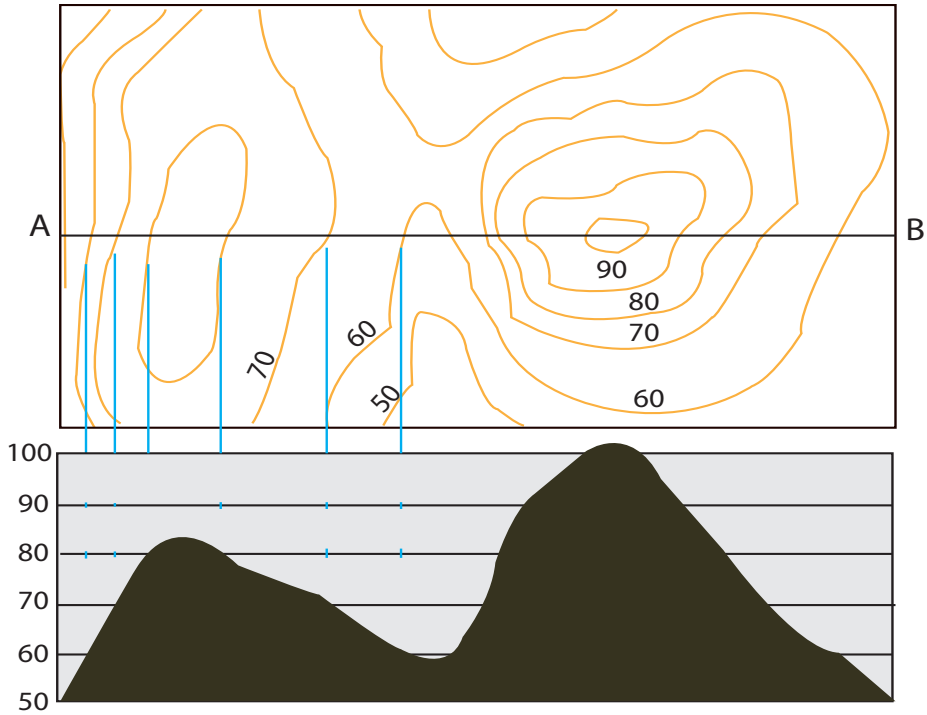


Figure 2.12: **A cross-section of the preceding map showing the mountains and pass that were shown by using contours**

The first part of Figure 2.12 shows the topography of the mapped area in a contour-line map. The contours are labeled with numbers indicating how high above sea level the contours are. The second part of the figure is a cross-section of the contour map along the line A-B. The x-axis (the horizontal axis) of the cross-section corresponds to the line from A to B on the topographical map. The y-axis (the vertical axis) of the cross-section is used with the x-axis to plot the height of each contour where it crosses the A-B line. In this way, a series of dots has been created and they have been connected to each other to create the cross-section of the landscape.

From the above cross-section, one can easily understand that the area represented by the contour map is a pass between two rising landforms/hills. It is also possible to see the nature of the slope along the sides of the hills. For instance, the hills are steeper along the left side, while they are gentler along the right. Note that the steeper slopes are represented by closely drawn contours, while the gentler slopes are represented by contours that are widely spaced.

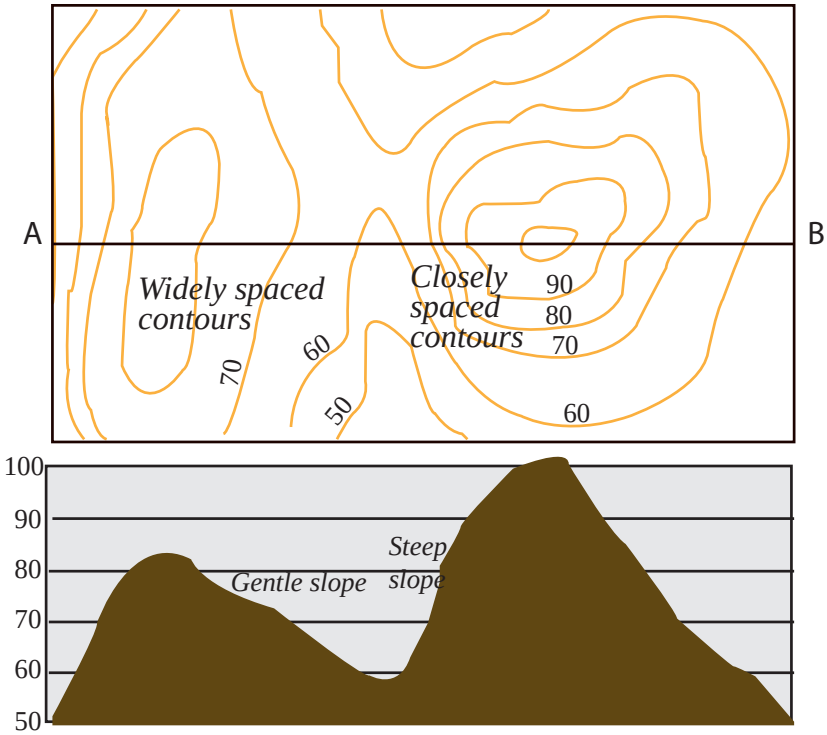


Figure 2.13: **The relation between contour maps and their profile**

In almost all cross-sections, the horizontal scale is smaller than the vertical scale. This forms a simple relationship between the contour interval and the vertical distance between the horizontal lines on the graph paper. For instance, a section from the 1 cm thus plotted on $\frac{1}{10}$cm would have a horizontal scale of $\frac{1}{100{,}000}$cm and a vertical scale of $\frac{1}{10{,}000}(1\text{cm to } 10{,}000\text{cm})$. The vertical exaggeration would be approximately 10 times.

Activity 2.4

Draw a cross-section of the following (Figure 2.14) map along the line A – B by following the procedures that we have followed in the preparation of the cross-section diagram above.

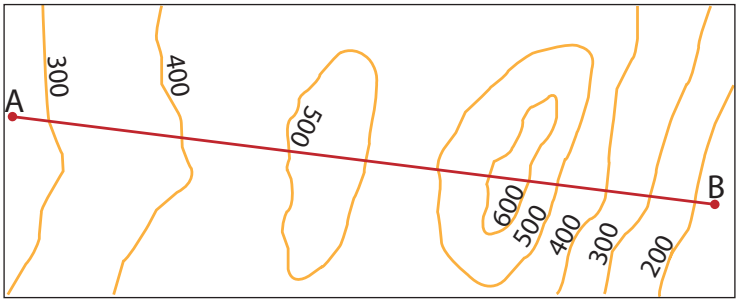


Figure 2.14: **Diagramatic map showing landform**

While drawing the cross-section of an area, using a vertical scale may be required. This becomes a must if the map is drawn in such a way that may result in inconvenient cross-sections. Using a vertical scale greater than the horizontal scale in a cross-section is called **vertical exaggeration**. Cartographers exaggerate the vertical scale in order to clearly visualize the terrain of an area. Some times less exaggeration is used in areas where the relief elevation is high. When the relief represented is a relatively flat area or an area of low altitude, more exaggeration is needed.

The degree to which we exaggerate the vertical scale (V.E.) depends on:

- ⇨ *the scale of the map from which the profile is drawn*
- ⇨ *the relief configuration of the area that we are dealing with.*

Vertical exaggeration is both advantageous and disadvantageous. Some of the advantages and limitations of vertical exaggeration are listed below.

Advantages	Disadvantages
⇨ *it increases the visual effectiveness of a given relief.*	⇨ *it causes the slope of a hillside to look steeper than it actually is.*
⇨ *it has the potential to give a very strong impression.*	⇨ *it may cause some distortion.*

Focus

When we draw a cross-section, we have to show graphically the proportions between horizontal and vertical distances. When we want to show the profile of a given piece of land, the variations in altitude are very small when compared with the horizontal distances involved.

2.1.3 Intervisibility

Brainstorming

1 What do we mean by intervisibility?
2 Why is it important to study the intervisibility of places?
3 What are the factors that affect intervisibility?

Intervisibility is simply defined as the visibility of places to each other. If an observer standing at a certain point can see another observer standing at another point, then the two places are said to be intervisible. Any land that is not visible from a certain point or place is known as "dead ground" relative to that area. Contour maps are important tools to determine whether two places are intervisible or not. An important feature of contour maps is that they allow us to know whether one place can be seen from another and vice versa.

Studying intervisibility is important for many reasons, for example

- ⇨ *Intervisibility is important for planning military operations;*
- ⇨ *It is also important for understanding the distribution of dead and visible ground with respect to proposed plans of infrastructure;*
- ⇨ *Intervisibility provides information for the evaluation of proposed sites for forest-fire lookouts;*
- ⇨ *Intervisibility plays a significant role in the planning of logging; and*
- ⇨ *It is important for selecting appropriate sites for the development of recreation and refreshment centers.*

The intervisibility of places can be affected by several factors, amongst which the most important ones are the following.

i The type of slope between the two points;

ii The general relief between the two points; and

iii The amount of vegetation that covers the area.

When we study intervisibility from contour maps, we have to consider the characteristics of contour lines. This is so because contour lines with varying shapes and patterns represent varied relief features. As we know, the nature of the landscape is the most important determining factor regarding intervisibility. Accordingly, we can say that under normal conditions,

- ⇨ *Two points separated by an even slope are said to be intervisible. However, in such a case, the vegetation cover should be taken into consideration before we make our decision. If the slope is covered with forest, the two points may not be intervisible;*
- ⇨ *Two points having unequal heights but separated by ground lower than the lower ground of the two points are intervisible;*
- ⇨ *Two points of equal altitude may or may not be intervisible, depending on other factors. For example, the two become intervisible if there is no higher ground or thick vegetation cover between the two points;*
- ⇨ *Two points separated by a concave slope are said to be intervisible if no other factor exists that hinders intervisibility;*
- ⇨ *Two points separated by a convex slope are not intervisible to each other because there is out-bulging land between the points;*
- ⇨ *Two points that are located at the opposite sides of high ground are not intervisible because the higher ground between the two obscures their intervisibility.*

For example, in the following contour map (Figure 2.15), the intervisibility of points A and B and C and D can be determined by observing the nature of the contour lines and the direction at which elevation increases. Accordingly, we can conclude that:

a Points A and B are not intervisible. As a result, the men standing at the two points cannot see each other. This is due to the presence of higher ground between the two points. As you can see from the map, the persons stand at the opposite sides of the hill. Point A lies at 60 m altitude, while point B is at 70 m altitude, but there is ground higher than 80 m in altitude between the two. This obscures their intervisibility.

b Points C and D are intervisible and therefore the men standing at the two points can see each other. In this case, the two persons are standing on the same side of the hill but at different altitudes. As shown on the map, point C lies at an altitude of 90 m, while point D is located at an altitude of 60 m. As there is no higher ground between the two points, and as the slope is gentle, the two places are intervisible.

⇨ *due to the type of the slope = concave*

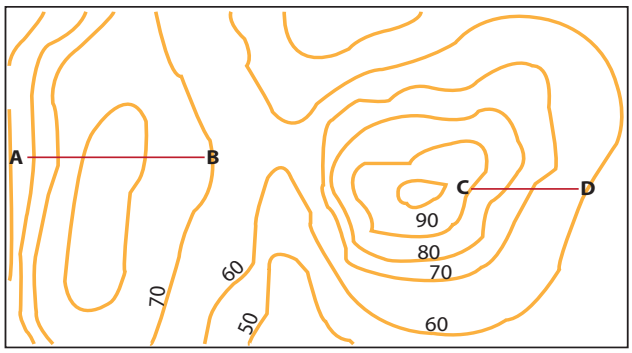


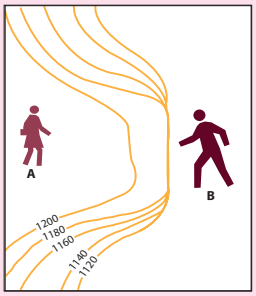
Figure 2.15: **Intervisibility between two points**

The intervisibility of places can easily be determined when the places shown on the contour map are presented in cross-section. The most important purpose of drawing cross-sections is to determine the intervisibility of places. For instance, the intervisibility of the points shown on the above contour map can be easily decided by observing the nature of the landscape between the labeled points in the following cross-section diagram of the contour map presented above.

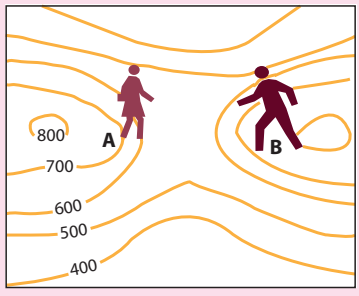
Figure 2.16: **Determining intervisibility by using relief cross-section**

Activity 2.5

Based on the figures presented below, try to determine whether the points indicated on Figures 2.17 a) and b) are intervisible or not and justify your answers.



a)



b)

Figure 2.17: **Intervisibility**

While determining the intervisibility of points or places labelled on a contour map, knowing the following facts simplifies your work. However, do not forget that these conditions are functional only under normal condition. This is to mean that there should not be any other factors, such as thick vegetation, that may hinder the intervisibility of the points.

1 Points located at different altitudes (for example, one at the top and the other at the bottom of a hill) with contours that are drawn close to each other at the top and farther apart at the bottom (i.e., concave slopes) are intervisible.

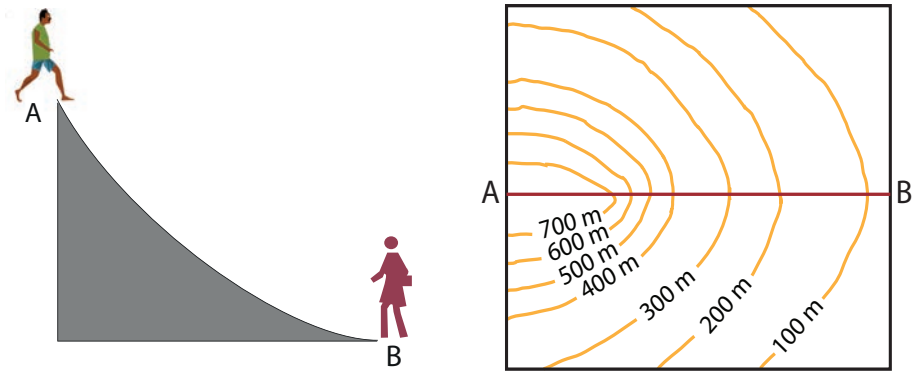


Figure 2.18: **Intervisiblity on a concave slope**

2 Two points, one located at the top and the other at the bottom of a hill, with contours that are drawn far apart at the top and close to each other at the bottom (i.e., convex slopes) are not intervisible.

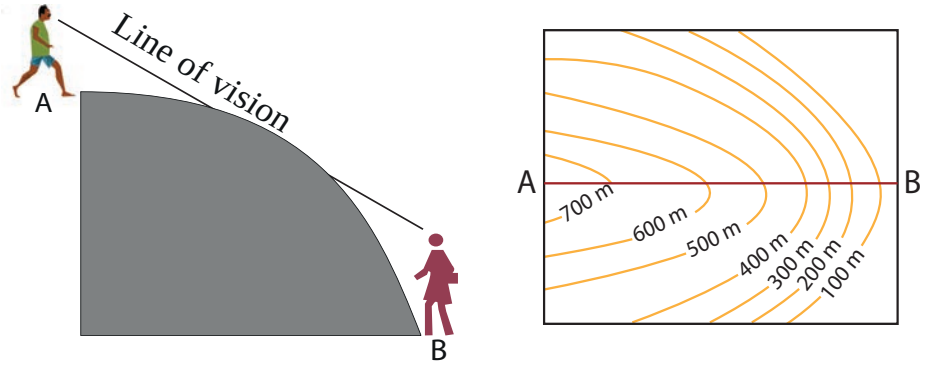


Figure 2.19: **Intervisiblity on a convax slope**

3 Two points, one being located at the top of a hill and the other at its bottom, with contours that are evenly spaced (i.e., gentle slopes) are intervisible.

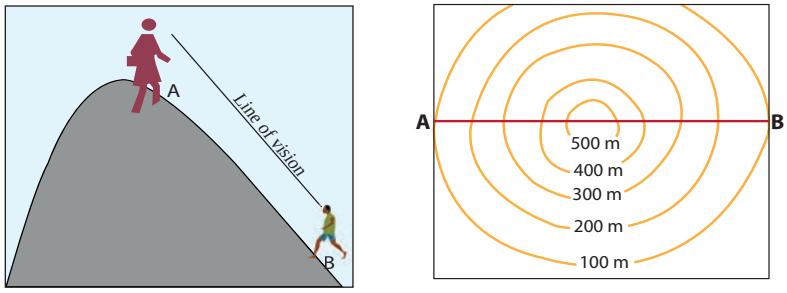


Figure 2.20: **Intervisiblity on an even slope**

4 Two points, one being located on top of a cliff or an overhanging cliff and the other at the bottom of it (a relief feature that is represented by contours that merge at the points where the landscape becomes a cliff) are not intervisible.

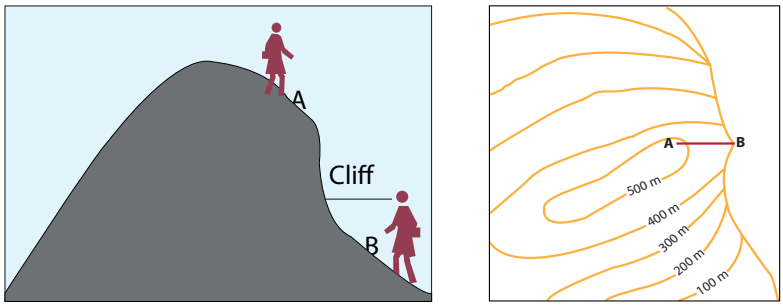


Figure 2.21: **Intervisiblity between two heights along a cliff**

5 Points that are located at the same altitude are intervisible if there is no higher ground between the points. Otherwise, they are not intervisible.

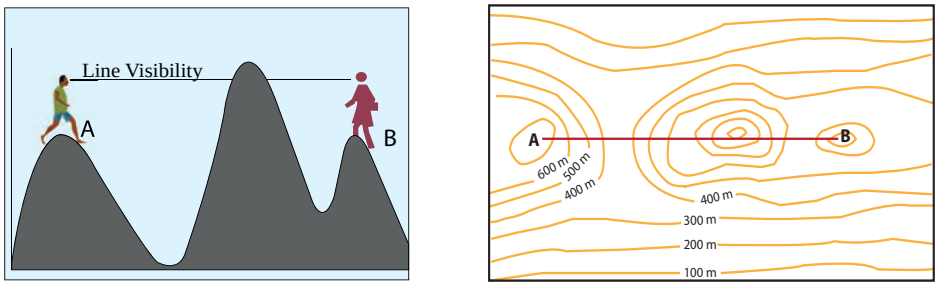


Figure 2.22: **Intervisiblity between two points with higher groundbetween them**

6 Two points that are located at the opposite sides of a hill or a mountain (represented by nearly circular closed contours with their values increasing towards the smaller (innermost) closed contour) are not intervisible to each other because the higher ground between the two points prevents intervisibility.

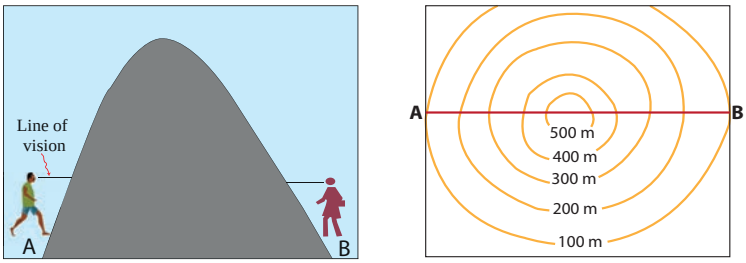


Figure 2.23: **Intervisiblity between two lower points**

7 Two points, one located inside a depression on top of a mountain and the other on the side of the mountain outside the depression (shown by nearly circular closed contours with their values increasing towards the top of the mountain up to the beginning of the depression and then closed contours with their values decreasing towards the most interior point) are not intervisible.

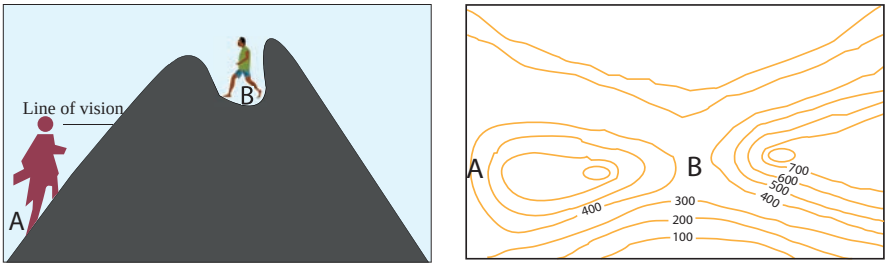


Figure 2.24: **Intervisiblity between two points at lower and dead ground but at a higher altitude**

The intervisibility of two points can also be determined by using a skeleton diagram that shows only the altitude of the points for which intervisibility is to be investigated. Figure 2.25 gives you some idea about how to determine intervisibility between points by using this technique. Such a method is especially important for determining intervisibility between points when, for some reason, it is difficult to determine intervisibility by using contour maps.

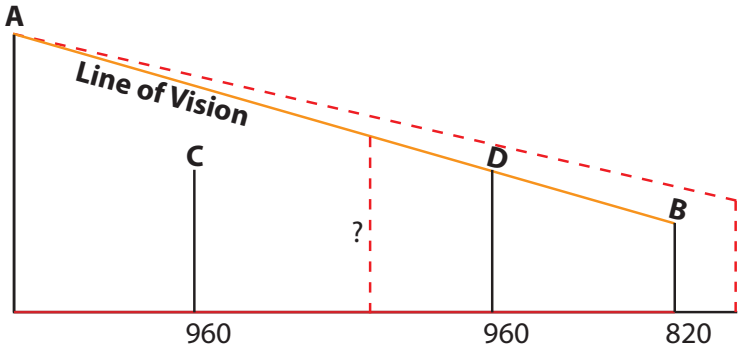


Figure 2.25: **Determining intervisibility by using a skeletal section**

In the above section, we find that the line of vision drawn from A to B is obscured by the height of D (960 m), and therefore the two points A and B are not intervisible. This can also be decided by the very position of D and B. If spot height D had been closer to C, or if point B had been farther away from D, points A, B, and D would have been intervisible. Therefore, the intervisibility of points on such landforms cannot be decided with the help of the contour map unless we use a skeleton section like the above one.

Activity 2.6

Part I

Construct a cross–section across the line x-y for the following contour map and try to determine whether the points given below are intervisible or not. You should also provide a justification for your answers.

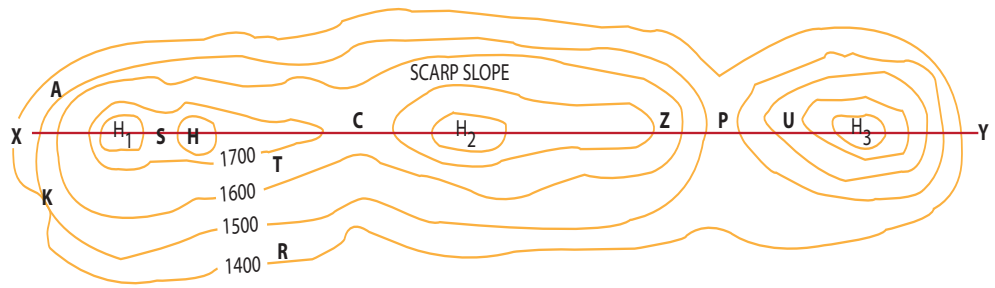


Figure 2.26: **A contour map of place "X"**

1 points C and P 2 points C and S 3 points Z and P

Part II

Figure 2.26 shows part of a range of small hills. Study the map and then answer the following questions:

1 Identify and write down the type of landform represented by the letter P.
2 Find a steep slope and a gradual slope (dip slope).
3 Are you going uphill or downhill if you walk from
   i Z to P ii R to T
4 Which letter represents steep slope?
5 Which letter represents a col?
6 What sort of landform does letter S represent?
7 The type of landform represented by K is _____.

2.1.4 LandForms on Contour Maps

What sort of merit does contour lines have for showing land features on maps? How do we identify different land features with the help of contour lines? How do you identify different slopes on contour maps?

Contour maps show different relief features by using contour lines with different shapes and spacing. Their patterns help map readers to easily identify the kind of terrain feature represented. For instance, mountains and plateaus are shown by contour lines with different shapes. The same thing is true when valleys and depressions are represented. As a result, various terrains on contour maps appear with their own distinct shape and pattern. Map makers exploit this advantage of contour lines to depict the nature of the landforms they show on their maps. The following discussion gives you some ideas about how different terrains are represented on topographic maps.

1 ***Hill:*** A hill is an area of high ground but is lower than a mountain in elevation. From the top of the hill the ground slopes down in all directions. On a topographic map, a hill is shown by contour lines forming concentric circles. The inside of the smallest closed circle indicates the hilltop. The following figure shows you how a hill is represented on a contour map.

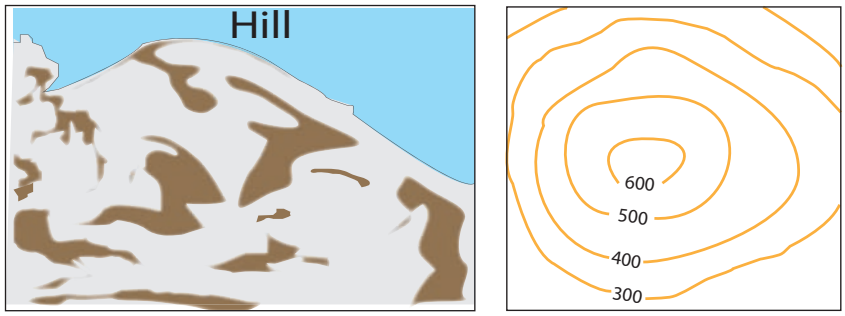


Figure 2.27: **A hill and its contour representation**

- ⇨ *Col is a relatively lower and deeper than saddle often found between two streams.*
- ⇨ *Pass is a deeper, more pronounced depression than a col between two hills or mountains.*

2 ***Saddle:*** A saddle is a dip or low point between two areas of higher ground. The feature is like the seat on a riding horse. It is not necessarily the lower ground between two hilltops. It can rather be a simple dip or break along a level ridge crest. A saddle has high ground in two opposite directions. A saddle is normally represented as an hourglass.

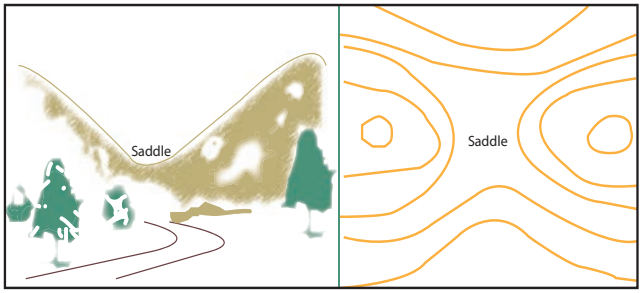


Figure 2.28: **A saddle and its contour representation**

3 ***Valley:*** A valley is a long low-lying area of land, often with a river or stream running through it, that is surrounded by higher ground. It is a stretched-out channel in the land, usually formed by streams or rivers. A valley begins with high ground on three sides, and usually has a course of running water through it. In a valley, three directions offer high ground, while the fourth direction offers low ground. Contour lines forming a valley are either U-shaped or V-shaped. While U-shaped contours represent valleys with steep slopes and flat bottoms, V-shaped contours show valleys with relatively gently descending slopes with V-shaped bottoms. To determine the direction water is flowing, look at the contour lines. The closed end of the contour line (U or V) always points upstream or toward high ground.

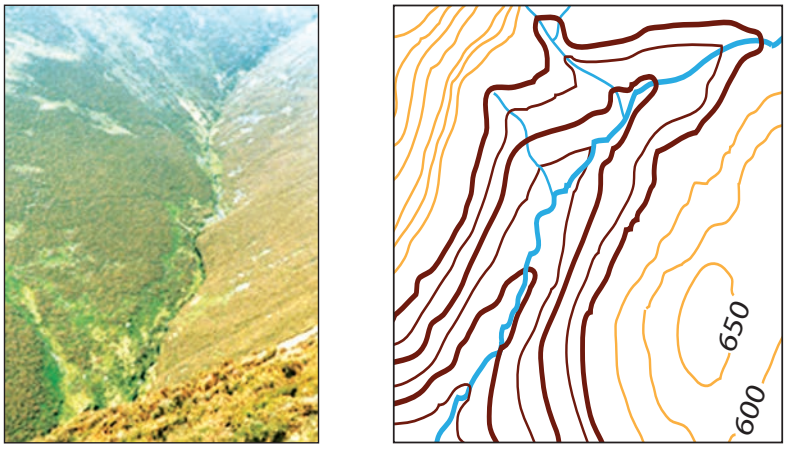


Figure 2.29: **A valley and its representation on a contour map**

4 ***Ridge:*** A ridge is a sloping line of high ground. It is a long narrow hill top or a range of hills. A ridge normally has low ground in three directions and high ground in one direction with varying degrees of slope. Crossing a ridge at right angles results in climbing steeply to the top and then descending steeply to the bottom. Contour lines representing a ridge tend to

be U-shaped or V-shaped. The closed end of the contour line points toward lower ground.

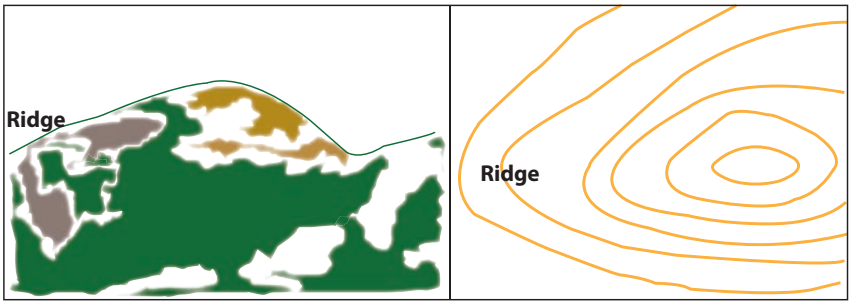


Figure 2.30: **A Ridge and its Representation on Contour Map**

5 ***Depression:*** A depression is an area of land that is lower in altitude than the areas surrounding it. It is a low point on the ground or a sinkhole. It could also be described as an area of low ground surrounded by higher ground in all directions, or simply as a hole in the ground. Usually only depressions that are equal to or greater than the contour interval will be shown. On maps, depressions are represented by closed contour lines that have tick marks pointing downward to lower ground.

Figure 2.31: **A depression and its representation on a contour map**

Activity 2.7

1 Why do different contour lines have different shapes and spacing?
2 What kind of landform is represented by contour lines forming concentric circles?
3 What type of land form is represented on contour maps when altitude decreases from outer contour lines to the inner ones?
4 Describe the difference between a valley and a spur.
5 What is a re-intrant?

What is a re-intrant? What is the difference between a re-intrant and a spur?

6 ***Re-intrant:*** A re-intrant is a less-developed stream course that is smaller than a valley. It has no level ground and, therefore, little or no movement room within its limits. In a re-intrant, the ground slopes upward in three directions and downward in the other direction. A re-intrant could be considered as the initial stage in the formation of a valley. Like those representing a valley, the contour lines representing a draw are U-shaped or V-shaped, pointing toward higher ground.

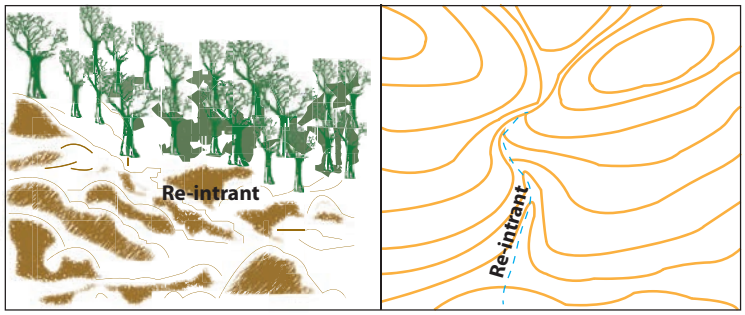


Figure 2.32: **A re-intrant and its representation on a contour map**

What is a spur? What makes it different from a valley?

7 ***Spur:*** A spur is a short and continuously sloping line of higher ground that normally extends out from the side of a ridge. Usually, a spur is formed by two roughly parallel streams that cut draws along the side of a ridge. A spur has three of its sides sloping downwards and upward sloping on the other direction. Spurs are shown on a contour map by using contours that point towards the lower ground with "U" or "V" shapes.

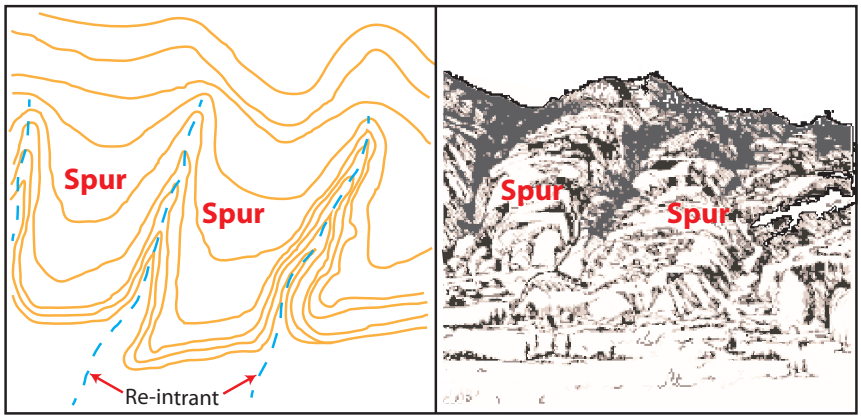


Figure 2.33: **A spur and its representation on a contour map**

What is a cliff? How it is shown in a contour map?

8 ***Cliff:*** A cliff is a vertical or nearly vertical relief feature with a sudden change vertical distance (elevation) with almost no change in its horizontal distance. Cliffs are shown on topographic maps by using contour lines that are very close together (when there is a little change in horizontal distance and rapid increase in vertical distance) and, in some cases, by contours that overlap (merge) when there is no change in horizontal distance at all.

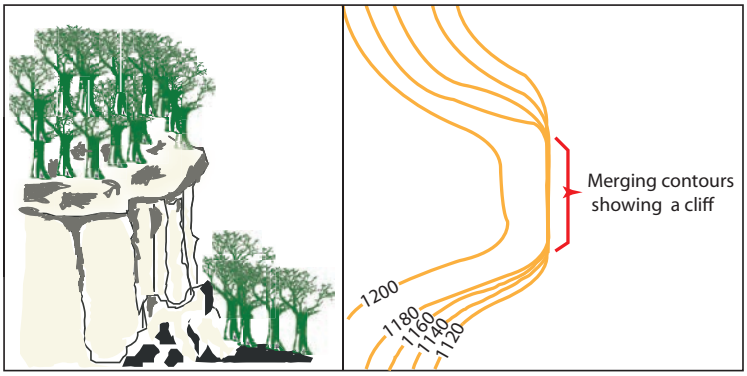


Figure 2.34: **A cliff and its representation on a contour map**

Supplementary Terrain Features

1 ***Cut:*** A cut is a human-made feature that results from the cutting of higher ground, usually to form a level bed for a road or railway track. Cuts are shown on a map when they are at least 10 m high. They are usually drawn with a contour line along the cut line. The contour line extends the length of the cut and has tick marks that extend from the cut line to the road bed, if the map scale permits this level of detail.

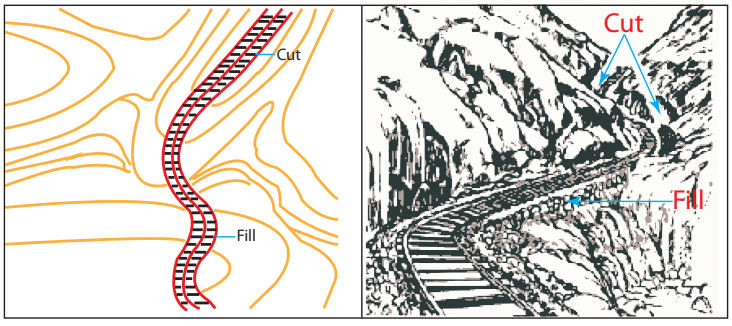


Figure 2.35: **A cut and its representation on a contour map**

2 **Fill:** is a human made feature resulting from filling a low area usually to form a level bed for a road or rail road track. Fills are shown on a map when they are at least 3 m. high.

Activity 2.8

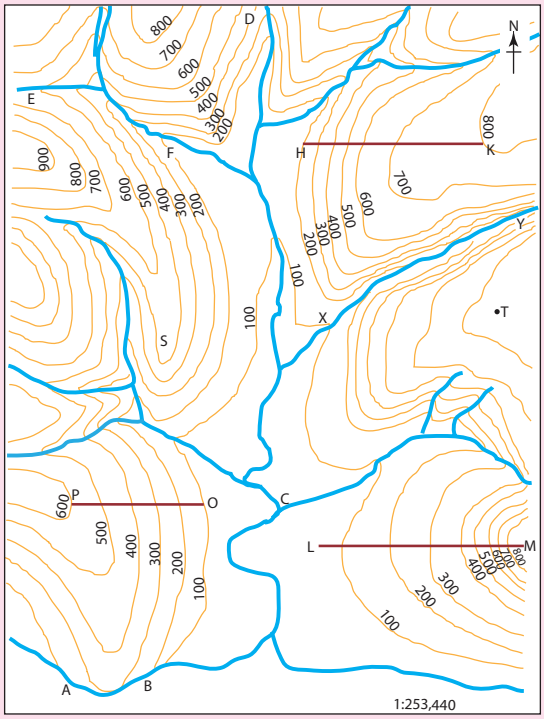


Figure 2.36: **Relief features on a contour map**

By referring to the above contour map, try to identify the relief features that are represented by the numbers indicated below and justify how you identified the feature. To help you answer the rest of the questions accordingly, the first one is done for you.

		Feature	Justification
1	The type of slope from L to m	Concave slope	_____
2	The type of slope from H to K	_____	_____
3	What does letter C show	_____	_____
4	The type of slope A to B is	_____	_____
5	The landform represented by the letter 'S' is	_____	_____
6	The type of slope from 'O' to 'P'	_____	_____
7	Are K and H intervisible?	_____	_____
8	How would you rise if you walked from L to M?	_____	_____
9	The type of landform represented from X to Y	_____	_____

2.2 DRAINAGE ON MAPS

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

- determine catchment areas from watershed on contour map;
- distinguish different drainage patterns;
- demonstrate river capture; and
- demonstrate stages of river valley development using contour lines.

Key Terms

- Watershed
- Catchment area/drainage basin/ divide/
- Drainage pattern
- Drainage system
- Main river
- Tributary
- Confluence
- River capture
- Pirate stream
- Victim stream
- Distributary
- Delta

What is drainage?

The drainage of an area consists of the different water resources that drain it. The drainage includes the rivers that flow over the region and the other water resources, including lakes and swamps. How rivers drain a certain area can be depicted by using contour maps. It is also possible to show the catchment areas and drainage basins of rivers as well as their general characteristics on contour maps. Hence, map readers and map users can acquire adequate information about the drainage of a certain place from contour maps.

Brainstorming

1. What is a watershed? What about a catchment area and a drainage pattern?
2. What is a river capture?
3. What are the stages of river valley development?
4. How are the different drainage features represented on contour maps?

2.2.1 Watershed and Catchment Area

The rivers that drain a certain geographical area flow over the region and form a certain pattern that is termed drainage pattern. A *drainage pattern* refers to the

general arrangement of a river and its tributaries within their drainage basin/ catchment area. A *drainage basin/catchment area* refers to the entire geographical space that is drained by the major river and its tributaries. For example, the whole area that is drained by the Abay River and all its tributaries forms the Abay River Basin in Ethiopia. A number of river basins together form the drainage system of a certain place. A *drainage system* is a system that is made up of all the river basins that flow in the same direction. For instance, all the rivers that flow in the western direction from the central highlands of Ethiopian form the Western Ethiopia Drainage System, which is also called the Mediterranean Sea Drainage System, based on their destination.

Adjacent drainage basins are separated from one another by watersheds. A *watershed/divide* is higher ground which serves as a source region for streams and rivers that flow in different directions within their own distinct basins. Along the sides of a watershed, rivers flow into different drainage basins. That is why we say that a watershed is a dividing line between neighboring drainage basins. The patterns of most drainage basins evolve over a long period of time and usually become adjusted to the structure of the basin.

Figure 2.37 shows you what the features that we have been discussing above look like in a certain geographical region.

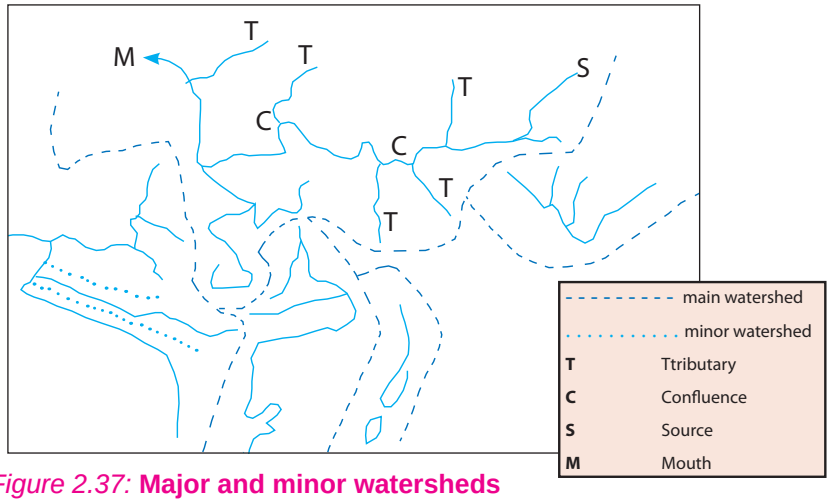


Figure 2.37: **Major and minor watersheds**

A drainage basin and its watershed can be identified on a contour map. This can be done by observing the patterns and shapes of the contour lines that are used to represent the topography of the mapped area. To further simplify the process, it is good to investigate the flow direction of the streams and rivers that originate from the higher ground. The following steps can help you identify a drainage

basin and its divide on contour maps.

- ⇨ *Identify the course of the main river on the map;*
- ⇨ *Identify the tributaries of the main river on the map;*
- ⇨ *Look at the contour lines near the origin of the tributaries and find high points and ridges;*
- ⇨ *Look at other rivers that originate nearby and check whether they flow away from the main river;*
- ⇨ *Once you identify the rivers that flow away from the main river, follow the way between those rivers that flow towards our main river and away from it. Then mark these points with solid or broken lines to show the river basin and its watershed.*

While inserting a watershed on contour maps we should be very careful. The most important considerations follow.

i A watershed (divide) is not drawn parallel between streams; rather the streams flow away from the watershed in opposite directions (see Figure 2.38).

ii Look at the streams' direction of flow carefully. A watershed may wind but it never crosses the channel of a river,

iii A watershed usually passes through the highest points between adjacent river basins.

iv A watershed runs in the middle of two contour lines of different altitude. In the case of a river capture, however, a river can cross its watershed.

Let us now try to identify the drainage basin and watershed of the river that is labeled "River A" in the following figure. Study how we follow the procedure described above as we identify the river's basin and its divide. The red circle shows you where the river is located on Figure 2.38.

