Unit 3

PHYSICAL GEOGRAPHY OF ETHIOPIA AND THE HORN

Unit Outcomes

After completing this unit, you will be able to:

- describe the location and size of countries in the Horn of Africa;
- recognize the geological history, structure and relief of the Horn of Africa;
- discuss the significance and characteristics of the drainage systems of Ethiopia and the Horn;
- appreciate water-resource conservation and management policy;
- identify the factors influencing the spatial and temporal distribution of elements of climate in Ethiopia;
- realize the different types of natural vegetation and wild animals of Ethiopia;
- describe soil types, problems and conservation in Ethiopia.

Main Contents

INTRODUCTION

Where is the Horn located?

Do you know why this part of Africa is called the Horn?

To answer these questions, look at the map of Africa carefully. You will immediately see why this name is associated with a certain area on the map of the continent.

The Horn of Africa, a part of the continent, is a narrow tip that protrudes into the northern Indian Ocean, separating it from the Gulf of Aden.

The Horn of Africa consists of four countries: Djibouti, Ethiopia, Eritrea and Somalia. It covers an area of 1.88 million square kilometers and is inhabited by more than 95 million people. It is also the home of different ethnic groups with distinct cultures.

Physiographically, it is made up of these landforms:

- *uplifted mountains*
- *depressions*
- *deep river-cut gorges*
- *fault lines and rifts*
- *extensive lowlands*
- *plateaus*

These *physiographic features* (landforms) play significant roles in the social, economic and political values of the inhabiting people.

Recent paleonthological findings indicate that the Horn of Africa, especially Ethiopia, is the birth place of homonids; see Figures 3.1 – 3.3.

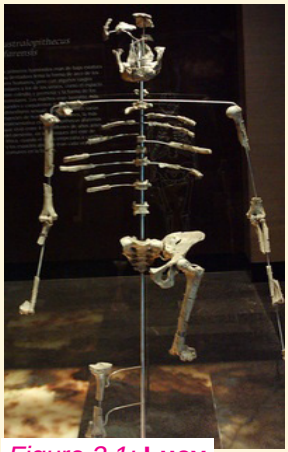


Figure 3.1: **Lucy**

Lucy

- Amharic name, "Dinknesh"
- Discovered November 24, 1974 at Hadar, Afar.
- Lived 3.2 million years ago.
- Discovered by Johanson and his team members.

Figure 3.2: **Selam**

Selam

- Discovered by Dr. Zeresenay Alemseged.
- Lived 3.3 million years ago.
- A three-year-old girl.
- September, 2006 (discovered)

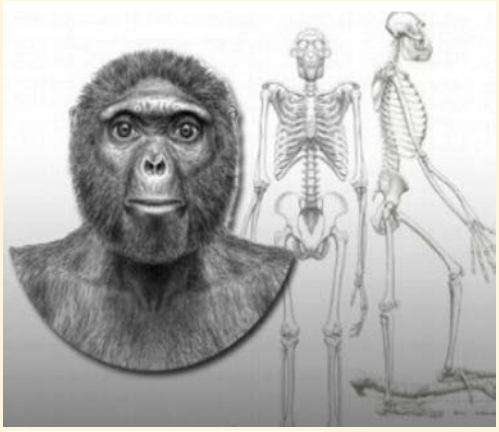


Figure 3.3: **Ardi**

Ardi

- The name "Ardi" is a short form of Ardipithecus ramid.
- Lived 4.4 million years ago.
- The oldest known fossil of a human ancestor.
- Discovered November 5, 1994 by Yohannes H/Selassie.

3.1 LOCATION OF THE HORN OF AFRICA AND SIZES OF MEMBER COUNTRIES

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

- indicate the location of the Horn of Africa;
- compare the size of countries of the Horn.

Key Terms

- Absolute location
- Relative location
- Latitude
- Longitude
- Vicinal location
- Geological location

3.1.1 Concept of Location and Location of the Horn

What is your definition of location?

Why is the location of things important in geography?

In geography, the term *location* is a much more abstract concept than what an ordinary person knows. This important term is expressed in the form of:

- Absolute location
- Relative location

Absolute Location

Absolute location is expressed as a geographical extent, in terms of latitudes and longitudes. The absolute location of the Horn of Africa is bounded within:

- *18°N – 1°S latitudes*
- *33°E – 51°24'E longitudes*

Because of this aspect of their location, countries of the Horn have tropical characters and lie in the GMT+3 time zone.