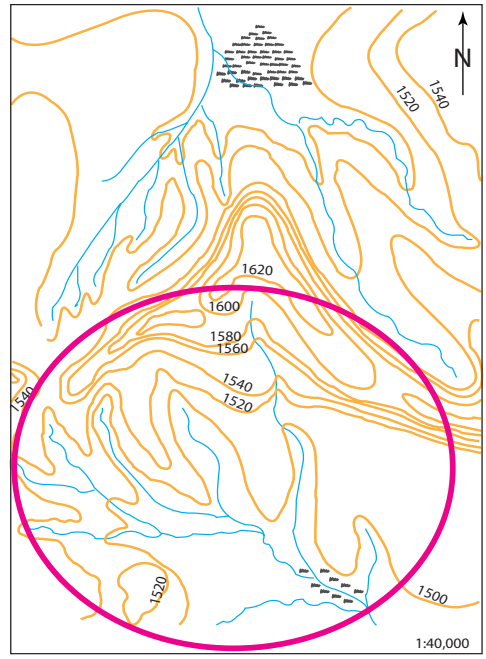
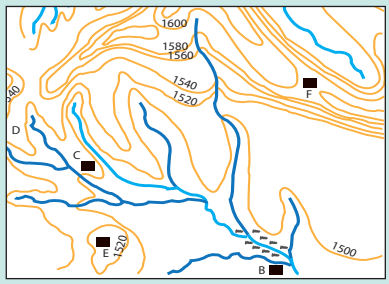
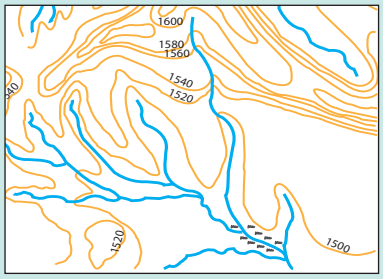
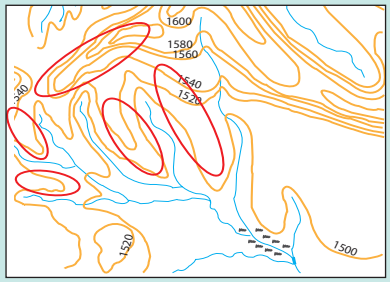
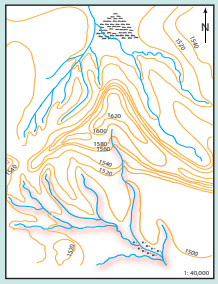
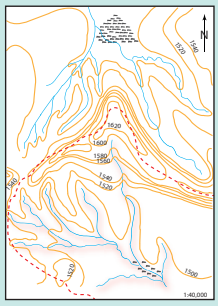


Figure 2.38: **Map of River A**

No	Steps	Figures
1	Identify the course of the main river on the map. The main river in this basin is the one which is the longest.	
2	Identify the tributaries of the main river on the map. The tributaries are those streams that feed the main river.	
3	Look at the contour lines near the origin of the tributaries and find high points and ridges. This helps you to locate the watershed of the basin.	
4	Look at other rivers that originate nearby and check whether they flow away from the main river. If the rivers flow away from the main river, that means they are rivers of another basin.	
5	Mark the points at which the rivers that flow into another direction and towards our main river with solid or broken lines to show the river basin and its watershed.	

A river's catchment area includes all the geographic space that is drained by a ***major river*** and many other small streams that feed the major river with water. The major river in a river basin is the **longest** of all the rivers in the basin. The other small streams that supply water to the main rivers are called ***tributaries***. The point at which the tributaries meet with the major river is called ***confluence***. The point at which the major river in a basin starts is called the ***source*** of the river. Likewise, the point at which the river empties itself into an ocean, a sea or a lake is called the ***mouth*** of the river. Figure 2.39 shows you the points that we have discussed above.

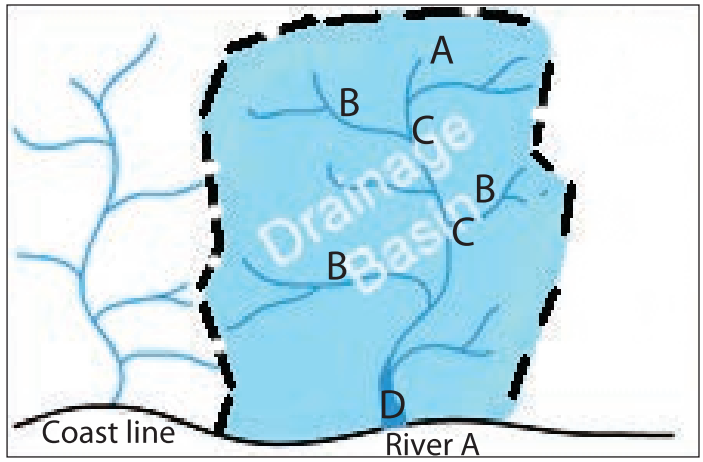


Figure 2.39: **A river's catchment area**

The labels on the map in Figure 2.39 represent the following features.

- *Letter "A" represents the source of the main river;*
- *Letter "B" represents the tributaries of the main river;*
- *Letter "C" represents the confluences; and*
- *Letter "D" represents the mouth of the main river.*

Activity 2.9

By referring to Figure 2.52 answer the following question and perform the following tasks.

1 How many drainage basins can you identify in the figure?

2 Draw the watersheds that separate the given drainage basins.

Show major and minor watersheds, using labels. Use letter 'A' for the main (major) watershed and letter 'B' for minor watersheds .

2.2.2 Drainage Patterns

What is a drainage pattern? How does it differ from a drainage basin?

The rivers in each drainage basin form different patterns. A drainage pattern shows the characteristic way tributaries that feed other larger streams and rivers branch off in different directions. In other words, it could be understood as a pattern that is formed by the main river and its tributaries as they flow over the surface of the earth. Drainage patterns can have many different forms. They are based largely on the geological structure of the rocks on which they form. As topography varies, so does the drainage pattern. In addition, the types of rocks over which the river flows and the geological history of the region may also influence the drainage patterns of rivers.

Brainstorming

1 How many drainage patterns do you know?
2 How do you distinguish one from the other?

There are a number of drainage patterns that rivers form in their basins. However, the most common ones are the following.

- ⇨ *Dendritic drainage pattern*
- ⇨ *Trellis drainage pattern*
- ⇨ *Radial drainage pattern*
- ⇨ *Centripetal drainage pattern*
- ⇨ *Rectangular drainage pattern*

The features of the five drainage patterns are presented in the following descriptions and diagrams.

1 ***Dendritic Drainage Pattern:*** The term dendritic is derived from the Greek word "dendron" which literally means "a tree". This drainage pattern is characterized by a tree-like shape with branches. The smallest tributaries are the outermost twigs, and the main river channel forms the trunk. The lower-order streams (tributaries) join the main (higher-order) streams at acute angles (less than 90° angles), forming

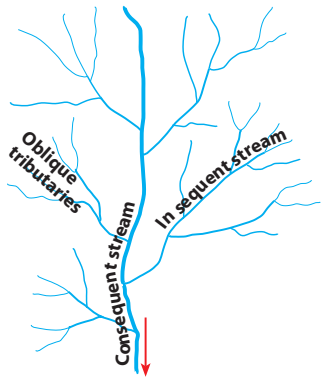


Figure 2.40: **Dendritic drainage**

Y-shaped junctions. Dendritic patterns are usually formed in areas of homogeneous rock which comprises horizontal strata rock masses. In this drainage pattern, geological processes such as folding or faulting do not create structures that would affect the development of the river system. It is the most common drainage pattern of all the patterns.

- ***In sequent stream*** *– these are tributaries that flow towards the main valley joining the main river (consequent stream) obliquely and in turn minor tributaries join them and the points where they flow into the main streams are accordant functions.*
- ***Oblique tributaries*** *– these are minor tributary streams having a sloping direction, that join the in sequent stream obliquely.*

2 ***Trellis Drainage Pattern:*** Trellis drainage patterns develop in areas where harder and softer rocks alternate. The pattern of this drainage pattern is greatly affected by tectonic forces (folding and faulting). The branches of the river system usually join one another at nearly right angles. The branches are given different names, depending on their origin and direction of flow. These are:

i *First-order streams (obsequent)*: are the tributaries of the subsequent streams that flow in the opposite direction to the consequent stream (main).

ii *The consequent stream*: the principal river which flows down the slope is called a consequent river.

iii *The subsequent streams*: are the tributaries which cut out valleys and which do not flow down the main slope.

iv *Secondary consequent streams (resequent)*: are the tributaries of the subsequent streams that flow in the same direction to the consequent stream.

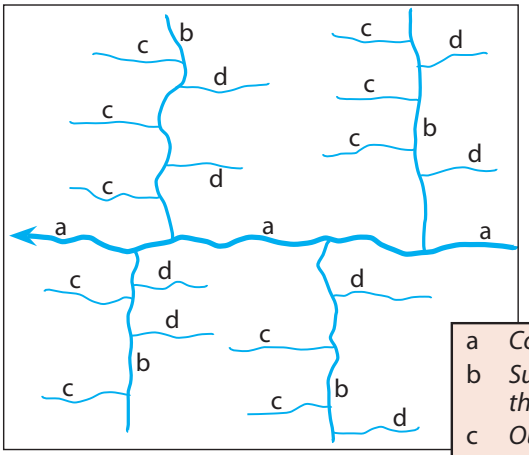
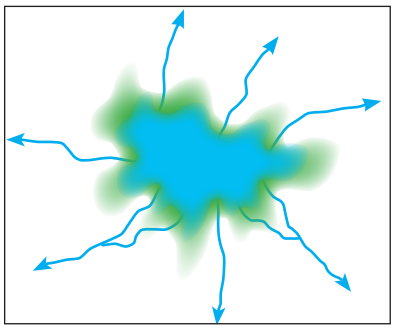


Figure 2.41: **Trellis drainage pattern**

a	*Consequent stream*
b	*Subsequent (main tributaries of the consequent stream)*
c	*Obsequent streams*
d	*Resequent streams*

3 ***Radial Drainage Pattern:*** Radial drainage patterns occur where rivers flow in all directions away from a raised feature. The raised feature may be a volcano or a mass of rock that is more resistant to erosion than the surrounding rock and therefore stands higher than its surrounding.



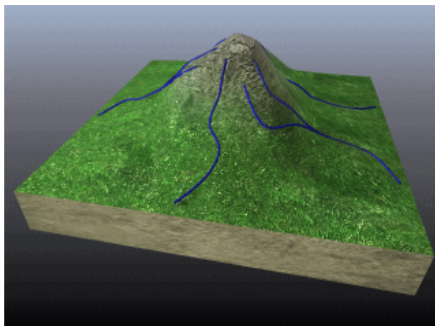


Figure 2.42: **Radial drainage pattern**

4 **Centripetal Drainage Pattern:** Centripetal drainage patterns are found in areas where rivers flow from surrounding high ground toward a central basin, which is often occupied by a lake. The rivers flow into one common centre.

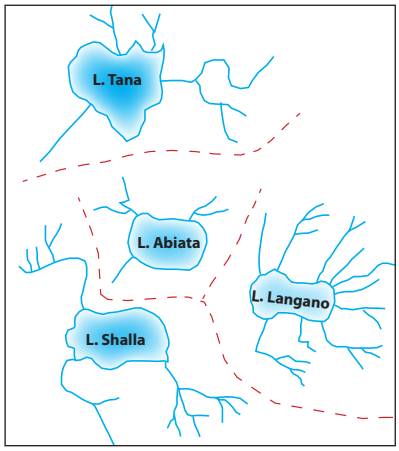


Figure 2.43: **Centripetal drainage pattern**

5 **Rectangular Drainage Pattern:** Rectangular drainage patterns usually form in areas that have numerous cracks that form a grid pattern. This pattern is common over certain types of rock, such as granite, in which cracks called joints develop to form a grid. Stream channels tend to follow these joint systems.

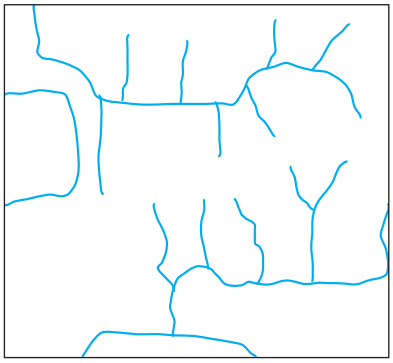


Figure 2.44: **Rectangular drainage pattern**

Five different kinds of drainage patterns are formed by streams. These are dendritic, rectangular, radial, centripetal and trellis. Drainage patterns result from the type of soil in the area of drainage and the erosion of the soil by flowing water. Dendritic patterns usually form in areas of flat sedimentary rock, while areas with high central peaks, such as volcanoes, exhibit radial drainage patterns. Sometimes, water flows into a bowl-shaped valley by centripetal drainage and creates a lake or erodes areas between ridges to create deep valleys, as seen in trellis drainage.

Activity 2.10

Explain, creating by well-labelled diagrams, the main differences between the following pairs of features:

i Radial and dendritic drainage pattern

ii Waterfall and rapid

2.2.3 River Capture and Stage of River Valley Development

A *River Capture*

Brainstorming

1 What is a river capture?

2 How does a river capture form?

In a river capture situation, a river joins another river down-slope from a watershed that separates the two basins. In a river capture, a river of one basin will run over the drainage basin of another river. The river that flows over the basin of the other river is called the ***pirate stream***, and the other river, whose basin is overrun by the pirate stream, is known as the ***victim stream***.

There are certain situations that cause the formation of river captures. The conditions include the following. When:

- ⇨ *the rock on the side of the victim river is softer.*
- ⇨ *heavy rainfall falls on the pirate's river side of the watershed.*
- ⇨ *the pirate river has a steeper course and erodes its course as a result.*
- ⇨ *the watershed consists of very low ground and the watershed itself becomes indefinite.*

Focus

In a river capture, the following features are commonly observed.

i **Elbow of capture:** is a point where one strong river cuts into the course of another weak river during river capture.

ii **Misfit or underfit stream:** is a stream which is deprived of its headwaters and becomes too small for the valley it belongs to.

iii **Reverse drainage:** occurs when a river which was part of the original captured river C_2 now flows into C_1 in the opposite to that of direction the original direction of flow.

iv **Wind gap:** is found at the elbow of capture which was once covered by the captured stream but now contains no rivers and therefore becomes a "wind gap".

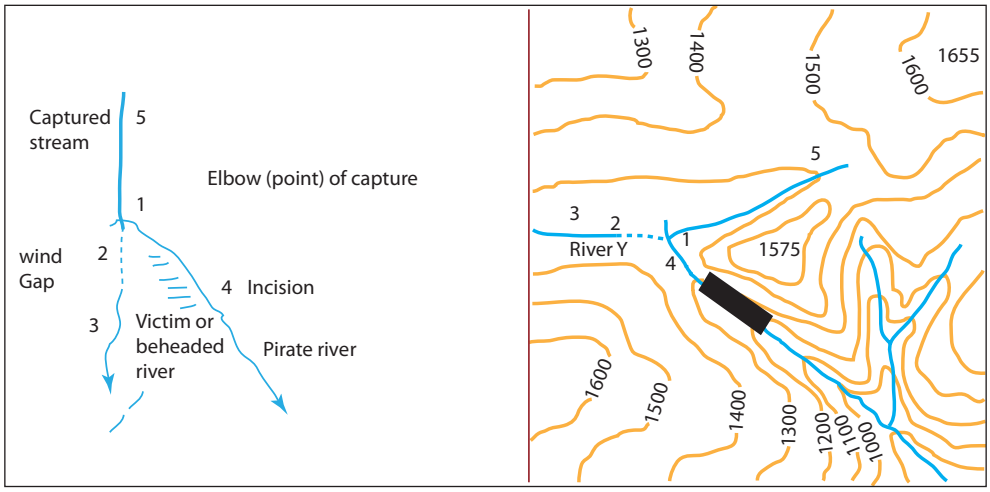


Figure 2.45: **A river capture**

Typical examples of river capture in Africa include:

1 ***Tival River Capture (Kenya):*** In Kenya; the lower Tiva River has captured a former tributary of the Galona.

2 ***Cunene River Capture (Angola):*** The upper Cunene River used to flow out from the Bihe plateau to a large inland drainage basin, similar to the Okavango Delta, but it was captured by a vigorous coastal steam and now turns west to the Atlantic.

Immediately after the formation of a river capture, there might be a connection across the newly formed watershed. This connection is known as a *bifurcation*, which means a stream divided into two.

Content Check

I ***Give short definitions of these terms.***

1 Wind gap

2 Underfit-stream

3 Reversed drainage

II ***Fill in the blank space.***

4 A place where the pirate river diverts the head water of its victim river is called _____.

5 The beheaded river which, having lost its head waters, may be reduced in volume, causing it to be very small relative to its valley is called _____.

B *Stages of River valley Development*

Brainstorming

1 What is a river valley? How does a river valley develop?

2 How many stages does a river have from its source up to its mouth?

The volume and gradient of a river are the two determinant factors of the force of a river before it reaches its base level. ***Base level*** is the surface of a river or lake or the sea into which a river flows. All rivers have their own sources and mouths. The source of a river can be a spring, a lake or a marsh, but it is generally in a higher ground where:

- ⇨ *precipitation is high and there are other sources of water for the river; and*
- ⇨ *there is a slope down which the run-off can flow.*

The higher ground serves as the source region of the river or as the point at which the course of the river starts. From there, the river flows down-slope and passes

through different courses until it reaches its mouth. Along its entire course, from its headwaters at the top of the watershed to its mouth, a river has three distinct parts. These are:

A the upper or mountain course;

B the middle or valley course; and

C the lower or plain course.

A *The Upper Course*

What are the characteristics of a river at its upper course?

The upper course of a river is the headwater zone in the mountains or hills where sediment is supplied from hillsides and transported down steep channels with narrow flood plains. In these narrow, steep canyons, the bed of the river may be covered with large boulders as the river passes through many rapids.

The following are the characteristics of a river at its youth stage:

- ⇨ *The development of deep narrow valley with V-shapes;*
- ⇨ *The development of valleys with narrow and steep gradients;*
- ⇨ *The presence of fast-flowing rivers;*
- ⇨ *The development of pot-holes;*
- ⇨ *The formation of interlocking spurs; and*
- ⇨ *The presence of waterfalls, rapids and cataracts.*

B *The Middle Course*

What are the major features of a river at its middle course?

The middle course of a river forms when the mountains give way to the plains, where the steepness of the river channel decreases from as high as a 1-to-10 percent to less than 0.1 percent. At this stage, the volume of the river may increase. However, the ability of the river to carve into rock and carry sediment decreases, due to the fact that the river's channel has become less steep. As the speed of the river decreases, its power to carry and transport large-sized sediment also decreases. As a result, the sediment in the river gradually decreases in size from boulders (larger than 256 mm in diameter) to cobbles (between 64 and

256 mm) and to gravel (between 2 and 64 mm). As the gradient of the valley continues to decrease, the sediment becomes very fine, consisting mostly of sand, silt, and clay. At this stage, the floodplain of the river widens.

At this stage, the river is characterized by the following features.

- ⇨ *the river flows over a relatively gentle gradient as compared to its upper course, and the river flows slowly as a result;*
- ⇨ *the river's volume increases gradually as it is joined by the tributaries that feed water to the river;*
- ⇨ *the river's valley gets wider and deeper. The slope along the valley's sides gets gentler, altering the valley's shape from a V-shape nearly to a U-shape, and*
- ⇨ *braided streams may develop if large sheets of material are deposited on the level plain, splitting the river into several channels.*

C *The Lower Course*

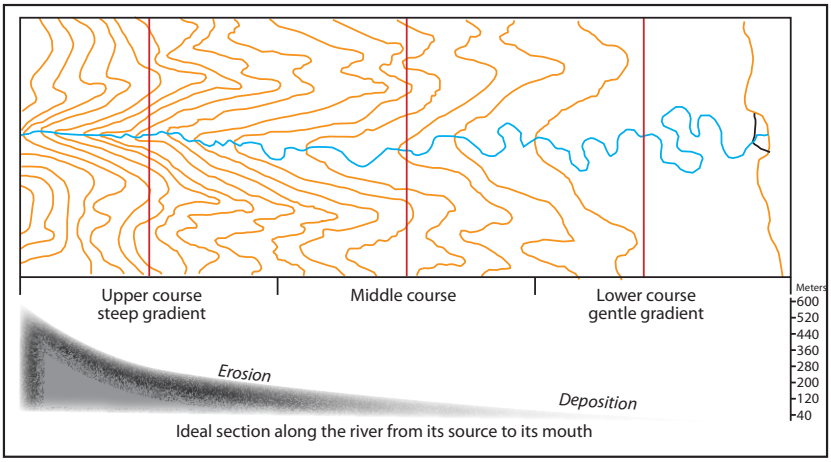
Discuss the major features of the lower course.

The lower course of a river is the third stage in a river valley's development. It is the course that is influenced by the ocean or lake where the river ends. The steepness of the river channel in this course is usually less than 10 centimeters per kilometer. Because the river flows very slowly, the sediment transported becomes very fine. At this stage, a delta may develop if enough sediment settles out of the water. Unlike a ***floodplain***, a delta is a feature where the river splits into many new channels called ***distributaries*** while discharging into an ocean, a sea or a lake where it ends. If not enough sediment settles out to form a ***delta***, the river may discharge into the sea in an ***estuary***. Unlike a delta, an estuary is a wide channel where the fresh water from the river mixes with the salty seawater without forming distributaries.

At this stage, a river may have the following characteristics.

- ⇨ *The river flows in a U-shaped valley with a flat river bed, the rate of change in slope is minimal, and the river flows very slowly as a result;*
- ⇨ *The river carries a heavy load of fine sediment of which some is deposited on its bed;*
- ⇨ *The river flows with a number of twists and bends, resulting in the occurrence of meandering;*

- *The development of oxbow lakes as meanders gradually develop cut-offs;*
- *The development of floodplains rich in alluvial deposits as fine sediment is accumulated on the river bed; and*
- *The river's mouth may sometimes be blocked by sediments causing the river to branch out forming distributaries. In such a case, a delta may develop. If the river empties into its end freely with no distributaries formed, an estuary will develop.*



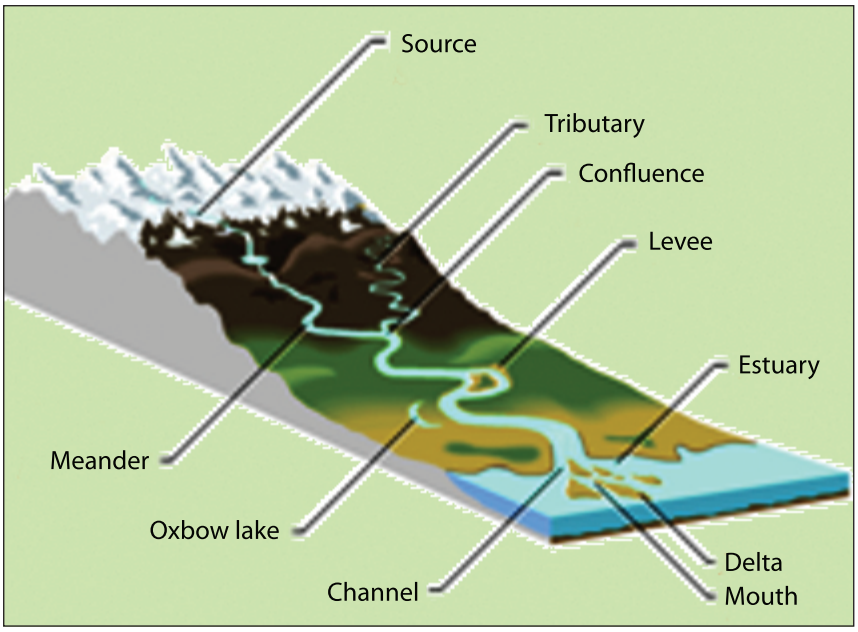


Figure 2.46: **The course of a river from its source to its mouth**

The meanings of the features shown in Figure 2.46 are explained below. Study them carefully.

Source: The source of a stream is the point at which it begins.

Tributary: A tributary is a small stream or river that flows into a larger stream or river.

Confluence: A confluence is the point where a river and its tributary or a river and a glacier flow together. The word confluence can also mean the place where two or more streams merge into one.

Levee: A levee is a ridge of sediment on either side of a river channel. This sediment is gradually deposited as the river periodically floods and overflows its banks.

Estuary: An estuary is the area in which the mouth of a river meets the ocean.

Delta: A delta is a triangular deposit of soil or silt at the mouth of a river. In deltas, rivers split into multiple channels called distributaries. There are three types of deltas. They are based on the deltas' shapes.

- **Arcuate delta:** *This kind of delta has a convex outward margin. It is formed when the river empties into the sea. It is composed of coarse sediments like gravel and sand.*
- **Bird's foot delta:** *This kind of delta projects irregularly into the sea. The river channel derides into a few distributaries. This is the only type of delta which maintains clearly defined channels.*
- **Cuspate delta:** *It is formed when a river joins its mouth (sea) on a straight coastline along which there is a strong current or tide so that the sedimentation takes place on either side of the river mouth.*

Figure 2.47: **The three types of deltas**

Mouth: The mouth of a river is the area in which the river enters a larger body of water. The mouth of a canyon is where the canyon empties onto a plain.

Channel: A channel is the deepest part of a river and often has been used for navigational purposes.

Oxbow lake: An oxbow lake is a loop of an old river meander that has been completely cut off from the river because of a shift in the river's course.

Meander: A meander is a bend in a river created by the normal action of a mature stream as it winds across its floodplain. The river deposits sediment on the inner curve of the meander, where the current is the slowest. On the outer curve, where the current is strongest, the river banks erode. Eventually, the meander may develop into such a long loop that the river cuts across it to follow a shorter course, leaving behind an oxbow lake.

Content Check

1 Define the following terms and concepts
   - a drainage pattern
   - b divide
   - c watershed
   - d confluence
   - e river capture

2 Write the major features that characterize a river in its:
   - a upper course
   - b middle course
   - c lower course

2.3 THE STUDY OF HUMAN-MADE FEATURES ON MAPS

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

- distinguish various patterns of settlement on maps;
- interpret the shape of settlements;
- explain the types of settlements;
- estimate factors influencing the sitting of settlement
- reflect the function of settlements;
- identify various airfields on maps.

Key Terms

- Settlement
- Signs and symbols
- Site
- Rural
- Urban
- Transport network
- Gradient

Brainstorming

Discuss the following questions with your friend and try to come up with some ideas.

1. What is a settlement?
2. How is a settlement formed?
3. What sorts of factors determine the establishment of a settlement?

A settlement is a place where people live close together. It is a unit or organized group of people inhabiting a certain geographical area and making a living out of their surrounding environment. A settlement can also be defined as a group of buildings (houses) in specified area with people living in them. Settlements differ in their ***size***, ***complexity*** and ***stage*** of development. While some settlements are extremely large with diversified socio-economic conditions, others are very small and less diversified. Settlements range from a little collection of single buildings to megalopolises. As a result, we can have different hierarchies of settlements. Figure 2.48 shows you the different types of settlements based on their population size and diversity of services.

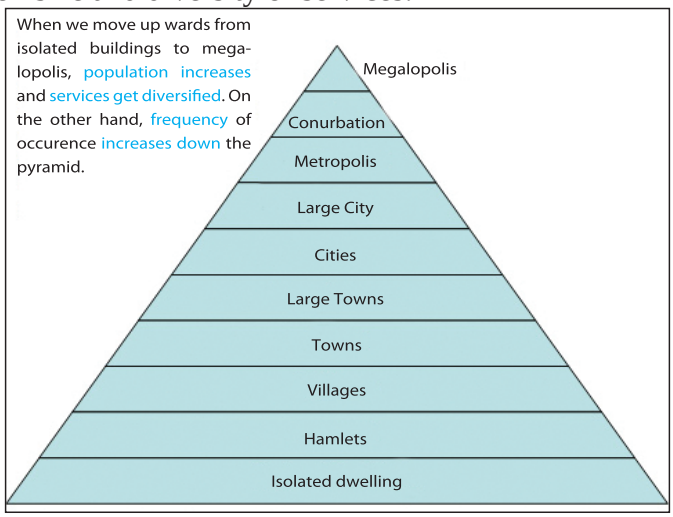


Figure 2.48: **Settlement Pyramid**

In Figure 2.48 ,above isolated dwellings with a few people living in them is represented by the lowest level of the pyramid, and the megalopolis, which has the greatest number of people, is at the top. As we move from the bottom to the top of the pyramid, we observe changes in population size and in service delivery, quality and diversity. In terms of frequency, smaller settlements are the most frequently developed settlements in the world. The meaning of each of the types of settlement in the above diagram is given below.

Megalopolis: a group of conurbations, with each having more than ten million people.

Conurbation: a group of large cities and their suburbs, with three to ten million people.

Metropolis: a large city and its suburbs, consisting of multiple cities and towns with one to three million people.

Large city: a city with a large population and many services with a population of between 300,000 and 1 million.

City: a city has abundant services, but not as many as a large city. A city has a population of between 100,000 and 300,000.

Large town: a large town has a population of 20,000 to 100,000.

Town: a town has a population of 1,000 to 20,000.

Village: a village generally does not have many services, possibly only a small corner shop or post office. A village has a population of 100 to 1,000.

Hamlet: a hamlet has a tiny population, usually less than 100, and very few or no services, and few buildings.

Isolated dwelling: an isolated dwelling would only have 1 or 2 buildings or families in it. It would have negligible services, if any.

Settlements can be urban or rural. Urban settlements are developed in areas with non-agricultural economic activities. In contrast, rural settlements develop in areas where agriculture forms the base of the economy. Smaller settlements are usually in rural areas, and larger settlements are associated with urban environments. The location, size, shape, function and pattern of settlements can be shown on maps. Cartographers use different kinds of signs and symbols to represent settlements on maps. The discussion below gives you some idea about how settlements are represented on topographic maps.

2.3.1 Representation of Settlements on Maps

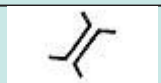
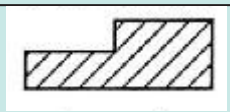
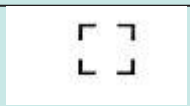
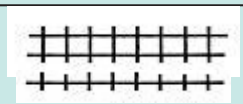
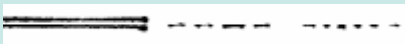
How do human beings establish their settlements? How do we represents settlement on maps? What factors determine the patterns of settlement?

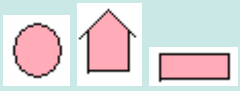
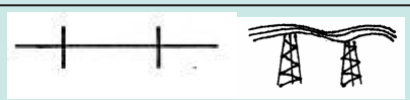
Maps are important tools for showing settlements. In different ways, maps depict the shapes settlements have, different features that are found in the settlements, the patterns of settlements and their functions. To represent settlements and their features, cartographers use different techniques including colors and different signs and symbols.

Signs and Symbols Used on Settlement Maps

Most topographic maps contain abundant information about human-made features. One of these features is human settlement. A number of different features, such as residential areas, schools, hospitals, mining sites, industries, communication and transportation features, and the like, are found in settlements. Cartographers use different techniques to show these features on their maps. One of these techniques is using various types of signs and symbols to show features that are found in the settlements represented. The common signs and symbols used for showing settlement features are given in Table 2.2.

Table 2.2: **Signs and symbols that are used to show settlement features on maps**

Map symbols	Features represented
	Town, city, major city, capital city
	Built-up areas (towns and cities)
	Bridge
	Parking lot
	Ruin
	Railway (double/single track)
	All-weather road (hard and loose surface)
	Dry-weather road, track, trail
	Garbage bin

Map symbols	Features represented
	Lighthouse
	Villages, scattered settlements, farms
	Church or chapel
	Mosque
	School
	Airport Class I, Airport Class II, Heliport
	Clinic or hospital
	Battlefield
	Mineral workings
	Post office
M	Market
 / T	Telephone
	Electric power line/transmission line

II *The Shape of Settlements*

Brainstorming

1. Do you think that all settlements have the same shape? Why or why not?
2. How many settlement shapes do you know?
3. What causes the different shapes that settlements have?

Settlements have different shapes that result from many factors. Some of these factors are the site and situation of the settlement. The term Site means where the settlement has been developed. On the other hand, Situation refers to the "where" of the settlement in relation to the surrounding area. Situation can also be described as the "where about" of a settlement. The site and situation of a settlement is the most important determinant factor of its shape. Basically, settlements are classified into three major groups based on their shapes. These are:

- Dispersed settlement
- Nucleated settlement
- Linear settlement

a ***Dispersed settlements:*** These are settlements established by one family or a few family residences scattered about in isolated places. They are separated from one another by physical barriers. Life in this kind of settlement is simple, quiet, and much the same all the year round. There is little opportunity for social gatherings. Dispersed settlements are typically found in the tropical rainforests and scrub lands in Africa and Australia. Dispersed settlements are mostly found in rural areas.

b ***Nucleated settlements:*** These are groupings of several family residences such as hamlets, villages and small periodic-market towns. Such settlements are usually developed around a certain central point. In such a settlement, there are collective amenities to serve the community like shops, houses, schools, places of worship, entertainment and transport networks. The pattern of the settlement is compact, concentrated and can be distinguished by certain well-developed features. Ethiopian examples of nucleated settlements are Addis Ababa, Bahir Dar, Harar, Gondar, Bishoftu etc.

c ***Linear (Ribbon) Settlements:*** A linear settlement is a kind of settlement which has an elongated pattern. This type of pattern is usually a road-oriented settlement pattern. Most of the towns that are found along the main highway lines from Addis Ababa to Gondar, Mekele, Asosa, Harar, and Jimma are good examples of linear settlement in Ethiopia. Some linear settlements are situated on an elongated relief feature such as a ridge. The town of Ghimbi in Welega is a good example of a settlement that develops along a ridge.

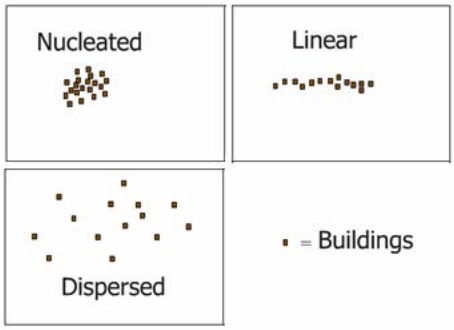


Figure 2.49: **The three types of settlement shape**

III *Types of Settlements*

How many types of settlements are there? How do you differentiate urban settlement from rural settlement? What are the major economic activities in rural areas?

Based on where settlements are developed, they can be grouped into two types as Rural settlement and Urban settlement. Rural settlements are those that develop in agricultural areas. In contrast, urban settlements are those that develop in non-agricultural areas where the major economic activities are non-agricultural. Each of the two types of settlements has its own features. For instance, rural settlements have very low levels of socio-economic infrastructure and are poorly interconnected. Services are limited. Their economy is primarily agricultural. Rural settlements have very low divisions of labor. They are also sparsely populated. Contrary to this, urban settlements are characterized by non-agricultural activities such as different businesses, service-giving sectors, industries and the like. They also have a high division of labor. Infrastructures, such as transport and communication facilities, schools, and hospitals, and modern houses, etc. are well-developed. Urban settlements are densely populated as people live very close to each other.

Rural and urban settlements can easily be distinguished based on the features that each manifests. The characteristic features that can help the easy differentiation of urban (town, city) settlements from rural settlements on topographic maps include the following.

Urban	Rural
⇨ has groups of buildings on vast built-up areas; ⇨ has planned streets; ⇨ has defined shapes of settlement.	⇨ has houses made out of simple materials (wood and mud); ⇨ has no planned streets; ⇨ has narrow and irregular roads; ⇨ has no defined shape; ⇨ covers a small area.

IV *Factors Influencing the Location of Settlement Sites*

What factors influence, the location of settlements? How do they affect the locations of settlement sites?

The site of a settlement is where it has been built. Settlements develop when people settle in a certain area. Their settling in an environment to form a permanent settlement is the result of a number of factors influencing the settlers. There are a number of factors that were important to the original settlers.

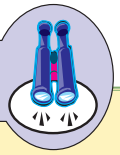
When we carefully observe the location of towns and cities, we can see that their sites and situations have various advantages that have helped them to grow there. This is related to the factors that caused the development of the settlements. For instance, Addis Ababa is sited at the foothills of the Entoto Mountains where the hot springs of the present day ***filuwuha*** are situated. Its position is its location in relation to the rest of the region. Similarly, the town of Bahir Dar is situated to the southwest of *Lake Tana* and northwest of the *Tis Esat* fall.

The choice of a settlement site is affected by many factors. The following are some of the more favorable combinations of site and situation which have led to the establishment of settlements.

- ***Fertile alluvial plain:*** *the primary and basic necessities of humanbeings are food and water. A fertile alluvial plain drained by rivers is ideal for raising food crops and maintaining a potable water supply. A flat landscape facilitates the movement of people and goods. It is an ideal situation for the exchange of products and ideas. It is the potential center for trade communication and administration. Examples are Hawasa on the rich Lake Hawasa plain, Wereta in the intensively cultivated Fogera basin drained by the Rib and Gumara Rivers.*

- ***Coastal lowlands:*** *where narrow coastal plains are bounded on the landward side by mountains, agriculture, transport and settlement all have to be carried out on the lower land. Where there is a mountain barrier, this naturally leads to the growth of a town.*
- ***Water supply:*** *water is one of the most important natural resources to human beings. Therefore, at any cost, the site of a settlement should be near a good water supply. Springs, streams, and storage dams should be remote from flooding and water germs. Such settlement sites include ports, confluences, bridge points, and spring lines at the base of escarpment river banks. For example, Khartoum is a confluence city and Djibouti is a port town.*

Focus



Water (wet-point) sites are ideal for a settlement for a number of reasons like pure and adequate potable water, fishing, irrigation, power generation (HEP) and communication.

- ***A natural focus of routes:*** *These are the nodal towns. By the very nature of their geographical location, many towns assume importance as centers of road, rail or water communication. People tend to provide commercial and social services that passing travelers can make use of. An example of such nodal town in Ethiopia is* ***Kombolcha****.*
- ***Sites for Generating hydro–electric power:*** *waterfalls are of paramount importance for generating hydro–electricity. Where such a site occurs, the availability of cheap power attracts industrial establishments. These require labor and other services and a settlement is very likely to grow up taking advantage of the cheap power. Examples of such settlements include* ***Buffalo*** *to the south of the Niagara Falls in the US, and* ***Bahir Dar*** *and* ***Fincha*** *in Ethiopia.*
- ***Defensive Sites:*** *a defensive site is a place that is difficult to attack. This was a deciding factor in the 19th century in Ethiopia when defensive strategy that was executed at the right moment could save the whole community. However, in modern warfare with aerial attacks the community could not be saved. Some settlements were chosen due*

to their physical protection for a given tribal group against another tribal enemy. Some towns in Ethiopia were established on a hilltop or hillsides for defense and patrolling purposes. For instance, the Yirgalem, Chencha (Gamo–Gofa), Asela, etc. villages on the Bouci plateaus were established in isolated spots at the bases of rocky ridges and covered by dense forest. Government policies in the hidden areas of modern Africa have established nucleated defensive settlements.

- ***Communications:*** *Communication networks are important factors in settlement sites. This becomes evident if the settlement produces cash crops for market. Proximity to transportation networks eases movement for speedy marketing of agricultural products. Large villages grow into large towns if they are situated at road junctions. Good examples of this case in Ethiopia are Mojo, Awash, Shashmene, Wereta, and Woldya.*
- ***Mineral wealth:*** *The discovery of minerals and their extraction can be a facilitating factor for the development of settlements. Anywhere on earth, be it on mountain tops or arid (desert) areas, valuable minerals attract investors and investment to work in the mines. Such conditions create favorable opportunities for settlements to develop. For example, Johannesburg's growth in the Republic of South Africa has been accelerated by the discovery of gold in the Witwatersrand. It is now the second largest city in Africa next to Cairo.*

V *Function of Settlement*

Settlements, by their very nature perform certain useful functions to ascertain their continued existence, most of them have several functions. A village or a town may serve the community as a meeting place for people and goods and have no other functions to distinguish it from other villages. A village grows in to a town and later in to a city, the increase in population alone insures many activities that a village does not require. Towns may comprise several functions. However, most towns have one dominant function. Maps can give us some sort of information regarding the land use (economic importance) of settlements. There is a possibility to know the function of a town by just looking the situation and the name on topographic maps. For example, beach side holy day resorts, Commercial ports, mining centers, etc. We can therefore, classify towns according to their functions.

1 **Market towns:** These are towns whose major function is as centre of exchange of goods and service. They are distribution centres for local

products, for example, Nedjo (Welega), Kola Diba (N. Gondar), Ginchi (near Ambo), Agaro (in Jimma), Tepi (in Kaffa), Durbete (west Gojam), etc. Kumasi (Ghana).

2 **Industrial towns:** Towns of these kinds are engaged in processing raw materials into finished goods. These towns have some advantages as industrial sites such as:

- *Proximity to power,*
- *Minerals,*
- *Raw materials, labor or markets,*
- *Are served by modern net work of communication.*

Example:

Akaki, Dukam, Adama, Dire Dawa, Bahir Dar, Gondar, Mekele, Hawasa, etc.

3 **Commercial towns:** The major function of these types of towns is just serving as centers of commerce and finance, where trade is the primary concern. There are financial institutions such as banking, insurance and other financial sectors. London is the financial head quarters of the common wealth. New York is the financial centre of USA, Addis Ababa is the financial centre of Ethiopia.

4 **Mining towns:** mining oriented towns may be located in very unusual places , but adequate mineral resources. Some towns shrink and become ghost towns due to the exhaustion of minerals. Many acquire other functions and are permanent towns. Mining centers can be located on maps by quarry symbols. This includes rocks (building stone, limestone and gravel for road construction). Gravel pits heavy machinery, water and power supply, smelteries , roasting, oil roads, railways and pipelines are indicators of mining villages.

5 **Holiday resorts, hill and health resorts:** These towns with various kinds of resorts are located in favorable geographical surroundings. They include coastal resorts for batting and yatching. For example, Mombasa (Kenya), port Sudan (Sudan), Pretoria (south Africa).

Hill resorts for mountain climbing and for the cool mountain air. For example, Semien mountain(Ras Dejen). Health resorts for those whole need specialists treatment. For example, Soderie (Oromia), Wondo Ghent (Oromya), Wanzaye (south Gondar).

6 **Forestry (Lumbering):** Forestry oriented towns are classified according to their latitudinal location and forest type these are deciduous, coniferous tropical and mixed wood land. They are depicted on maps by pictorial (tree) symbols

7 **Administrative towns:** these types of towns are the head quarters of the government and they are capital cities or centres of local administration. They deal with the administration and organization of the nation. Some are continental capitals (Addis Ababa) and international capitals (Geneva, New York)

8 **Cultural and educational towns:** These are towns in which are found world renowned universities. For example, Oxford and Cambridge in England and Laiden in the Netherlands:

9 **Ecclesiastical cities:** towns under this category are very exceptional. Towns of this type are perform special functions such as historical and religious centers and are frequently visited by pilgrims from all corners of the world. These include Jerusalem (Judaism, Christianity), Mecca (Islam), Varanasi (Hinduism) other smaller ones include religious associations for example, Vatican, Lalibela, Axum and Kulubi (Orthodox Christianity), Nejash (Islam) in Ethiopia.

Activity 2.11

1 For what purpose do people chose alluvial plain for settlement?
2 Explain the difference between wet site and dry site settlements.
3 List some towns in Ethiopia which were established for defense purpose.
4 To which type of site does Oxford belong?
5 Explain the reasons (causes) why some towns shrink and become ghost towns.

2.3.2 The Study of Communication on Maps

Transport Network

What is a transport network? What are those factors that affect transport networks?

Communication feature can be shown on topographic maps by using different signs and symbols. It is also possible to measure distance from one point to another. Gradients of various transport networks can be also calculated and viable

types of vehicles for them can be identified based on slope gradients.

Recognizing communication features on maps:

> ⇨ *Marginal information on maps is the most important tool for map readers who are reading those communication features on topographical maps. These include foot paths, tracks, roads, railway lines airways, waterways etc. Those features can be distinguished from their names and conventional signs and symbols depicted on the map.*

a ***Foot paths (Trails):*** These are usually found in the open countryside and in hills or mountains where construction of metalled road surfaces is impossible or extremely expensive. These are commonly found in rural Africa, and most of the people are served by trails and tracks.

b ***Roads:*** Roads ranging from mule tracks to modern highways are the most universal form of transport. Roads are classified by their width and surface quality: Topographic maps show various classes of roads by using different symbols. Some of them are: tarmac (asphalt) roads or first-class roads (highways), metallic (graded surfaced) roads, and cart tracks (dry-weather roads).

c ***Railways:*** compared with road transport, rail travel avoids congestion causes less pollution, is cheaper and quicker over relatively long distances, and is safer and more comfortable.

Railway lines can be distinguished on topographic maps by symbols. Such a map also shows railway lines with single and multiple tracks, small-gauge and mineral working lines and all the constructional detail is given alongside the track. Therefore, a railway line is controlled by relief. Railway lines find river gaps and passes and maintain a level course by cutting bridges, via ducts and embankments.

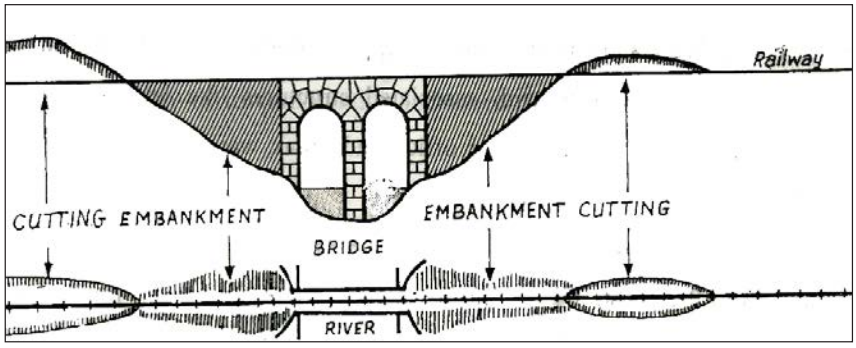


Figure 2.50: **A railway with a bridge, cutting and embankments**

d ***Cart tracks:*** most of the cart tracks shown on topographic map are, at least in the dry season, used by four-wheel drive vehicles.

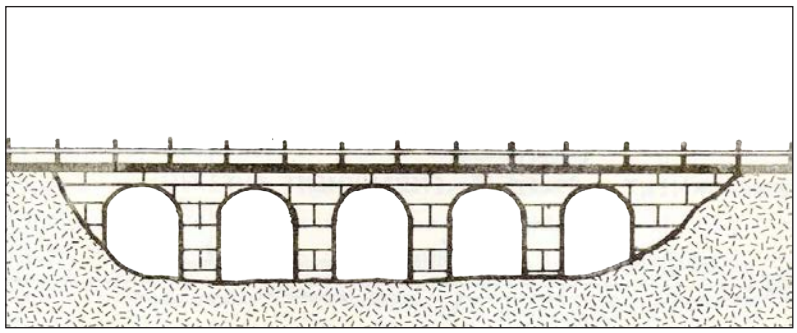


Figure 2.51: **A via duct: The road bridge across low lying dry land**

e ***Waterways (Navigation):*** waterways are divided into two major groups:

- ⇨ *Inland waterways.*
- ⇨ *Sea routes.*

The inland waterways include navigable rivers, canals and coastal shipping routes. They can be identified on maps by the presence of sea ports in association with structures like jetties, lighthouses, harbor offices and break waters. Rivers are also important to convey goods and passengers from the coast to the inland. The location of ports near a river mouth and the occurrence of locks following paths, piers for unloading, straightened courses, and dense building along the bank of the river show that the river is navigable.

Canals are easily recognized on a map. They are depicted on topo maps as long straight sections along the contours, moving from one level to another with the help of locks.

f ***Other means of communication:*** These include communications, radio/ TV stations and microwave and tower stations which are shown by their own symbols and names.

Factors Affecting the Development of Transport Network

What are the factors that affect the development of transport net work?

The major factor that affects the development of a transport network is the need for transport. Transport facilities are prime necessity for two purposes:

- ⇨ *to serve economic activities*
- ⇨ *to make strategic control of a country possible.*

These purposes can be coordinated when the transport network of a given country is planned. Economic development is unthinkable without the development of transport networks.

It is obvious that roads and railways can be constructed in any place where they are needed. However, the actual course followed and the pattern of the resulting network is influenced by the natural environment through which the roads and railways have to pass. The two important elements to be considered by road planners are relief and natural water courses.

i **Relief:** One of the major obstacles for transport development is relief (terrain). Due to these large changes in altitude, roads make use of serpentine bends and tunnels or they pass around the mountains or over them.

ii **Water shed road route:** sometimes road routes follow watersheds just to avoid crossing numerous rivers which require expensive bridges. For example the Addis Ababa-Mekele road via Dessie follows the watershed between the Abbay Basin on one side and the Awash Basin draining towards Djibouti.

iii **River valley roads route:** river valleys are preferred under certain conditions. Usually the gradients of river valleys have been smoothed by erosive action of rivers. This makes road construction easier and less costly.

iv ***Water bodies:*** These are another hurdle to road and rail construction. Rivers can be crossed either by bridges or ferries. Swamps and marshy areas are negotiated by road and rail engineers. If there is no choice, they are crossed by viaducts or long continuous embankments.

g ***Air Transport***

What advantage does air transport have over the others?

Air transport is a recent mode of transport. This new form of transport has great advantages, because it is affected very little by different land forms or ground conditions. An airplane can cross mountains, dense forests and large oceans with the greatest ease and speed. It can reach the remotest, the farthest and the most inaccessible places on earth, provided a landing place is available. Air fields, due to their long runways and the undesirable associated noise and danger, are constructed a somewhat distant from densely populated and heavily built-up areas.

Airfields, where airplanes land and take off, are the only physical evidences of air transport in the landscape. These points are known as aerodromes, airports, landing strips or heliports, depending on the facilities existing at these points. Aerodromes and airports are points where single or several tarmac runways equipped with navigational aids exist. The Addis Ababa international air field layout is a good example and it is the largest in Ethiopia, followed by those in Dire Dawa, Mekele, Bahir Dar, Gondar and Axum.

The map on the preceding figure portrays a modern airport with the necessary equipment. The map shows the railway and the road connecting the airport with the land-transport network for taking passengers and goods from and to the airport.

2.3.3 Climbing Capacities of Vehicles

Do you remember what you have learnt about gradient in the previous lessons?

What is gradient? How do you explain gradient in relation to slope and altitude?

The surface of the earth is not uniform throughout. There are a number of ups and downs with slopes varying in degree. A particular surface landform may be concave, convex, uniform or irregular. But the slope, as opposed to the actual landform, will still be the same. Therefore, the slope is determined by the relationship between the end points of a line; the slope and the altitude between the two points. Ups and downs are expressed in terms of slope and gradient.

When there are big differences in local relief, roads usually climb or descend along the rivers. Railways are very much more affected by relief than roads because of their low hill-climbing capacity. This is because railways require much smaller gradients than roads, 2 percent is given as the maximum for railways. This means that when a railway and a road have to travel the same ascent, the railway uses a different and much longer route than the road.

Example:

Two points, 'A', located at the foot of the eastern escarpment in Ethiopia at an altitude of 500 m, and 'B' located at 2500 m are to be joined with a road and a railway

a what is the length of the road?

b what is the length of the railway?

Solution:

Using the formula for calculating gradients, we get:

$$\text{altitude difference} = \frac{2500 - 500}{1000} = 2 \text{ kilometers}$$

Maximum gradient for cars = 25%

Ground distance (unknown) = x

a the shortest possible distance for the road is:

$$25 = \frac{\text{Altitude differenece}}{x} \times 100$$

$$25 = \frac{2 \times 100}{x} = 8 \text{ km } (\textit{the length of the road})$$

b The shortest possible distance for the railway is:

$$2 = \frac{2 \times 100}{x} = 100 \text{ km } (\textit{the length of the railway})$$

The solution applied in road construction, the building of roads in serpentines, cannot be applied to railways.

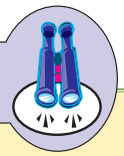
Railways avoid drastic changes in altitude for two reasons:

- ⇨ *requires high cost of construction*
- ⇨ *the daily operation costs are high*

Generally railways avoid large changes in altitude, which involves the construction of tunnels, embankments, cutting, etc.

The gradient of the slope is determined by the relationship between the vertical distance of two points and the horizontal distance between them.

Focus



Slope is a measure of the vertical difference in the altitude (elevation) of a surface at two different points.

As discussed in the previous lessons, railway lines and road transport networks are constructed in accordance with the maximum possible hill-climbing capacity of vehicles. This means the road should serve all vehicles ranging from four-wheel drive cars to ordinary bicycles. In doing so, we should not build them in a straight line up the slope. Instead a winding (bending) line or "serpentine" road.

This is done in order to reduce the steepness or gradient of the road. This reduction of gradient is necessary since different vehicles have different hill-climbing capacities. The following is a list of maximum gradients for different means of transport.

Table 2.3: **Maximum gradients for different means of transport**

Means of transport	Maximum Gradient
Train	2%
Ordinary cars	25%
4 wheel drive cars	30%
Man–walking up Without support of hands	45%
Bicycles	10%

One should bear in mind that their numbers stand for ordinary trains, cars or bicycles. When one buys a car or bicycle, he should be informed about the specific hill-climbing capacity by the vehicle's technical data.

The highest road gradient in Ethiopia is the Limalimo road, (which is 12 percent gradient) which stretches from R.Tekeze to Debark, where we find numerous detours to minimize the gradient of the slope.

Activity 2.12

For the following questions refer to the contour map below.

1 Construct a road network that joins
   - a town F with town A
   - b town E with town C
   - c town C with town F

2 Calculate the gradient in percent from town F to town A and from town E to town A. The altitude of A is 1500 m.
   - a Which gradient is the highest and requires high cost of construction?

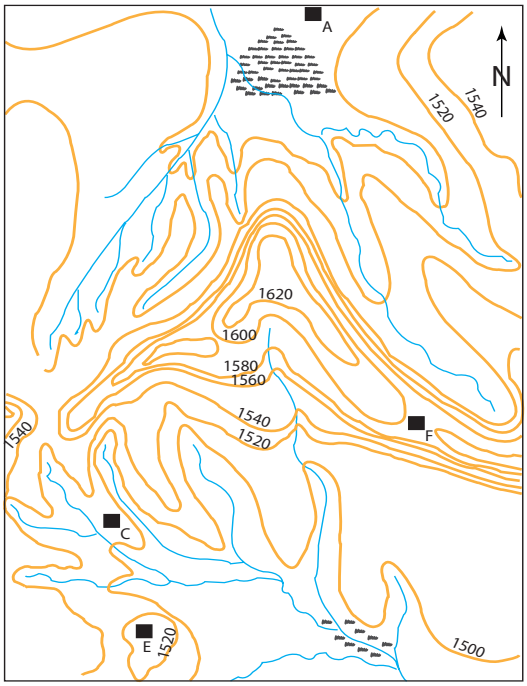


Figure 2.52: **Contour map of an area**

NOTE

When you construct a road network, the following points should be taken in to consideration.

- *Every meter of road costs a lot of money to build and therefore, all unnecessary bends in the road should be avoided.*
- *Avoid the construction of unnecessary bridges.*
- *If your road follows a river, bank with the least number of tributaries should be chosen. If a major river has to be crossed, the crossing should be done in the upper course of the river where the width of the river is as narrow as possible.*
- *Detours to avoid bridging should be reasonable.*
- *Avoid unnecessary changes in altitude.*
- *When it is necessary to overcome large differences in altitude, as is the case very often in Ethiopia, the road should be made to follow a river valley. This is for the reason that river valleys naturally have lower gradients. When you cross a mountain range, you should look for the lowest possible section of that ridge which can be a pass or a col.*
- *Avoid marshy ground. The construction of a road through marshy ground is very expensive, difficult and sometimes impossible.*
- *Pass the road through existing towns and heavily crowded villages.*

2.4 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

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

- discuss what geographical information system means;
- explain turning points in the development of GIS;
- state the use of GIS;
- show appreciation for the uses of GIS.

Key Terms

- GIS
- Data
- GPS
- Remote sensing

2.4.1 What is Geographic Information System (GIS)?

Students may give different answers for this question. The main reason for this is that GIS can be understood by different people differently. For some, GIS is a branch of information technology, for others it is a computer-assisted mapping and cartographic application, and for others it is a set of spatial-data analytical tools.

At this level we would like to define GIS as a system of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modeling and display of spatially referenced data for solving complex spatial problems.

Before understanding how the system works it is important for you to understand data, information and systems.

Data are a collection of raw facts representing places, things, people, events and concepts in the form of numbers, text, figures, symbols and signals.

Information is data that have been transformed through processing such as structuring, formatting, conversion and modeling.

The word system can be used in different contexts. It can be used to describe physical entities or conceptual entities

Physical entities

- *Solar system*
- *Ecosystem*
- *Drainage system*
- *Immune system*

Conceptual entities

- *Political system*
- *Democratic system*
- *Computer system*
- *Economic system*

In this context, GIS is a physical entity designed to achieve the specific objective of collecting, storing, analyzing and presenting information in systematic ways

2.4.2 Turning Point on the development of GIS

- *The first GIS called the Canada Geographic Information System was built in the 1960s by the Canadian government to analyze data collected by the Canada Land Inventory.*
- *Similar systems were built by other governments and university laboratories following the developments in Canada.*
- *The increased accessibility of computers in the 1970s as a result of technological improvements and lower costs of computers heralded the beginning of wide application of GIS.*
- *In the 1980s GIS sales increased tremendously as governments and businesses found more uses of the systems. New GIS software began to be produced by a number of companies to program computer systems to increase their functions.*
- *By the early 1990s, about 100,000 GIS systems were in operation.*
- *By now, GIS has come to be one of the most important systems in making spatial analysis and many other geographic researches.*

Uses of GIS

Some of the applications of GIS are stated as follows:

- ***Urban planning:*** *This is concerned with the development of master plans. The first step in an urban GIS is the production of improved property descriptions. The high quality database is immediately useful for many purposes.*
- *GIS is used to monitor patterns of urban growth. This is done by overlaying urban area maps for two different times to produce a change map showing urban growth. Such information helps city planners for example, in planning schools.*
- *GIS data can also be used in neighborhood planning applications – for example, in a given city, it is possible to evaluate neighborhoods requesting funding to help increase owner occupancy of housing.*

Traffic Control

GIS is used to regulate and monitor traffic flows in streets and overcrowded highways. Information is provided into GIS from video monitors, vehicle detectors, etc. When there is traffic congestion, the information is used as background for decisions about changes in message signs, lane signals and other controls.

Emergency Management

GIS and GPS (Geographic Positioning System) techniques are used by emergency management personnel before, during and after natural or human-made disasters. Some of the natural hazards that cause human and material damage are earth tremors, floods, fires, hurricanes, tornados, etc. In order to take quick action, there must be background information about the accessibility of the disaster area, including its utilities, highways, population, terrain and other elements of the environment. This information is stored in a GIS system.

During an emergency, additional information is gathered and provided by GPS (Geographic Positioning System). In doing so, current maps of damage to roads, utilities and buildings can be produced. This information helps the emergency teams to plan alternate routes for emergency cars and other related tasks. The same information can be used after performing the emergency tasks. This includes the refinement of maps that are useful for assessing the number and degree of casualties and the value of damage.

GIS also plays an important role for recording, monitoring, and coordinating reconstruction and rehabilitation efforts. Eventually, such information can be collected earlier and combined with high-risk parameters. This information includes physical features like steep slopes, vegetation cover, types of building construction and material and building density.

This information is useful when transferring people from the disaster area and when generally reducing risks for the future.

Airport Noise Management

The degree of noise is mapped around airports using data concerning airport configurations accompanied by aircraft noise-generation monitoring. This information can be used to reduce noise impacts near the airports. This can be achieved by examining noise incidents and by planning future land use and airport designs to reduce exposure levels.

Education

GIS is used in schools of all levels. One junior high school, for example, carried out a project in which pupils formulated a regional GIS database. They handed over the results to show the school administration that the site of the newly constructed library building was vulnerable to being robbed. The quality of their report may have influenced the outcome of the project.

Scientific Research

GIS-conducted research can assess the quality of medicines that are imported from abroad to determine whether they fulfill international standards. The availability of this information will allow importers to map those countries that manufacture medicines below the international standard.

Social Programs

GIS methods are used to generate data on unemployment rate increases in relation to economic development in a given country. Such a study might be related to population growth rate.

Public Health

GIS has been used to identify health problems caused by lack of sanitary practices. Such application-generated maps show the relationship between income and level of education and the number of people that lack sanitary practices. Areas where many households were exposed to different diseases due to lack of sanitary practices have been given priority for free medical treatment.

Resource Management

Resource management problems prevail in many regions. In one coffee growing region, GIS was used to map, analyze and manage a complex weather condition. This weather condition, frost, affects the field and greatly affects the local economy.

Wildlife Management

GIS is also used in wildlife management applications – for instance, the identification of favorable Mountain Nyala habitats in the Bale mountains. The approach involved a study to find the territories of existing Mountain Nyala packs by radio tracking. Characteristics of these territories were analyzed in a GIS. The information gained was then used to search for similar habitats throughout the region. These potential habitats were analyzed to evaluate their potential for the introduction and protection of new Mountain Nyala packs.

Military Base Management

GIS is important for military purposes, especially to protect base residents. It is also used to protect plants and animal habitats when missiles and other weapons are tested. Regarding environmental problems, GIS provides information on facts such as wetlands, flood zones, archaeological sites, resort areas, etc.

GIS is also applicable to emergency cases such as chemical plumes, wildfires, etc. and for activities such as the selection of safe areas suitable for storage of explosives.

Agriculture

GIS is used in the agricultural sector. This application is known as *precision*

farming to increase agricultural production by reducing farm costs. The application depends on soil maps especially prepared by GIS technology.

The map is prepared based on aerial photographs and on soil samples taken in each field. The soil samples are analyzed, and a soil map of the farm is prepared in a GIS system. Decisions are passed based on the analyzed data, regarding the allocation of the appropriate fertilizer and herbicide for each soil type.

These requirements are mapped and put in another GIS file to be used in the field.

The attached computer compares the location of the tractor with the product application map and continuously adjusts the mix and application rate of the fertilizer/herbicide.

In previous times, fertilizers and herbicides were mixed and applied at an average rate over entire fields. This was an inappropriate application of fertilizer and herbicides.

Precision farming enables the farmer to apply fertilizer and herbicides proportionally with respect to the required amount. This method is applied at low cost and reduces all sorts of erosion.

In the Field of Tourism

GIS provides information about services and facilities of tourist sites.

Activity 2.13

Answer the following questions and perform the following activities:

1. Explain how GIS is used to promote urban growth?
2. Discuss how GIS data are used in neighborhood planning.
3. How is GIS applied to monitor traffic flow in over crowded highways?
4. In what ways does GIS assist rescue members in times of natural or human-made disasters?
5. What are the methods used to control airport noise?
6. Why does GIS relate unemployment rate with population growth rate?

Unit Review

UNIT SUMMARY

- The height of the surface of the earth varies from place to place.
- Land features such as plains, hills, mountains, valleys, etc. which make the earth's surface uneven are known as relief features.
- The accurate method of representing relief on maps is by means of contour lines.
- A contour is an imaginary line drawn on a map. It joins all points having the same height above mean sea level.
- Contour lines are drawn from pre-measure points called spot heights. The construction of contour lines becomes possible once the spot heights are plotted on the map.
- The landforms shown on contour maps can also be made more clear and simple to understand by drawing cross-sections, profiles and block diagrams.
- In the process of terrain study and analysis from a contour map, you have to describe the various kinds of landforms, the nature of slopes, gradients and intervisibility of different places.
- Topographic maps also show drainage features and patterns such as river basins, catchment areas, watersheds and other land features that develop in different stages of streams.
- The types and distribution of human settlements and communication features are shown on topomaps by using conventional signs and symbols.
- You should keep in mind that the site of a settlement is not arbitrarily chosen. It has been chosen for a combination of several reasons.
- Relief, water supply, health, defence, communications, government policies, and economic resources are some of the facts that influence the choice of site of settlement.
- It is useful to learn to read and understand maps that show different communication features ranging from roads to airways.
- The science of GIS is very important. The system of GIS (Geographical Information System) needs flexibility.

  The system should include capabilities for manipulating, comparing, or combining the data in different ways.

REVIEW EXERCISE FOR UNIT 2

I *Write "True" if the statement is correct and "False" if the statement is not.*

1 The relief features of the earth have two dimensions.

2 The most accurate and modern method of showing relief on maps is by form lines.

3 We can see physically on the surface of the earth?

4 In one or a series of map sheets, the difference in altitude between two successive contour lines (V.I.) is always the same.

5 We can obtain mean sea level by measuring the level of the sea at all stages of the tides, seasonally.

II *Match column A with column B.*

	A		B
6	Centripetal drainage pattern	A	Main stream
7	Radial drainage pattern	B	Found in arid and rift Valley Lakes of Africa
8	Trellis drainage pattern	C	Develop in areas of homogeneous rock
9	Dendritic drainage pattern	D	Develop on a dome or conic cone
10	Consequent stream	E	Affected by folding and faulting

III *Chose the best answer*

11 A wide projection on a mountain side extending from the mountain towards the lowland is called:

A Valley
B U-shaped valley
C Spur
D Re–intrant

12 A very wide space between successive contours represents:

A Gentle slope
B Steep slope
C Convex slope
D Plain

13 We use a big vertical interval for areas with:

A Very plain relief
B Rugged terrain
C Mountain ridge
D Rough terrain

14 Two places are said to be intervisible:

A If there is higher relief between the two points
B If there is dense vegetation
C If there is no higher ground between the two points
D If there is high altitude between the two points

15 A cross-section of a given contour map is used:

A To examine whether two places are intervisible or not
B To visualize the types of land forms represented by a given contour map
C To visualize whether a given area is deforested or not
D A and B
E A and C

16 Contour lines intersect in the case of:

A Waterfall
B an undulating plain
C a concave slope
D a convex slope

IV *Fill in the blank space with the appropriate word or phrase*

17 The most accurate method of interpolation is _____.

18 A small V–shaped cut in a steep slope or the side of a hill which looks like a small short valley is _____.

19 A slope where the gradient changes several times from the top to the bottom of the slope is _____.

20 A type of slope which is indicated by widely-spaced contours at the lower levels and close together at the higher levels is known as _____.

21 The rate of change in altitude of a slope is called _____.

V *Give short answers for the following question and activities*

22 Explain the difference between rural settlement and urban settlement.

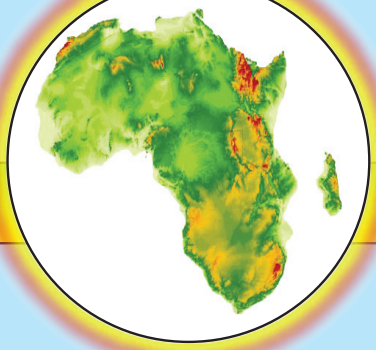
23 Define the term watershed.

24 What is GIS?

25 Write the three components of GIS.

26 In which stage do we get waterfalls in a river system?

Unit 3



AN OVERVIEW OF PHYSICAL GEOGRAPHY OF AFRICA

Unit Outcomes

After completing this unit, you will be able to:

- understand the locational and geological aspects of Africa;
- recognize the climatic characteristics of Africa;
- know and appreciate the characteristics of the drainage patterns and other water resources of Africa;
- appreciate the wildlife resources of Africa; and
- distinguish the soil resources of Africa.

Main Contents

INTRODUCTION

In the previous unit, you have learned about map reading and interpretation. There, issues related to relief representation on contour maps, representation of drainage on maps, human-made features on maps and the geographic information system were discussed.

In this unit, you are going to learn about Africa. The unit will give you an overview of the location, size and shape of the continent and its regional divisions, its geological history and relief structure, and the continent's climate and related issues. In addition, the drainage of Africa and its wildlife resources will be discussed. Also, the soil resources of the continent will be emphasized.

3.1 POSITION, SIZE AND SHAPE OF AFRICA

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

- demonstrate the relative and absolute location of Africa using world map;
- compare the size of Africa with other continents;
- discuss the impacts of the coastal and continental shape of Africa on its development;
- describe the regional division of Africa;
- show the geographical location of each region;
- relate the sub regions in terms of size, access to the sea and major relief structure; and
- analyze the socio-economic and geo-political similarities of each region.

Key Terms

- Absolute location
- Relative location
- Latitude
- Longitude
- Area size
- Shape
- Region
- Epeirogenesis

3.1.1 Position of Africa

Brainstorming

1 What is location? How is it described?
2 Where is Africa located?
3 Can you state the relative and absolute locations of Africa?

Africa's location can be expressed in two ways, namely, absolutely and relatively.

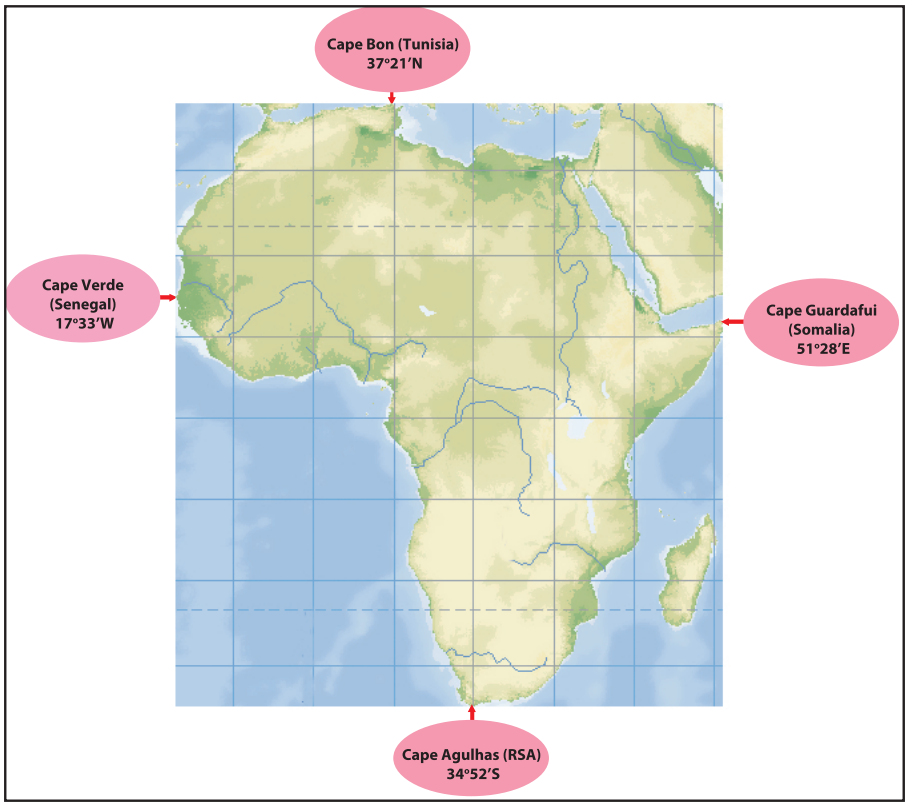


Figure 3.1: **Africa's Astronomical Location**

As you can see from Figure 3.1, Africa lies between 37°21'N and 34°52'S latitudes and between 17°33'W and 51°28'E longitudes. This means that the continent extends for about 37° to the north of the equator and 35° south of it. Similarly, Africa extends for about 17° west and 51° east of the Greenwich Meridian. From this absolute location, we can understand that the continent stretches in all the four hemispheres.

The four extreme points of the continent, which mark the extreme points of Africa are the following.

- *Extreme North - Cape Bon (Tunisia) -37°21'N*
- *Extreme South - Cape Agulhas (Republic of South Africa (RSA)) - 34°52'S*
- *Extreme East - Cape Guardafui (Somalia) - 51°28'E*
- *Extreme West - Cape Verde (Senegal) - 17°33'W*

Activity 3.1

In a small group, study Figure 3.1 and answer the following questions.

1 What unique features do you observe about Africa's absolute location?
2 What impacts has Africa's absolute location on its climate, natural vegetation, fauna, agriculture, and human settlements?

From the map that shows the absolute location of Africa, we can learn that:

- *when we measure Africa's greatest north-south and east-west extents, we find that they are almost equal:*
  - *north-south – approximately 8000 kilometers*
  - *east-west – approximately 7,600 kilometers*
- *the equator crosses Africa almost at its north-south center. The north-south extents above and below it are almost equal, although the northern area is greater than the southern one. The land area north of the equator is about twice that of the south.*
- *Africa is the only continent crossed by all of the following: the Tropic of Cancer and Tropic of Capricorn, the Equator and the Prime Meridian.*
- *almost ¾ of the continent's total area is found within the tropics, and therefore much of the continent experiences tropical climates.*

When Africa's position is expressed in relation to the major landmasses and water bodies that are close to it, it can be described as follows. Africa is found to the:

- *South of Europe*
- *Southwest of Asia*
- *South of the Mediterranean Sea*
- *West of the Indian Ocean*
- *East of the Atlantic Ocean*
- *North of the Southern Ocean*

Figure 3.2: **Africa's Relative Position in the world**

Activity 3.2

1 By referring to Figure 3.2, describe the relative location of Africa in relation to the features mentioned above.

2 Where is Africa closest to:

a Europe? b Asia?

As the map shows, Africa gets closest to Europe across the **Strait of Gibraltar**, which is about 22 kms wide between Morocco and Spain. With relation to Asia, the continent comes closest across the **Strait of Bab-el Mandab**, which is about 40 kms wide. A narrow stretch of land called the **Isthmus of Suez**, which is cut into two by an artificial canal called the **Suez Canal,** connects Africa with Asia.

Activity 3.3

Refer to the above Figure 3.2 and using an atlas perform the following activities.

1 Locate the Strait of Gibraltar, the Strait of Bab-el Mandab and the Isthmus of Suez.

2 Find the four extreme points of Africa.

The relative position that Africa has, in relation to the rest of the world, gives the continent many advantages. The following are the most important ones.

- *The continent occupies a central location in the world. This makes the continent close to the rest of the world, providing it geographical accessibility.*
- *The geographical proximity that the continent has with Europe and Asia has resulted in socio-cultural contacts. This has encouraged socio-economic and cultural exchange and integration among the three continents.*

3.1.2 Size of Africa

Brainstorming

1. How large is Africa's land area?
2. What percentage of the world's landmass is Africa's?

Africa is the second largest continent in the world, following Asia. The continent's total area is about 30,335,000 km^2. This constitutes 20.2% of the earth's total land surface. With this area, the continent is about two-thirds of the size of Asia and 3.36 times larger than Europe. Table 3.1 indicates the sizes of the world's continents.

Table 3.1: **Area of the Continents**

Continent	Area (000' km^2)	% of World Area
Africa	30,335	20.2
Asia	45,000	30.0
Europe	10,000	6.67
Australia and Oceania	8,700	5.8
N. America	24,200	16.14
South America	17,000	11.34
Antarctica	14,000	9.3
World total	149,900	100

Africa's large area gives the continent several advantages, including the following:

- ⇨ *A large area of land that can be used for settlements, agriculture, and other economic activities.*
- ⇨ *Huge resource potentials in terms of resources like soil, water, minerals, flora and fauna and the like, which are vital for its development.*

However, Africa's large size also has disadvantages. For example, it makes geographical connectivity difficult among the people of the region and of the world. As a result, there are problems related to integration among peoples of the continent and others outside, making both integrated development and international trade a challenge.

3.1.3 Shape of Africa

What is shape? What is its significance?

How do you describe Africa's shape?

Shape is defined as the geographical form of an area. In other words, it is the external geographical appearance of a place. It has great impact on the socio-economic integration and flow of goods and services within each region.

The *shapes* of places can be described in different ways for example, as moderately compact, elongated, fragmented, perforated, and the like. A *moderately compact shape* is close to that of a circle. An *elongated shape* is a shape with one side longer than the other. A place with a fragmented shape is made up of multiple disconnected areas. For example, some countries are composed of islands.

Africa has a relatively compact shape. This means that the continent's longest east-west and north-south distances are almost the same. The following evidence supports the above statement.

- ⇨ *The east-west and north-south extensions are almost equal, with a minor difference.*
- ⇨ *Africa has a fairly unbroken coastline. The continent's coastline does not have many indentations, inlets, bays or gulfs. This condition creates a relatively smooth coastline, compared to those of other continents, and therefore a relatively short one. For example, if we compare Africa and Europe, the coastline of the latter is, by far, longer than the former.*

- *The unbroken coastline of Africa makes the continent poor in natural harbors.*
- *Many places in Africa are not very far from the coast. Almost all places are at most located 1500 km from the coast. Therefore, many countries of the continent are not very far from the sea.*
- *The unbroken coast line discourages external communication.*

3.1.4 Regional Division of Africa

The mainland of Africa has five major regions. They are defined in terms of socio-economic and cultural similarities. Each region consists of a number of countries with their own regional variations. The regions are

- *Eastern Africa*
- *Central Africa*
- *Northern Africa*
- *Southern Africa*
- *Western Africa*

The geographical location of these regions and their political units are given in the following figures. A brief description of the socio-economic conditions of each region is also made below the figures.

Study them carefully and try to identify each region's relative location as well as the countries that constitute the region.

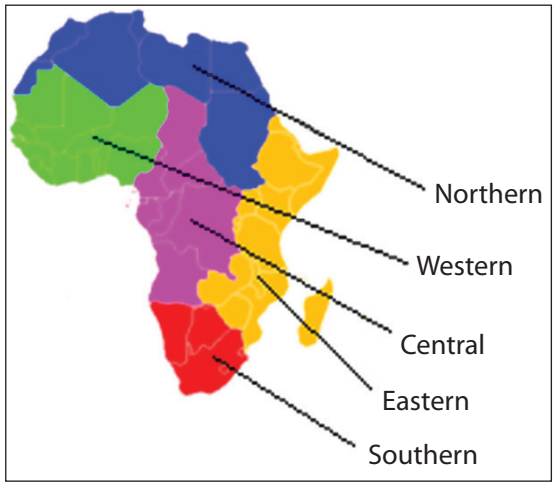


Figure 3.3: **Regional division of Africa**

Figure 3.4: **Political Map of Africa**

Table 3.2: **The regions of Africa**

Name of region	Area (km^2)	Population (2009)	Population Density (per km^2)	Number of Countries
Eastern Africa	6,384,904	316,053,651	49.5	18
Central Africa	6,613,253	121,585,754	18.4	9
Northern Africa	8,533,021	211,087,622	24.7	11
Southern Africa	2,693,418	56,406,762	20.9	5
Western Africa	6,144,013	296,186,492	48.2	17
Africa Total	30,368,609	1,001,320,281	33.0	61

N.B: The total number of countries and the total area given in the above table include the insular/island states of Africa and their area.

As shown in Table 3.2, Northern Africa is the largest in terms of its territorial size followed by Central and Eastern Africa. In terms of population size, Eastern Africa is the most populous followed by Western and Northern Africa. Likewise,

there are significant differences in the population densities of the various regions. Eastern Africa has the largest population density 49.5 people per km^2 followed by Western Africa. Central Africa has the continent's lowest population density, 18.4 people per km^2.

The following discussion provides you with a brief description of the Socio-economic conditions of the regions of Africa.

Eastern Africa

Eastern Africa is the region that is located between 18°N – 27°S latitudes and 22°E – 51°28'E longitudes. The region is the third largest in terms of its area accounting for about 21% of the continent's total area . A total of 18 countries, of which seven are landlocked, constitute the region. The physiographic of eastern Africa is characterized by diverse relief. Very high volcanic mountains, extensive plateaus, great rift valleys and low depressions dominate the region's topography. Such diversity in surface configuration has resulted in the presence of diverse climate that ranges from desert and semi-desert type to high altitude alpine climate. This, in turn, has helped the development of varied vegetation zones of tropical grasslands, forests, alpine vegetations and desert and semi-desert vegetations making the region rich in flora and fauna resources. Eastern Africa is drained by the Nile, Wabishebelle and Genale river basins. It is also the region where most of Africa's highland and rift valley lakes are found.

In terms of population, Eastern Africa is the most populous of all the regions accounting for about 31.3% of Africa's total population in 2009. Nearly 22% of the region's population is urban. Life expectancy averages 51 years. Agriculture is the most dominant economic activity in the region. Commercial cash crops such as coffee, tea, sisal, and sugar cane, are the most important agricultural products. Livestock resources are also important sources of income. The mining and industrial sectors are little developed in the region.

Northern Africa

Northern Africa is the largest region in terms of area. It covers nearly 1/3rd of the continent's total area. There are seven countries in the region, two of which namely Sudan and Algeria are among the largest states in Africa. All the states of this region have direct access to the sea. Northern Africa is characterized by desert climate. In addition, the Mediterranean type of climate also dominates the Maghreb region. The region's topography is dominated by mountains and plains.

The Atlas Mountains and the Sahara Basin and uplands are the most common features. Much of Northern Africa is covered by desert vegetation. However, Mediterranean vegetation is also found in areas where Mediterranean climate dominates.

In 2009, the population of northern Africa accounted for about 20.5% of Africa's total population. Nearly 50% of the region's population is urban and life expectancy averages 69 years. The Economy of northern Africa is dominated by agriculture, industry and mining.

Western Africa

The region of Western Africa is stretched between 4°N – 25°N latitudes and 17°33'W – 16°E longitudes. Accounting for about 20% of Africa's total area, a total of 17 countries constitute the region. Highlands and lowlands make up a good part of the relief of Western Africa. The Guinea highlands, the Fouta Djalon and Jos plateau form higher parts of the region. The Niger, Benue, Volta, Gambia and Senegal rivers drain the region. The climate of the region shows great variation, while the western coasts experience tropical humid climates with very high rainfall and temperature, the interior lowlands are characterized by low rainfall and high temperature. These climatic conditions have resulted in the presence of diverse vegetation that includes tropical forests, tropical woodlands and grasslands.

Western Africa is the second most populous region in the continent. In 2009 the region accounted for about 29.7% of the total population of Africa. Africa's most populous country, Nigeria, is found in this region. About 42% of the region's population lives in urban areas and life expectancy averages 51 years.

The economy of Western Africa is dominated by agriculture. Coffee, Cacao, Palm oil, rubber and ground nuts are among the most important agricultural cash crops produced in the region. Industrial development is limited to coastal areas. In some countries like Nigeria, Ghana and Guinea, mining is the most important economic activity.

Central Africa

Central Africa is located between 23°30'N – 15°30'S and 8°E – 32°E. Covering about 22% of Africa's total area and possessing 9 countries, Central Africa is the

second largest region in Africa. A good part of Central Africa, nearly 2/3rd of the region, is a vast depression that is drained by the Congo basin. Highland areas in the region include the Cameroon mountains and Ruwenzori Range.

Central Africa experiences almost all types of climates of the content, except the Mediterranean type. Equatorial, tropical savanna, mountain (highland) and desert climates are among the most dominant ones. The diverse climatic conditions of the region make Central Africa rich in bio-diversity. Equatorial rainforests, Savanna woodland, Gallery(Riverine) vegetation, Desert and semi-desert vegetation are among the most common vegetation covers of the region.

Central Africa accounts for about 12.5% of the total population of Africa. The region is characterized by low population density due to its climatic conditions. 41% of the region's population is urban. The average life expectancy in Central Africa is about 51 years.

Agriculture, forestry, mining and manufacturing constituted a good part of Central Africa's economy. However, the dominant economic sector that supports the lives of the majority of the population in the region is subsistence agriculture. Central Africa has huge potential for commercial crop production. The region owns about 30% of Africa's tropical woods. The region also has large reserves of different types of minerals such as copper, zinc, aluminum, diamond, gold, and oil. A number of oil refineries and timber processing plants are found in the region. Angola, Gabon and Cameroon are the richest countries in petroleum resources in the region.

Southern Africa

The absolute location of Southern Africa is between 18°S – 34°52'S and 7°E – 32°E. The region is divided into five sovereign states. Accounting for about 8.9% of Africa's total area, Southern Africa is the smallest region in the continent. The topography of Southern Africa is dominated by high plateaus of over 300 m high. Among the highest areas in the region are the Drakensberg mountains. The region is drained by major river basins that include the Limpopo, Orange, and Vaal. There are also major inland basins in the region including the Ngami-Kalhari, Makarikari and Okovango basins.

The climate of Southern Africa is highly diverse. There are tropical, desert, alpine and Mediterranean climates. The Mozambique and Benguela currents produce

greater impact on the climate of the east and west coast of the region, respectively. As a result of the diverse climate, the region is endowed with different species of flora and fauna.

Accounting for about 5.8% of Africa's total population, Southern Africa is the least populous in the continent. Nearly 56% of the regions population resides in urban areas and the region's life expectancy averages 52 years.

Southern Africa has the most diverse economy in the continent. Agriculture, mining, manufacturing and tourism form the major occupation of the region's population. Agriculture in the region is highly mechanized and comercialized. The region is also rich in terms of mineral resources. Gold, diamond, and coal are among the most important ones. The region has most of the major mining and manufacturing industries in the continent.

Content Check

Fill in the blank spaces.

1 The exact location of a place that is expressed by using latitudes and longitudes is know as _____.
2 The two water bodies that are connected by the straight of Bab-el-Mandeb are _____ and _____.
3 Africa's shape can be described as _____.
4 The most populous region of Africa is _____
5 The Northern and Southern extreme points of Africa are _____ and _____, respectively.

3.2 GEOLOGICAL HISTORY AND RELIEF STRUCTURE OF AFRICA

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

- reconstruct the geological history of Africa;
- identify major relief structures of Africa on a map;
- appreciate the unique relief features of Africa; and
- compare the relief of Africa with other continents.

Key Terms

- Geological history
- Geological time scale
- Orogenesis
- Denudation
- Peneplanation
- Basement complex
- Fluvial rains
- Relief
- Rift valley

3.2.1 Geological History of Africa

Brainstorming

1. What is geology?
2. What does geological history mean?
3. How do geologists study the earth's past?
4. Do you know the major geologic events that took place in Africa?
5. How did they affect the present surface structure of the continent?

The present relief structure of Africa is the result of long, complex and continuous processes that have taken place for several millennia.

In this lesson, we will consider the geological history of Africa. Throughout the 4.5 billion year history of the planet, several geologic processes acted on the planet and formed its relief. In this process, Africa underwent several major geological events and changes.

The continent of Africa was part of the old continent that we call *Pangea*. In the Jurassic period of the Mesozoic era, some 200 million years ago Pangea broke into two, forming **Laurasia** and **Gondwanaland**. Laurasia was the northern continent, and Gondwanaland was the southern. Africa was part of Gondwanaland. As time passed, each of these continents was further broken down, forming the seven present-day continents.

In this process of change, the planet experienced several geologic events that resulted in the formation of the world's present surface structure. In Africa, major geologic events and processes acted on the continent's surface and left their scars, forming the continent's diverse relief.

Now let us see the major events that took place in the African continent in each era.

Activity 3.4

In a small group, discuss to answer the following questions.

1 What were the major geologic events that took place in the Pre-Cambrian era in Africa?

2 What were the major geologic events that took place in the Paleozoic era in Africa?

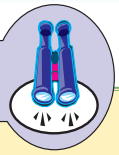
3 Identify the major geologic processes that took place in the Mesozoic and Cenozoic eras in Africa.

Precambrian Era (*4.5 billion - 600 million years before the present*)

This era is the oldest and largest division of the geological time scale. It covers almost 5/6th of the geological history of the planet. Due to its remoteness in time and lack of fossil evidences, not much is known about this era. However, two processes are believed to have been dominant. These are *orogenesis* (a series of mountain-forming processes) and *metamorphism*.

For Africa, the following events are assumed to have been dominant in this era.

- **Formation of the Basement Complex Rocks:** *the oldest rocks of the continent, which are called Precambrian or* crystalline basement complex rocks, *were formed during this era. These rocks cover nearly two-thirds of the continent. Precambrian rocks are rich in metallic mineral deposits, such as gold and copper.*
- **Orogenesis:** *is a mountain-forming process. In this era, many mountains that make the face of the continent very rough and undulating, were formed.*



Focus

Orogenesis (mountain building): changes in the level of the earth's crust in which rocks are thrown up into folds or blocks to form ranges of mountains. In course of time, the mountains may be considerably denuded and may there after be depressed or elevated by Epeirogenesis.

Paleozoic Era (*600 - 250 million years before the present*)

This is the second-longest and second-oldest era in geological history. This era witnessed no major rock formation processes. As a result, it is a gap, relative to

rock formation in Africa. However, several other important events took place during this era. The following are the most important ones.

- **Series of denudation and peneplanation:** *during this era, internal and external forces acted on the face of Africa, resulting in denudation and peneplanation of its surface. Denudation is the lowering of the earth's surface, while sinking of land and its resultant peneplanation refers to the formation of almost level surfaces as a result of lowering in altitude.*
- **Heavy erosion:** *the denudation and peneplanation processes were facilitated by the* heavy erosion *that affected many places in Africa. The eroded materials accumulated in the Maghreb region, the western Sahara, and the Southern Cape. From Eastern Africa, sediments were taken to Southern Africa and the Middle East. These sediments finally formed sandstones, shale and limestone. Also during this era,* fold mountains *that run parallel to the Great Karroo, the interior plateau, formed.*
- *Formation of coal during the Carboniferous period.*

Focus

Carboniferous period: The coal Age: is that part of the Paleozoic Era when coal was extensively formed. Thick layers of partially decayed swamp vegetation, covering coastal lowlands were buried under marine deposits when the coastal lands sank. More swamps were formed when the water grew shallower and the process was repeated. As the deposits became compressed and hardened, the vegetation matter formed coal.

Mesozoic Era (*250-70 million years before the present*)

The Mesozoic era is the third-largest and third-oldest era in the geological history of the earth. For Africa, the era was a time of alternate sinking and rising of the land. The era is divided into three periods. These are the **Triassic**, **Jurassic** and **Cretaceous**. During the first period, the Triassic, there was sinking of the land in the eastern part of the continent. The land remained under the sea during the Jurassic period. Rising (uplifting) of the land began in the Cretaceous.