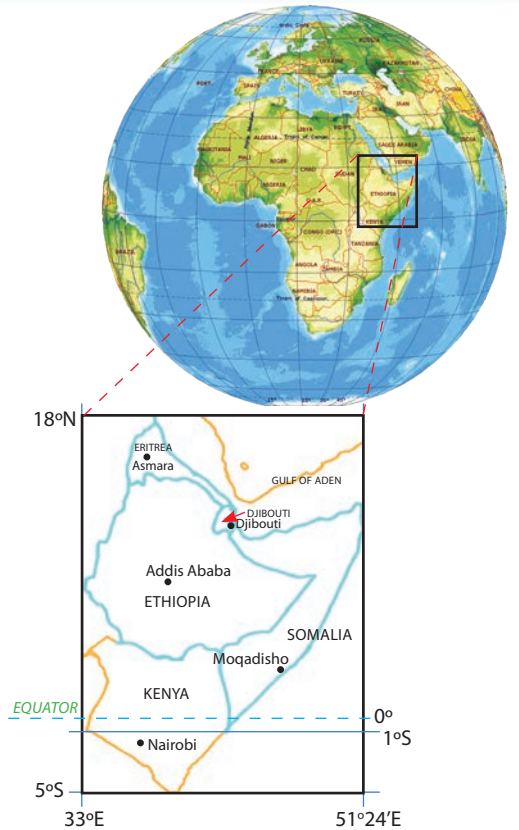


Figure 3.4: **Absolute location of the Horn**

Relative Location

Can you identify the relative location of your school or residence?

The frame of reference for a place's relative location differs from that of its absolute location, in that it is the surrounding bodies of water and landmasses that come into account instead of latitudes and longtiudes. One way in which the relative location of the Horn can be described is as a region or subregion bounded by:

- *the Indian Ocean in the southeast,*
- *the Red Sea and Gulf of Aden in the northeast,*
- *Sudan, in the north and west, and*
- *Kenya in the south.*

Relative location can also be expressed in terms of vicinal (nearness) and geological (strategic) terms. The geological approach considers a broad aerial extent.

For example, when we describe the geological location of the Horn countries we list the Middle East, Southwest Asia, the Mediterranean, adjacent countries etc.

Activity 3.1

1 Draw a map of the Horn of Africa and show the political divisions of the countries of the Horn.

2 Locate and name their capital cities.

3 Which non-Ethiopian capital city is the nearest to Addis Ababa?

3.1.2 Sizes of Countries of the Horn

Do you know the largest country in the Horn of Africa?

The countries of the Horn vary in *size*, i.e., in *area coverage*. This variation has both advantages and disadvantages for individual countries.

Table 3.1: **Comparison of size among countries of the Horn of Africa**

Countries of the Horn of Africa	Total Area (in km²)
Dijibouti	23,200
Eritrea	118,000
Ethiopia	1,106,000
Somalia	637,661
Total	1,884,861

Comparatively speaking

- ⇨ *Ethiopia is the biggest.*
- ⇨ *Djibouti is the smallest.*
- ⇨ *Eritrea and Somalia are less than Ethiopia by almost ten times and twice respectively.*

In geography, relative size implies relative possibilities for possessing diversities in resources, culture, agro-ecological zones, etc. This concept applies to the countries of the Horn.

The countries should consider these disparities and participate in many forms of zonal cooperation in order to benefit one another.

Activity 3.2

Referring to your Grade 11 geography students' textbook, answer the following questions.

1. What are the major exports of the countries of the Horn?
2. Is there a duplication of exportable goods and products?
3. Do you think that trade among these countries is possible? If not, what barrier is there?
4. Do you remember IGAD? Please discuss what IGAD's present status is.
5. Applying your skills in statistical diagramming, show the proportionate size of each country.

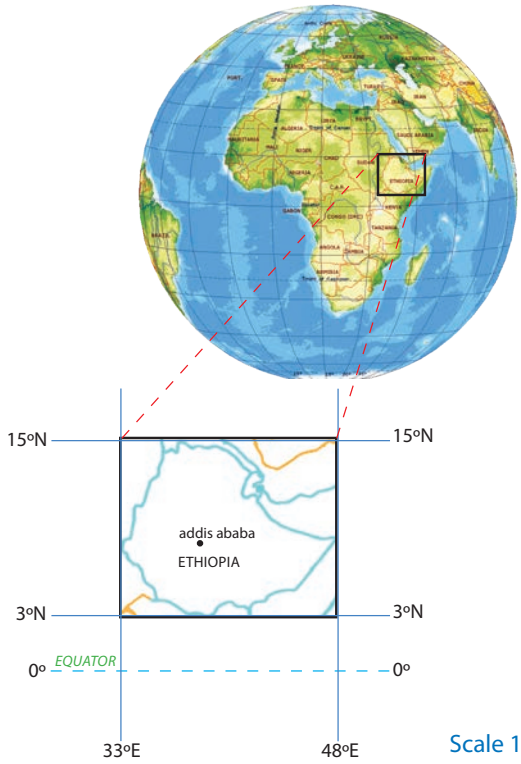
3.2 LOCATION, SIZE AND SHAPE OF ETHIOPIA

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

- demonstrate the relative and absolute location as well as the shape of Ethiopia.