The following are the most important events that took place during the Mesozoic era in Africa.

- *Sinking of the Horn of Africa resulted in the gradual transgression of the sea during the early years of the Triassic period;*

- *Formation of sedimentary rocks like those in eastern Africa, which were the results of the alternate sinking and rising of the land;*
- *Uplifting of the land in the Horn of Africa, resulted in the regression of the sea during the Cretaceous period;*
- *The flooding of the Sahara region, by water that advanced from* ***Tathys*** *(a sea that separated Laurasia from Gondwanaland), and the subsequent accumulation of sediments.*

Cenozoic Era (*70 million - present*)

This era is the most recent and the shortest era in the geological history of the earth. It covers the time from 70 million years ago to the present. As a result, the era is sometimes called *the living era*. There are two periods in this era. These are the *Tertiary* and *Quaternary* periods. A number of geologic events that changed the face of the continent took place in this era. The major geologic events of this era are the following.

- *Formation of the Mediterranean Sea, the Great East African Rift Valley, the Red Sea and the Gulf of Aden.*
- *Formation of many of the volcanic mountains, plateaus and young fold mountains (Atlas Folds) of Africa. The volcanic mountains that shape the landscape in eastern Africa were formed during this era.*
- *Climatic change that resulted in the cooling and later warming of the earth's climate. The cooling of the climate resulted in the* Pluvial (Fluvial) rains *in tropical Africa, which caused heavy erosion in many parts of the continent. Later, warming of the climate resulted in heavy evaporation and drying up of many water surfaces. In some instances, such a change resulted in the formation of extensive salt plains like the one in northeastern Ethiopia (Afar).*

NOTE

The Cenozoic Era is responsible for the formation of the present surface configuration of the African continent. The present shape, position and relief of Africa was formed during this era. The very high volcanic mountains, the extensive plateaus, the plains and drainage basins of Africa were all formed as a result of the series of geologic events of this era.

The various geological events and processes that took place in the four major eras of the geological time scale have affected the African landmass. The diverse landscapes that we see today in Africa are the results of these processes. Table 3.3 gives a summary of the major geologic events that took place in Africa during the four eras and during their periods and epochs.

Table 3.3: **Summary of the Geological History of Africa**

Era	Period	Epoch	Geologic Events in Africa
Cenozoic	Quaternary	Recent Pleistocene	River terraces and raised beaches formed glaciations in Eastern African mountains; down- warping of the Chad basin; heavy deposition in basins such as the Kalahari basin.
	Tertiary	Pliocene	Mountain building (for example, the Atlas Mountains); intense volcanic eruption in East Africa.
		Miocene	
		Oligocene	East African Rift Valley developed; extensive lava flows in Ethiopia
		Eocene	
Mesozoic	Cretaceous		Marine sediments deposited in many areas, e.g., southern Nigeria.
	Jurassic		Mountain ranges uplifted, e.g., Cape Mountains.
	Triassic		
Paleozoic	Permian		Central and Southern Africa in grip of ice age .
	Carboniferous		
	Devonian		
	Silurian		
	Ordovician		
	Cambrian		Ice age in parts of Northern Africa.
Pre- Cambrian			Mountain building; oldest rocks (4 billion years) in Southern Africa.

3.2.2 The Relief Structure of Africa

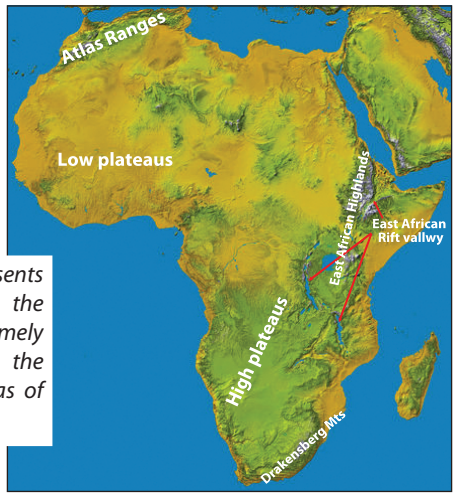
What is relief? How do you describe the relief of Africa?

Africa's relief is made up of huge mountains, extensive plateaus, deep valleys and gorges, plains, and the like. However, much of Africa is plateau. The continent's relief consists of 71% plateaus, 25% plains and 4% mountains. Africa is the only continent that is predominantly covered by plateau lands, and that has only a small proportion of plains.

The relief of Africa ranges from 5,895 m above sea level (at Mt. Kilimanjaro in Tanzania) to 132 m below sea level (at the Qattara Depression in Egypt). This makes the maximum relief of Africa to be 6027 m. The plateau nature of Africa can be seen in the Table 3.4.

Table 3.4: **Percentage distribution of major landforms of the earth, by continent**

Continent	Landform Types (%)		
	Mountains and Hills	Plateaus	Plains
Africa	4	71	25
Asia	44	24	32
Europe	25	8	67
North America	24	24	52
South America	20	24	56
Oceania	28	24	48



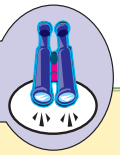
N.B: *Yellow color represents lower altitude while the gray color shows extremely higher altitude and the green color shows areas of high altitude.*

Figure 3.5: **The Topography of Africa**

As the Table 3.4 indicates, much of Africa is composed of plateau landscape. In contrast to the rest of the continents of the world, Africa has the greatest part of

its relief as plateau. However, other features also dominate the continent. These are mountains, plains and the Rift Valley. Now, we shall discuss each of these relief features.

Focus



Maximum relief is the difference in altitude between the highest and lowest points of a place.

Plateaus

What is Plateau?

In most parts of Africa, areas above 300 m above sea level altitude are considered to be *plateaus*. Their altitude reaches its maximum in Eastern Africa, and the Ethiopian plateaus reach over 2000 m above sea level.

Africa's average altitude, 700 m, is a dividing line for plateau types. The continent's landmass can broadly be divided into two types of plateaus **high plateau** and **low plateau**.

High plateaus: are extensive plateaus that lie above 700 m, and their general elevation is above 2000 m. They are found in southern and eastern Africa. The East African plateau, the Bihe (Bie') plateau, the Southwest African highlands and the Malagacy highlands are included in this group. The Kalahari in the west and the Great Karoo in the south are the two major *basins* in this plateau.

Low Plateaus: lie between 300 and 700 m above sea level. The northern and western parts of Africa are predominantly areas of low plateau. As they are surrounded by high plateaus, they form inland basins, such as the Chad, Libyan and Sudd basins. The surrounding uplands of the low plateaus include the Fouta Djalon Mountains, the Jos plateau (Bouchi plateau), the Adamawa uplands, the Ahagar Mountains, the Tibesti and Red Sea hills.

Mountains

What is a Mountain? Where are most of the Mountains of Africa found?

A *mountain* is a high land with steep slopes and a peak. Africa's landform is dominated by two major types of mountains. These are volcanic and fold mountains.

Volcanic mountains: were formed as a result of the great volcanic activities that took place in the Tertiary period of the Cenozoic era. They constitute the highest points (peaks) of the continent, with many of them being above 4,000 m above sea level. Many of the volcanic mountains of the continent are concentrated in Eastern Africa. Table 3.5 shows you the major volcanic mountains of the continent with their heights and locations.

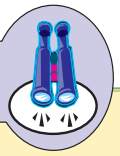
Table 3.5: **Volcanic Mountains of Africa**

Mountain	Elevation (m)	Location
Killimanjaro	5895	Tanzania
Kenya	5200	Kenya
Ras Dejene/Dashen	4620	Ethiopia
Meru	4567	Tanzania
Elgon	4321	Uganda and Kenya border
Cameroon	4070	Cameroon

N.B. Mount Ruwenzori (5119 m) is among the highest mountains in Africa the formation of which was associated with tectonic movement.

Fold Mountains: are found in the northern and southern extremes of Africa. They are of two types: young and old. The *young fold mountains* are located in northwestern Africa, particularly in the Maghreb region, a region that covers areas in Morocco, Algeria and Tunisia. They are called the **Atlas** *Mountains*. These mountains are contemporary to the Alps of Europe and the Himalayas of Asia, and they were formed during the Alpine orogenesis during the Cenozoic era. Their general elevation declines from west to east. The *old fold mountains* are found in South Africa. They were formed during the Hercynian orogeny in the Mesozoic era. They are contemporary to the Australian Alps. They are called the **Cape Ranges**.

Focus



Fold mountains are formed as a result of compressional forces. When the earth's crust is compressed due to horizontally moving surface, the land between two places will be forced to bend up wards and forming fold mountains as a result.

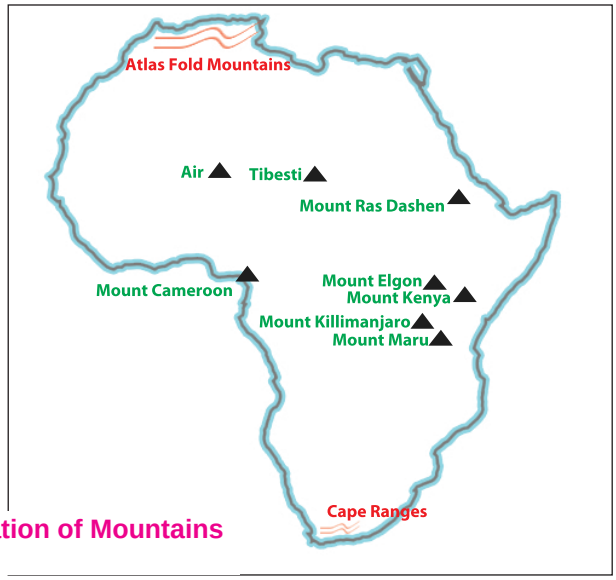


Figure 3.6: **The Location of Mountains in Africa**

Plains

Plains are areas of low relief with more or less flat surface configurations. In Africa, places that lie below 300 m above sea level are generally considered plains. Plains are confined to the coastal areas of eastern, northeastern, southeastern and western Africa. They are very narrow structures that account for about 25% of Africa's relief. They are very small in size, hot dry, poorly vegetated and sparsely inhabited. In addition, their shores, are smooth and regular, and therefore without large bays or gulfs. As a result, the continent lacks good natural harbors.

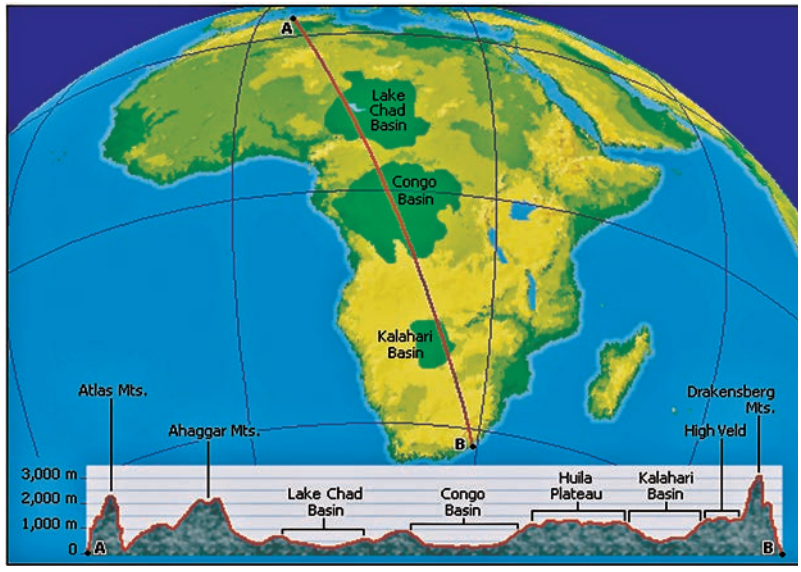


Figure 3.7: **Cross-section of Africa**

NOTE

The topography of Africa features a series of relatively flat plateaus and saucer-shaped basins, broken by highlands, mountain ranges, and valleys. Northern and western Africa, widely known as *Low Africa,* has much lower mean elevations than the south and east, that is often called *High Africa*. As a result, while the northern and western plateaus area are called *low plateau*, the eastern and southern parts are called *high plateau*.

The Great East African Rift Valley

What is a rift valley? How do you describe the Great East African Rift Valley?

The East African Rift Valley is part of the world's Great Rift Valley system, which stretches from Syria, in the Middle East, to Mozambique, in Southeastern Africa, over a distance of about 7,200 km. It was formed in the Tertiary period as a result of faulting processes that acted on the crust of the earth in the region. This rift system extends a distance of about 5600 km in Africa, touching 15 countries in the continent. The Rift Valley has four trenches (branches). These are:

- *Ethio-Eritrea-Djibouti-Northern Somalia Branch*
- *Western Branch*
- *Eastern (Gregory) Branch*
- *Malawi Rift Valley*

Ethio-Eritrea-Djibouti-Northern Somalia Branch

As the name itself implies, this branch runs through the four countries of the Horn of Africa. It is the northern most part of the African Rift Valley, extending north from Lake Turkana in Kenya. It branches out into three trenches at the Afar Triangle, forming the Red Sea and the Gulf of Aden. It has many lakes, including Ethiopian Rift Valley lakes like Lakes Hawassa, Langano, Shalla, Abijata, and Ziway.

Western Branch

This part of the Rift Valley runs from Uganda in the north, southwards through the Democratic Republic of the Congo, Rwanda and Burundi to Tanzania. This part of the Rift Valley hosts the continent's highest block (horst) mountain, Mount Ruwenzori, and also lakes such as Lake Edward, Kivu and Tanganyika.

Eastern (Gregory) Branch

It runs from Lake Turkana in northern Kenya, crossing Tanzania to the east of Lake Victoria. Lakes such as Turkana, Naivasha, Norton, Manyari and Eyasi are located in it.

Malawi Rift Valley

This part of the Rift Valley exists where the Western and Eastern Branches converge. It runs through Tanzania and Mozambique, and ends at port Biera of Mozambique. Lakes Malawi, Rukuwa and Chilwa are among the major lakes in this part of the system.

Figure 3.8: **The East African Rift Valley**

Focus

The Great Rift Valley is a geologic depression that extends from Syria in southwestern Asia to Mozambique in southeastern Africa. It takes the form of a series of valleys and bodies of water that are bounded by parallel fault lines. The Great Rift Valley is widening ,slowly but surely, and in the process is causing many volcanic eruptions and earthquakes in the area.

Africa's largest lake, Lake Victoria (83,000 km^2) is found trapped between the western and eastern trenches of the Rift Valley.

The following are the major characteristics of the East African Rift Valley:

- *It is bounded by steep escarpments (edges);*
- *It has numerous active and dormant volcanoes;*
- *It is often affected by earth tremors like earthquakes, volcanism and landslides, making the Rift Valley very unstable;*
- *Has a hot and dry climate in its many parts, making the place difficult for human habitation;*
- *Many structural basins (lakes) occupy the floor of the Rift Valley.*

Activity 3.5

In a small group, discuss the major characteristics that distinguish the East African Rift Valley region from the rest of Africa.

Content Check

Give short and precise answers for the following questions

1. What is the geologic time scale?
2. Write five geologic events that took place in the Cenozoic era in Africa.
3. Where do we have the high plateaus of Africa?
4. Which areas of Africa are dominated by fold mountains?
5. Describe the great East African Rift Valley.

3.3 CLIMATE OF AFRICA

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

- review the elements of weather and climate;
- identify the major climatic controls of Africa;
- describe the seasonal temperature conditions of Africa;
- explain the seasonal distribution of rainfall in Africa;
- locate the climatic regions of Africa;

- compare and contrast the different climatic regions of Africa;
- relate climatic data with the different climatic regions of Africa;
- explain the causes and consequences of drought in Africa; and
- locate drought-prone areas of Africa.

Key Terms

- Weather
- Climate
- Climatic region
- Controls of climate
- Elements of climate
- Drought
- Famine
- Sahel

Activity 3.6

Discuss the following questions.

1. What do we mean by climate?
2. What constitutes the climate of a certain place?
3. Why do different places have different climates?
4. How do you describe the climate of Africa?

3.3.1 Controls of Weather and Climate in Africa

Brainstorming

1. Do all places in Africa have the same climatic conditions? Why or why not?
2. What are the factors that affect the nature of the atmosphere in a certain place?
3. Which of these factors, do you think, are the most important ones in Africa? Why?

Africa has varied climatic conditions. *Why are there varied climates in Africa?* The answer is that the variation in the climatic conditions of the different places in Africa is due to the intervention of weather and climate controls. The most

important factors that are responsible for this variation include latitude, altitude, distance from the sea, mountain barriers, ocean currents and major planetary winds and pressure belts. These factors are called climate controls because they regulate the conditions of the elements to produce different weather and climatic conditions. They are discussed below in detail.

Latitude

What is latitude? How does it affect the climate of Africa?

Latitudes indicate the distance places have from the equator. A place's latitudinal location affects the amount of incoming solar radiation the place receives, and thereby its temperature. As we discussed earlier, much of Africa (nearly 2/3rd) lies within the tropical latitudes. Hence, the continent receives high sun angles throughout the year. Due to its latitudes, Africa is the hottest of all the continents.

Altitude

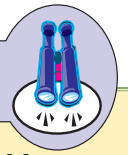
What is altitude? How does it affect the conditions of temperature and rainfall in Africa?

Much of Africa is plateau. There are also high mountains in many parts of the continent, especially in Eastern Africa. These plateaus and mountains have great impacts on the continent's climate.

The plateaus and high mountains reduce maritime influence. This condition reduces temperature. For instance, Eastern Africa, despite its closeness to the equator, experiences highland climates. Similarly, the Atlas Mountains of North Africa and the Cape Ranges of South Africa experience the coldest temperatures in the continent. There are several reasons for this. One of the reasons that temperature is low in higher altitudes is that the air is very thin. This reduces the temperature-retention capacity of the air. The other reason is that, when air rises, it cools.

The third factor is the fact that the atmosphere is heated from below (by the earth) directly, not by the sun. These are some of the factors why we feel colder at mountain tops than in valley bottoms.

Focus



In Africa, the impact of altitude on climate is highly pronounced in the areas of the Atlas mountains, the Cape Range-Fold Mountains, and the extensive East African Highlands.

Distance from the Sea

How do you describe the impacts of the Sea on the climate of Africa?

Water bodies that are adjacent to land masses have great impacts on the temperature and rainfall conditions of those places. Africa in its northern part is very wide. This makes much of the area far from the sea. In addition, the extensive plateaus of Africa, which almost reach the coast with steep edges, form barriers greatly reducing the influence of the sea. Furthermore, the continent's relatively straight and smooth coastline also reduces the impact of the sea in the interior areas. As a result, many parts of interior Africa experience continental climates with insignificance maritime influence.

Ocean Currents

What is Ocean Current? Which ocean currents affect the climate of Africa?

Oceanic water moves in two dimensions, vertically and horizontally. The horizontal movement of oceanic water is called *ocean current*. Based on their origin, ocean currents are of two types. These are **warm** and **cold**. *Warm ocean currents* have high temperatures and high moisture content, and therefore they have warming effect. They also tend to bring moisture to the coastal areas.

In contrast, *cold ocean currents* have cool temperatures and low moisture content. Therefore, they have cooling effects on the areas that they blow over. They also bring no rain to adjacent areas, making places over which they blow very dry and desert.

Three major ocean currents affect the African continent. These are the **Canary Cold Current**, the **Benguela Cold Current** and the **Mozambique Warm Current**. The first two make the northwestern and southwestern parts of Africa both cool and dry. On the other hand, the Mozambique warm ocean current makes Southeastern Africa warm and wet.

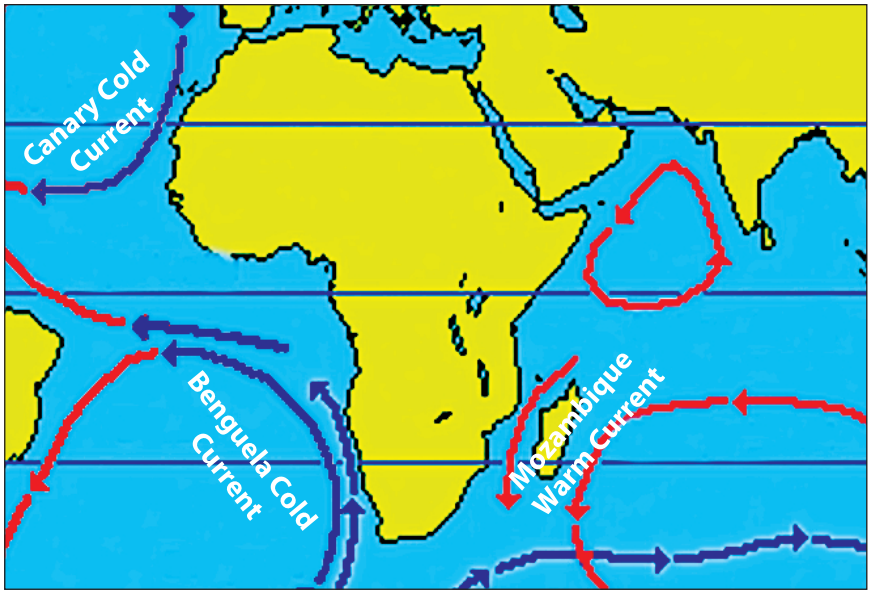


Figure 3.9: **The major ocean currents affecting the climate of Africa**

Major Planetary Winds and Atmospheric Pressure

What is wind? What about atmospheric pressure?

What are the major winds and pressure systems that affect Africa?

Most of Africa lies within the tropics. Hence, much of it lies within the trade-wind belts. The **southeast trades** and **northeast trades** dominate the climate of tropical Africa. The westerly winds from the subpolar high-pressure belts of the world reach the southern and northern tips of the continent. The Guinea monsoon winds (equatorial westerlies) also have significant impacts on the climate of equatorial Africa.

Of the global pressure belts, the subtropical highs (around 30°N and S) and equatorial lows (doldrums) (between 5°N and 5°S latitudes) are the main pressure belts that affect the climate of the continent. In addition, the Inter Tropical Convergence Zone (ITCZ), which is the zone of convergence between the trade winds, regulates the winds that blow into Africa at different seasons. The ITCZ moves between the tropics of Cancer and Capricorn, following the overhead sun, pulling winds towards it. Hence, it controls the distribution of rainfall in Africa.

Figure 3.10: **Major winds that affect the climate of Africa**

Activity 3.7

1 In a small group, discuss the following questions.

- a How do the ocean currents that blow over the coastal areas of Africa affect its climate?
- b Identify the global winds that blow over Africa and explain how they influence the continent's climate.
- c What is the ITCZ? How does it influence the climate of Africa.
- d How does altitude control the temperature and rainfall conditions of Africa in general, and of Eastern Africa in particular.

2 Answer the following questions.

- a How does altitude affect the climate of Africa?
- b What are the major ocean currents that affect the climate of Africa?
- c What are the major planetary winds that affect the distribution of rainfall in Africa?
- d Account for the impact of distance from the sea on the climate of Africa.

3.3.2 Temperature Conditions in Africa

Brainstorming

1. How is the spatial and seasonal distribution of temperature in Africa?
2. Which areas in Africa are the hottest? What about the coldest ones?
3. Why does such a variation in temperature occur?

Spatially, lowlands (coastal areas) and the desert and semi desert areas of Africa experience the highest temperatures in the continent. The Sahara, the largest desert in the world, has the highest temperature. The Kalahari Desert in the south has relatively cooler temperatures as a result of the cold Benguela ocean current. The Ethiopian and East African highlands, on the other hand, have lower temperature condition as a result of their high altitude. The **Atlas of Morocco** and **Cape Ranges** of south Africa have the lowest temperature in the continent as a result of their high altitudinal and latitudinal location.

The distribution of temperature in Africa also has seasonal variation. Such variation is the result of the apparent movement of the overhead sun between the two tropics. The months of December, January and February constitute the summer season in the southern hemisphere. During this time, the sun is overhead, south of the equator. As a result, areas of high temperature are found in Southern Africa. The Northern and northeastern parts of the continent remain relatively cool and dry at this time.

Similarly, the summer season in the northern hemisphere corresponds with the months of June, July and August. This season is a season of high sun angle in Africa north of the equator. Hence, the Sahara and other parts of Northern Africa experience high temperature conditions. In contrast, the areas south of the equator are characterized by lower temperatures at this time.

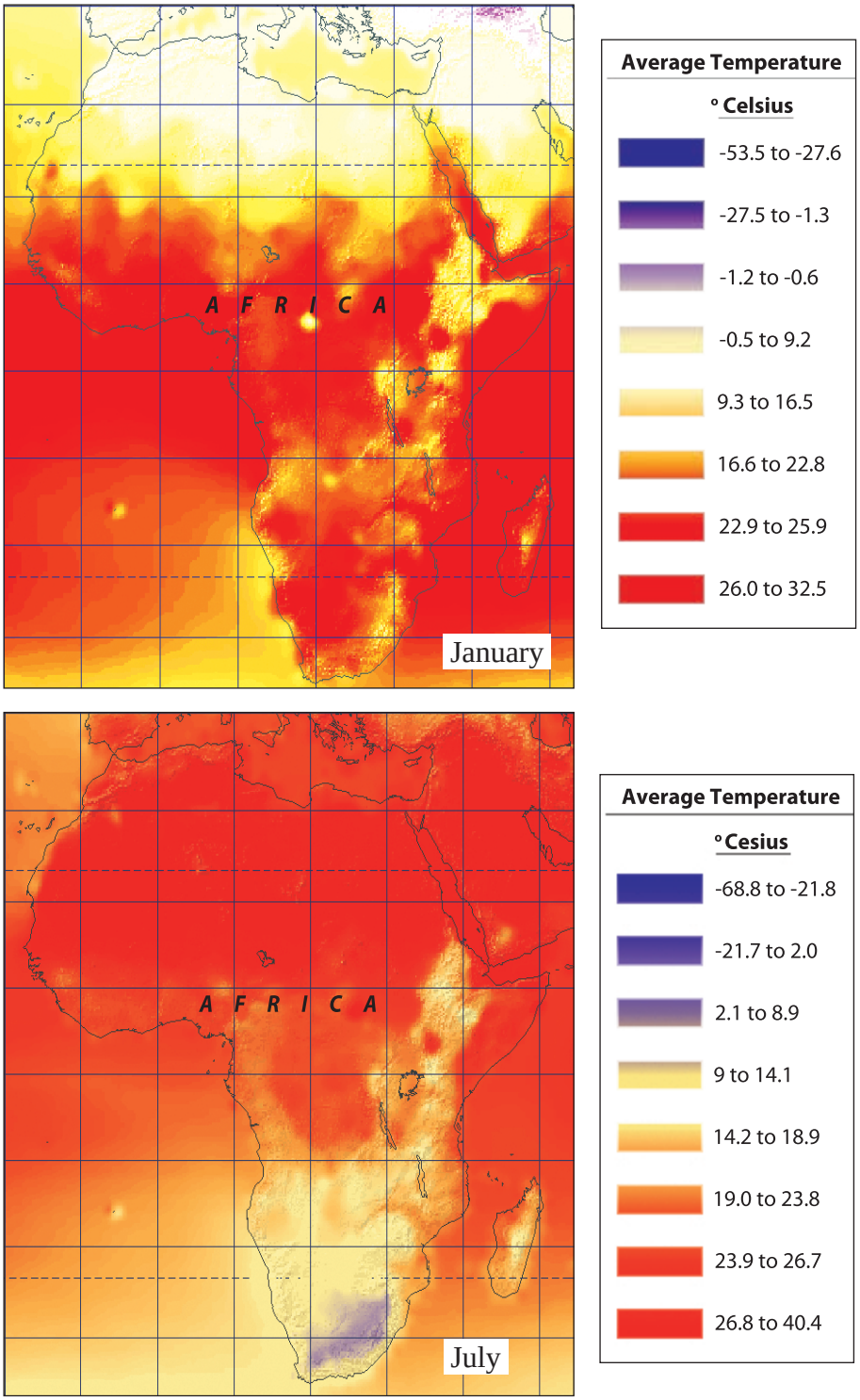


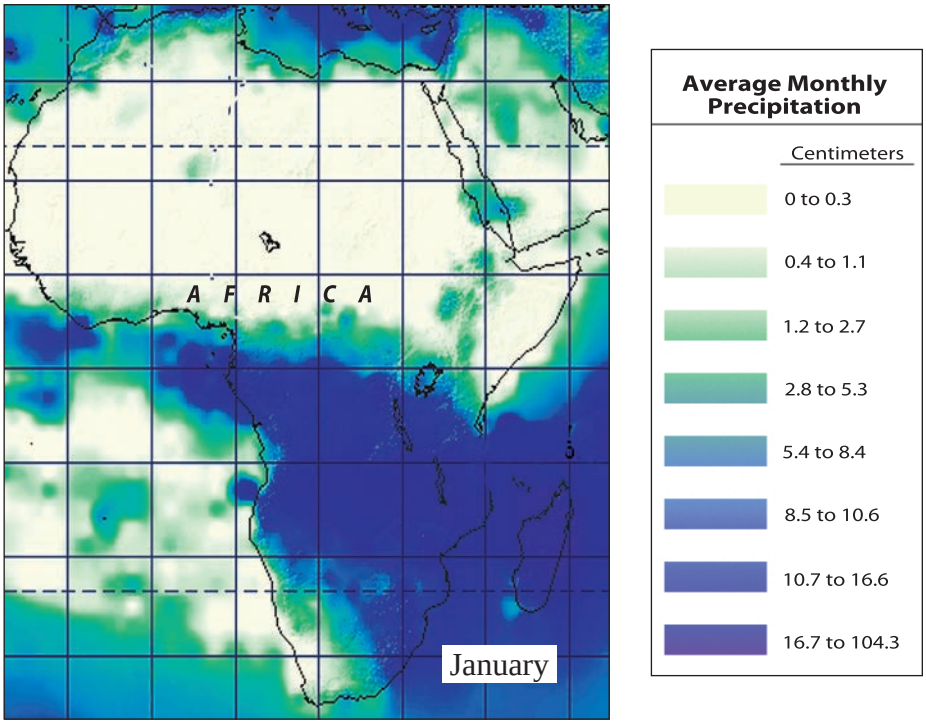
Figure 3.11: **The Seasonal Distribution of Temperature in Africa (the red color Indicates Areas of High Temperature)**

3.3.3 Rainfall Distribution in Africa

The distribution of precipitation (rainfall) in Africa is controlled by the Inter Tropical Convergence Zone (ITCZ). The position of ITCZ is, in turn, determined by the position of the overhead sun. For instance, in July the overhead sun is located near the Tropic of Cancer. Hence, winds that carry moisture from the Atlantic and Indian Oceans, the Guinea monsoon (equatorial westerly) and the southeast trade winds, invade parts of Africa north of the equator, causing the region to receive high rainfall. In this season, West African coastal areas, the Ethiopian highlands, and eastern Madagascar get their heavy rainfall.

In January, the sun is overhead near the Tropic of Capricorn, pulling the northeast trade winds southward over Africa. These winds are continental in origin, carrying limited or no moisture. In this season, therefore, Northern Africa remains dry, except for the Maghreb region, where the Mediterranean type of climate dominates. Southern Africa, however, gets its maximum rainfall from the southeast trades of the Indian Ocean. The Congo Basin gets rainfall from the moist winds of the Atlantic Ocean. To better understand the points so far discussed, study the following points.

- *The Guinea monsoon(equatorial westerly) winds from the Atlantic Ocean bring rainfall to the north of Africa up to the southern fringes of the Sahara in July;*
- *Moist winds from the Atlantic Ocean and the southeast monsoon winds from the Indian Ocean bring rainfall to Southern Africa in January;*
- *The westerly winds bring rainfall to the Maghreb region of North Africa and the Cape Province of South Africa in their respective winter seasons. Summer is not the wettest season in these places;*
- *Summer is a season of heavy rainfall in all parts of Africa, except in the Sahara desert and the Mediterranean-climate regions;*
- *Winter is dry in all parts of Africa, except for the equatorial and Mediterranean climate regions.*



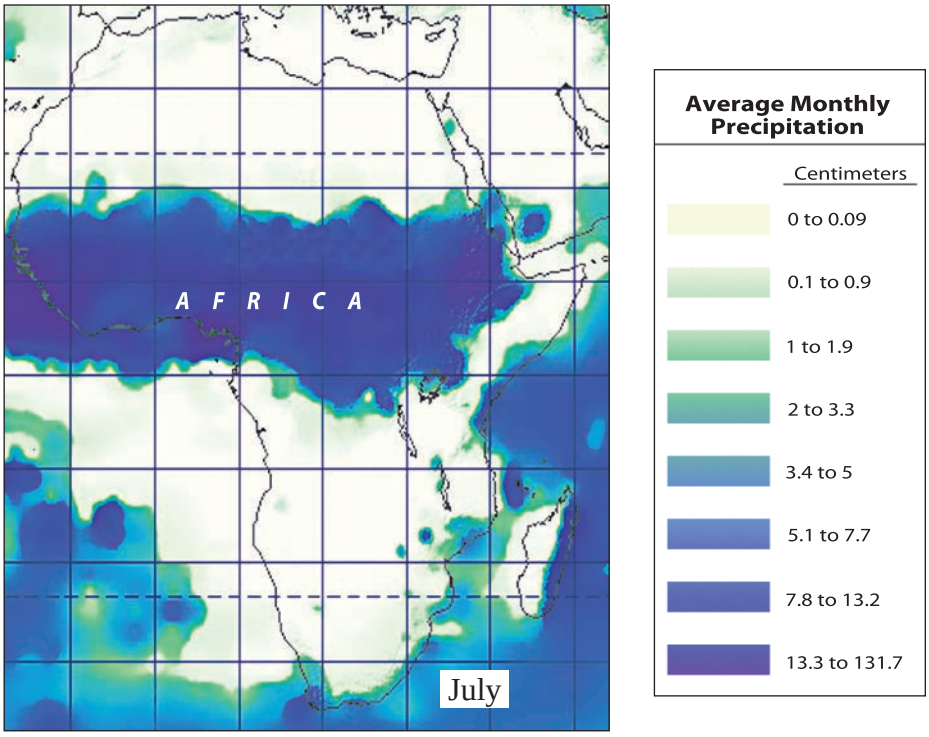


Figure 3.12: **Seasonal distribution of rainfall in Africa**

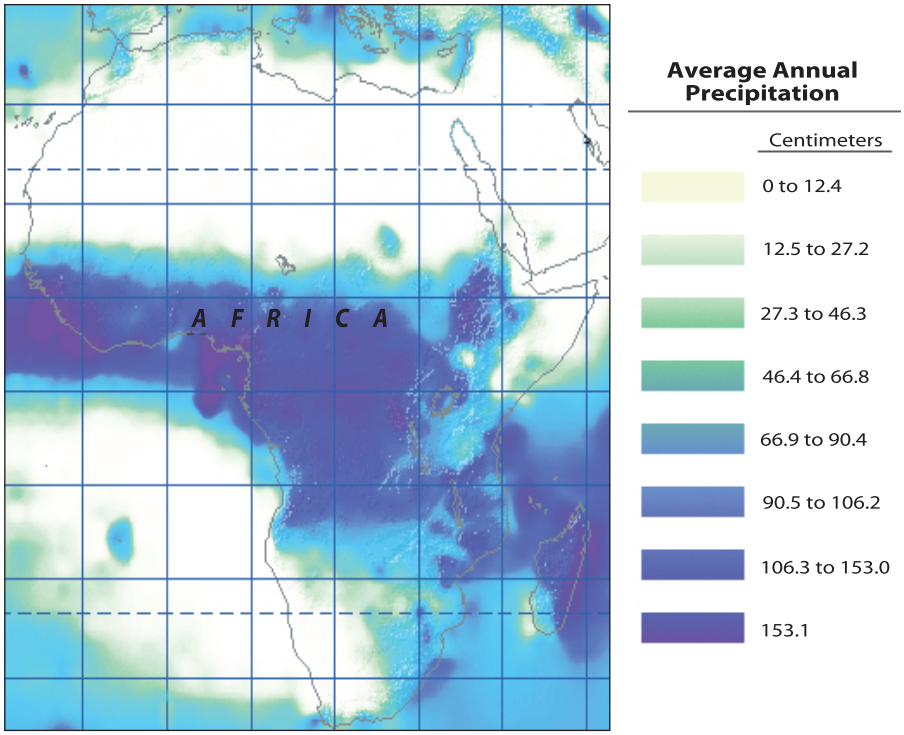


Figure 3.13: **Annual precipitation**

Activity 3.8

By studying the preceding precipitation maps of Africa, answer the following questions.

a Which areas of Africa get maximum rainfall in the months of January, and which in July?

b Relate the annual precipitation map of Africa with the political map of the continent, and identify the countries that receive the highest annual rainfall in Africa.

c Describe the distribution of temperature in the month of July in Africa.

d Account for the spatial distribution of temperature in the African continent.

e What are the dominant rainfall types in Africa?

f Discuss the distribution of rainfall in the month of December in Africa.

g What are the major winds that bring summer rainfall to most African countries?

3.3.4 Climatic Regions of Africa

Brainstorming

1. Do you think that all places in Africa have similar climatic conditions? Why or why not?
2. What are the different climatic regions of Africa?
3. Which of these climates is/are dominant in your area? Ethiopia?
4. Can you list the major characteristics that distinguish each climatic region?

The distribution of temperature and rainfall show great spatial and seasonal variations in Africa. As a result, many different climatic regions are established by these variations. A climatic region is a geographical area with more or less similar climatic characteristics mainly of temperature and rainfall. Multiple areas can be characterized by a single climatic region,

There are seven main climatic regions in Africa. These are:

- Equatorial
- Tropical continental (savanna)
- Tropical desert and semi-desert
- Tropical maritime (monsoon)
- Warm temperate continental
- Highland (mountain)
- Mediterranean

The following map shows the locations of the major climatic regions of Africa. Study it carefully and try to identify the geographical locations of each region.

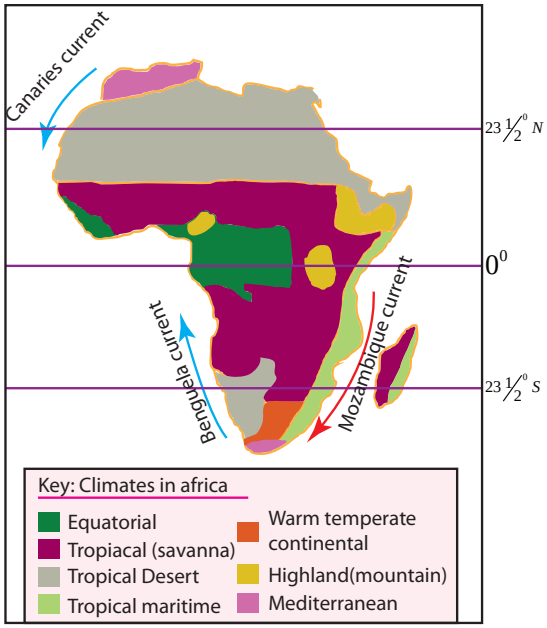


Figure 3.14: **Climate Regions in Africa**

Figure 3.14 shows the geographical locations of the various climatic regions in Africa. Now let us discuss the major characteristics and distinguishing features of each climatic region.

The Equatorial Climate

Which part of Africa has equatorial type of climate? What climatic characteristics does this type of climate have?

The parts of Africa that are found around the equator have this type of climate. The region surrounds the equator extending between 6° or 7°N and S latitudes. This climatic region is dominant in Western and Central Africa. The region has a high mean annual and mean monthly temperature due to the high angle of the sun. Temperatures remain high throughout the year, averaging more than 27°C annually, and rarely falling below 21°C. Most of the time, the annual range of temperature of this region is between 1°C to 3°C.

This climatic region is particularly known for its wetness. Rainfall is high, normally exceeding 1,500 mm per year, and it reaches 3,200 mm in some places. The region receives extremely high amount of total annual precipitation throughout the year. In this region, the convectional type of rainfall is dominant.

The region is characterized by:

- *High sun angle throughout the year;*
- *High mean monthly and mean annual temperatures;*
- *High daily and low annual range of temperature; and*
- *High total annual rainfall, with rain falling throughout the year.*

Tropical Continental (Savanna) Climate

Where in Africa do we have the savanna climate? What climatic features characterize this type of climate?

This climatic region is found between 5° and 15° north and south latitudes. It occurs north and south of the tropical wet zone, in many parts of Western Africa and Southern Africa and in most of Madagascar. The region is situated between the wettest and driest climate zones of the continent. As a result, it is said to be the *zone of transition* between the equatorial and the desert climatic regions of Africa. In this region, summer is very hot, with an average temperature of 25°C, and winter is cool, with an average temperature of slightly above 15°C.

The region is characterized by:

- *a well-defined dry season of three to eight months, with annual rainfall ranging between 500 and 1,500 mm;*
- *a progressive decline in total annual rainfall,north and south wards;*
- *that part of the savanna which borders the equatorial rainfall region receives high rainfall, with that amount decreasing as distance from the equator increases.*
- *slightly higher ranges of temperature than the equatorial climatic zone, with the range increasing with distance from the equator; and*
- *high daily temperatures averaging more than 30°C in its northern section throughout the year, with relatively lower temperatures in its Southern and eastern sections, due to higher altitudes.*

The Tropical Desert and Semi-desert Climate

What characterizes the desert and semi-desert climatic regions? Where in Africa are these types of climate found?

This type of climate is found bordering the tropical savanna climatic region, especially in north central and Southern Africa. There are two types of deserts in Africa. These are the *coastal* and *continental* deserts. The coastal type includes deserts that are found along the western coast of the continent, like the Namib and western Sahara.

In contrast, the Sahara, which constitutes Africa's continental type of desert, is located north of the equator.

The following characteristics distinguish the tropical-desert and semi-desert climatic region from the others.

- *A short rainy season of up to three months. There are about 250 to 500 mm of rain per year in the semi-desert areas and less than 250 mm in the desert regions;*
- *Variable, unreliable and insufficient precipitation, which hinders plant growth;*
- *High daily average temperature, which ranges between 25°C and 36°C;*
- *Significant annual temperature variations and also extreme fluctuations in temperature over the course of a day. For instance, in the Sahara desert, daytime summer temperatures exceed 50°C, but winter night temperatures drop below freezing.*

Tropical Maritime (Monsoon) Climate

Where is the location of monsoon climates in Africa? What features characterize it?

The tropical monsoon climatic region is found only in the southern hemisphere, dominating areas that are located on the southeast coast of Africa. The region extends roughly between Durban in South Africa and Dar-es-Salaam in Tanzania. The region's characteristics are similar to those of the tropical climates, with heavy rainfall almost throughout the year. This characteristic is the result of the warm Mozambique Ocean Current, which brings warm and moisture. Summer is the wettest season of the region. Temperature is high throughout the year, with summer being the hottest season, and winter being warm. Temperature ranges are greater than in the equatorial areas, though they are not as high as in the tropical continental climates.

The region is characterized by the following conditions.

- *The impact of the warm Mozambique ocean current on temperature and rainfall conditions;*
- *High total annual rainfall throughout most of the year, due to the wetting effect of the warm Mozambique current;*
- *High temperature throughout the year, due to the warming effect of the warm Mozambique current; and*

- *Low annual range of temperature, which is similar to, but relatively higher than, that of the equatorial climatic regions.*

Warm Temperate Continental Climate

Which parts of Africa are having this type of climate? What climatic characteristics does it have?

This climatic region is confined to the southern part of Africa, especially to the high veld (temperate grasslands) of the Republic of South Africa. The region is the smallest of all the climatic zones in the continent. Higher rainfall and cooler temperature conditions characterize it. The region's climate is influenced by the high altitude of the area. Rainfall is controlled mainly by the onshore winds that blow from the Indian Ocean.

This climatic region has the following distinguishing features.

- *Great influence of the high altitude of the region on its temperature and rainfall conditions; and*
- *Great influence of onshore winds that originate from the Indian Ocean.*

Highland (Mountain) Climate

Which parts of Africa have mountain climate? What makes this climatic region different from others?

The *highland climate* type is predominantly found in areas where altitude is relatively high. It is dominant in the equatorial and tropical highlands and plateau regions of the continent. For example, the Ethiopian and East African highlands and the higher parts of South Africa (The Drakensberg mountain region) and the Atlas mountains region of northern Africa have this type of climate.

The climate is similar to the *temperate climate* of the world. The tropical nature of the regions' climate is modified by high altitude. Temperature is cool, with small annual ranges. Some areas are covered by permanent snow, as on Kilimanjaro and Kenya mountains. The region also experiences high rainfall, mainly of orographic origin. The rainfall increases with the rise in altitude.

Mediterranean Climate

Which parts of Africa are known for their Mediterranean climate? What unique features does this type of climate have?

The *Mediterranean climatic region* is found in the northern and southern tips of Africa. The Maghreb region in the north, from Morocco to northern Libya

and the Cape Province of South Africa are the main areas that have this type of climate. In this region, summer is not the rainy season. Most of the rain falls in winter, with a total annual rainfall that ranges from 250 mm to 1000 mm. This makes the region unique in its climatic characteristics. As a result, the region is one of the most attractive climatic zones in the continent. Many tourists visit the region every year.

The following conditions characterize the Mediterranean climatic region of Africa.

- *A hot, sunny, bright, dry summer season; and*
- *A mild wet winter season.*

3.3.5 Drought in Africa

Brainstorming

1. What is drought?
2. What do you think are some of the causes of drought?
3. Which areas in Africa are drought-prone?

Drought is a condition of unusually dry weather within a geographic region. Expected rainfall does not occur during drought. Therefore drought conditions differ greatly from conditions in an area that is normally, or at least seasonally,dry.

The term is usually applied to a period in which an unusual shortage of rain causes a serious hydrological imbalance a situation whereby water-supply reservoirs empty, wells dry up, and crop damage follows. The severity of a drought is measured in terms of the degree of moisture deficiency, its duration, and the size of the area affected.

Droughts tend to be more severe in some areas than in others. Disastrous droughts occur mostly at latitudes of about 15°-20°, in areas bordering the permanently arid regions of the world. As most parts of Africa lie within these latitudes, the continent is one of the most drought-affected areas in the world. Repeated drought is common in many areas.

Major causes of drought in Africa include unwise use of natural resources,

including deforestation, overgrazing and over cropping, expansion of farm lands and settlements, and the resultant environmental degradation.

The repeated drought that occurs in many areas of the continent causes environmental degradation, habitat destruction, shortage of water and famine (shortage of food). This, in turn, results in the displacement/migration and death of people and animals. The huge displacement of people and the high rural-urban migration that occurs in many countries of Africa is associated with this phenomenon. Drought also affects the biodiversity of a place. As drought prevails, plants and animals may fail to survive. As a result, some species of plants and animals may become extinct or be exposed to danger of extinction. This is happening in the drought-affected areas of the continent.

The Sahel region of Africa is one of the extremely drought-affected areas in the continent. The region is a transitional zone between the Sahara on the north and the wetter tropical areas to the south. Desertification of the Sahel was aggravated by extended drought between the late 1960s and early 1980s, the worst in 150 years. The stress of increasing human and livestock populations is another major contributor.

Desertification is the process whereby soil loses its ability to retain moisture , and then desert encroaches on arable land. Desertification is shrinking the size of the Sahel and causing famine in many parts of the region. This climatic condition covers many countries that are found to the south of the Sahara desert. As a result, they are among the areas repeatedly affected by drought.

The following figure shows you the drought-prone areas of Africa. Study it carefully and try to identify the countries that are found in the zone. To do so, cross-reference between the figure and the political map of Africa Figure 3.15.

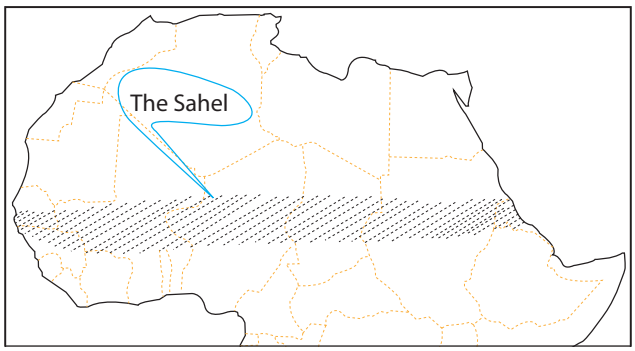


Figure 3.15: **The Sahel, drought-prone areas in Africa**

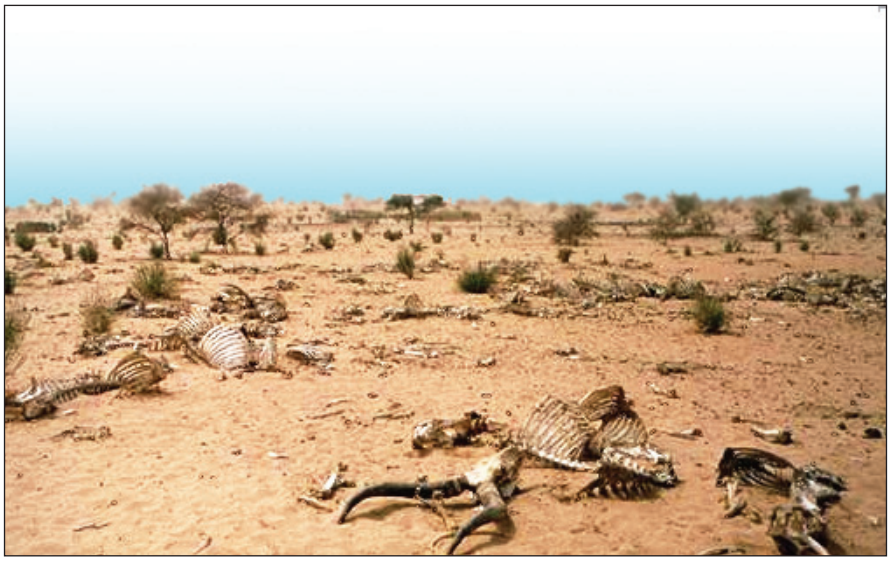


Figure 3.16: **Sahel drought devastation**

NOTE

The drought in the Sahel region of West Africa, which began in the late 1960s and lasted until the early 1980s, was the worst drought of the 20th century. The agriculture and livestock of much of Mauritania, Mali, Burkina Faso, Niger, and Chad were devastated, and the countries' economies suffered.

Content Check

I ***Define the following.***

a Climate

b Weather

c Drought

d Elements and controls of climate

II ***Give short answers for the following questions.***

1 What are the major factors that affect the climate of Africa?

2 Write at least four characteristics of Equatorial climates.

3.4 DRAINAGE SYSTEMS OF AFRICA

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

- demonstrate the major rivers and drainage systems of Africa;
- discuss the characteristics of the major African rivers;
- identify the location of lakes and swamps in Africa;
- realize the economic significance of African rivers and lakes; and
- analyze the hydro-politics of the Nile River.

Key Terms

- Drainage system
- Discharge
- Catchment area
- Seasonal fluctuation
- Swamp
- Lake
- Drainage Density

Africa is rich in terms of water resources. Thousands of rivers that originate in African highlands drain the extensive landmass of the continent. Furthermore, large numbers of lakes are found in the continent. Swamps are also dominant drainage features in Africa. These resources have tremendous potential. However, the people of the continent are far behind the developed world in terms of their socio-economic status, and therefore also in the technology and other resources needed to develop this potential.

3.4.1 The Major Rivers and Drainage Systems of Africa

Brainstorming

1. What is meant by drainage basin, drainage system and discharge?
2. What factors affect the drainage systems of Africa?
3. Which are the major river basins and drainage systems of Africa?
4. Why does the Congo basin experience low annual fluctuation in its discharge/ volume?

The entire area that a river drains is called its *catchment area* or *drainage basin*. A *group of drainage basins,* which are supplied by multiple rivers, with common characteristics, such as a common destination, form a *drainage system*.

Nine major rivers drain the African continent. These are the Nile, Congo, Zambezi, Limpopo, Orange, Niger, Volta, Gambia and Senegal rivers. These basins are categorized into four major types of drainage systems, based on their flow direction. These major drainage systems are

- *Atlantic Ocean drainage system;*
- *Indian Ocean drainage system;*
- *Mediterranean Sea drainage system; and*
- *Closed (Inland) drainage system.*

The following discussion provides you with some facts about each drainage system. Figure 3.17 shows you the locations of these systems.

Figure 3.17: **Major Rivers in Africa**

A The Atlantic Ocean Drainage System

What are the major rivers that constitute this system?

This system is made up of all major rivers that drain westward and southward and empty into the Atlantic Ocean. The system is the largest in terms of catchment area, annual discharge and drainage density. It accounts for about 90 percent of the content's surface flow. The major river basins that constitute this system are the Congo, Niger, Volta, Gambia, Orange and Senegal basins. Several other, small rivers are also found in this system. Table 3.6 shows you the major river basins and their tributaries.

Table 3.6: **Major rivers in the Atlantic Drainage system**

River Basin	Length (Km)	Remark
Congo	4,380	Largest river in Africa in terms of total annual discharge, 2nd longest river in Africa and 2nd largest in the world.
Gambia	1,130	One of the smallest major river basins of Africa
Senegal	1600	Has two major dams. the Manantali Dam in Mali, and the Maka-Diama dam on the Mauritania-Senegal border.
Niger	4000	Drains Guinea, Mali, Niger, Benin and Nigeria. 3rd longest in Africa.
Volta	1500	Has Africa's largest artificial lake, Lake Volta; has three major parts. Black Volta, White Volta and Red Volta.

B The Mediterranean Sea Drainage System

Which river is the most important in this system? Why?

This drainage system includes all the major rivers that flow northwards into the Mediterranean Sea. However, the system has only one major river basin, which is the Nile. The **Nile** is the longest river in the world.

Two major tributaries, namely the White Nile and Blue Nile, form the Nile proper when they converge in the Sudan, at Khartoum. The White Nile originates from Lake Victoria in Uganda, while the Blue Nile emerges from Lake Tana in Ethiopia, near Bahir Dar.

The Nile flows generally northwards through the Sudan and Egypt and empties into the Mediterranean forming an extensive delta in north Egypt.

C The Indian Ocean Drainage System

Which rivers of Africa form the Indian Ocean Drainage System?

The *Indian Ocean Drainage System* includes all the major rivers that flow eastwards into the Indian Ocean. This system is the second largest system, in

Africa in terms of drainage density, catchment area and annual discharge. The Zambezi, Wabishebelle and Juba river basins are the major basins in this system.

Table 3.7: **Major River Basin of the Indian Ocean drainage system**

River Basin	Length (Km)	Remark
Zambezi	2750	Has Africa's largest waterfall, Victoria Falls; has two major dams: Kariba (Zambia and Zimbabwe) and Cabora Bassa (Mozambique)
Wabishebelle	2000	Has High seasonal variation, and therfore usually fails to reach the Indian Ocean in winter. However, it manages to reach the ocean during the summer season.
Jubba	1600	Forms one of Somalis most fertile agricultural region in its lower valley.

D *The Closed (Inland) Drainage System*

What are the rivers that form the Inland drainages system of Africa?

The rivers of Africa that do not have direct access to the sea form this drainage system. Most of the rivers in this system have multiple flow directions. This makes the system different from the rest of the drainage systems in Africa. This drainage system covers nearly 32% of the total area of the continent. It receives nearly 4% of the continent's total annual runoff.

The Awash and Ghibe/Omo rivers in Ethiopia, the Okovango Swamp in Botswana, the Sudd Basin in the Sudan, the Danakil Basin in Ethiopia and Eriterea and Lake Chad Basins are among the major inland drainage basins of the continent. The Chad Basin is the largest inland basin in Africa.

Table 3.8: **Catchment Areas and Lengths of Some of the major Rivers of Africa**

River	Length (km)	Catchment Area ('000' km^2)	Main Tributaries
Nile	6650	2862	Blue Nile, White Nile, Sobat, Atbara
Zaire/Congo	4380	3700	Kassai, Ubangi
Niger	4000	1112	Benue
Zambezi	2700	1300	Cubango, Cuando
Ghenale/Juba	1600	168	Dawa, Weyb, Mena, Welmel
Wabeshebelle	2000	205	Erer, Fafen, Ramis

3.4.2 General Characteristics of African Rivers

Brainstorming

What factors affect the economic utilization of African rivers?

What major features characterize African rivers?

Most African rivers share some common characteristics:

a **Steep long profile:** Most of the rivers in Africa have steep courses, as a result of the continent's relief. Furthermore, most of the rivers empty into the major water bodies by falling from the edges of interior plateaus of the continent. This affects the navigability of many of the rivers of the continent.

b **Waterfalls and Rapids:** Many African rivers are interrupted by waterfalls and rapids, which impede navigation. The waterfalls and rapids are due to Africa's number of plateau lands, with their steep sides, and strong erosion-resistant rock, which the rivers encounter in their courses. Some examples of rivers with these features are the Congo, Nile, Niger, Zambezi, Orange and Cunnen Rivers.

Study the following table, which presents Africa's major waterfalls.

Table 3.9: **Major Waterfalls in Africa**

Name and Location	Height of Falls (m)
Tugela, South Africa	614
Chirombo, Zambia	268
Kalambo, Tanzania, Zambia	221
Maletsungane, Lesotho	192
Victoria, Zimbabwe, Zambia	108
Tis Isat, Ehtiopia	45

c **Seasonal Fluctuation:** Many of the rivers of Africa have their origins in areas of seasonal rainfall distribution. As a result, there are variations in their volumes between the wet and dry seasons. The Nile and Niger Rivers are good examples of this phenomenon. Both originate in wet highlands with seasonal rainfall. In contrast to the other African rivers, the Congo River does not show significant volume variation. It is the only African

river with a steady volume throughout the year. This characteristic is due to the fact that it has tributaries running from both with in and south of the equator.

d **Deltaic Mouths and Mangrove Swamps:** Many of the African rivers have low pressure force along their lower courses. This allows the rivers to branch out into distributaries, and results in the formation of deltas and mangrove swamps at the mouths of the rivers. For instance, the Nile, Niger and Zambezi rivers have extensive deltas and are swampy at their mouths. Such conditions affect the penetrability of the rivers from the coast.

e **Exotic Nature of the Rivers:** Many of the rivers of Africa, like the Nile, Senegal and Orange, travel across different physiographic regions that range from cool to extremely hot climatic conditions. As a result, they lose much of their water through evaporation and seepage before they reach their final destinations. The Nile River faces the greatest impact in this case. It loses nearly 64% of its total run off through evaporation and seepage. The Senegal River loses 54%, and the Orange River has a total loss of 44% in its runoff.

NOTE

Deltaic mouths, mangrove swamps, the fluctuation regime of the rivers, and waterfalls and rapids across the major rivers of Africa hinder the navigability of their courses. However, these rivers have high HEP potential. The water falls of Africa, if regulated, could produce enormous amounts of hydro-electric energy.

Activity 3.9

Discuss the following questions.

1 Identify the major rivers that constitute the Indian Ocean drainage system.
2 Why do African rivers show high seasonal variations?
3 What are the major factors that affect the navigability of African rivers?
4 Define drainage basin and drainage system.
5 Compare the major drainage systems of Africa in terms of their catchment areas and annual discharge.

3.4.3 Lakes and Swamps of Africa

What is a lake? What about swamps?

Where are most of the lakes of Africa found?

Africa has many lakes and swamps. Some of them are natural, and others are human-made (artificial). The lakes differ in their size and depth. For instance, lakes Tanganyika and Malawi are deep and large, while Victoria and Tana are wide and shallow, respectively.

Lakes of Africa

The lakes are divided into two types-*natural* and *artificial (anthropogenic)*. *Natural lakes* are formed by tectonic, volcanic and/or denudation processes. Anthropogenic lakes are formed when water is accumulated at the backs of dams that are constructed across rivers for various purposes, including hydro-electric production and irrigation.

Natural Lakes

What is a natural lake? How are lakes formed naturally?

These are lakes that are formed under natural conditions. Based on location, natural African lakes are divided into two groups: *Rift valley* and Non-Rift *Valley* lakes. The first group includes all the lakes that occupy the floor of the Great East African Rift Valley. Lakes, like Turkana, Tanganyika, Kivu, Albert, Malawi, Edward and the numerous Rift Valley lakes in Ethiopia belong to this group.

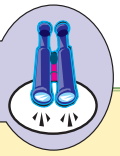
The major non-Rift Valley natural lakes include Victoria, Chad and Tana.

Table 3.10 Presents the major natural lakes of Africa and some of their characteristics.

Table 3.10: **Natural Lakes of Africa**

Lake	Area (km^2)	Maximum depth (m)	Type	Remark
Victoria	83,000	92	Non Rift valley	Largest in Africa, largest tropical lake in the world, 2nd largest freshwater lake in the world and 3rd longest in the world
Tanganyika	32,890	1435	Rift valley	World's longest fresh water lake, Africa's deepest lake and second in the world, Africa's second largest lake
Malawi	30,800	706	Rift Valley	The most southern lake in the Great African Rift Valley system
Chad	18,000	12	Non-Rift valley	-
Turkana	8,660	72	Rift valley	-
Albert	5,500	17	Rift valley	The northernmost of the chain of lakes in the Great Rift Valley
Meru	4,920	NA	Rift valley	-
Tana	3,600	9	Non-Rift valley	Shallowest in Africa
Edward	3,550	NA	Rift valley	-
Kivu	2,650	475	Rift valley	-

Focus



Most of the African lakes that are found along the Rift Valley are long and narrow. Many of them that mark the western branch of the Rift Valley have outlets to the ocean through rivers. For example, Lakes Edward and Albert empty through the Nile River, and Lake Tanganyika empties through the Congo. In contrast, most of the lakes that mark the eastern branch of the Rift Valley participate in the Inland Drainage System. Lake Malawi, which is also a member of the eastern-branch lakes, is an exception, as it drains into the Indian Ocean through the Shire river.

Artificial (Anthropogenic) Lakes

What are artificial lakes? How and why are artificial lakes formed?

Africa has large numbers of rivers that have enormous hydro-electric power and irrigation potential. To utilize the rivers for these and many other purposes, large dams have been constructed across their courses. The major *anthropogenic lakes* in Africa are Nasser, Koka, Volta, Kaindji and Kariba. Table 3.11 presents the major artificial lakes in Africa.

Table 3.11: **Artificial lakes of Africa**

Lake	Dam	River	Country
Nasser	Aswan High Dam	Nile	Egypt
Koka	Koka	Awash	Ethiopia
Volta	Akosombo	Volta	Ghana
Kaindji	Kaindji	Niger	Nigeria
Kariba	Kariba	Zambezi	Zambia and Zimbabwe

Activity 3.10

In a small group discuss the following questions.

1 Why do people construct dams across rivers?

2 What are the impacts of dam construction on local populations and the environment?

Swamps of Africa

What is swamp? How are they formed?

There are many seasonal and permanent swamps (marshes) in Africa. They develop mostly in depressions and areas of seasonal flooding along the courses of the major rivers. The major swamps of Africa include

- *Sudd swamps, along the Nile river basin;*
- *Kamulando swamps, in the Congo Basin;*
- *Batorse and Kafue swamps, in the Zambezi Basin;*

- *Okovango swamps, in Botswana;*
- *Swamps adjacent to lake Chad;*
- *Mangrove (coastal) swamps along the deltaic mouths of the major rivers;*
- *Timbukto swamps, in Mali along the Niger river.*

3.4.4 The Uses of African Rivers and Lakes

Brainstorming

1. What are some important socio-economic features of Africa's rivers and lakes?
2. How far are these resources exploited in Africa?
3. Why are the rivers and lakes of Africa underutilized?

The rivers and lakes of Africa have great potential for development. They can contribute to the socio-economic development of the continent if they are properly developed and utilized. Some of their uses are discussed below.

Hydro-Electric Power (HEP)

Africa has about 40% of the world's HEP potential. The steep profile of the rivers and the waterfalls and rapids that develop along their actual and potential courses make the continent rich in this respect. Although, very little (about 5%) of this potential is actually being utilized, large dams have been constructed for this purpose. For example, see Table 3.12.

Table 3.12: **Major Dams of Africa**

Dams	River	Location
Aswan High Dam	Nile	Egypt
Owen Falls	White Nile	Uganda
Koka	Awash	Ethiopia
Akosombo	Volta	Ghana
Kaindji	Niger	Nigeria
Kariba	Zambezi	Zambia and Zimbabwe
Inga I and II	Congo	Congo, DR
Cabora Bassa	Zambezi	Mozambique
Ghibe I and II	Gilgel Ghibe	Ethiopia
Tekeze	Tekeze	Ethiopia

Irrigation

The rivers and lakes in Africa have great potential for irrigation. However, what has been utilized so far is insignificant compared to this huge potential. Lack of technology, capital and skilled human power, as well as conflicts and political unrest, are among the factors that result in low development of irrigation in Africa. Among the major irrigation schemes, some are the Gezira and Kenana irrigation in Sudan, Nile Delta and lower Nile irrigation in Egypt; Fish river, Orange and Pongola irrigation in RSA.

Fishing

What is fishing?

Africa's rivers and lakes are rich in fish resources. There are about 2,000 different species of fish in the continent.

The most widespread human use of lakes in Africa is for fishing, but this economic sector is poorly developed. Most fish production in the continent is for home consumption. As a result, very little is taken into the market. This situation is primarily due to insufficient technical skills in the continent.

Navigation (Inland Waterways)

Most of the rivers in Africa are characterized by waterfalls, rapids, steep profiles, deltaic mouths and seasonal volume fluctuation. These conditions hinder their navigability. However, the Nile, Niger, Senegal and Gambia Rivers are navigable along parts of their courses, especially in summer. The Congo River is navigable for a good part of its course throughout most of the year. Lakes like Chad, Victoria, Tana and Malawi also provide transport services for a good number of people.

Tourism and Recreation

In many countries in Africa, rivers and lakes are good tourist destinations and centers of recreation. The waterfalls along the rivers and the birds of the lakes are attractive. The Nile in Egypt, Victoria Falls on the Zambezi River, and Lake

Nakuru in Kenya and Lake Malawi in Malawi and Tis Abay on the Abbay River, and Awash Falls in Ethopia are good examples.

Fresh-Water Supply

The rivers and lakes in Africa constitute most of the continent's fresh-water resources. The piped water supplies for urban Africa and the water supply for the rural population, are all dependent on the rivers and lakes of the continent.

Source of Minerals and Construction Materials

Rivers and lakes carry various rocks and their fragments that are good sources of minerals and construction materials. For instance, the alluvial deposits along the major rivers of Africa contain gold and diamonds, as well as other minerals, for example, tin in Ghana and Namibia. Salt and potash as well as sand and gravel can be obtained from rivers and lakes.

The Hydro Politics of the Nile River

The Nile River is one of the most politically significant rivers in Africa. In its basin countries have significant interest over its water. The countries that are found in the Nile basin are Ethiopia, Egypt, Kenya, Sudan, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Eritrea and Tanzania. Based on the general alignment of the river these countries are categorized into two as upper course and lower course countries. The upper course countries are those that contribute the water for the river and are generally found at higher altitude where the major tributaries of the Nile originate. On the other hand, the lower course countries, namely Sudan and Egypt, are those that are found at lower elevation where the water of the river flows gently over vast plains.

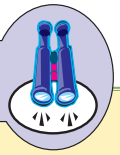
Figure 3.18: **The Nile basin**

Blue Nile is the largest contributor of water to the Nile proper. Together with Baro-Akobo and Tekeze rivers, Ethiopia accounts for about 84% of the water of the Nile.

The Hydro-politics of the Nile is, therefore, related with the degree to which the Nile river is utilized in its upper and lower courses. Of the total estimated 110 bn m^3 of annual water resource, nearly 65% (72 bn m^3) occurs in the Ethiopian portion of the Nile basin. Of this, about 52.6 bn m^3 is accounted by the Abay river alone.

Historically, the two countries, Egypt and Sudan have been the most benefited of all the countries in the Nile basin. This is especially true for egypt where the Nile River's water and alluvial soil along its flood plain have become the source of life in the desert affected Egypt. The Aswan high dam that is constructed along the Nile River in Egypt has been the most important source of water, energy, fish and recreation for the Egyptians. In Sudan, too, the river has been developed to a greater extent. Contrary to this, the upper course countries have been the least benefited. This unbalanced and unfair utilization of the river between the upper and lower course countries has been a great area of interest.

Focus



The Aswan high dam

- *Was started in 1960 and completed in 1967.*
- *Its purpose was to create an artificial lake of high capacity.*
- *Its lake is 10 km wide and 500 km long of which 350 km is in Egypt and the rest 150 km in Sudan.*
- *Has a total capacity of storing about 160 bn m^3 water*
- *Has the following functions.*
  - *Protection against floods*
  - *Generating HEP of about 10 bn kwh/day*
  - *Irrigation*
  - *Reduces salt intrusion in the agriculture field.*

However, the countries of the basin are now in a situation where by they are working together to bring about equitable utilization of the river. The Nile basin initiative is a good example in this case. Through the initiative, the countries are working together to maintain balanced utilization of the river in the upper course and lower course countries.

Content Check

Answer the following questions.

1 Name three major rivers of the Atlantic ocean drainage system in Africa.

2 Discuss the major characteristics of African rivers.

3 Write the major rivers across which major dams are constructed.

3.5 NATURAL VEGETATION AND WILD ANIMALS OF AFRICA

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

- relate natural vegetation and wild animals with climatic regions;
- appreciate the types and economic uses of wild animals in Africa; and
- show interest in implementing natural-vegetation and wild-animals conservation measures.

Key Terms

- Natural vegetation
- Alpine vegetation
- Wild animal
- Endemic
- Xerophite
- Poaching
- Reforestation
- Afforestation
- Conservation

There are different types of climates in Africa. As a result, varied types of natural vegetation develop over the landmass of the continent. There are also various species of wild animals that inhabit the various physiographic regions of the continent.

3.5.1 Major Vegetation Zones of Africa

What is Natural Vegetation? What are the major vegetation types that develop in Africa? What causes a variation in vegetation type and distribution in Africa?

The type of natural vegetation that develops in a certain environment is a reflection of the climatic characteristics of that place. Africa has a number of different climatic regions with their own distinguishing climatic features. As a result, we have various types of natural vegetation covering the different geographic regions of the continent. In general, five different vegetation zones can be identified in Africa. These vegetation types are discussed below.

- *Tropical rainforests*
- *Tropical grassland (savanna)*
- *Desert and semi-desert vegetation*
- *Afro-montane (Afro-alpine) vegetation*
- *Mediterranean vegetation*

Brainstorming

1. To what type of natural vegetation, is each climate type conducive?
2. What are the dominant types of natural vegetation that could develop in each climatic region?
3. Is there any correspondence between climatic regions and vegetation zones in Africa?

Tropical Rainforests

What is a rainforest? Where in Africa do we have rainforests?

What unique features do rainforests have?

Tropical rainforests develop in areas with equatorial climates. In Africa, they are confined to Central and Western Africa, and eastern Madagascar. In these places, the climate is typically tropical, with high rainfall and high temperatures throughout the year. Tropical rain forests are also known as *equatorial broad leaf evergreen forests*. Africa's most extensive rainforest is found in the Congo Basin.

The following points give you some ideas about the nature of these forests.

- *Rain forests are complex, with these three distinct layers:*
  - Top layer – *made up of tall trees (30 - 50 m) with buttress roots;*
  - Middle layer – *made up of tree ferns, lianas (creepers), epiphytes, and trees with heights of 19 - 34 m; and*
  - Bottom layer – *consists of ferns, herbaceous plants, saprophyte (plants which live on dead plants) and trees with heights of up to 17 m.*
- *They contain broad-leaved evergreen trees (green throughout the year);*
- *Different plants exhibit different stages of growth at the same time, due to the absence of climatic seasons. Some are in flower, some in fruit, and others in the leaf-fall stage;*
- *They have little undergrowth, as the canopies of the tall trees prevent light penetration;*
- *Most of the trees are hardwood, like mahogany, ebony, ironwood, rosewood and green heart;*
- *They have high species diversity and thick growth.*

Study sketch given below to learn what the vegetation in tropical areas looks like.

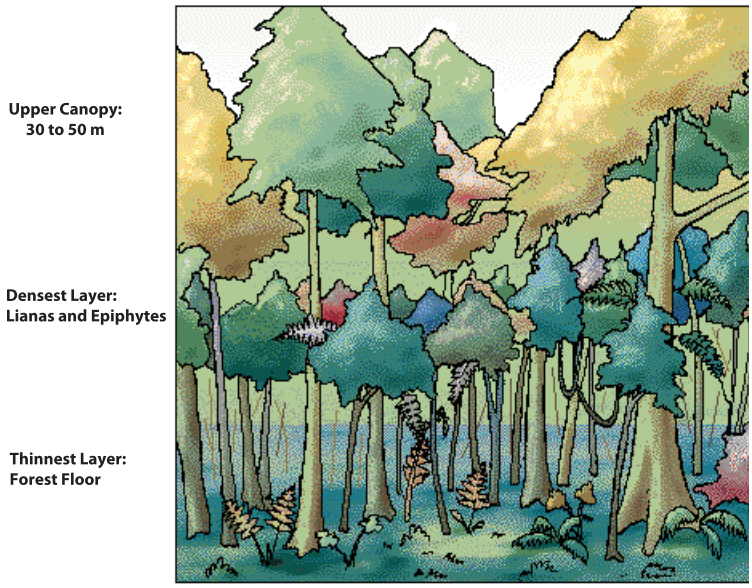


Figure 3.19: **A Sketch of the Tropical Rainforest**

Tropical Grassland (Savanna)

What is a Savanna? Which parts of Africa have savanna vegetation?

This kind of vegetation develops in areas of seasonal rainfall. Tropical grassland vegetations are extensively developed in areas that have wet summers and dry winters.

Tropical grasslands exist in Northern and Southern Africa, and they encircle the equatorial rainforests. Rainfall in savanna areas varies, decreasing over the range from the forest margins to the edges of the desert. Savanna areas that are close to the equatorial rainforests receive more rainfall, compared to the areas at the edge of the desert. This results in the development of three Savanna zones in Africa. These are:

i ***Park (Wetter) Savanna:*** it is found close to the rain forests and made up of many trees and grasses. Geographically, it is found in Western Africa, northern Congo, southern Sudan and central Malawi.

ii ***High (True) Savanna:*** this type of grassland is developed between the wetter and drier savannas. It is made up of more grasses than park-savanna areas, and contains scattered trees only. It is found in Zimbabwe, Malawi, southern Kenya, eastern Tanzania and Western Africa.

iii ***Thorn Scrub (Drier) Savanna:*** this savanna zone is developed along the desert margins and is made up of short grasses with widely scattered thorny trees, thorn bushes and low scrub. It is common in the semi-arid areas of the Sahel region that extends from Senegal to Ethiopia, Northern Kenya, Angola and Botswana.

The main features of savanna vegetation include the following.

- *They have tall grasses that are often as tall as 2 m;*
- *Trees are more common than grasses in areas bordering the forest, and grasses are more common than trees in areas bordering the desert;*
- *Most of the grasses wither and turn brown in the dry season and regain in the wet season;*
- *The trees survive the dry season by shading their leaves, storing water, having long roots, thorny leaves, and only a small number of leaves.*

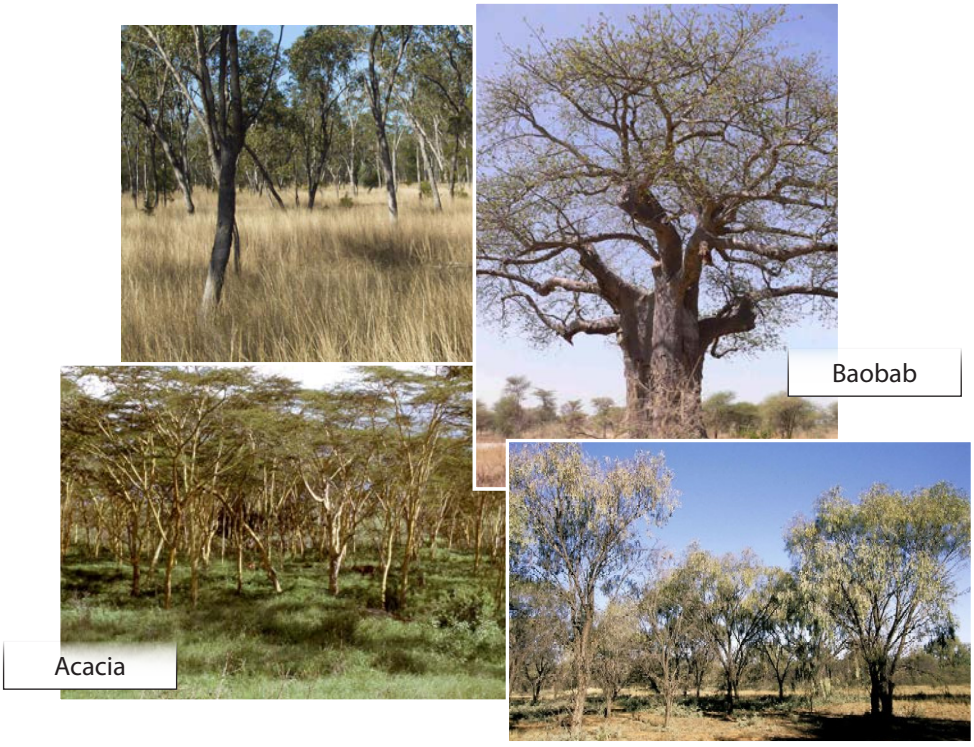


Figure 3.20: **Tree types in the savanna lands**

Desert and Semi Desert Vegetation

What is a desert? What about a semi-desert climate? What type of vegetation develops in such climatic regions? In which parts of Africa do we have desert and semi-desert vegetation? Why?

Desert and semi-desert vegetation is developed in areas where rainfall is scant. This climatic condition is found in the driest areas of the continent. The Sahara, the largest desert in the world, the Namib deserts and the Sahel region of Africa have such vegetation.

You may think that deserts are devoid of natural vegetation. The reality, however, is that it is different in Africa. The continent's drier areas have high species diversity. For instance, more than 3,000 species of plants (about 20% endemic) are found in the desert and semi-desert zones of Northern Africa. Even the southern deserts support plants. Cactus, thorn bushes and coarse grasses are among the most common plants in this vegetation zone.

The desert and semi-desert climatic regions are characterized by very low rainfall, extremely high evaporation and low humidity. The plants that develop in such regions are xerophytes with high drought resistance. To withstand such problems and survive in deserts, desert plants have different mechanisms of adaptation. For example,

- *They have long roots that can penetrate to great depths to reach the underground water table;*
- *They store water in their spongy leaves, stems, roots, fruits, and the like (example, cactus);*
- *They have waxy or needle-shaped leaves to reduce water loss through transpiration;*
- *They produce seeds that lie dormant for several years during extreme dry seasons until rain falls;*
- *Their leaves are small in size and few in number, reducing water loss through transpiration; and*
- *They have thorny leaves to protect them from being eaten by herbivores, etc.*

Afro-Montane (Afro-Alpine) Vegetation

What type of vegetation is Afro-Alpine vegetation? In which parts of Africa do we have this type of vegetation?

This type of vegetation develops over the tropical highlands of Africa, mainly over the Ethiopian and Eastern African highlands. In these areas, the climate is highly modified by altitude, with temperature decreasing as altitude increases. As a result, the vegetation that would have existed in the tropical climate at lower temperatures is replaced by vegetation typical of temperate regions. The vegetation consists of highland (temperate) forests and temperate grasslands. As altitude decreases, vegetation varies. For example, alpine (cold-resistant) plants like Asta and Gibera (in Ethiopia) grow in areas with altitudes above 3000 m. Afro-montane forests grow in altitudes up to 3000 m. Bamboo forests are found at 2000 – 2500 m. Then we find temperate evergreen (coniferous) forests of trees such as Tid, mountain grassland, and heath.

Mediterranean Vegetation

Which parts of Africa have this type of vegetation? What are the common trees of the Mediterranean vegetation in Africa?

As the name indicates, this type of vegetation develops in the northwestern and southwestern extremes of the continent, where Mediterranean climate is dominant. The region is rich in plant species. Evergreen and deciduous trees constitute a good part of the vegetation of this zone. Cork oak, maquis, and wild olive, are among the most common plant types in the region.

Mediterranean climatic regions have hot dry summer seasons. Thus, plants develop certain adaptation mechanisms to withstand the summer drought. Among others, the following adaptation mechanisms are common.

- *Storing water in their leaves and bark and using it during the dry season;*
- *Having waxy thick leaves to reduce water loss through transpiration;*
- *Having spiny small leaves to reduce water loss through transpiration; and*
- *Having long roots to tap underground water.*

NOTE

In addition to the five major vegetation zones of Africa, there are also other vegetation areas. Most important of these is the Mangrove vegetation zone. Such vegetation grows in the swampy areas of Africa, especially along lake shores, deltaic mouths and flood plains of the Congo and Niger rivers , tropical coasts and the Okavango swamps. The vegetation includes both trees and grasses.

Factors Affecting The Natural Vegetation Of Africa

Despite the richness of the continent in terms of natural vegetation, the resource is far from being properly utilized. Deforestation, overgrazing, burning (wildfire), and the expansion of settlements and farmlands are among the major problems affecting natural vegetation in the continent.

Activity 3.11

Answer the following questions.

1 What is deforestation, overgrazing and wildfire?
2 Why do people encroach into naturally vegetated areas?
3 What are the impacts of human encroachment on vegetation areas, humans and the environment?
4 What should be done to minimize human impact on the natural vegetation of Africa?

Of all the challenges of natural vegetation in Africa the most serious one is deforestation. *Deforestation* is indiscriminate cutting or over-harvesting of trees.

The deforestation rate in the continent is both very high and escalating. In the late 1970's, for instance, the annual rate of deforestation in the continent was about 3.6 million hectars per year. Slightly less than a decade and a half later, this rate (according to 1993 FAO estimations) had reached 4.3 million hectars/year. At the present time, the figures are even greater than what we have seen above.

Clearance of tropical forests for various reasons is a common practice in many African countries where rainforests develop. People clear the forest for many reasons. The major ones, however, are the following.

- *They clear the land for shifting cultivation, especially in the equatorial areas where soil leaching is a common problem;*
- *The need for land for permanent agriculture;*
- *The increased need for fuel wood - nearly 90% of African energy demands are satisfied by using fuel wood that is collected from forests;*
- *Extractive forest uses, such as selective forestry, to get logs for industries.*

Deforestation has multifarious impacts. Forests regulate the climatic conditions of the earth and reduce soil erosion. Thus, deforestation can cause climatic change, resulting in problems like desertification and soil loss through erosion.

In addition, where the forest habitats are destroyed, the animals that live in the forests are affected. As a result of habitat destruction, animals may migrate and

even die. Deforestation results in the extinction of some of the wild animals and plants of the continent. There are also many endangered plants and animals in the continent due to deforestation and related impacts.

Possible Conservation Measures

The problem of deforestation can be reduced through the application of different forest-conservation measures. These measures include reforestation, afforestation, agro-forestry and social forestry.

Reforestation: is planting trees in areas where the original forest cover has been removed. It is done to replace the trees that have been cut by humans for different purposes.

Afforestation: is planting trees in areas where there was no original forest cover. For example, afforestation is appropriate for areas where the land is left empty and therefore is exposed to erosion.

Agroforestry: is forestry combined with farming. It is a practice of integrating the planting of trees into farming to provide fuel, fruit, forage, shelter for animals or crops, and other benefits. In short, it refers to associating crop production with forest development.

Social forestry: refers to planting trees in urban areas in association with human settlements.

NOTE

The problem of deforestation is very serious in Africa. In addition to the above-mentioned measures, raising the people's awareness of the importance of forests is crucial. In addition, changing the way people make their living at the present time is also important, as poverty is one of the factors that escalate deforestation.

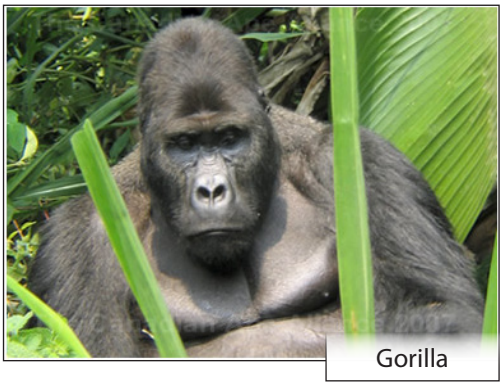
3.5.2 Wild Animals of Africa

What are wild animals? Do you think that Africa is rich in terms of wild animal resources? Why?

Brainstorming

1. What is meant by wild animal?
2. What are some of the major types of wild animals found in Africa?
3. Is there any relationship between the distribution of climate, natural vegetation and wild animals in Africa? How do you describe that relationship?

It is a well known fact that natural vegetation serves as habitats for wild animals. Thus, the different vegetation zones of Africa, together with the varied climate and topography of the continent, create an ideal situation for wild-animal diversity.



Gorilla

For example, the equatorial rainforests of Africa are habitats for different species of wild animals. The region hosts different kinds of tree climbing (arboreal) animals like monkeys, apes, baboons, and gorillas, as well as birds. The aquatic environment of this zone hosts large animals like hippopotamus and crocodiles.

Baboons

The region has the highest species diversity in Africa. Most of the time wild animals that live in the equatorial rainforest have small body sizes. This is because the thick and dense forest of the region limits movement in the forests.

There are also large numbers of herbivorous and carnivorous animals in the Savanna lands of the continent. The herbivore animals include numerous species of antelope, zebra, giraffe, buffalo, African elephant, and rhinoceros. The carnivore wild animals include the lion, leopard, cheetah, hyena, jackal and mongoose.

Savanna Elephant

African elephants live in grassy regions south of the Sahara Desert. The savanna elephant is the largest of the three species of elephants. They live in grasslands and drier woodlands throughout Kenya, Tanzania, Botswana, Zimbabwe, Namibia, and South Africa.

Black Rhinoceros

The black rhinoceros (Diceros bicornis) once ranged from Southern Africa to Western and north-eastern Africa. Today, only fragmented populations remain in Southern, Eastern, and Central Africa. The black rhino has two horns, the front one usually larger than the rear one.

Black Rhinoceros and Calf

NOTE

Rhinoceroses are among the most seriously affected wild animals in Africa. People hunt rhinos for their horns. A single rhino horn can bring thousands of dollars on the black market. Consequently, the black rhinoceros and its close relative, the white rhinoceros, have been hunted nearly to extinction. Black rhinos once ranged throughout Africa south of the Sahara but are now restricted to parks scattered throughout that range. To prevent inbreeding and to ensure the survival of the species, park personnel truck rhinos between isolated reserves for mating.

Pride of Lions

This group of lions lives in the savanna region in Masai Mara, Kenya, in Africa. The grasslands are ideally suited to the needs of these carnivores.

Oryx, Mago National Park, Ethiopia

Zebras in Serengeti National Park

Zebras drink and graze near a river in Tanzania's Serengeti National Park. Millions of animals spend the rainy season in this grassland reserve. When the rivers dry up at the end of the rainy season, the animals migrate to Kenya's Masai Mara Game Park, where more abundant water conditions enable them to survive the dry season. Established in 1941, the Serengeti is one of Africa's largest nature reserves.

Some animals of Kruger National Park

One of the ten largest national parks in the world, Kruger National Park in RSA covers 19,485 sq km.

Spotted Hyena, found in many areas of Africa

There are also various species of wild animals in the desert and semi-desert areas of the continent. The desert fox, hares, gazelles, jerboa, the wild ass and different reptiles like snakes, lizards and tortoises are among the most common species.

Wild Ass in the Afar area

Marabou Stork

The marabou stork of Africa is the largest member of the stork family. Marabous soar for long distances searching for carrion, often feeding on carcasses with vultures and hyenas.

Green Mamba

A mamba is a poisonous member of the cobra family. Mambas live in tropical areas of Africa and are one of the world's fastest-moving snakes.

Jerboa

Jerboas are jumping rodents capable of covering a distance of 3 m with one leap. Jerboas live primarily in the arid regions of Africa and Central Asia and feed on plants, seeds, and insects.

Desert Dwelling Fennec Fox

The desert dwelling fennec has the largest ears of any fox, in proportion to body size. It uses its ears to cool itself and to detect the sounds of predators and prey.

Black-Backed Jackal Scavenging

A black-backed jackal in Hwange National Park, Zimbabwe, flees with a piece of scavenged meat.

Similarly, the rivers, lakes and swamps of the continent are inhabited by different species of aquatic animals. There are crocodiles like the Nile crocodiles, hippopotamuses, fish (about 2,000 different species), and different species of birds like the guinea fowl (the leading game bird in Africa), pelicans, goliath herons, flamingos, storks, egrets, and the ostrich, mainly in Eastern and Southern Africa.

Nile Crocodile

One of the largest reptiles on the earth today, the crocodile is also one of the most ferocious. The crocodile of the Nile, Crocodilus niloticus, pictured here, is one of the best known of the 12 species of crocodile.

Ostriches

Native to Africa, the ostrich is the largest living species of bird, growing to a height of 2.4 m and a weight of 150 kg. Although flightless, the ostrich can run at speeds as high as 65 km/hr .

Flamingos

They are found in shallow alkaline soda or salt lagoons and lakes in parts of Africa. Flamingos feed on microscopic algae, diatoms, and invertebrates that they strain from the water and mud with their sieve-like bills.

In addition to the above wild animals, the continent also has a variety of destructive insects, notably mosquitoes, driver ants, termites, locusts, and tsetse flies.

South African Tsetse Fly

The South African tsetse fly, common to Central Africa, is responsible for transmitting the parasitic protozoan that causes sleeping sickness, a disease that can be fatal to humans and domestic cattle.

Female Mosquito Sucking Blood

There are approximately 2,000 species of mosquitoes ranging from the tropics to the Arctic Circle and from sea level to mountaintops. Female mosquitoes have hypodermic mouthparts which enable them to pierce the skin and suck the blood of mammals, birds, reptiles, and other arthropods. Female mosquitoes of the genus Anopheles are responsible for transmitting the malaria parasite from person to person.

This wild-animal resource of Africa is of great importance for the people of the continent. They serve a wide range of purposes, including the following. They:

- ⇨ *are used as sources of animal protein in many countries of Africa;*
- ⇨ *help to maintain the balance of nature by feeding on each other and plants;*

- *serve as source of income through tourism, legal hunting and legal sale of live wild animals;*
- *provide scientific and educational opportunities to researches, students and the like;*
- *provide inputs (industrial raw materials such as skins and excreta) for various industries;*
- *add aesthetic value to the environment, hence serving as source of recreation for people;*

Factors Affecting Wild Animals

Despite all these and many other advantages that wild animals provide to the people of Africa, the attention paid by the people to animal conservation is inadequate. Many animals face serious problems that emanate from human interference-for example, with their habitats. Such interventions threaten many species. As a result, some animals and birds are extinct and still others, like the Mountain Nyala and Walia Ibex in Ethiopia, and the Ostrich in Algeria, are endangered or threatened.

Activity 3.12

In a small group, discuss the following issues.

1. What are the problems of wild animals in your area? What about in Africa in general?
2. What, do you think, should be done to conserve the wild animal resources of Africa?
3. Are there any measures being taken by the local government or population in your area to conserve wild animals? If yes, mention some of the measures.

Wild animals in Africa are facing different challenges. The following are the most serious ones.

- **Illegal hunting (poaching):** *In many parts of Africa, poaching, or illegal hunting, is a common practice. People hunt wild animals for many reasons. While some are economic, others are socio-cultural. For instance, elephants are hunted for their tusks, rhinos for their horns, lions, and cheetah, for their skins etc. This activity threatens some species like the African elephant and black rhinoceros. Some animals in Africa are also brutally exterminated for several reasons. For example,*

animals are killed because they are considered to be pests. They are also killed for food. People also kill animals to be honored by society, as there are cultural group that attach bravery/heroism to killing large dangerous wild animals. This practice exists particularly in the very traditional parts of the continent.

African Elephant Killed by Poachers

Elephant populations are on the brink of extinction due to poachers who kill elephants for their ivory tusks

- **Human Encroachment:** *in many areas of Africa, people encroach into the natural habitat of wild animals. For instance, many people in Ethiopia enter into the habitats of wild life in the Bale Mountains, Semien Mountains and Awash National Parks and disturb the habitat. The encroachment is the result of the increased need of human populations for farm and grazing land, settlement areas, fuel wood and the like. Such increased needs result in:*
  - *Deforestation – people in Africa clear forests for shifting and permanent cultivation, fuel wood, charcoal, settlement and the like. This disturbs the habitats of wild animals and causes the migration and death of wildanimals.*
  - *Burning of vegetation cover in order to obtain land for shifting or permanent agriculture, people set fire to vegetated areas.*
  - *Overgrazing – When land is grazed beyond its carrying capacity, overgrazing occurs. This, in turn, leads to environmental degradation.*
  - *Desertification – it is the expansion of desert-like climatic conditions, which occurs as a result of changes in the characteristics of the local climate.*
  - *Drought – is extreme shortage of rainfall. It occurs when expected rains fail to fall in an area.*

Possible Conservation Measures

These and many more challenges are affecting Africa's wildlife resources. Animals migrate, and even die due to the disturbance of their environment as humans encroach. To curb the situation the following measures can be taken.

- **Conserving natural vegetation:** *the conservation of one type of natural resource means the conservation of others. Conserving natural vegetation that serves as habitats and sources of food for wild animals can ultimately help with their conservation.*
- **Establishing national parks, game reserves and sanctuaries:** *these areas provide protection and conservation for wild animals. They are established to conserve wild animals and their habitats so that they have a secure environment that is safe for their survival. In this regard, Kenya, Tanzania, the Republic of South Africa and Uganda are significant. In Ethiopia, too, nine national parks and many other sanctuaries and game reserves have been established to promote the conservation of the wildlife resources of the country.*
- **Controlling illegal hunting***: it can be done by developing strict legislation whereby illegal hunters are punished or penalized for their illegal acts. For instance, an international ban on ivory trade, instituted in 1989 by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and supported by over 120 countries, has diminished the illicit ivory trade and reduced the related wild-animal killing.*
- **Raising the people's awareness:** *this can be done by educating the people about the uses of wild animals so that their attitudes and activities change. This is the most important conservation measure, and it needs the closest attention, because nothing can be done without getting the support of local communities.*
- *Changing the economic condition of the people through good and applicable policies and programs.*

Content Check

Answer the following questions.

1 Describe the equatorial rain forest of Africa.

2 Discuss the major problems of natural vegetation in Africa.

3 What are the major problems that Africa's wild animals face?

4 Discuss possible measures of conservation for the wildlife resources of Africa.

3.6 SOILS OF AFRICA

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

- state the major soils of Africa with their specific characteristics;
- relate the soils of Africa with their respective climatic regions; and
- analyze soil problems and measures of conservation in Africa.

Key Terms

- Soil
- Weathering
- Erosion
- Soil degradation
- Terracing
- Contour ploughing

Soil is defined simply as a loose and unconsolidated material that overlies the crust of the earth. Soil is Africa's most important resource. This is because the majority of the people in the continent, and almost the entire economy of the continent, depend on activities that are directly or indirectly linked with this resource.

Brainstorming

1 What is soil? How is it formed?
2 What are the major soil types in Africa? What are the major soil types that are dominant in your locality?
3 Can you identify some of the problems of soil resources in Africa?
4 What measures, do you think, should be taken to conserve soil resources in Africa?

3.6.1 Major Soil Types of Africa

Why is Africa endowed with varied typed of soils? What are the most common soil types of Africa?

The diverse climatic conditions, natural vegetation and the geology of Africa result in the presence of different soil types. The Food and Agricultural Organization of the UN (FAO) has classified the soils of Africa into several groups, of which the following are the most important:

- *Pedalfers (the largest group in Africa)*
- *Pedocals*
- *Hydromorphic soils*
- *Azonal soils*

Based on their geographical distribution, the soils of Africa are classified into the following types. These are **Ferrasols**, **Nitosols**, **Acrisols**, **Lixisols**, **Plinthosols**, **Luvisols**, **Planosols**, **Vertisols**, **Calcisols**, **Solonchaks**, **Gleysols**, **Fluvisols**, **Arenosols**, **Regosols** and **Leptosols**. The geographical locations and characteristics of each of these soils is discussed in brief in the next sections.

A *Pedalfers*

Pedalfers are soils with aluminum deposits. They are soils without a layer of accumulated calcium carbonate. such soils have high content of iron and aluminum. Soils of this group include the following.

Ferrasols: are found in the central parts of Africa around the equatorial forests and savanna lands. They are red and yellow in color. Since they are found in areas

of heavy rainfall, they are affected by leaching. As a result, they are characterized by high concentrations of iron, clay and aluminum.

Nitosols: These soils mainly develop in humid climatic regions. Their parent materials are usually volcanic rocks. Such soils have a deep profile and are rich in humus content. Therefore, they are the most productive soils in Africa. As a result, they are ideal for crop production.

Acrisols: These are soils that develop in hilly areas with wet tropical and monsoon climates. These soils are weathered, acidic and shallow. As a result, they are unproductive. This soil type is found in Western Africa and the Lake Region of East Africa.

Lixisols: Lixisols are found in the savanna and semi-arid areas. These soils are reddish and sometimes yellowish in color. Geographically, they are abundant in the plains of Western Africa, Eastern Africa and east-Central Africa. Lixisols are more fertile than ferrasols and acrisols.

Plinthosols: these soils exist on plains and gently-sloped areas. They are soft and laterite. Such soils also develop in rainforest areas and the savanna regions, where marked dry and wet seasons characterize the climate.

Luvisols: these soils are developed in the Mediterranean climatic regions of the continent. They have high mineral reserves and are fertile.

Planosols: these soils dominate the High Veld of South Africa, particularly the waterlogged plains of the country. They are used mostly for grazing.

Fluvisols: fluvisols develop in seasonally flooded plains, valleys and tidal marshes. They are found in the Nile and Zambezi River Deltas, and the coasts of Western Africa and Lake Chad. They have a brown color. Most of these soils are young and fertile. As a result, they are suitable for large-scale irrigation.

B *Pedocals*

Vertisols: These are black basaltic soils with clay character. Due to their clay, they become sticky during the rainy season and crack during the dry season. As a result, working such soils is very laborious. They are found in the Sahel region at the southern border of the Sahara. In some parts of Africa, these soils are

cultivated with the help of irrigation and rainfed agriculture. However, generally they are used for grazing.

Calcisols: They are found in the Sahara and Namib deserts of Africa. Though they are potentially fertile in terms of mineral content, they are poor in humus. These soils are used mostly for grazing.

Solonchaks: these soils are found in inland river basins, bottoms of ancient lakes, depressions and coastal areas. They are saline and not very productive.

C *Hydromorphic Soil*

Gleysols: Like solonchaks, they are found in depressions and low-lying areas of shallow ground water. They are extensively found in the Niger Delta, the Congo Basin and interior parts of Angola. In Africa, these soils are used for the production of rice, sugar cane, yam and vegetables.

D *Azonal Soil*

Arenosols: They are found in the humid tropical parts of Africa, the semi-arid zones of the southern Sahara, southwest Africa and Africa's coastal plains. They are used mainly for grazing and dry farming.

Regosols: They are found in arid areas extending from West Africa to Ethiopia and Somalia. They are used for pastoralist grazing.

Leptosols: These are young, shallow and stony soils that are highly susceptible to erosion and drought. They are found in the strongly dissected uplands of Northern Africa, the Sahara, and in Southern, Central and Eastern Africa. Terracing is the most important mechanism for cultivating these soils. Otherwise, they are devoted to transhumance, forestry and tourism.

3.6.2 Problems and Conservation Measures of Soils in Africa

Problems of Soils in Africa

What are the major problems of soil in Africa? What measures, do you think, should be taken to conserve Africa's soil resources?

Soil erosion and environmental degradation are among the major problems concerning soils in Africa. The major causes of soil erosion and degradation in the continent include traditional farming practices, overgrazing, deforestation, and over-exploitation of vegetation for domestic uses. Due to these and many other factors, the continent loses huge amounts of soil every year to erosion. Also, such problems result in the deterioration of the quality and productivity of the soil.

Soil erosion is affecting Africa in many ways. Among others, the following are the major impacts. It results in the:

- *deterioration and depletion of agricultural and range (pasture) lands;*
- *decline of productivity of the major cereal crops;*
- *the collapse of agriculture and thereby the migration of people;*
- *downstream pollution, sedimentation, floods and damage to settlements, irrigation and farmlands;*
- *comsumption of national economic resources to control erosion. For example, Zimbabwe invests 3% of its total annual budget for applying fertilizer to replace nutrients lost through erosion.*

As we have said earlier, soil erosion is serious throughout Africa. However, the problem is more intense in some areas than others.

These areas are highly affected by the problem.

- *Most of the Sahel Region of Western Africa, and the Sahara and Namib deserts of Africa where wind is the major agent of erosion;*
- *The subhumid (savanna) regions and the tropical rainforests, where water is the main agent of erosion; and*
- *The tropical highlands and mountain areas of Africa such as those of Ethiopia and other East African countries.*

Activity 3.13

In a small group, discuss the following points.

1 What are the impacts of soil erosion in your area? What about in Ethiopia and Africa?

2 What do people do to conserve soil in your area? What other measures do you suggest to better conserve soil resources in Africa?

Conservation Measures

Major soil conservation measures that could be taken to increase soil fertility in Africa include the following.

- ***Terracing:*** *constructing stair like structures along hillsides to reduce the speed at which water flows down the slope, thereby reducing erosion.*
- ***Agroforestry:*** *is associating agriculture with forest development.*
- ***Afforestation:*** *is planting trees in areas which originally were not covered by forests.*
- ***Reforestation:*** *is planting tree seedlings to replace cut forests.*
- ***Windbreaks and shelter-belt plantations:*** *planting trees along a line to break the speed of the blowing wind and reduce its erosivity.*
- ***Check dams:*** *are small ditches that are prepared along sloppy areas to reduce the impact of the down slope surface flow.*
- ***Strip cultivation:*** *is planting two or more types of crops on the same farm, using a pattern of stripes of alternating crops. This approach reduces soil erosion because different types of plants use different ways of binding soil particles to themselves.*
- ***Contour plowing****: is plowing the land sideways, following contours. It is commonly used in sloped areas, forming furrows perpendicular to the angle of the slope. These furrows act as blocks, slowing the flow of downhill water.*
- ***Crop rotation:*** *planting different crops alternately on a farm.*
- ***"Green manure":*** *This approach uses plants that have soil-nutrient value to enrich the soil in the same way that animal faeces are used as fertilizer. The "green manure" plants are cultivated on the land and then ploughed under to mix them with the soil.*
- ***Mulching****: is covering the soil with plant residue to let the soil regain some nutrients as the residue decays.*
- ***Fallowing****: is leaving the farm idle for a while until the soil regains its fertility.*

Unit Review

UNIT SUMMARY

- Africa is absolutely located between 37°21' N and 34°52' S latitude and 17°33' W and 51°28' E longitude.
- As a result of the absolute location of Africa, the continent is characterized by almost balanced east-west and north-south extent, tropical location, and its being crossed by the equator almost at its half.
- Relatively, the continent is close to Europe and Asia. It gets closer to Europe across the Strait of Gibraltar, which is about 22 kms wide between Morocco and Spain. With relation to Asia, the continent comes closer across the Strait of Bab-el Mandab, which is about 40 kms wide. A narrow stretch of land called Isthmus of Suez, which is now cut into an artificial canal called the Suez Canal, connects Africa with Asia.
- Africa has a total area of 30.4 million sq. km. Accounting for about 20.2% of the world's total land area, the continent is the second largest in the world, next to Asia.
- The presence of large area for settlement, high resource potentials, varied climate, and plant and animal life are among the advantages of Africa's large area.
- The absence of smooth coastlines and more or less equal north-south and east-west distance makes Africa's shape relatively compact.
- The continent of Africa is generally divided into five major regional units. These are Northern Africa, Southern Africa, Central Africa, Western Africa and Eastern Africa.
- Serious of denudation and peneplanation activities dominated Africa's geological history during the Palaeozoic era.
- Alternate sinking and rising of the land of the Horn of Africa had been a common geologic event of the Mesozoic era in Africa.
- Most of the major landforms and relief features of Africa, including the Great East African Rift Valley and the very high volcanic mountains and plateaus, were formed during the Tertiary period of the Cenozoic era.
- Much of Africa is dominated by plateau lands. Mountains and hills account only for 4% of Africa's relief while plains account for 25%.

- Eastern Africa is the most elevated part of the continent having most of the very high mountains that rise over 2000 meters.
- The Great East African Rift Valley is the world's largest rift valley system. It stretches from Port Biera of Mozambique to Syria in the Middle East travelling a total distance of about 7200 kms.
- Africa is divided into seven major climatic regions. These are Equatorial Climate, Tropical Continental (Savanna) Climate, Tropical Desert and Semi-desert Climate, Tropical Maritime (Monsoon) Climate, Warm Temperate Continental Climate, Highland (mountain) Climate, Mediterranean Climate
- Latitude, altitude, ocean currents, distance form the sea, winds and atmospheric pressure are among the factors that affect the climate of Africa.
- Climatic change due to deforestation, overgrazing, and other unwise ways of using the natural environment is the common problem in Africa. This has resulted in repeated drought and other environmental hazards and problems.
- Africa is rich in terms of water resources. The continent has thousands of rivers, many lakes and swamps. The rivers are generally categorized into four major drainage basins. These are the Atlantic Ocean, the Indian Ocean, the Mediterranean Sea and the Inland or Closed drainage system.
- Presence of steep and long profile, rapids and falls, seasonal fluctuation of the rivers, presence of deltaic mouth and mangrove swamps and the exotic nature of the rivers are among the common characteristics of Africa's rivers.
- Many lakes drain Africa. Most of these lakes are found in the rift valley region.
- Hydro-electric power generation, irrigation, fishing, transportation, tourism and recreation are among the major uses of Africa's rivers and lakes.
- The diverse nature of Africa's climate has resulted in the presence of different vegetation zones. Forests, grasslands, desert and semi-desert vegetations, high altitude plants, Mediterranean vegetation, etc are among the major vegetation zones.
- Deforestation, overgrazing, wild fire, shifting cultivation, etc are among the major problems of natural vegetation in Africa.
- Africa is also rich in terms of wild animal resources. Different species of wild animals inhabit the continent.
- Illegal hunting, human encroachment, deforestation, overgrazing, wild fire and the like are among the major challenges that Africa's wildlife face.
- Conservation of the natural environment, establishing wildlife conservation areas, controlling illegal hunting and raising people's awareness could be

among the major conservation measures of wild animals.

- Different soils with varied characteristics and agricultural potential cover the continent of Africa.
- Soil degradation due to soil erosion and unwise agricultural practices is the most important problem of soils in Africa.
- Terracing, crop rotation, green manure, mulching, strip cropping, contour ploughing, and fallowing are among the possible soil conservation measures.

REVIEW EXERCISE FOR UNIT 3

I *True or False: Write true for correct statements and false if otherwise.*

1 The north-south and east-west extensions of Africa are almost equal.

2 Being the world's second largest continent, Africa covers nearly 20% of the world's total landmass.

3 Though larger than Europe in terms of land area, Africa has a shorter coastline.

4 Periods are the largest time divisions of the geological timescale.

5 The Great East African Rift Valley was formed during the Mesozoic era.

6 Mountains are the most dominant relief feature in Africa.

7 The Atlas fold mountain ranges are found at the southern tip of Africa.

8 June, July and August are months of heavy rainfall in Africa north of the equator, except in the Mediterranean climate.

9 The equatorial climatic region is wet all the year round with high total annual rainfall.

10 The Sahel is the area of Africa that is most affected by drought.

II *Multiple Choices*

11 Which one of the following factors affects the climate of East Africa the most?

A Distance from the sea
B Latitude
C Altitude
D Ocean currents
E Winds

12 Of all the climatic regions of Africa, the one with the highest rainfall variability is:

A Highland climatic region
B Mediterranean climatic region
C Warm temperate continental climate
D Desert climatic region
E Equatorial climatic region

13 Which one of the following was an event of the Cenozoic era in Africa?

A Formation of the basement complex rocks
B Formation of many of the recent volcanic mountains of Africa
C The denudation and peneplanation of the African landmass
D Alternate sinking and rising of the land in the Horn of Africa
E None of the above

14 One among the following is false about Africa. Which one is it?

A Nearly 2/3rd of Africa lies within the tropics.
B Much of Africa gets rainfall in the winter season.
C The Mediterranean climatic region has mild wet winters.
D Eastern Africa is characterized by the Great Rift Valley system.
E Africa has a short smooth coastline, which contributes to the fact that its shape is compact.

15 Which one of the following rivers is not part of the Atlantic Ocean Drainage System in Africa?

A Limpopo
B Niger
C Volta
D Senegal
E Congo

16 The largest lake in Africa is Lake:

A Tanganyika
B Malawi
C Chad
D Victoria
E Tana

17 Identify the wrong pair.

A Zambezi River-Kariba Dam
B Niger River-Kaindji Dam

C Volta River-Akosombo Dam
D Nile River-Aswan High Dam
E Ghibe River-Koka Dam

18 The equatorial rain forest of Africa is characterized by:

A Broad-leafed evergreen trees
B Hardwood trees
C Three canopies
D A small amount of undergrowth
E All of the above

19 Of the major problems of wild animals in Africa one is:

A Afforestation
B Illegal hunting
C Reforestation
D Wildfire
E "B" and "D"

20 A method of soil conservation that involves the construction of fencse-like structures along hillsides to reduce erosion is:

A Contour plowing
B Mulching
C Strip cropping
D Terracing
E Fallowing

III *Fill in the blank spaces with appropriate answers.*

21 Africa gets closer to Europe across the Strait of _____.
22 The natural land bridge that used to connect Africa with Asia is called _____.
23 Africa's shape can be described as _____.
24 The northernmost point of Africa is called _____.
25 The narrow body of water that connects the Red Sea and the Gulf of Aden is called _____.
26 The easternmost point of Africa is known as_____.
27 Africa's total area accounts for about _____% of the world's land area.
28 Much of Africa's relief is dominated by _____.
29 The highest block mountain in Africa is Mount _____.
30 The lowest place in Africa is called _____.
31 Africa's young fold mountains are found in the region called _____.

32 The part of the Ethio-Eritrea-Djibouti Rift Valley that branches out into three at its northern end forms the _____.

33 _____ is the climatic region found along the southeast coast of Africa.

34 The wettest climatic region in Africa is _____.

35 In March, the ITCZ is located around _____.

36 The climatic region in Africa that is characterized by a mild wet winter season is _____.

37 The wetness of the tropical monsoon climate in Africa is attributed to_____.

38 Rainfall in the Mediterranean climatic region is brought by the _____ winds.

39 The climate of the equatorial and tropical highlands of Africa is highly dominated by _____.

40 The most dominant type of rainfall in equatorial Africa is _____.

41 The Mediterranean type of climate in Africa is located in the _____ and _____ regions.

IV *Arrange the following geologic events according to their reverse chronological order, from the most recent to the oldest.*

a Formation of the Rift Valley.

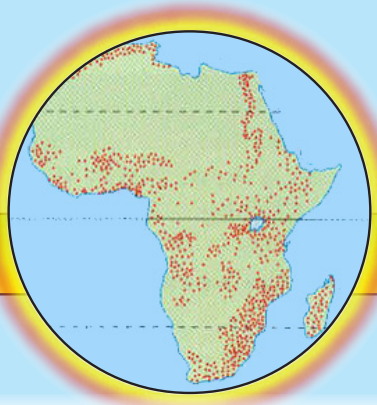
b Formation of the Atlas Mountains.

c Occurrence of pluvial rains in Tropical Africa.

d Formation of the Red Sea.

e Formation of the basement complex rocks.

Unit 4



POPULATION, ECONOMY AND NATURAL RESOURCES OF AFRICA

Unit Outcomes

After completing this unit, you will be able to:

- describe the size, growth and distribution of population of Africa;
- discuss determinants and characteristics of African population;
- analyse the extent of migration and level of migration in Africa;
- explain the concept of economic growth and development and describe the characteristics of African economy;
- asses the present features of African socio-economic development;
- distinguish indicators of development and analyse the challenges and prospects of African economic development;
- recognize major resources its exploitation and development; and
- appraise resource utilization and conflict management.

Main Contents

4.1 ASPECTS OF POPULATION, ECONOMY AND NATURAL RESOURCES OF AFRICA

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

- explain population size and growth in Africa;
- describe population distribution of Africa using map; and
- discuss the regional variation of population of Africa.

Key Terms

- Fertility
- Mortality
- Migration
- Natural increase
- Population growth rate
- Life expectancy
- Sex structure
- Age structure
- Dependency ratio
- Pull and push factors

Start-Up Activity

1. How do you compare Africa with other continents in terms of population size?
2. Is Africa a continent with high or low population?
3. What is the negative effect of rapid population growth in developing countries?

4.1.1 Population Size, Growth and Distribution

A *Size*

How large is Africa's Population?

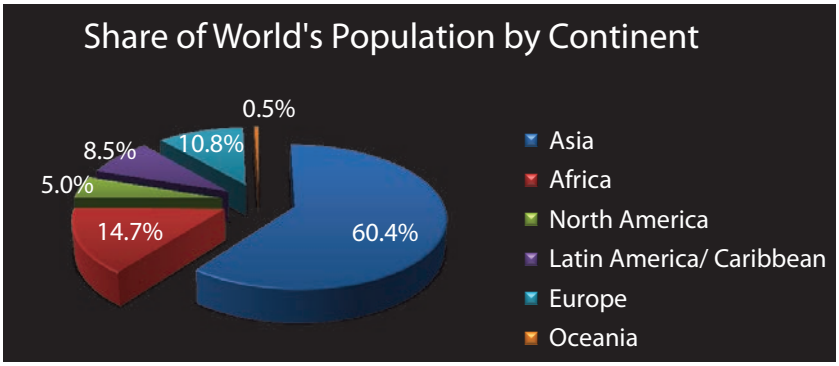
What percent of the world's population is constituted by Africa's population?

Africa has one of the world's largest populations. The continent is the world's second most populous next to Asia. According to the World Population Data sheet, by the mid of 2009, the continent had a total population of 999 million (nearly 1 billion). This makes up nearly 14.7 % of the world's total population. As the table below depicts, Africa's population is nearly 1/4th of that of Asia, the most populous, and 28 times that of Oceania, the least populous.

Table 4.1: **World population distribution**

No	Region	Population (in millions)	Percentage of world total
1	Asia	4117	60.4
2	Africa	999	14.7
3	North America	341	5.0
4	Latin America/ Caribbean	580	8.5
5	Europe	738	10.8
6	Oceania	36	0.5
7	World Total	6811	99.9

Source: *UN World Population Data Sheet, 2009*



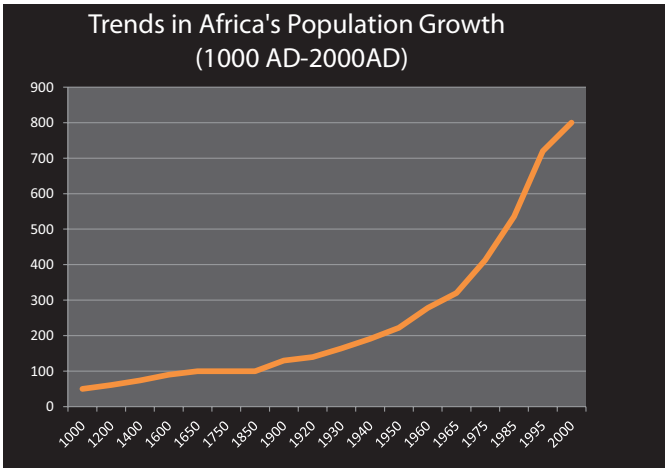
B *Growth*

What is population growth? What are the components of population change? How fast is Africa's population growing?

Africa has one of the world's fastest growing populations. The continent has been experiencing rapid changes in its population size as a result of many factors including the interactions between fertility and mortality. Despite the gradual decline in the birth and death rates, the continent continues to experience high rate of population growth. As some historical sources indicate, Africa's population had been increasing very slowly until recent times. However, since the 1950, the continent's population began to increase very rapidly. As a result, the continent's population had almost been quadrupled between 1950 and 2000. The following Table 4.2 shows you the trend in the population size of Africa between the years 1000 A.D and 2000 A.D.

Table 4.2: **Population growth in Africa from 1000 to 2000 A.D**

Year (AD)	Population in million	Year (AD)	Population in million
1000	50	1930	164
1200	61	1940	191
1400	74	1950	222
1600	90	1960	278
1650	100	1965	320
1750	100	1975	413
1850	100	1985	536
1900	130	1995	720
1920	140	2000	800



As it can clearly be seen from the above table, Africa's population had been increasing very slowly until the early 1950s. The 1000 A.D. population of Africa had taken more than 650 years to double itself. Another nearly 300 years were passed until the 1650 population doubles again. Since the 1950's the continent's population began to grow faster and it took only about 25 years to double itself. Another population doubling has still been experienced in the last 25 years of the 20th century between 1975 and 2000. Since 2000 till 2009, another 200 million people were added making Africa's population nearly a billion.

The population growth rate of Africa is the fastest in the world. According to the 2009 world population data sheet, the continent had a rate of natural increase of 2.4%. The general growth rate, on the other hand, was 2.3%. This appears being

the highest rate in the world and twice as fast as the world's average growth rate. In terms of the period that Africa's population needs to double itself, the continent has the world's shortest doubling time of about 29 years. Such a rapid population growth rate and short doubling time is the result of the very high fertility rate that the continent has. Although birth rate is declining in the continent, it is still high as compared to the rest of the world. The declining mortality in the continent is also the highest in the world. The difference between the two has produced a very high rate of population growth and short period of doubling time in Africa.

Rate of Natural Increase (RNI) is the difference between Birth Rate and Death Rate expressed in percentage. On the other hand, General Growth Rate is the difference between RNI and Net-migration Rate expressed in percentage. The doubling time of a population is calculated by dividing 70 by the growth rate of the population.

Table 4.3: **Demographic characteristics of the world by continents**

No	Region	Birth Rate/1000 population	Death Rate/1000 population	RNI (%)	Doubling Time in years
1	Asia	19	7	1.2	58.3
2	Africa	36	12	2.4	29.2
3	North America	14	8	0.6	116.7
4	Latin America/ Caribbean	20	6	1.4	50
5	Europe	11	11	0	-
	Oceania	18	7	1.1	63.6
7	World	20	8	1.2	58.3

Source: *UN World Population Data Sheet, 2009*

Table 4.4: **Demographic characteristics of Africa by major regions**

No	Region	CBR	CDR	RNI	TFR	IMR	NMR
1	Sub-Saharan Africa	39	13	2.6	5.3	80	-1
2	Northern Africa	25	7	1.8	3.0	38	-1
3	Western Africa	40	14	2.6	5.5	80	-1
4	Eastern Africa	40	13	2.7	5.4	76	-1
5	Central Africa	42	14	2.8	6.1	95	0
6	Southern Africa	24	15	0.9	2.8	48	3
7	Africa	36	12	2.4	4.8	74	-1

Source: *UN World Population Data Sheet, 2009*

C Distribution

What is population distribution? What are the factors that affect the distribution of population? Which areas in Africa are most populous? Why?

Population distribution refers to the way people inhabit and occupy the earth's surface. As elsewhere in the rest of the world, Africa's population distribution is uneven. As a result, there are areas of high and low population density. Some parts of the continent, particularly the vast Sahara, have few permanent residents. While, others rank among the world's most densely populated areas. The Nile Valley of Egypt, the Atlantic coastal area that stretches from Côte d'Ivoire to Cameroon, Rwanda, Burundi, and South Africa's province of KwaZulu-Natal are among the most densely populated areas in the continent. The continent's average crude population density during the mid of 2009 was about 33 people/km^2.

Certain human and physical factors are responsible for such spatial variation in the distribution of population in the continent. Among the physical factors some are climate, relief, availability of water, fertility of soil, distribution of minerals and the like. On the other hand, the human factors that determine the extent to which humans inhabit a certain place include economic conditions, political situations and other social factors.

Figure 4.1: **Africa density of population, 2008**

However, there exists a significant regional variation in population density. As it can be seen from the following table, Eastern Africa has the continent's highest crude density of 49 p/km^2 followed by Western Africa with 48 p/km^2. Contrary to

this, central Africa has the continent's lowest crude density of 19 p/km^2 followed by Southern Africa (22 p/km^2) and Northern Africa (24 p/km^2).

Table 4.5: **Population density by major regions of Africa**

No	Region	Crude Population Density/km^2
1	Sub-Saharan Africa	34
2	Northern Africa	24
3	Western Africa	48
4	Eastern Africa	49
5	Central Africa	19
6	Southern Africa	22
7	Africa	33

Source: *UN World Population Data Sheet, 2009*

On country level, the most populous countries are Nigeria, Egypt, Ethiopia, the Democratic Republic of the Congo (DRC) and the Republic of South Africa (RSA). These countries all together account for about 43% of the continent's total population. In terms of population density, while some are heavily populated, others have very low population density. The following table gives you the ten most densely and most sparsely populated countries of Africa.

Table 4.6: **The ten-top densely and sparsely populated countries of Africa**

Ten Top Densely Populated Countries		Ten Top Sparsely Populated Countries	
Country	Density/km^2	Country	Density/km^2
Mauritius	625	Western Sahara	2
Mayotte	503	Mauritania	3
Seychelles	375	Botswana	3
Reunion	324	Namibia	3
Comoros	302	Libya	4
Burundi	298	Gabon	6
Rwanda	191	Central African Republic	7
Sao tome and Principe	169	Chad	8
Gambia	165	Mali	10
Nigeria	142	Congo	11

Source: *UN World Population Data Sheet, 2009*

Activity 4.1

Answer the following questions:

1 Which continent has a very short period of population doubling?
2 Rapid population growth rate has adverse effects on the quality of life of the people. Briefly explain.
3 Clarify the relationship between growth rate and period of population doubling in a given country.
4 Define the term "population stagnation."
5 Most African countries were in a better condition of life in the 1960s; but things have gone bad for the last three decades. Explain why.
6 Define the term "over population."
7 Which continents have had very low population growth rate?

4.1.2 Determinants of Population Change in Africa

Brainstorming

1 Do you remember what you learnt about population change in your previous grades?
2 Which demographic variables are responsible to bring population change in a given region or country?

The three components that determine population change are birth rate, death rate and migration. Population change in a given country is affected by:

- ⇨ *The difference between deaths and births also known as natural change*
- ⇨ *The balance between immigration (coming in) and emigration (going out) also known as net migration.*

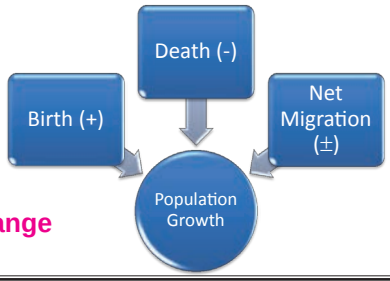


Figure 4.2: **Components of population change**

In Africa, the current population change (growth) is a function of fertility, mortality and migration. There is frequent migration of people within a country.

However, these days there are not significant migrant flows from country to country or from region to region due to lack of pulling factors. Since most African countries are in their lower stage of development, there are little or no opportunities to accommodate a huge influx of people from another country. Africa's migration pattern is highly related to political instabilities and natural catastrophes.

Fertility Patterns in Africa

What is fertility? What are the factors that affect the fertility rate of the African population?

Fertility refers to the occurrence of birth in the human population. It is a natural positive factor that tends to increase the human population size. Africa's fertility rate is the highest in the world. Birth rates are high in Africa because:

- ⇨ *people have less access to contraceptives;*
- ⇨ *people are backward and poverty stricken;*
- ⇨ *women are of low status;*
- ⇨ *many children are needed to work on the land;*
- ⇨ *children are considered as symbol of virility;*
- ⇨ *people are of low educational background; and*
- ⇨ *many religions encourage large families.*

According to the UN World population prospects of the year 2009, the average birth rate for Africa is estimated at 36/1000. This is the highest even for the standard of developing countries, which is (22/1000).

Brainstorming

1. What are the two major factors that affect population distribution?
2. Describe the three components of population change.
3. What are the two major factors that instigate migration in Africa?
4. What major reasons influence people to have more children in Africa?

Table 4.7: **Patterns of rates and life expectancy by major regions in Africa (2009)**

Region	Crude Birth Rate per 1000 population	Crude Death Rate Per 1000 Population	Rate of Natural Increase (%)	Infant mortality rate per 1000 live Births	Life expectancy at birth (years)
World	20	8	1.2	46	67
Developed	12	10	0.2	6	74
Developing	22	8	1.4	50	65
Africa	36	12	2.4	74	53
Northern Africa	25	7	1.8	38	67
Western Africa	40	14	2.6	80	50
Eastern Africa	40	13	2.7	76	50
Central Africa	42	14	2.8	95	49
Southern Africa	24	15	0.9	48	50

Source: *Population reference Bureau, UNO (2009)*

Activity 4.2

Discuss in group about the following issues.

1. Africa's population growth rate is the highest in the world. What will happen if Africa's population growth rate continues in such a manner?
2. Some developed countries' population growth rate is stagnant. The old age population number is growing from time to time. What sort of implication will this bring upon the socio-economic condition of these countries?

Although fertility is high in Africa, it still varies from country to country or region to region. Currently African countries having birth rates below 30/1000 include:

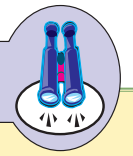
- *Mauritius 14/1000*
- *Tunisia 17/1000*
- *Morocco 21/1000*
- *South Africa 23/1000*
- *Botswana 24/1000*
- *Egypt 25/1000*
- *Seychelles 18/1000*
- *Reunion 18/1000*
- *Libya 24/1000*
- *Namibia 25/1000*
- *Algeria 23/1000*
- *Lesotho 27/1000*

Other African countries comprise rates ranging from 31/1000 in Swaziland to 50/1000 in Guinea Bissau and Nigeria.

N.B. *Ethiopia's CBR was about 39/1000 in 2009.*

Table 4.7 shows the status of Africa in terms of crude birth and death rates and life expectancy vividly. Central Africa, for instance, had the highest birth rate 42 births per 1000 population followed by Eastern and Western Africa each of which was having 40 birth per 1000 population.

Focus



Birth rate is defined as the number of live births per 1000 population in a year. For example, when we say the birth rate of Africa is 36/1000, we mean that 36 births will occur for every 1000 people, on the average, every other year.

Death rate is the number of deaths per 1000 population in a year. For example, Africa's death rate is 12/1000. This is to say that 12 deaths will occur for every 1000 people on the average every other year.

The difference between birth rate and death rate is conceived as a difference influenced by natural change. The natural change for Africa can, therefore, be computed as:

36/1000 – 12/1000 or (36/1000 (birth rate) – 12/1000 (death rate))

$$= \frac{24}{1000} \times 100 = 2.4\%$$

2.4% is the natural increase for Africa

There is an inverse relationship between the level of economic development and the fertility rate. In Africa, the regions that have a relatively better economic progress are likely to have low rate of fertility.

Mortality Patterns in Africa

What is mortality? How does it affect the population of Africa? What are the factors that affect mortality in Africa?

Simply defined, mortality refers to the occurrence of death in the human population. As was shown in Table 4.7 Africa's mortality rate is the highest in

the world. It is also the highest even from the perspective of the developing regions. The continent had a crude death rate of 12 deaths per 1000 population. When regional comparison is made, death rate ranges from 7/1000 in Northern Africa to 15/1000 in Southern Africa. In terms of infant mortality rate, which is the death of infants under one year per 1000 live births, the continent still has the world's largest rate of 74 deaths per 1000 live births. Infant mortality rates also vary from region to region. Accordingly, Central Africa has the highest rate of 95/1000 followed by Western Africa 80/1000 and Eastern Africa 76/1000 live births. The lowest Infant Mortality rate is in Northern Africa which only 38/1000.

Africa's high death rate is attributed to the following major factors:

- *Low standard of living*
- *Low access to health facilities*
- *Poor sanitary practices*
- *Civil war and political instability*
- *Wide spread of famine caused by recurrent drought*
- *Poor nutrition, and*
- *High incidence of disease and infections*

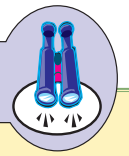
Africa's death rate is declining since world war II due to development in medical technology, and sanitary practices, and the discovery of medicines and vaccines for tropical diseases. However, the continent's crude death rate remains being the highest in the world.

Focus

Infant mortality rate is generally regarded as a prime indicator of socioeconomic development. Infant mortality has declined from 138/1000 in 1950 to 88/1000 in 1975 – 80; and now, it is down to 74/1000.

There is disparity in life expectancy between rich and poor countries. But this has shown a significant converge over the last 50 years despite widening wealth gap between them.

Focus



Life expectancy at birth: is the average number of years a newborn infant can expect to live under current mortality levels.

Table 4.8: **Level of life expectancy for selected developed and developing countries**

Country	Years	Country	Years
Japan	83	Swaziland	46
Australia	81	Ethiopia	53
France	81	Mozambique	43
Italy	82	Angola	46
Sweden	81	Malawi	46
Switzerland	82	Zambia	43

Source: *World Population Data Sheet, 2009*

What would you conclude about Africa's population from the point of view of its birth and death rates?

The current birth and death rates of Africa reflect a very young (and economically dependent) population of low life expectancy. Almost all sub-Saharan countries have a population of under 15 years of age rated in percent at more than 40. This has resulted in high dependency ratio in the continent. The average life expectancy for the whole continent is 54 years. (Table 4.9)

Table 4.9: **Life expectancy at the regional level**

Region	Life expectancy
World	68
Developed	77
Developing	55
Africa	54
Sub-Saharan Africa	50
Northern Africa	69
Western Africa	51
Eastern Africa	49
Central Africa	51
Southern Africa	49

Source: *World Population Data Sheet, 2009*

Africa's life expectancies are the lowest in the world. There is though, a wide disparity of this fact from regions to regions within Africa ranging from 69 years for Northern Africa to 49 years for Eastern and Western Africa.

Migration

What is migration? Why do people migrate?

Migration is a socio-cultural components of population change. It has both negative and positive impacts based on its net effect. A negative net migration rate tends to reduce the population of region. On the other hand, a positive net migration rate tends to increase population size.

The third component of population change is migration. It is an important control of population change next to fertility and mortality. Migration is the movement of people from their home place to another one. The most important aspects in the study of migration are its motives. The motives leading to migration in Africa include:

- *prevalence of diverse and wide range of climatic zones*
- *presence of diverse and multitude natural resources*
- *coincidence of the continent's large size*
- *pervasiveness of varying economic activities ranging from agriculture to trade: and existence of divergent level of economic and social development.*

4.1.3 Characteristics of African Population

Brainstorming

1. What does characteristics of population mean?
2. What are the major characteristics of African population?

The structure or composition of African population falls under two categories classified thus on grounds of biological and cultural characteristics. Biological characteristics include race, ethnicity, sex and age. The cultural characteristics comprise education, health, nutrition, religion, occupation, and the like.

Biological Characteristics

Age structure

How do you describe the age composition of Africa's population?

Africa is a continent which one can deduce, could be characterized by young population (See Table 4.10). This can be easily identified from the median age. If the median age is low, it implies that the population is young; for example, Africa's median age is 18 years. In contrast, if the median age is high, the population is likely to be adult and old age group; for example the median age for Europe is 37 years. Low median age reflects high fertility and high population growth rates whereas high median age prevails in a population where population growth rate is low and slow (See Figure 4.3).

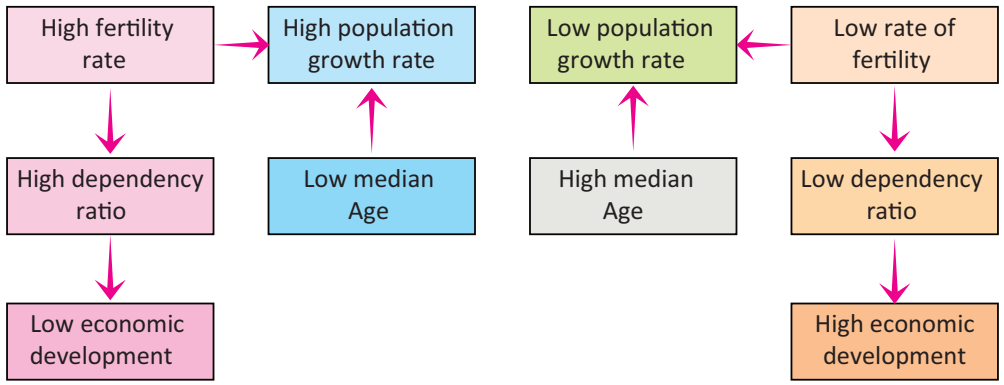


Figure 4.3: **The adverse consequence of low median age on economic development**

Table 4.10: **Africa's Population by age and major regions**

No	Region	0-14	15-64	65+	ADR
1	Sub-Saharan Africa	43	54	3	85.19
2	Northern Africa	33	62	5	61.29
3	Western Africa	44	53	3	88.68
4	Eastern Africa	44	53	3	88.68
5	Central Africa	45	52	3	92.31
6	Southern Africa	33	62	5	61.29
7	Africa	41	56	3	78.57

Source: *UN World Population Data Sheet, 2009*

Activity 4.3

1. Which continent is characterized by the highest percentage of young population?
2. Which continent comprises the lowest percentage of young age population and highest old age population.
3. Explain briefly the impact of having high percentage of young population on socio- economic changes.
4. Discuss the benefits and problems of young dependent population and adult (economically active) population.
5. Why is a large elderly dependent population generally viewed as a problem?

As it is shown in Table 4.10 , Africa is the only continent which comprises high young population, but very low old age population. In developing continents like Africa, the level of fertility is very high; and so the rate of population growth is high, too. This is readily attributed to their predominantly youthful age structure. As high fertility persists, the pressure on scarce resources for development increases. The demand for food, education, health facilities, employment opportunities, housing and other services also increases. In order to maximize these needs so as to meet the demand of the growing population, physical and institutional infrastructures have to be increased abundantly.

Persisting high rate of population growth constantly dwarfs whatever is achieved in the economic sector. Resources which could be used for development purposes, could be shifted to the provision of basic supply for the additional members.

Activity 4.4

Discuss in group how to get rid of population pressure caused by high fertility rate.

The Demographic structure of a given country (region) is best illustrated by the use of population pyramids (like the one in Figure 4.4). Population pyramids are used to portray the proportion of males and females in different age groups. In Figure 4.4 below, each bar represents a five year age group apart from the upper most bar which illustrates the population above 85 years. The male population is shown on the left of the vertical axis; and that of the females, on the right.

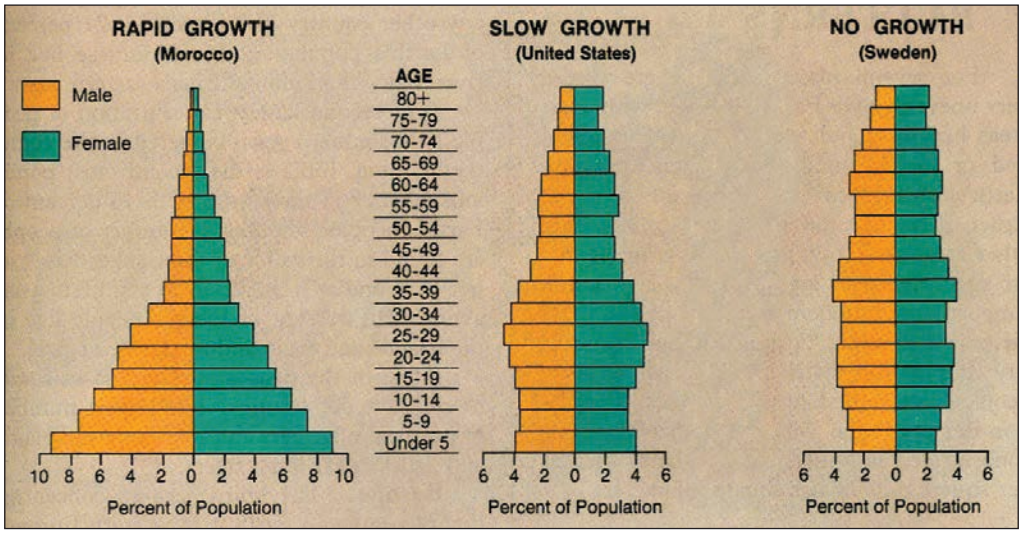


Figure 4.4: **Population Pyramid**

As it is portrayed in the figure above, the population pyramid for Sweden:

- ⇨ *is a narrow pyramid indicating equal numbers in each age group.*
- ⇨ *reflects a low birth rate and a low death rate indicating a steady and static population growth.*
- ⇨ *illustrates that more females live over 75 years than males do.*
- ⇨ *gives a picture of the fact that a large proportion of the population is in the pre- and post-reproductive age groups and that a small number is in the 15 – 64 age group, which is the one that produces children and most of the national wealth.*
- ⇨ *This can be shown in the dependency ratio expressed as:*

Economically dependent	Children (0 – 14) and elderly (65+)
Economically active	Working age (15 – 64)

Let us take hypothetical countries called "X" and "Y" to calculate dependency ratio.

Country	Non-economically active (0 -14)	Economically active (15 – 64)	Old age populations
X	13,387,000	31,616,000	7,307,000
Y	15,431,000	20,200,000	2,145,000

i The dependency ratio for country x is:

The number of dependent population under-15 years = 13,387,000
Number of old age (dependent) population > 64 = 7,307,000
Number of independents 15 – 64 = 31,616,000

$$\text{Age dependency ratio} = \frac{13,387,000 + 7,307,000}{31,616,000} \times 100$$

Therefore, the age dependency ratio of country "X" is 65.45%

This simply means, for every 100 people of working age, there are 65.45 people who depend on them.

ii Country Y's dependency ratio is:

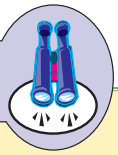
$$\frac{15,431,000 + 2145,000}{20,200,000} \times 100$$

The dependency ratio is, therefore, 87%.

The above dependency ratio is explained as for every 100 economically active people. The case country "Y", for instance, can be stated as: there are 87 persons that depend up on 100 persons. This dependency ratio is the highest in the world.

When we see the age dependency ratio, of Africa by its major region, central Africa has the highest ADR of 92.31% followed by western and eastern Africa each of which having (88.68%) and northern and southern Africa having 61.29% each. The overall ADR of Africa was 78.57% and that of sub Saharan Africa was 85.19% in 2009.

Focus



The following are among the major characteristics of the African Population

- *High fertility and mortality rates;*
- *Generally young population;*
- *Triangular population pyramid indicating the prevalence of high fertility and mortality rates;*
- *High age dependency ratio and youth dependency ratio and low old dependency ratio;*
- *Low life expectancy; and*
- *High population growth rate.*

Activity 4.5

1. Which dependency ratio represents typically developing countries?
2. Which of the two countries represent developed countries?
3. What demographic factors contribute to the high dependency ratio?
4. Explain briefly the correlation between dependency ratio and economic development.
5. Which country of the above two is most likely to represent Africa's dependency ratio?

Sex Structure

Sex ratio is an important demographic characteristics. It refers to the proportion of males to females in the overall population of a given area. Sex ratio is expressed in terms of the number of males for every 100 females.

$$\text{Sex Ratio} = \frac{\text{Male Popualtion}}{\text{Female Population}} \times 100$$

Sex ratio is an important indicator of the economy of a given country and is useful for regional analysis. The proportion of the two sexes in the population of a region has impact on other demographic elements such as marriage rate, occupational structure, growth, etc.

With regard to sex ratio, Sub-Saharan Africa sex ratio is below the world's average which is less than 98%. This means there are 98 males per 100 females, which is equitably balanced. Most Sub-Saharan African countries, however, have sex ratio of far less than 100. That is to say, there are greater number of women than men. Such an event is associated with a huge loss of men population due to war and migration. In some countries of the region, though, male births consistently exceed female births due to combined biological and social reasons. Some among such countries are equatorial Guinea, Uganda, Gambia and Kenya.

The context of high sex ratio in these countries is attributed to the prevalence of a large number of immigrants. The fact that these countries exceptionally comprise high sex ratio for reasons of immigration indicates that migration is age and sex selective. If there is a large influx of population to a given country, then that country will have high sex ratio. High sex ratio means a large proportion of active population age group will be added to that country.

In countries where there is a strong rural to urban migration, the population structure of the areas affected can be different.

Activity 4.6

Give brief answer for the following questions

1 What are the reasons for the declining trend of death rate both in developed and developing countries?
2 Explain briefly the Socio-economic implication of a high rate of young population of a given country.
3 Mortality is showing a declining rate in all countries of the world. But in some developing countries it is rising. Explain why?
4 How do you define sex ratio?
5 What sort of impact does a high sex ratio have on a given country?

4.1.4 Migration and Urbanization in Africa

Brainstorming

1 What does the word migration mean?
2 What are the two types of migration?

Migration

The two major types of migration which bring about population change and effect its distribution are:

A Internal migration B International migration

A *Internal Migration*

What is internal migration?

When people move from one part of a country to another part, we say internal migration has taken place. Internal movement of this kind is practised in many parts of Africa. Internal migrations are caused mainly by economic reasons.

Internal migrations are of two types, namely,

- *permanent and*
- *temporary.*

Permanent migration refers to peoples movement from their original place of residence to another where they establish a new residence on a permanent basis.

Another form of permanent internal migration is the urban to rural migration. This one is also known as the return migration. In such migration, people who are unable to find job that can sustain their family in the city move back to their old places. Such people include retired people from civil service and those who worked and lived in cities for a long period of time.

Temporary migration involves the movement of people whereby they leave their original residence for another for a short period of time, and then come back to their original place. Such migration is often practised only periodically. For example, people move from one area to another to find seasonal job. The Migration of labourors from the densely populated highland regions of Ethiopia to the middle Awash valley during the seasons of sugar cane plantation and harvesting is a clear illustration of this trend. Similarly many young people migrate from east and west Gojjam, Tigray, Wollo and Gondar to nearby towns to avail themselves at employment opportunities accessible only seasonally.

Temporary migration can also take place on annual or diurnal basis. Many people move from small towns to large cities in Africa every day seeking employment or running into other purposes.

Another internal migration is related to a rural-rural one. This type of migration is attributed to pushing and pulling factors. Examine the illustration below.

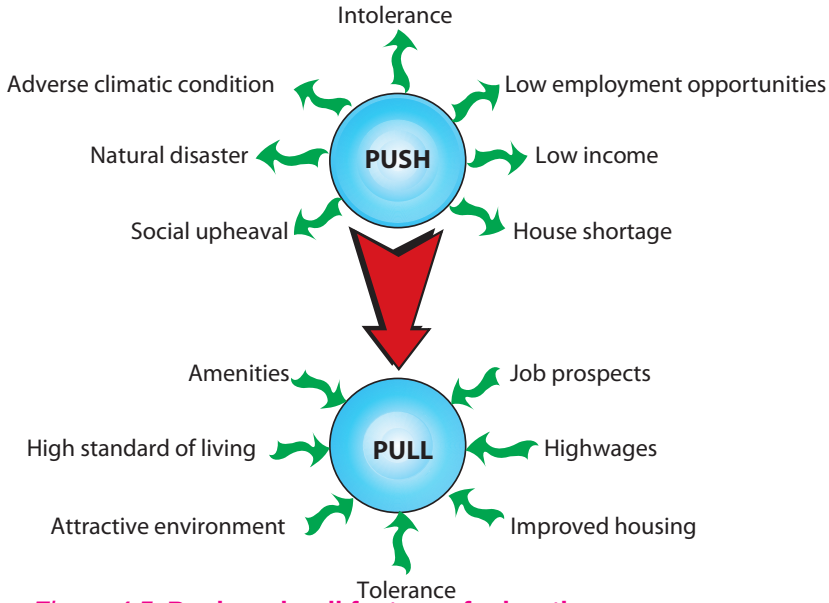


Figure 4.5: **Push and pull factors of migration**

Focus

Internal migration takes the following forms:

- *Rural-urban*
- *Rural-rural*
- *Urban-rural*
- *Urban-urban*

Migration may emanate from a combination of reasons. These include: aversion of residence: This is to mean that people may migrate if they dislike certain things about their residence. Such unfavorable conditions are referred to as pushing factors or repellent reasons for migration.

- *people may migrate to a new place because they think certain conditions about that place are all active and welcoming. These are known as pulling factors.*

B *International Migration*

What is international migration?

When people move from one country to another, wherever this may be in the world, we say International migration has taken place. International migration happens in various forms and has a long history. Several migrations took place before the colonial era. The most important movements were accompanied by Slave Trade whereby Africans were enslaved and taken to the America's and Middle East. This form of emigration persisted for about 300 years.

The other wave of migration was that of people from the Middle East and South Asia to Africa. These were the first Arab (Semites) migrants to Africa before the slave trade. These people inhabited North Africa starting from the 7th and 8th centuries and spread their language, religion and culture all over Northern Africa and the Sahara. These people are known as the Berbers and comprise 25% of the total population of Africa.

Activity 4.7

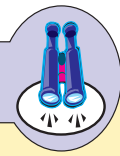
Give short answers for the following questions:

1. Which type of migration brings about population change in African urban areas?
2. Explain the influence of international migration on brain drain.
3. Migration is age selective. Which age and sex group migrate from Ethiopia to the Middle East? Explain the pushing and pulling factors in connection with this question.

4 What is the difference between internal and international migration?
5 What was the first form of emigration from Africa?

Brainstorming

1 Discuss in group the advantages and disadvantages of emigration for the destination and origin countries
2 What relationship does globalization have with migration?



Focus

Brain-drain is the movement of highly educated people such as engineers, researchers, lawyers, university instructors, medical doctors, etc from their country to countries abroad (overseas) where working conditions and payments are thought to be better.

Intra-continental migration: this is movement of people within the same continent, in the present case, within African countries. This kind of migration is usually done by labourers and is known as labour migration.

Labour migrants are motivated by ample remunerations provided by establishments engaged in plantation agriculture and discovery of mineral deposit. These conditions have brought about the divergence in economic growth among African countries.

The places involved in plantation agriculture and the mining sector that attract a large number of people from different parts of Africa include the:

- *Cacao belt of Ghana and Western Nigeria.*
- *Citrus and Vine plantation of Algeria, Tunisia and Morocco.*
- *Tobacco plantation of Zimbabwe and Zambia.*
- *Sisal, Coffee and tea regions of Kenya and Tanzania*
- *Copper belts of Shaba (DRC) and Zambia.*
- *Gold and diamond mines of the Republic of South Africa.*
- *Oil fields of Nigeria and North Africa.*
- *Cotton region of the Gezira plain of the Sudan.*

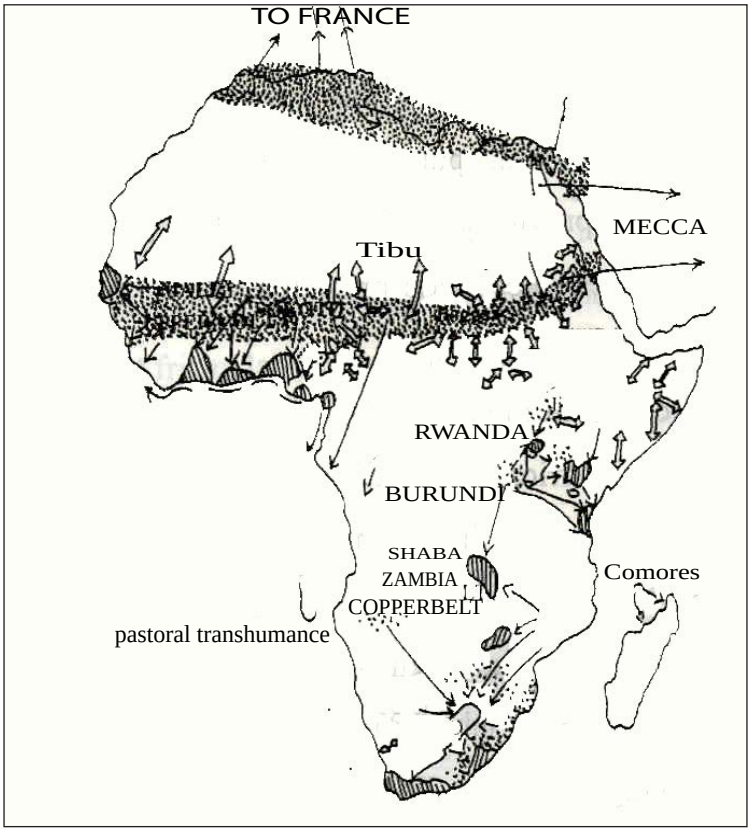


Figure 4.6: **Steams of Labour migration in Africa**

Summary Table of International Migration in Africa

Table 4.11: **Immigration (In-migration) and Emigration (out migration)**

Immigration	Source area from	Period	Outcomes
1 The Arabs	Middle East and South Asia	7th and 8th century A.D	Spread their religion and language all over northern Africa and Sahara. They comprise about 25% of the total population of Africa
2 Europeans (White)	European metropolis and South Asia	During the colonial period	The maghreb countries (morocco, Algeria, Tunisia) Zimbabwe, Zambia East Africa, South Africa became colony
3 Technical experts and entrepreneurs emigration	Europe, Asia, USA (out migration)	After independence	Motivated by economic progress, the growing period for specialized labour investment coming of many technical experts and entrepreneurs

	Emigrants	Source area from	Period	Otcomes
4	The white people	Africa	1950s and 1960s	Many African countries gained their independence during this time ⇨ Africans began ruling themselves ⇨ The white people were forced to leave Africa
5	Africans	Africa	Since the 20th century specially after independence	Economic growth demanded Africans to go abroad to study in Europe and USA. Substantial proportion have never returned ⇨ This is known as brain- drain

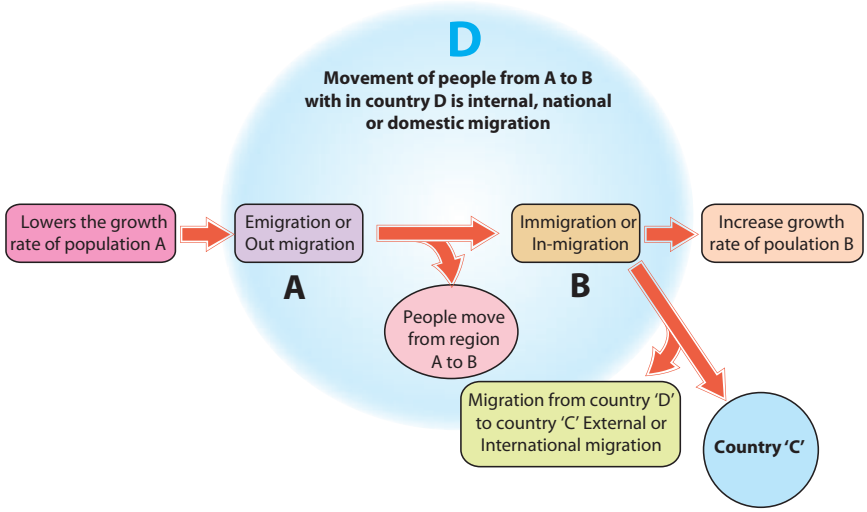


Figure 4.7: **Migration in country D**

Table 4.12: **Advantages and disadvantages of migration to the losing and receiving countries**

Advantages	Disadvantages
Losing Country	
⇨ Reduces pressure on jobs and resources (example food). ⇨ Loses people of child bearing age causing decline in brith rate	⇨ Loses people in working age group ⇨ Loses people most likely to have some education and skills ⇨ Mainly males leave causing a division in families ⇨ Left with an elderly population and so a high death rate.

Advantages	Disadvantages
Receiving Country	
⇨ Over comes labour shortage ⇨ Prepared to do dirty unskilled jobs ⇨ Prepared to work long hours for low salaries ⇨ Cultural advantages and links ⇨ Some highly skilled migrants ⇨ In a developing country these migrants could increase the number of skilled workers.	⇨ Pressure on jobs but most likely to be the first unemployed in a recession. ⇨ Low quality over crowded housing lacking in basic amenities ⇨ Ethnic groups tend not to integrate ⇨ Racial tension ⇨ Limited skilled/educated group ⇨ Lack of opportunities to practice their own religion, culture, etc. ⇨ Language difficulties

Urbanization

Brainstorming

1 What does the word urban mean?
2 What is urbanization?
3 Try to recall what you learnt in grade ten about urbanization and give answers to these two questions.

Urban is defined as relating or belonging to town or city. Urban centres are settlements where the majority of the population is engaged in non-agricultural occupation.

Urbanization refers to an increase in the proportion of people living in towns and cities. It is a major aspect of socio-economic change.

Africa is the least urbanized of all the continents in the world. As compared to the other regions of the world, the continent has the least number of urban populations. On average, it is only 38% of the continent's population that lives in urban areas. However, as a result of the existing very high rate of rural-urban migration and high fertility in the urban areas, the continent has the world's highest rate of urbanization, which is about 5.4% per year. Furthermore, the continent is characterized by low level of urbanization. The living conditions, social services, housing conditions and transport and communication facilities are very low in the urban areas of the continent. It is also true to say that the continent has the world's least number of urban dwellers and urban centres.

The extent of urbanization shows great regional variation in Africa. As it can clearly be observed from the table below, Southern Africa is the most urbanized region with 56% of its population living in urban areas in 2009 followed by Northern Africa (50%). Contrary to this, Eastern Africa is the least urbanized region having only 22% of its population residing in the urban areas. In terms of rate of urbanization, there exists regional variation too. The highest in this regard is that of Eastern Africa (6.8%) followed by Western Africa (5.5%).

Table 4.13: **Percentage of Urban Population in Africa by Major Regions (2009)**

No	Region	Percentage Urban
1	Sub-Saharan Africa	35
2	Northern Africa	50
3	Western Africa	42
4	Eastern Africa	22
5	Central Africa	41
6	Southern Africa	56
7	Africa	38

Source: *UN World Population Data Sheet, 2009*

Rapid urbanization is causing several challenges in Africa. It creates problems on employment opportunities, housing conditions, provision of social services such as education and health services, and social security in the urban areas. It has also resulted in unplanned development of urban centres in many African countries. Consequently, many urban areas of the continent have poor road networks, sewerage channels and unplanned settlements which resulted in the development of slum or squatter settlements. Rapid urbanization in Africa is also affecting the rural economy. This is due to the high rural-urban migration that takes the rural labour force out to the urban areas leaving the farms in the rural areas for the children and old. In addition, it has also facilitated the expansion of social evils like crime, prostitution and the like.

Urban Growth and Major Urban Centres in Africa

The movement of people to cities in Africa began in early 20th century. Since then, many cities have expanded at a rate of 25 percent every ten years (decade). The movement from rural areas to towns and cities is dubbed as rural – urban

migration. Figure 4.8 shows that in most African countries movement to the cities is partly due to rural push and partly due to urban pull.

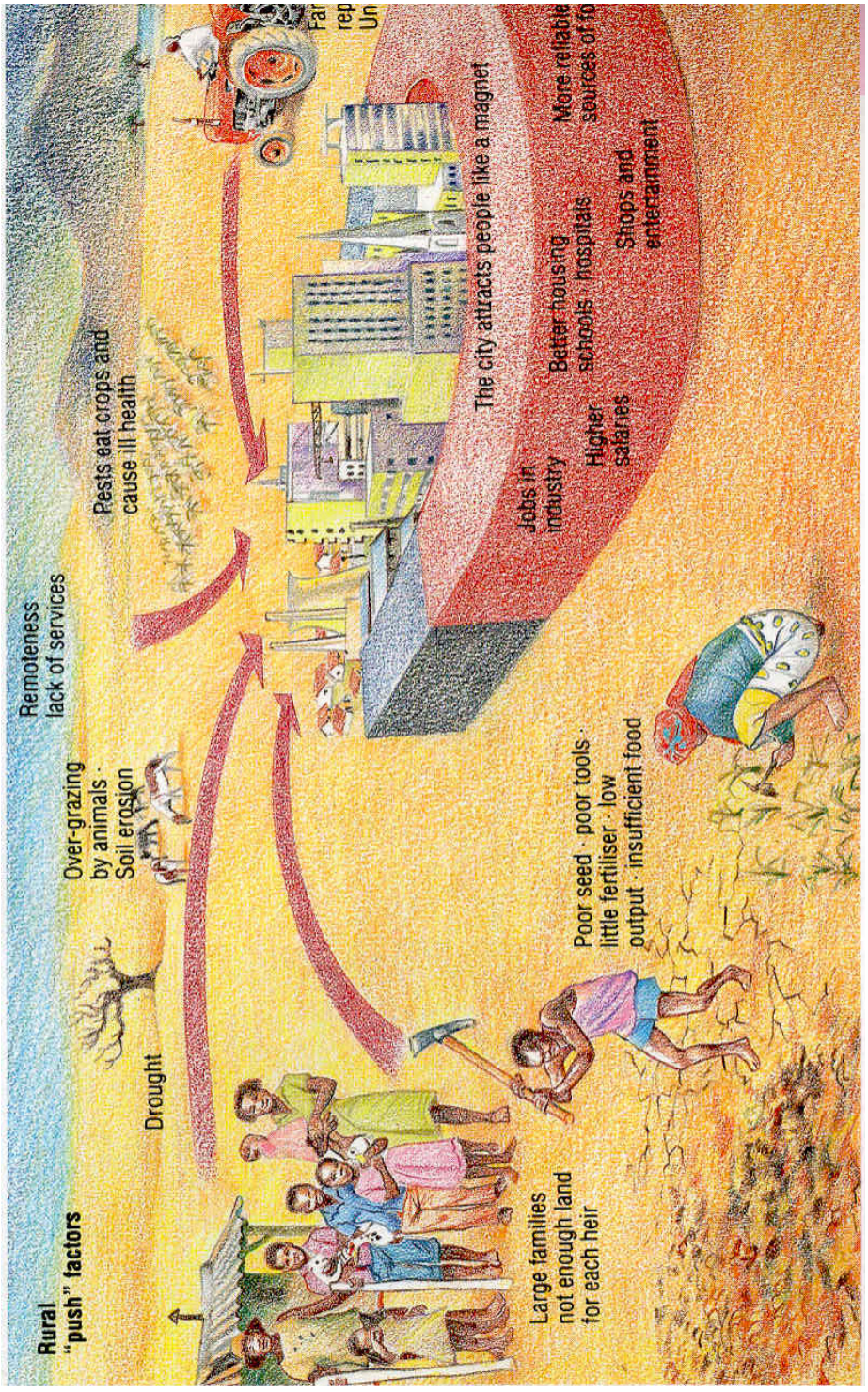


Figure 4.8: **Rural push factors and urban pull factors**

Activity 4.8

1 Write out the definition of each of the following
   a Urban b Urbanization
2 One feature of cities in the developing world is that they are growing very rapidly in terms of population as people move to them from surrounding rural areas.
   a What is this movement called?
   b Give three reasons why people may have to move away from the country side.
   c Name four problems that are likely to occur in urban areas when large numbers of people move in to them
3 Name a country which attracts migrants from the surrounding regions of Southern Africa.
4 Which regions of Africa have a high rate of migration?
5 The movement of professionals and highly educated persons from Africa to over seas countries is called _____.

Urbanization is increasing in both developed and developing countries. Cities in most developing countries are encircled by a number of problems. The following figure portrays some of the major problems affecting Urban centres.

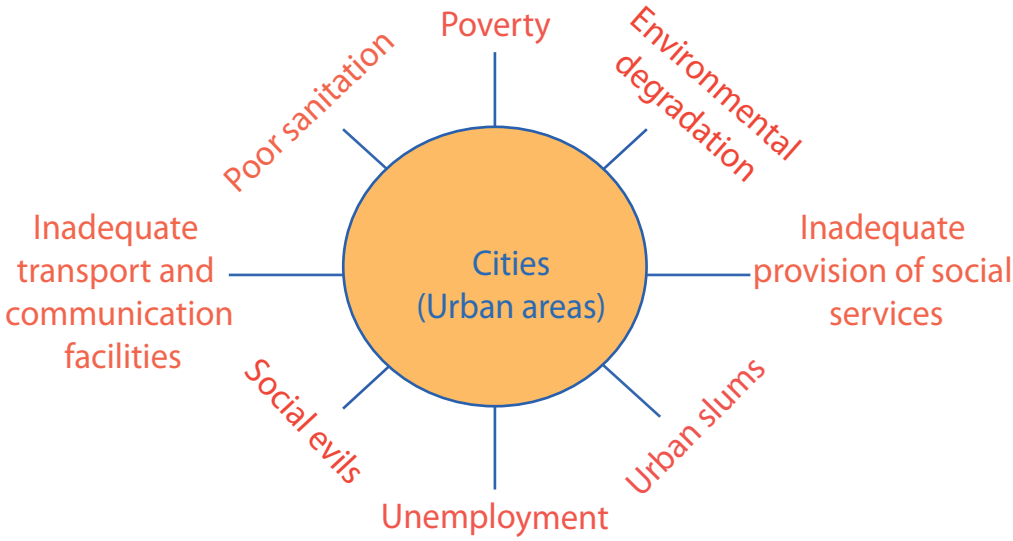


Figure 4.9: **Cities (urban areas) surrounded by problems that retard their growth (in developing countries)**

Current Urban Challenges

The outcome of rapid urbanization in Africa is that they pose challenges to the growing cities. Cities serve as major growth engines by providing opportunities for employment, education, technology, etc. These conditions, in turn, transfer markets for industrial and agricultural products; consequently, urbanization leads to further expansion of the cities where by their peripheral areas end up in changes of land use. The conversion of farm lands and watersheds for residential purposes has negative results in food security, water supply and the health of the people.

The adverse effects of urbanization in Africa are absence of employment opportunity, unreliable food security, shortage of water, scarcity of shelter and inefficient waste disposal, etc.

Table 4.14: **Sub-Saharan urban population Growth to 2025 (millions)**

Year	1990	2010	2025	% Growth (90 – 25)
Sub – Saharan Africa	527	937	1362	258%
Urban population	149	387	705	473%
Urban % of total	28%	41%	52%	

Source: *5.2 Venard, urban planning and Environment in Sub – Saharan Africa UNCED paper no 5 (ATES)*

Rapid growth in urban populations means growth in the size and number of urban places. It has been estimated that Africa will have eleven mega-cities (i.e., cities having five million inhabitants) and about 3000 cities with populations of more than 20,000 by the year 2020. See Table 4.15 below.

Table 4.15: **Sub-Saharan City growth to 2020**

Size	1990	2020	% change
More than 5 million in habitants	0	11	1100%
1 to 5 million	18	59	328%
500,000 to 1 million	26	75	288%
100,000 to 500,000	180	585	325%
20,000 to 100,000	790	2,200	278%
All cities	1,014	2,930	289%

Source: *5.2 Venard, urban planning and Environment in Sub – Saharan Africa UNCED paper no 5 (ATES)*

Unlike other regions of the world, urbanization in Africa has not contributed significant economics of scale and value added productive chains, to the growth in GDP. South East Asia and Africa have had similar rates of urbanization (4 – 5 % perannum) for the period 1970 – 95. However, while East Asia outshined by about 3.7% per annum whereas sub - Saharan Africa's GDP declined by 66%.

Many unique factors including immigration of destitute citizens affected by wars, drought and famine, have contributed to this phenomenon in urban Africa. What is more, difficult transitions from neo-apartheid colonial regimes to fragile self governance and crushing external debt (81% of GDP in Africa compared to 33% in East Asia) have added up to this problem.

Activity 4.9

1 State the major causes for urbanization in Africa.

2 Much of urbanization growth takes place in the absence of industrial expansion. Do you agree? Give your reasons.

3 What are the disadvantages of converting farm land into built up areas in Africa?

4 Urban poverty is much more costly than rural poverty. Explain the reasons.

5 Define the term "slum."

4.2 CONCEPTS OF ECONOMIC GROWTH AND DEVELOPMENT

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

- describe the concept of economic growth and development;
- analyze the economic growth and development trend of Africa;
- realize the characteristics of African economy;
- explain how and why most countries of Africa may be judged as less developed;
- discuss the present features of African socio-economic development;
- organize data of socio-economic growth and development and forecast the socio-economic challenges and prospects of Africa; and
- predict the socio-economic challenges and prospects of Africa based on the organized data.

Key Terms

- Economic growth
- Economic development
- GDP
- Per capital income
- Standard of living
- Developing
- Developed

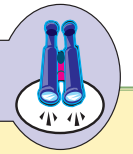
4.2.1 What is Economic Growth and Development?

Brainstorming

1. What is economic growth?
2. What is economic development?
3. Do you think that economic growth and development are the same? Why?
4. How do we distinguish a developed economy from developing one?
5. How do you describe the trend of economic development in Africa?

"Economic growth" and "development" are terms that we use to refer to the state of economic conditions in a certain society. Even if both are used to describe existing economic conditions, they still differ from each other in the ways they are employed. The term "economic growth" is used to describe the increase in the total amount of production and wealth of a given economy. As it is related to wealth, it focuses on explaining how fast the production and wealth of a country increases. Economic growth is usually quantitative as it is related to increasing production of goods and services, thereby allowing a state conceive how much income it has generated. On the other hand, economic development refers to growth in structural and technological change. Because of this, development is both quantitative and qualitative in that it involves increment in production, service provision and income implies, improvements in the over all living conditions of the population. That is why most agree to the idea that a growing economy can definitely promote development.

Focus



Growth versus Development

Economic growth may be one aspect of economic development but is not the same

- ***Economic growth*** *is a measure of the value of output of goods and services within a certain period of time.*
- ***Economic Development:*** *is a measure of the welfare of human beings in a certain state.*

Naturally, the agricultural sector absorbs the majority of the labour force as it is the main sector of production in the early stages of development. With the advent of growth, the manufacturing and service sectors become dominant. Consequently, diversified economic conditions with higher division of labour develop. Hence, we can say that development is the promotion of more intensive and more advanced economic activity with such inputs as education, improved tools and techniques of production, more available financing, better transportation facilities, and other booming businesses.

Economic development is characterized by the following:

- *The increased utilization of the natural resources of a state in order to raise people's standard of living and to improve the quality of life.*
- *The production of more and more goods and services that enter into markets for sale. For example, we know that people always eat, but as they have meals away from home and pay for restaurant services, the restaurant sector grows up.*
- *The growth in GDP (for instance, the sector listed earlier on in turn, is measured as part of the gross domestic product (GDP) i.e., the total of all goods and services produced within a country.*
- *Division of Labor: the process of development includes specialization in specific area of labour, which consequently leads to "division of labour." As people take on specialized economic functions, the scale of production increases and the output of each person rises. This type of organizational change is an important part of development as technological progress and mechanical invention or scientific discovery.*

- *Significant changes in the technical and institutional arrangements by means of which out put is produced and distributed.*

In general, development is understood as a complex and continuous process that involves people on one hand, and the factors of production and organization on the other. In other words, development is a process by way of which members of a society increase their personal and institutional capacities to mobilize and manage resources and to produce sustainable goods and services for their improved life.

Economic growth may not necessarily mean economic development. However, a growing economy paves the way for development. As we know countries of the world are categorized into two as developed and developing. But the question is how do we determine whether a certain economy is developed or not? What are the factors that determine the level of the economic development of a certain society? There are indicators of economic development that can help us answer these questions which we shall see them later.

4.2.2 Economic Growth And Development Trend In Africa

How do you describe the trend in Africa's socio-economic development?

Africa is generally regarded as a developing continent. Many countries in it have very low GDP and per capita income. As a result, the majority of the African people ache from the pain of low standard of living. Historically, the primary economic sector in general and agriculture in particular has been the dominant economic activity in the continent. The very low national wealth of African countries that resulted in low per capita income has always been the factor that determined the low standard of living of the continent's population. Consequently, low GDP, low income per capita, poor housing conditions, poor transport, inefficient communication networks, low educational and health coverage, widely spread unemployment, high mortality rate soaring human fertility and indecent life characterize the living conditions of millions of peoples in Africa. The following discussion gives you some idea about the trend of economic development that Africa has come through since its earliest record of history.

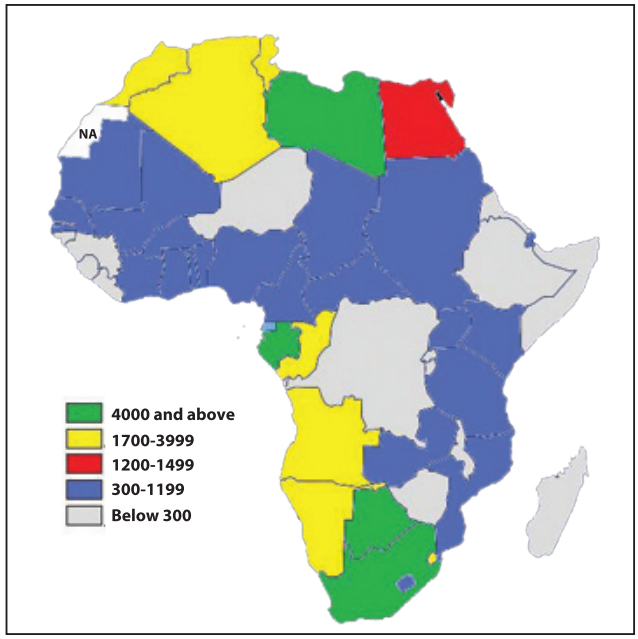


Figure 4.10: **Africa by GDP percapita in USD** **Source:** *Data from Encarta 2009*

- *Subsistence economy that is principally based on crop production and animal husbandry has dominated the economy of Africa since prehistoric times.*
- *Long-distance trade networks that promoted the exchange of raw materials and some specialized local goods between a few African states were developed in pre-colonial times.*
- *As overseas demand for certain African agricultural and mineral products increased during European colonization, the colonizers began constructing new transportation networks and introduced technological innovations and new crops; this trend has continued since the 15th century.*
- *One-way trade systems in which Africa's wealth of raw materials were exported to enrich foreign assets, with little regard for development within Africa, was what European colonies in Africa were involved in by the mid-20th century.*
- *As decolonization began in the late 1950s, the traditional rural economic sector supporting the majority, and a relatively modern sector that was based in cities and at mining and plantation sites, began to dominate.*
- *After independence, African governments began to take development initiative to improve the standard of living of their population. As a result, industries producing consumer goods and other service providing sectors such as education and health care began to grow.*

- *Rapid population growth in the second half of the 20th century, especially in the 1980s and 1990s, retarded, once again, the development of many African economies.*
- *Now, despite all the efforts made by African governments, the different economic sectors, especially the primary and secondary sectors are far from being integrated. Traditional subsistence activities are still dominant. Similarly, despite increasing levels of industrialization in many countries of Africa, the continent's raw materials continue to be produced primarily for export.*

African countries Human Development Index (HDI) values. The darker colors show the relative poverty of African countries.

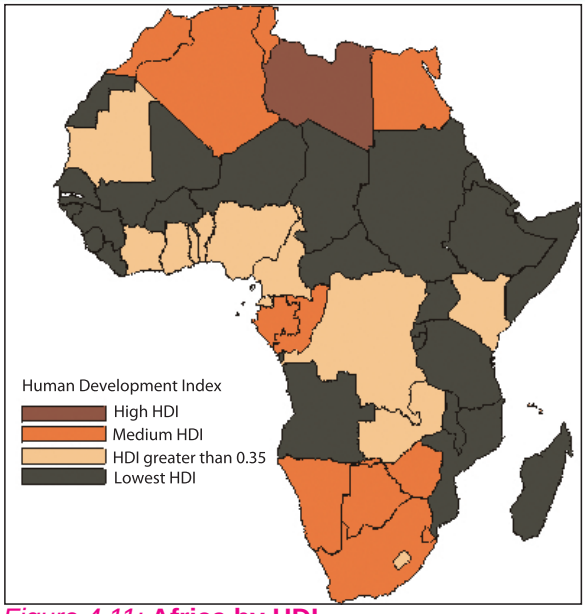


Figure 4.11: **Africa by HDI**

The modern economic sector of Africa was developed largely by Europeans during the colonial era and was geared toward the export of raw materials. Industrialization was and still minimum. Following independence, many African governments introduced industrialization programs with varying success. At present, many African states face the challenge of expanding their economies to fulfil the needs of their people while maintaining their profitable export-oriented activities.

Utilization of Natural Resources in Africa

How far are Africa's resources utilized? What are the factors that influence the degree of utilization of Africa's resources?

Africa is generally considered as a continent with untouched natural resources. The continent is rich in terms of all sorts of resources ranging from varied soil

types to diverse climate, enormous mineral wealth, energy sources, wildlife and huge human power.

Despite the continent's richness in resource potential, Africa falls far behind from fully exploiting its resources. Though soils with varying quality and diverse climate are common in Africa, agriculture is still less productive and at subsistence level. The huge energy potential of Africa in terms of hydro-electric power, solar energy and fossil fuels is also practically untapped. Minerals are also not well extracted even in areas where the extraction of such minerals as gold and diamond is said to be well developed. The wealth is rather more of a cause for conflict and civil war than for development. Pertaining to the huge manpower, We can safely make a sweeping statement that it is still less employed in highly productive activities; we reckon that the majority of Africans are engaged in subsistence agricultural activities.

Indicators of Development

How do we determine whether a certain socio-economic system is developed or developing? What are the major indicators of development?

Needless to say that development is a measurable concept. But, yes, It can be measured by using different indices that are called indicators of development. The component parts of the set of indicators indicate the level of development that a given society achieves. However, before rushing to these indicators, let us take up the following activity.

Activity 4.10

In a small group, discuss on the following questions and share your ideas with your classmates.

1 When do you say that an economy is developed or developing?

2 Do you know any factors that are capable of indicating how well an economy is developed? Mention as many indicators as you can if you think you know some.

Major Indicators of Development

Can you mention some of the socio-economic conditions that can tell about the level of development of a certain society?

The level at which a certain economy is said to be developed is directly linked with three most important conditions that are considered as major indicators of development. These are the Gross Domestic Product (GDP), the Per capita income (GNP per capita) and the Standard of living of a certain population.

Activity 4.11

Answer the following questions.

1 What is GDP?

2 What is GNP? What about GNP per capita?

3 What are the indicators of good standard of living?

a ***Gross domestic product (GDP):*** GDP refers to the total value of goods and services produced in a country over a period of time. It can be calculated by either adding up the value of all goods and services produced, or the expenditure on goods and services at the time of sale, or producers' incomes from the sale of goods or services. However, measuring GDP precisely is quite cumbersome. This is partly because every country has an unofficial economy that is often called a black economy that includes businesses that are not reported to government. Furthermore, GDP measures a country's economic activity regardless of who owns the productive assets in that country. For example, the output of Holland-owned companies based in Ethiopia is considered part of Ethiopia's GDP rather than part of the Holland GDP. The amount of GDP an economy has as well as the major sectors of contributors to the GDP of a country are important indicators of development. Another term, *Gross National Product (GNP)* is also used to measure a nation's wealth. GNP refers to the total annual flow of goods and services in the economy of a nation in monetary value. It includes income from within and out side of the state.

b ***Percapita income:*** This one refers to the average amount of money that an individual is expected to have as a result of the state's GNP. It is computed by dividing the GNP of a country by the total number of its people. As it is a crude measure, per cpita income does not tell who exactly gets how much. However, it indicates how much each individual in a state can potentially get if the total GNP of the state is evenly distributed among all people.

Though not an actual income of an individual, we can generally deduce that the higher the per capita income of a nation is, the higher standard of living and vice-versa.

c ***Standard of living:*** This is the threshold of material security measured by the availability of resources for an individual, family, or society. It is perhaps the best measurement of the quality of life of people in a given society. The standard of living that people have in a state is directly related to both GDP and per capita income. Hence, in economies we say that where we have higher GDP and per capita income, people have better standard of living. Contrary to this, people in countries with low GDP and per capita income have low standard of living.

These three factors are strictly interrelated to one another. Thus, a higher GDP means higher per capita income. Likewise, a higher per capita income means better living condition. In well developed economies, there is high GDP, per capita income and standard of living. Consequently, the things that are essential to satisfy the needs of the population are readily available. The following chart shows you how each of these concepts influence the other.

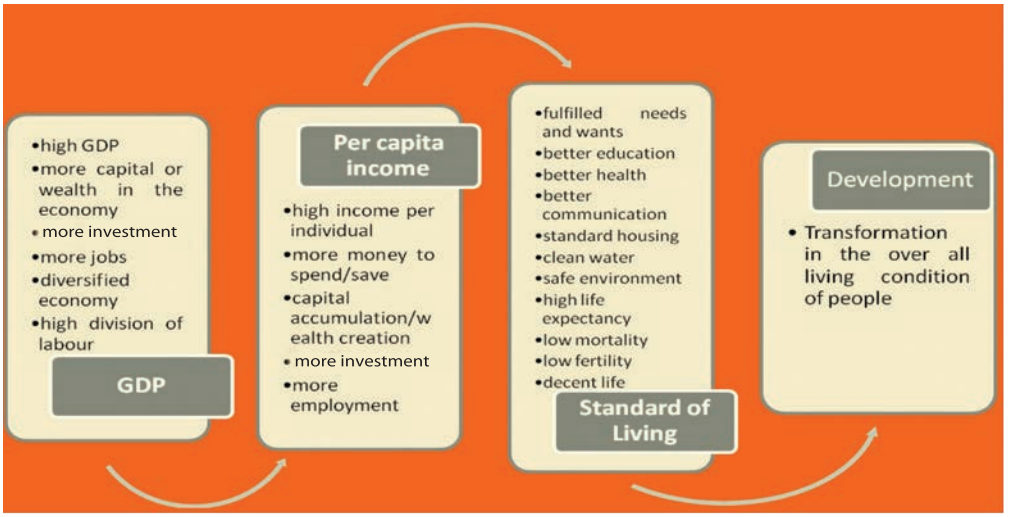


Figure 4.12: **The major indicators of Development**

The following table gives you a highlight of the basic features that characterize developing and developed countries.

Table 4.16: **Characteristics of Developing and Developed Countries**

Developing	Developed
Per capita incomes are low, and capital is scarce.	Per capita incomes are high and capital is readily available.
Wealth is unevenly distributed within individual countries, Example, Colombia, 2.6% of population owns 40% of the national wealth.	Wealth is comparatively evenly distributed, Example, Canada, 10% of population owns 24% of national wealth.
Primary industries dominate national economies.	Manufacturing and service industries dominate national economies.
High proportion of population engaged in subsistence agriculture.	Farming is commercial, efficient, and mechanized.
Populations are rural; but cities are growing rapidly.	Populations are urban, cities growing slowly.
Birth and death rates are high and life expectancy is low. There tends to be a high proportion of children.	Birth and death rates are low and life expectancy is high. High proportion of people over 60 years old.
Inadequate or unbalanced diets resulting from a low consumption of protein; hunger and malnutrition is common.	Adequate supplies of food and balanced diets; overeating sometimes a problem.
Diseases, especially infectious and parasitic diseases, are common. Health care is poor.	Low incidence of disease; good medical services available.
Overcrowding, poor housing, few public services, bad sanitation and poor social conditions.	Social conditions generally good.
Poor educational facilities, high levels of illiteracy and low levels of scientific and technological development.	Education opportunities excellent, high level of literacy, advanced science and technology.
Women may be held in an inferior position in society.	Women are increasingly treated on equal terms with men.

4.2.3 Characteristics of African Economy

What are the major characteristics of Africa's economy?

Africa is the least developed of all the continents in the World. Its economy is primarily dependent on the primary economic sector. The lion's share of

the continent's population earns its livelihood from such activities as shifting cultivation, crop production and animal husbandry. Hence, agriculture is by far the most important economic activity in the continent employing the majority of the labour force and being the main source of foodstuffs, industrial raw materials, and exportable items which provide the main source of foreign currency. Extraction of minerals, catching fish and other marine creatures and fetching gums from forests, which constitute the primary economic sector, are also major economic activities in which many Africans are engaging in.

The secondary and tertiary economic sectors are less developed in the continent, since these are recent developments. Most of the manufacturing industries are cottage types; the majority of the modern manufacturing industries are light industries that focus on the production of consumer goods. Heavy industries that could produce machineries, air crafts, ships and automobiles are almost non-existent in the continent, except a few. Regarding the service sector, it is still far behind a higher level of development. Transport and communication networks are underdeveloped. Trading undertakings, both inter and intra-continental ones, are again, far less developed. Education and health care services are poorly developed and so is tourism.

Generally, the following are the major characteristics of the economy of Africa.

- *It is largely dependent on the agricultural sector. In almost all countries of the continent, agriculture is the:*
  - *backbone of the economy;*
  - *main source of employment, industrial raw materials, foodstuff and exportable items;*
  - *main source of foreign currency; and*
  - *major contributor to the GDP of almost all countries.*
- *Other primary economic activities like fishing, forestry, mining, bee keeping and poultry, though all important, are less developed.*
- *The economy of many African countries is at less level of industrialization. Manufacturing industries are few in number and are confined to few urban centres.*
- *Inter continental, intra-regional and intra-continental trade is at low level. Commerce between African countries and regions is neutralized by similarity of products, lack of common currency, lack of foreign currency and poor communication networks of all kinds. Africa's*

international trade is dominated by the exportation of raw materials and importation of manufactured goods to and from the developed nations. This, in turn, makes Africa's trade balance feeble.

- ⇨ *Communication facilities, including land, air, and sea transport, telephone, fax and telegram are all poor, causing low level of socio-economic and political interconnections among the countries and peoples of the continent.*
- ⇨ *The various economic sectors of the continent run short of capital, skilled human power and efficient technology. As a result, most of the sectors remain dependent on insufficient local capital investment, traditional know-how of production and backward traditional technology.*
- ⇨ *As a result of low GDP and meager per capita income, the majority of the people live in poverty. Many countries also fail to provide basic social services such as education and health. Consequently, widely spread mass poverty, illiteracy and poor health conditions prevail in many countries.*

4.2.4 Present Features of Africa's Socio-economic Development

Brainstorming

1. How do you describe the existing socio-economic conditions of Africa?
2. Do you think that the existing situations are sufficiently enough for Africa to attain a better economic development in the near future?
3. What do you think would happen to Africa if the current conditions persist?
4. Do you think that African states and governments should develop new plans for their socio-economic development? Why?
5. What contributions could NEPAD have to Africa's development?

The overall socio-economic development conditions in Africa seem to be vague and unpredictable. While few countries of Northern and Southern Africa such as Egypt and the Republic of South Africa have better levels of socio-economic development, the majority of the states are characterized by very low socio-economic conditions. GDP is very low as the economy of the majority of the states in the continent is based mainly on the primary sector the outputs of which fail to be far from subsistence. Consequently, the share of individuals of

the national wealth, i.e., the concept per capita income, is precisely meager to enable Africans lead a better standard of living. As a result, poor and substandard housing conditions, inadequate provision of health and education services, poorly developed social infrastructure such as transport and communication facilities, malnutrition, illiteracy, and widely spread unemployment have become commonly observed phenomena in the continent.

Particularly, the countries in Sub-Saharan Africa are much affected by the conditions just stated above. Their tropical location coupled with intermittent inter- and intra-state conflicts, poor governance, corruption and poor infrastructure have made the region's backward socio-economic conditions. Though the continent is believed to have huge potential of natural resources that range from soils with varying quality to high labour potential, just a little of these resources has actually been utilized to improve the existing socio-economic conditions. Furthermore, the effects of colonialism have also played their part on the current socio-economic conditions of many formerly colonized states. The dependency of the colonies on their ex-colonizers in terms of trade relations and other socio-economic and political issues is exerting a lot of impact on their development.

Because of all the above situations, Africa stands at the fore front of low level of socio-economic development in the world. It is in fact, the least developed continent having the majority of its population living in a desperate situation. The majority of African's do not have better access to health and education services or to a better housing or rewarding employment. Fertility is high and population is growing rapidly despite the relative decline in morality rates in many countries. Though on a rise, life expectancy at birth is still very low and is the lowest as compared to the rest of the continents in the world. Adult illiteracy rates are high and even most school age children fail to get access to primary education. Clean water, adequate power supply and safe and healthy environments are far placed from the people. Leaving rural areas aside, they are even not adequately provided in the urban centres.

Lack of capital, lack of skilled human power and lack of advanced technology together with conflicts and civil war, corruption, bad governance and high foreign debt are among the factors that negatively influence socio-economic developments in Africa. To day, inter and intra-state conflicts and civil wars are easy to observe in the continent. Corruption is widely spread from top government officials to lower level office holders. Diverting Africa's limited capital resource from investment on social infrastructure to individual's pockets is common place.

Lack of good governance has resulted in lack of accountability. Formulating and executing development policies and programs as well as passing fundamental decisions on matters that could make life better in the continent have all become unworkable.

Debt crisis is another serious challenge of development in Africa. Due to their internationally disadvantaged status, nearly all African countries had to borrow money from foreign lenders to cover the difference between their export earnings and their spending for imports. The amount of accumulated external debt owed by Sub-Saharan African countries has risen from less than $6 billion in 1970, to $80 billion in 1985, to $230 billion in 1999. Interest payments to foreign creditors siphon away precious foreign exchange earnings. Such pressures on export earnings have led African governments to make stringent cuts in imports because of high tariffs and complete prohibitions.

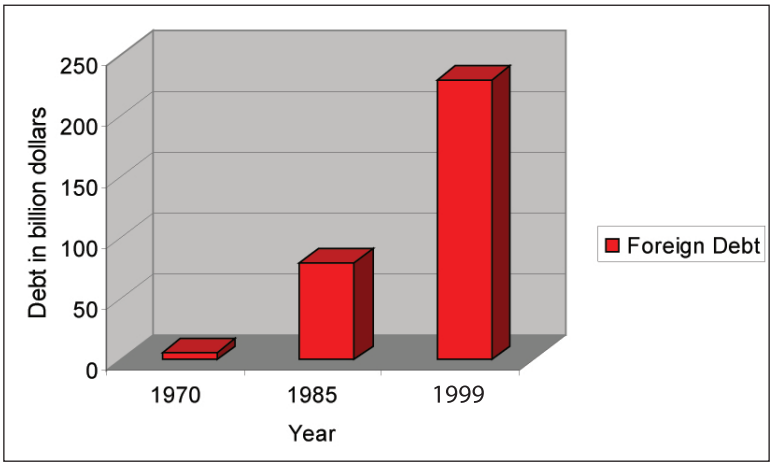


Figure 4.13: **External Debt owned by Sub-Saharan African Countries**

As was the case during colonial rule, Africa's role in the world economy remains to produce raw materials for use in developed nations. Investment by international corporations and most foreign governments has concentrated on expanding production of exportable mineral and agricultural raw materials. The emphasis on exports has left inadequate resources for developing domestic industry or changing the traditional, underdeveloped system of African smallholder food production. Neglecting their food-producing sectors has led African countries to increase their dependence on raw-material exports and has required many to import food to feed its people.

The continent's trade position has faced further dire challenges since the 1960s. The prices of manufactured goods and fuels imported by African countries

increased substantially, while the prices of almost all products of African mines and farms declined or fluctuated. This downturn meant that African countries not only had made them do with fewer needed imports, but also go into international debt to meet their financial requirements. Oil-exporting countries were able to avoid this pitfall for a time, but they too were beaten down by the collapse of world oil prices in the 1980s and 1990s. Africa has also been put at a disadvantage by the protectionist trade policies of industrialized countries, which accepted unprocessed raw materials tax-free but imposed substantial tariffs on imported products that have actually been made from their own raw materials.

4.2.5 Challenges and Prospects of Economic Development in Africa

Brainstorming

1. What are the major problems of economic development in Africa?
2. How far are these problems serious in the continent?
3. Do you think that there are prospective opportunities for Africa's development?
4. What, do you think, are the roles that continental and regional organizations can play in the development of the continent?

Despite its second position in the world in terms of territorial and population size, Africa is the world's poorest continent with stagnant socio-economic conditions. The continent's economy has been suffering from serious challenges since earliest times. Lack of capital, skilled human power and modern technology are the major problems hampering its development. In addition to these, political instability, civil war, lack of good governance and the resultant widely spread corruption, maladministration, poor infrastructure and the subsequent poor regional inter-connectedness, poor export performance, declining industrial outputs, environmental degradation and many other cultural factors have influenced negatively the work habit of the majority of Africans, which, in turn, have posed as dominant factors impeding its economic development. As a result, the per capita income of the majority of Africans becomes very low negatively affecting the standard of living of the continent's population. Social services are poorly developed. Health problems including HIV/AIDS and illiteracy are common. Saving and local capital accumulation are extremely limited. Hence,

the economy of the majority of the countries in Africa is dependent on foreign aid and debt. This has created intense pressure on Africans development.

Another significant challenge for Africa's development is rapid population growth. The continent's population is increasing rapidly. As a result, Africa has the world's fastest population growth rate. According to the 2009 World Population Data Sheet, the continent's population has been growing at the natural rate of 2.4%. The rate has even been higher in Sub-Saharan Africa with 2.5%. If this rate continues in the future, the continent's population would double in not more than 30 years. With such a rapid increase in population size, Africa's economy finds it difficult to meet the necessities of its people. Economic development is far behind from the rate at which the population of the continent is increasing. As a result, the limited capital of many African countries is shifting towards making Africans lead a subsistence life that is far from global standards. The imbalance between population growth and economic development in the continent is also becoming a source of conflict in many of its countries and regions. Resource competition and the increased need for means of subsistence is becoming a cause of inter-state and intra-state conflicts. This condition is adversely affecting the economy of many African states as it forces governments to shift their limited resource to war related expenses.

Though the current socio-economic conditions of Africa are under extreme pressure as a result of the problems stated above, the future of the continent seems to be promising some how. This is due to the establishment of so many continental, regional and sub regional organizations that are meant to facilitate socio-economic development in the continent. These organizations have different purposes. While some are of general purpose organizations, others are of specific ones.

Activity 4.12

1. Do you know any one of the organizations that have been established in Africa for purposes just cited above?
2. Which one of these organizations is multi-purpose? What about the ones with specific purposes?
3. What, do you think, are the roles that these organizations play in promoting socio-economic development in Africa?
4. Do you think that the presence of these organizations can possibly change the socio - economic conditions of Africans in the near future? Why?

The African Union (AU), the former Organization of African Unity (OAU), is the only continental organization in Africa. With its new organizational structure, the AU is meant to promote peace, unity and cooperation in the continent. The organization is also meant to resolve conflicts between nations and to pacify hostilities. Besides these, it is meant to coordinate political, economic, cultural, scientific, medical, and defense policies among member states. The organs of AU primarily the African Development Bank, the African Court of Justice, the Pan African Parliament and the Security Council are working on the promotion of peace, security, good governance, inter connectedness and development.

> The African Union is the largest international economic grouping on the continent. Its goals include the creation of a free trade area, a customs union, a single market, a central bank, and a common currency, thereby establishing economic and monetary union. The current plan is to establish an African Economic Community with a single currency by 2023. The African Investment Bank is meant to stimulate development. The AU plans also include a transitional African Monetary Fund leading to an African Central Bank.

In addition to AU, other regional and sub-regional organizations are also striving hard to improve socio-economic conditions in Africa. Among others, IGAD, NEPAD, SADC, COMESA and ECOWAS are the prominent ones. These organizations have varied purposes all of which boil down to promoting overall socio-economic development at regional and continental level. They work hard to improve trade and other socio-economic integration among member states. They labour to help member countries achieve better levels of development. They assist development efforts in different ways some of which include promoting peace, security and stable socio-economic conditions. They also provide financial, technical and technological support to member countries to help them mitigate their problems and foster development. The following map portrays the different regional organizations and their member countries.

N.B. *Overlapping colours that form stripes indicate multiple membership of countries.*

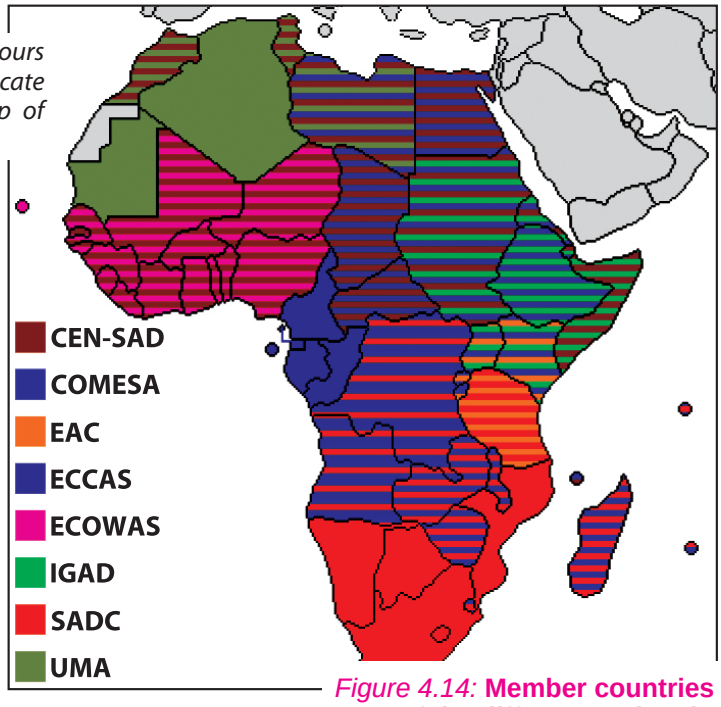


Figure 4.14: **Member countries of the different regional organizations in Africa**

- *CEN-SAD: Community of Sahel-Saharan States*
- *COMESA: Common Market for Eastern and Southern Africa*
- *EAC: East African Community*
- *ECCAS: Economic Community of Central African States*
- *ECOWAS: Economic Community of West African States*
- *IGAD: Intergovernmental Authority on Development*
- *SADC: Southern African Development Community*
- *UMA: Arab Maghreb Union*

In addition to these continental and regional organizations, other international organizations are also having impact on Africa's future development. For instance, the roles played by the different organizations of the UN like the ECA, UNESCO, UNICEF, WHO, ILO and FAO' among others, are significantly important. Generally, these organizations are working to improve overall development in areas including education, health, employment, agriculture, science and technology. Through financial and technological assistance, these organizations are promoting the socio-economic development of the continent.

By promoting inter-continental and international integrations and cooperation, these organizations are expected to foster Africa's socio-economic development. They are also meant to improve Africa's position in the world's socio-economic order. The organization work to make Africa beneficiary from the world's economic conditions by creating situations that favour African countries, especially in the world trade. Through financial, technological and material assistance, they are trying their level best to change African's socio-economic conditions. If these efforts are supported by progressive governmental policies and programs, Africa's future socio-economic development seems to be some how promising as the continent possesses huge but untouched natural and human resources.

From 1995 to 2005, Africa's rate of economic growth increased, by 5% in the average in 2005. Some countries experienced still higher growth rates, notably Angola, Sudan and Equatorial Guinea; all three of which had recently begun extracting their petroleum reserves or had expanded their oil extraction capacity. In Ethiopia, economic growth is being experienced. The country has been experiencing an average economic growth rate that exceeds 10% per year for the last five years. The country is also becoming one of the fast growing economies in Africa the situation is also being supported by the government's effort to increase resource exploitation to further boost economic growth.

Content Check

Define the following terms and concepts

a development
b growth
c GDP
d Standard of living

4.3 NATURAL RESOURCES OF AFRICA AND ITS POLITICS

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

- relate major resources of Africa to its exploitation and development of Africa;
- state the actual mineral extraction methods of Africa;
- relate the paradox between the potential and actual resources exploitation in Africa; and
- defend for the advantages of peaceful mechanisms of conflict management around resource utilization in Africa against aggressive mechanisms.

Key Terms

- Natural resource
- Conflict
- Mining
- Mineral
- Regional organizations
- HIV/AIDS
- Debt
- NEPAD

As some sources indicate, Africa is a naturally endowed continent. Its landmass possesses huge reserve of different kinds of minerals including precious gem stones such as diamond and gold, and petroleum. Its varied topography makes the continent rich in terms of climatic resources and biodiversity. The geology of the continent is also a cause for the presence of various soil types with varying degree of fertility. Water resources are abundant in forms of rivers, lakes and swamps, though there are still many areas with serious shortage of water. The world's second largest population of the continent is also a source of huge human power. Africa's tropical location also makes it potentially conducive for the continent to possess tremendous solar energy. However, all these resources do not seem to serve the cause of the continent's development. Instead, they are becoming causes of conflicts and war.

4.3.1 Major Resources of Africa

Brainstorming

1. What are the resources that Africa is believed to be rich with?
2. What, do you think, are the roles that these resources could play in the development of Africa?
3. Do you think that Africa is benefiting from these resources properly? Why?

As has been stated earlier, Africa is believed to be rich in terms of human and material resources. The physical environment coupled with the continent's varied geology makes Africa prosperous in terms of resources of various nature. Among others, the mineral, agricultural, water and human resources of the continent are of paramount importance for its future development.

Activity 4.13

1 What are the mineral resources that Africa is well known for globally?
2 Which of the countries of Africa are leading producers of these minerals?
3 What are the major agricultural resources that Africa contributes to the world market?
4 Account for the resource potentials of Africa's rivers and lakes.
5 How, do you think, can Africa's human resource be exploited to the extent that it contributes to the continent's development?

Mineral Resources of Africa

What are the minerals that Africa is well known for in the world market?

Africa's geology consists of various types of rocks and fuel oil. This makes the continent rich in mineral resources. Geographically, Northern Africa is rich in petroleum resources. West and Central Africa are also major regions with huge petroleum reserves. Metallic minerals and other gem stones are abundant in Southern Africa.

As some estimates indicate, Africa has 90% of the world's cobalt and platinum, 50% of the world's gold, 98% of the world's chromium, 70% of the world's tantalite, 64% of the world's manganese and one-third of the world's uranium. The DRC alone has 70% of the world's coltan (ore of Tantalum) and more than 30% of the world's diamond reserve. Guinea is the world's largest exporter of bauxite (ore of aluminum).

North African countries constitute one of the world's major centres of oil production. Libya, Algeria and Nigeria are among Africa's leading producers of crude petroleum. Algeria has a huge reserve of natural gas, as well. North Africa is also rich in phosphate deposits and production, Morocco being the world's leader in its output. Coal, iron ore, uranium, platinum, lead, zinc, and cobalt are also available in Northern Africa, though to a lesser extent.

Significant amount of oil reserve is also found in Western and Central Africa. With Nigeria being Africa's top petroleum producer. Other important oil-producing countries of the region include Angola, Gabon, and the Republic of the Congo. These regions also possess some of the world's most significant sources of cobalt, manganese, potash, bauxite, and copper. Guinea alone has about one-third of the world's reserves of bauxite. Other minerals of significant economic importance

in the regions are iron ore, gold, diamond, tin, uranium, phosphate, columbite, and titanium.

Likewise, Southern Africa is one of the world's richest source of gold, diamond, and several other rare metals. Among the countries of the region, the republic of South Africa alone has the largest and most diverse mineral economy. As a result, the country is a leading producer of gold and uncut (raw) diamonds. Zimbabwe is also an important producer of gold. Botswana and Namibia produce significant amount of diamond. Chromium, cobalt, antimony, uranium, lithium, nickel, manganese, asbestos, platinum, titanium, and vanadium are also important minerals produced in southern Africa.

Minerals account for about half of the export earnings of 12 African countries. Nearly 90 percent of the exports in Angola, Nigeria, Algeria, Libya, and Zambia come form minerals. As a result, Africa plays a significant role in the world's mineral economy. It produces about:

- three-quarters of the world's cobalt;
- half of the global supply of platinum, chromium, and diamonds;
- one-third of all gold, manganese, and uranium;
- one-fifth of all bauxite; and
- one-tenth of the world's petroleum.

Table 4.17: **Major minerals produced in Africa and the leading producers of the continent**

Mineral	Africa's Global share	Leading producers in Africa
Diamonds	77%	Zaire, Botswana, RSA,
Gold	55%	RSA, Ghana, Zimbabwe
Copper	20%	Zambia, DRC, Zimbabwe, RSA,
Bauxite	19 %	Guinea, Ghana and Sierra Leone
Iron ore	4%	Liberia, Mauritania, Morocco, Tunisia, RSA, Zimbabwe and Swaziland
Chromites	41%	RSA and Zimbabwe
Manganese	27%	RSA, Gabon
Petroleum	10%	Nigeria, Libya, Algeria, Egypt and Angola
Tin	13%	DRC(Katanga area) and Nigeria
Cobalt	76%	DRC and Zambia
Coal	6%	RSA , Zimbabwe, Nigeria, Zaire, Zambia, Mozambique, Malawi and Tanzania

Source: *FAO, production year book.*

Agricultural Resources

What are the major agricultural resources of Africa? Can you list some of the tropical crops that Africa is known for?

Agriculture is the backbone of many African countries. Apart from being the main source of foodstuffs and employment, the sector is a dominant source of agricultural outputs that enter into world market. Africa's physical diversity has made the continent an ideal environment for the production of certain agricultural products that are vitally demanded in the world market. The continent is rich in terms of certain tropical crops such as coffee, cocoa, tea, sugarcane, rubber, palm oil, sisal, cotton and ground nuts. The economy of many African countries is primarily agricultural. They are dependent on the exportation of these tropical crops. Crop production absorbs much of the continent's labour force; and the exportation of crops contributes a lot to the GDP of the exporting countries.

Table 4.18: **Leading producers of Tropical crops in Africa and Africa's share to the World's production**

Crop	Leading producers in Africa	Africa's Global share
Cocoa	Ghana, Cote D'Ivoire, Nigeria, Liberia, Togo, Cameroon	53%
Coffee	Cote D'Ivoire, Ethiopia, Uganda, Kenya, Cameroon, Tanzania, DRC, Angola	20%
Tea	Tanzania, Kenya, Ethiopia, Mozambique, Zimbabwe, Congo, Mauritius	13%
Palm oil	Nigeria, Ivory Coast, and Zaire	16%
Sugar cane	Sudan, Kenya, Uganda, Ethiopia	7%
Rubber	DRC, Ghana, Cote D'Ivoire, Cameroon Gabon, Sierra Leon, Kenya and Tanzania	6%
Sisal	Tanzania, Kenya and Madagascar	29%
Cotton	Sudan, Nigeria, Ethiopia, Mali, Congo and Egypt	7%
Ground nuts	Nigeria, Senegal and Zaire	29%

Water and Associated Resources

Do you think that different kinds of resources can be obtained from water bodies? Mention some examples.

Though the provision of clean water is a critical problem in many countries of Africa, the continent is still rich in terms of water resources. Thousands of rivers that altogether comprise the four major drainage systems of Africa flow over the vast landmass of the continent. The rivers that drain many areas of the continent include some of the world's greatest rivers namely Nile, Congo, Niger and Zambezi. There are also many lakes, a lot of which are concentrated in the Great East African Rift Valley, a site also containing varied biodiversity. The rivers and lakes have tremendous potential in terms of fishing, hydroelectric power generation, irrigation, and mineral extraction.

The rivers and lakes of Africa, as well as the adjacent seas and oceans make the continent rich in terms of fish resources. Major grounds for marine fish such as tuna, sardines, and hake are found some distance off from West African coasts stretching from Morocco to Senegal, and Angola to Namibia. The Nile, Niger, Congo, and Senegal rivers and Lakes Victoria, Tanganyika, Malawi, and Chad are also major sources of freshwater fish. Nile perch is the most common freshwater fish targeted in angling.

Morocco, Egypt, South Africa, Ghana, and Nigeria were the top African countries in total fish catch in 1999. Morocco, Namibia, South Africa, Senegal, and Libya exported the most fish in the same period. Morocco is also leading in fish-processing industries, producing more canned fish, fish oil, and fish meal than any other African country.

Africa's many large rivers provide the continent with a vast hydro electric power potential, Which, in fact, has scarcely been exploited. Several major dams including the Aswan High Dam on the Nile River, the Akosombo Dam on the Volta River, and the Kariba Dam and Cabora Bassa Dam on the Zambezi River have been constructed since 1960. In Ethiopia, the major rivers of the country mainly rivers Tekeze and Ghibe have already been dammed for this purpose. The country has also inaugurated a new dam construction project on the Abay river recently.

Irrigation is another potential to be exploited from Africa's rivers and lakes. As these water bodies contain fresh water, they can potentially be exploited for agricultural purposes. As many areas in Africa are rainfall deficient, the rivers and lakes that form the drainage systems of the continent can be used for the production of agricultural products. For instance, the Nile River supports the lives of millions of people in Sudan and Egypt by providing irrigable water to

these countries. Similarly, the Awash River in Ethiopia makes such a benefit available to the people of this country. There are many irrigation schemes along the Awash River basin including the Upper and Lower Awash agro-industries and the different sugar cane plantations in the region. However, the huge irrigation potential of many rivers and lakes in Africa is not yet fully exploited. Despite such available potential, decline in agricultural productivity is a common phenomenon in many African states. As a result, the continent often suffers from recurrent famine.

Another most important stockpile associated with water resources in Africa is mineral. The shores and beds of lakes and banks of rivers are of substantial source of minerals. In many countries of the continent, construction materials such as sand, gravel and boulders are being exploited from rivers and lakes. Gold and other precious metals are also being extracted from rivers in traditional ways in many countries. For example, many people in Ethiopia extract gold from the Baro River in the Gambella Regional State. Similar traditional gold mining practices are also being performed in many African countries.

Human Resources

Why do we say that Africa is rich in terms of human power?

Africa is the world's second most populous continent. According to the 2009 World Population Data Sheet, the continent is a home for about 1 billion people. Of this number 41% is under 15 and 3% above 65 years of age. The rest 56% is in the productive age. This makes the continent rich in terms of human resource potential. This indicates, firstly, the fact that about 56% of the total population is currently actively productive: and, secondly, the future potential of labour is relatively high since the 41% population of under 15 would soon join the labour force. Yet, we can say that the human resource potential of the continent has never been exploited to its full extent. In simple words, it fails to contribute to the development of the continent since much of the labour force, including the economically active, are unemployed or idle and even underemployed.

4.3.2 Natural Resources Exploitation and Mineral Extraction Methods in Africa

How are resources being extracted in Africa? To what extent is Africa's resource extraction sector developed?

As we have seen so far, Africa has tremendous potential of natural resources. However, the degree of exploitation of these resources of the continent appears

being very low. This is partly due to the prevalent lack of good governance, corruption, maladministration and lack of citizens' participation in resource development programs. In addition to this, lack of capital, skilled human power and technology have also contributed for the limited development of the resource exploitation sector in the continent. As a result, most resource extraction techniques are traditional in their nature. This in turn affects the level of productivity. Forest resources extraction, fishing, cultivation, and other sectors of the economy that are linked with natural resources are dominantly traditional in their nature.

The mining sector is also affected by these problems. As a result, the huge mineral potential of many African countries remains useless for most of them as it fails to guarantee the peoples' development. This is due to the backward mining technology that most of the peoples in these countries follow. Mineral extraction in many African countries is traditional and less productive. The people near by mineral deposits utilize different traditional techniques to take different kinds of minerals out from the soil. *Placer mining*, *strip mining* and *quarrying* are among the most common mining methods in Africa. *Placer Mining* is the extraction of mineral deposits from excavations of sand, gravel, clay, or silt. *Minerals mined* in this way include gold, platinum, tin, and diamonds. Placer mining is most common among societies living near river valleys, where such minerals as mentioned above are brought to the surface by erosion. *Strip Mining* is uncovering and removing coal, metal, or a mineral that is near the surface of the ground. And *quarrying* is open excavation from which any useful stone is extracted for building and engineering purposes, and the operations required to obtain rock in useful form from a quarry.

Some countries that are rich in natural resources, i.e. those that receive more than 25 percent of their government revenues from natural resources extraction, actually tend to have high and growing levels of poverty, extreme income inequalities, greater risk of conflict, and high levels of corruption.

4.3.3 Resource Utilization and Conflict Management

As has been elaborated in preceding discussions, Africa is naturally endowed with varied resources that could potentially contribute a lot to the continent's development. However, the degree of exploitation of these resources is practically insignificant. The huge mineral potential of the continent is untouched. The

water resources are untapped. Even in areas where the extraction of minerals is better developed, the resource is becoming more of a cause of conflict than of a socio-economic development. As you might have heard from different sources of information, Africa is the only continent that is well characterized by political unrest, conflicts, civil war and related humanitarian crisis including huge displacement of people. As a matter of fact, the continent is considered as the world's largest refugee camp since millions of Africans live in refugee camps as a result of displacement for reasons of conflicts and civil war.

Activity 4.14

1 Do you know any African country where resource utilization is a cause of conflict and civil war? If yes, identify the countries and discuss what causes the conflict or the civil war.

2 Have you ever seen or heard of a conflict caused by resource exploitation, such as land utilization, for grazing in your area? If yes, how did the people solve their problem (if at all they have solved it)?

3 What, do you think, should be done to manage conflicts that arise from resource utilization at local and or continental level?

The major source of conflict in many resource exploitation areas of Africa is related to inappropriate use and allocation of resources. If we consider many of the conflicts and civil wars in Africa, their causes are deep rooted in resource allocation and utilization. In most of the cases, governments fail to provide better opportunities for the residents of the areas where resources, especially minerals, are being exploited. To add fuel to the problem, many governments do not even make the inhabitants of resource extraction areas beneficiaries of the exploited resources. Thus, while many Africans live in extreme poverty expensive resources get tapped and exported to rich countries. This causes conflict. In demand of having their opportunities fulfilled, peoples of such areas confront their governments. When the government fail to properly address the issue, the conflict intensifies and people die ultimately, the case worsens and civil war occurs.

The conflicts that have made Africa an extensive battle field of civil wars are in one way or another associated with unfair utilization and allocation of resources. The Civil wars in Southern Sudan, Liberia, Democratic republic of Congo, Angola, and Rwanda are fought because of inappropriate resource utilization and allocation, besides seeking political power.

Activity 4.15

1 Have you ever heard about the issue of "blood diamond" in Liberia? What is it supposed to mean?
2 What are the causes of the civil wars in Angola and the Democratic Republic of Congo?

Civil war is the exception rather than the rule across much of the developing world. The combination of weak governance structures and resources that offer the promise of windfall gains to those who control production and export is the major cause of violent conflict. In the post–cold-war era, revenues from natural resources have replaced superpower funding as the fuel of war. Between 1990 and 2002, the world saw at least 17 such conflicts in which wealth from natural resource was a primary factor. Diamonds in Angola and Sierra Leone, timber and diamonds in Liberia, gems in Afghanistan, and copper, gold, cobalt and timber in the Democratic Republic of the Congo have all been at the centre of civil conflict. In the case of the Democratic Republic of the Congo, such a cause of conflict has been accompanied by incursions supported by neighboring states.

In this manner, financial flows that could have been used to support human development have frequently been diverted into funding civil wars, with governments, rebels and assorted warlords seeking control over oil, metals, minerals and timber. The wealth from the second largest oil reserves in Africa (Angola) and the fourth largest diamond reserves in the world was used to fuel a civil war that killed and wounded nearly 1 million people and left other 4 million internally displaced between 1975 and 2002. Today, Angola ranks 160 among 177 countries on the Human Development Index (HDI), with a life expectancy of about 40 years only. The following table gives you a highlight on the duration and causes of civil conflicts in selected countries of Africa.

Table 4.19: **Conflicts associated with natural resources in Africa**

Country	Duration of Conflict	Resources
Angola	1975-2002	Gems, Opium
Angola, Cabinda	1975-	Oil, Diamonds
Congo	1997	Oil
DRC	1996-97, 1998-2002	Copper, Coltan, Diamonds, Gold, Cobalt
Liberia	1989-1996	Timber, Diamonds, Iron, Palm Oil, Cocoa, Coffee, Marijuana, Rubber, Gold
Morocco	1975-	Phosphates, Oil
Sierra Leone	1991-2000	Diamonds
Sudan	1983-2005	Oil

Source: *Adopted from Bannon and Coller, 2003.*

Unit Review

UNIT SUMMARY

- Africa and other developing regions make up an increasing share of world population. The world population has shown a tremendous increment from 1950 to 2000. Africa, Asia and Latin America contribute the highest proportion to this share.
- According to the 2050 world population projection a high population concentration shifts to developing countries.
- The projections suggest that the share for developed countries declines from 18 percent in 2008 to less than 14 percent in 2050.
- The growth rate of population is a vital demographic feature that can help us understand the population change that a given society has undergone and will undertake in the future.
- Africa is the only continent whose population is growing faster than any other continents on earth.
- There is not an even distribution of population in the world. Deductively, Africa's population distribution is uneven.
- The unevenness of African population distribution is attributable to human and physical factors.
- The three major components that bring about a change in matters related to population in any country are fertility, mortality and migration.
- Africa's rapid population growth and backward Socio-economic development have turned Africa into the world's lowest social amenities. As a result, poor health, inadequate education, deficient nutrition and inferior housing facility widely tangle the people of the continent.
- Africa's rate of urbanization is the highest in the world.
- Currently, the uncontrolled and rapid urbanization has depopulated the rural areas. This has crippled agricultural production, especially the production of food crops.
- Generally speaking, rapid urban growth has become a major cause of growing poverty both in rural and urban areas in Africa.

- The term Economic Growth is used to describe the increase in the total amount of production and wealth in the economy of a given society.
- Economic development refers to growth with structural and technological change. It includes the concept of overall transformation in the living condition of the people of society.
- The level of developed of a certain economy is directly linked with three most important conditions that are generally considered as major indicators of development. These are the Gross Domestic Product (GDP), Per capita income (GNP per capita) and Standard of living of a certain population.
- High GDP, Per capita Income and standard of living indicate higher level of development. The reverse indicates under development.
- Low GDP, low income per head, poor and inadequate housing conditions, poor transport and communication networks, low educational and health coverage, widely spread unemployment, high mortality rates of all sorts, high human fertility and indecent life characterize the living conditions of millions of peoples in Africa.
- Africa is generally considered as a continent with untouched natural resources. However, the continent fails to fully exploiting its resources.
- Dependency on agriculture, low level of industrialization, poor inter- and intra-regional trade performance, poor transport and communication network, low GDP and per capita income characterize Africa's economy.
- Lack of capital, skilled human power and modern technology; rapid population growth, HIV/AIDS and other factors are among the challenges that affect Africa's development.
- Many African countries have extremely high foreign debt.
- The different continental and regional organizations in Africa are believed to be motors of change in Africa's socio-economic condition.
- Africa is rich in terms of natural and human resources. However, the degree of exploitation of these resources is found to be very low. As a result, what the people of Africa benefit from the immense resources of their continent appears being insignificant.
- In most of the cases, places of mineral extraction are areas of violence, conflict and civil war. There have been many conflicts among Africans that were caused by mining related factors.

REVIEW EXERCISE FOR UNIT 4

I *Write True if the statement is correct and False if the statement is wrong*

1 Population growth rate for developed countries is higher than developing countries.

2 In developing countries, there is usually a mismatch between population growth rate and economic development.

3 Migration has nothing to do with natural increase in population.

4 Internal migration, in many African countries, takes place between relatively poor and relatively rich areas.

5 Africa's mortality rate is declining and has become the lowest in the world.

II *Matching: Match Column A with Column B*

A		B	
6	Population pyramid with narrow apex	A	Migration from Ethiopia to U.S.A
7	Low rate of fertility	B	Belongs to developing countries
8	Short population doubling period	C	Migration from Ethiopia to South Africa
9	Intra-continental migration	D	Belongs to developed countries
10	Inter-continental migration	E	High population growth rate

III *Write short answers for the following questions*

11 What is economic growth?

12 Define economic development.

13 What are the major indicators of development?

14 Identify the leading producers of the following items in Africa.

a diamond
b gold
c petroleum
d coffee
e tea
f cacao

15 What are the factors that affect Africa's economic development?

Glossary

Aerial photograph - Photograph of things including the earth, taken from a plane.

Age Dependency ratio - the ratio between working age and non-working age population.

Age structure - the pattern that results from the distribution of population into different age categories.

Approach - is a method used to make scientific thinking by any field of study.

Altimeter - a device used in an aircraft to measure how high it is from the ground.

Applied geography - is the application of geographical knowledge and skills to the solution of economic and social problems and in the realms of planning.

Census - a periodic counting of a population, in which certain facts on age, sex, occupation, and the like are recorded.

Confluence - the place where two rivers meet together and become one larger river.

Contour - a line on a map connecting all points with the same, known altitude above a specific datum loosely termed sea level.

Contour interval - the altitude (height) difference between two successive contour lines.

Data - are varieties of information needed for investigation of a given problems. Basically, there are two broad groups of data sources, namely primary and secondary sources.

Deforestation - the process of indiscriminate destruction of the natural vegetation covers of an area without adequate replacement.

Delta - An area of low flat land sometimes shaped approximately like a triangle where a river divides into several smaller rivers before flowing into the sea.

Determinism - is a school of thought which believes in that the history, culture, life style and stage of development of a social group or a nation are exclusively or largely governed by the physical factors of the environment.

Demography - the scientific study of how births, deaths, and migration affect the composition, size, and distribution of populations.

Distributary - An individual channel into which a river may split, as in a delta, which does not rejoin the main stream but reaches the sea independently.

Divide (watershed) - a line on the map separating two river basins.

Drainage basin - the area drained by a single river system.

Drainage pattern - the layout or plan made by rivers and their tributaries on the landscape.

Environment - the conditions that you live or work in and the way that they influence how you feel or how effectively you can work.

Geography - is the study of the spatial variation of phenomena on the earth's surface on one hand and the two-way relation ship existing between human kind and the environment on the other hand.

Geo-sphere - Area that belongs to the planet earth.

Geodetic control network - Geodetic survey used to provide the overall control, or framework, for mapping

GIS - Geographical information system.

GPS - Geographical positioning system.

Gradient - the rate of change in altitude of a slope expressed basically as a proportion between vertical change per unit length horizontally.

Ground survey - to measure and record the details of areas of land especially on a map.

Infant mortality rate - the number of deaths among infants under one year of age per 1,000 live births in a given year.

Interdependence - dependent on each other.

Inter disciplinary - the relationship among various disciplines e.g. the relationship between geography and other disciplines (between geography and economics, geography and biology, etc.).

Interpolation - a technique which is employed to draw contour lines in a given area with the help of individual spot heights.

Intervisibility - two places (points) mutually seen.

Misfit stream - the remaining part of a captured river (Victim stream).

Modeling - in digital geographic information system logical sequence of analytical operations used to produce information.

Mortality Rate - the relative frequency of deaths among members of a population segment.

Natural science - is a field of study which includes physics, biology, mathematics, geology, chemistry,etc.

Overlying analysis - As used in the computation of the coefficient of areal correspondence, mapping of two distributions at the same scale and placing of the outline of one over the outline of the other.

Phenomena - something that exists and can be seen, felt, tasted.

Preventive checks - moral restraint such as late marriage, avoiding sexual conduct before marriage, etc proposed by Malthus as controls of fast population growth.

Pollution - damage to the environment caused by waste levels that overload natural recycling systems or by synthetic materials that cannot be broken down by natural process.

Population density - the average number of people per square kilometer area.

Population distribution - the proportions of people in world countries, provinces, regions, cities, etc.

Population policy - a policy designed to control and plan population growth based on the socio-economic and political conditions of a country.

Population pyramid - a graphic representation of the age and sex structure of a given population.

Positive checks - the catastrophes (such as poverty, famine, war, diseases, etc) proposed by Malthus as consequences and controls of fast population growth.

Possibilism - is a school of though which believes that human society cannot fully tame nature and is not always victorious.

Profile - The outline produced when a plane of a section cuts the ground along a curved line like a road, river, or railway.

Quantitative revolution - is a shift (change) of approach from descriptive to inquiry methods by adopting statistical techniques.

Region - a particular area or part (of the world, of the body, etc) or any of the large official areas into which a country is divided.

Regional approach - it deals with all aspects of a given area and compares that area with others i.e. it deals with the complete geography of specific areas.

Relief - landform - (mountain, plateau, plain, etc.)

Remote sensing - Gathering data by means of a sensor that is not in contact with the objects in the scene being observed. Includes aerial photographs images from radar and other airborne sensors and satellite images.

River capture - the diversion of the head waters of a river system into the basin of a neighbour river with a greater erosional activity which is following at a lower level.

Rural - country side or non-urban place a settlement is a whole inhabitants depend on agriculture for their livelihood.

Satellite imagery - Remotely sensed image captured by instruments taken aloft in a space craft, with or without a human crew.

School of thought - is (a group of people who share) a set of ideas or opinions about a mater.

Science - is the systematic study of the structure and behaviour of the physical world, involving experimentation and measurement and the development of theories of describe the results of these activities.

Scope - is the range of facts ideas, contents covered by a given discipline, programme, discussion, class, etc.

Settlement - any place where people live-a house hamlet, village, town and city.

Sex ratio - the number of males per 100 females.

Sex structure - the pattern that results from the distribution of population according to sex.

Site - is the exact location or land area of settlement or building, the actual float of land on which the village or town is built.

Slope - a surface which lies at angle to the horizontal so that some points on it are higher than others.

Social science - the study of all the features of society.

- A field of study which deals with politics, economics, sociology, philosophy etc.

Spatial - an belonging to space/understanding of where things are in relation to other things.

Spatial interaction - the relationship that exists (phenomena) in relation to space.

Spatial phenomena - position, size, shape of things.

Spot height - lesser survey points which have been measured to determine their position and especially height.

Sterioscope - Simple instrument that permits the simultaneous viewing of a sterio pair of aerial photographs so that the desired three dimensional effect is achieved.

Systematic approach - is the study of the spatial organization or location aspect of a specific phenomenon and its interaction with other phenomena.

Surface - Variation in elevation representing differences in the value of (physical or statistical) variable over a region.

Total fertility rate - the average number of births a woman will have in her life time.

Tributary - a stream or river which joins a larger one.

Urban - non-rural area example town, city, etc.

Urbanization - the process whereby large number of people leave the countryside and small towns in order to settle in cities and surrounding metropolitan areas.

Vertical exaggeration (V.E) - a deliberate increase in the vertical scale of a section or profile in comparison with the horizontal scale in order to make the section clearly perceptible.

Water-shed - a line separating two or more river basins.

GEOGRAPHY

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