Key Terms

- Compact
- Elongated
- Truncated



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Source: *Adapted from School Atlas of Ethiopia*

Figure 3.5: **Location of Ethiopia**

3.2.1 Location of Ethiopia

Do you know the extent to which the location of a given place is important in world politics? What locational significance does Ethiopia have as a country that is in the Horn and near the Red sea route?

In the study of spatial science, *location* is very significant. Every place has its own particular location in relation to its surroundings. Ethiopia's location can be expressed in two ways: *relative location* and *absolute location*.

Relative Location of Ethiopia

Relative location can be expressed in vicinal and geological terms.

I *Relative (Vicinal) Location of Ethiopia*

Ethiopia is a landlocked country that is surrounded by five neighboring countries. Each country shares different lengths of Ethiopia's borderlines. The total length of Ethiopia's boundary line is 5260 km.

Table 3.2: **Ethiopia's boundary line length, as shared with neighboring countries**

S/N	Bordering Countries	Shared boundary-line length in kms
1	Djibouti	310
2	Eritrea	840
3	Kenya	760
4	Somalia	1600
5	Sudan	1750

Table 3.2 indicates that

- *Sudan shares the longest length of boundary line, followed by Somalia.*
- *The Republic of Djibouti shares the smallest boundary line length.*

II *Strategic (Global, Geological) Relative Location of Ethiopia*

Ethiopia's geological location can be described in the following ways. It is found:

- *to the southwest of the Asian continent,*
- *to the south of Europe,*
- *to the northwest of the Indian Ocean,*
- *in the Nile Basin, and*
- *in northeastern Africa.*

Absolute (Astronomical) Location of Ethiopia

Ethiopia's absolute location is expressed as follows.

Ethiopia is located between

- *$3^oN – 15^oN$ latitudes and $33^oE – 48^oE$ longitudes*

As a result, Ethiopia's extreme points lie at

- *Badime in the north (Tigray)*
- *Moyalle in the south (Borena)*
- *Akobo in the west (Gambella) and*
- *The tip of Ogaden in the east (Ogaden).*

Activity 3.3

1. Your teacher will help you and your classmates to form three groups. Each group will collect information from different sources:
   - books and documents,
   - teachers and other knowledgeable people,
   - Internet or Encarta.
2. With your group members, investigate these issues, using the source material assigned to your group.
   - The major religions practiced in your locality
   - The place of origin of each of the religions
3. Determine the factors that have influenced the acceptance and practices of these religions by millions of Ethiopians.

3.2.2 Size of Ethiopia

What is size in terms of spatial distribution? Does size influence the economic strength of a country?

Ethiopia is the tenth largest country in Africa, with a total area of 1,106,000 square kilometers. It contains about 0.7 percent of the world's land area and about 3.6 percent of Africa's land mass.

Table 3.3: **Comparison of Ethiopia's areal size with its neighbors'**

Country	Total area extent (km^2)	Rank	Size in comparison to Ethiopia
Ethiopia	1,106,000	2	–
Djibouti	23,200	6	Almost 50 times smaller
Eretria	118,000	5	9.42 times smaller
Kenya	580,000	4	1.91 times smaller
Somalia	637,661	3	1.73 times smaller
Sudan	2,505,813	1	2.3 times bigger

Note

Ethiopia is the largest country in the Horn. This status in size, in combination with its status of having a large population, confers many advantages to Ethiopia in the Horn area.

What advantages and disadvantages does Ethiopia's large size offer the country?

Advantages: Ethiopia's large size lets it:

- *possess diverse agro-ecological zones, resulting in a wide variety of fauna and flora,*
- *possess a large amount of arable land,*
- *have a great variety of mineral resources, and*
- *be the home of diverse ethnic groups.*

Disadvantages: Its large size compels Ethiopia to:

- *require great financial power to construct infrastructural facilities,*
- *have a large army to protect its sovereignty,*
- *preserve an efficient and popular government to administer its vast territory.*

3.2.3 Shape of Ethiopia

Look at the shape of Ethiopia and the neighbouring countries. Does Ethiopia have shape similarity? Can you identify the shape of each neighbouring country?

Countries vary not only in location and size but also in *shape*. Some have nearly *circular (compact)* shapes, others have *elongated (linear) shapes*, and still others have *truncated (shortened)* shapes. These shapes affect each country's administration, defence and economic integration, both within the country and in respect to outside areas.

Ethiopia's shape is of the compact type. Its shape is considered to be compact, or essentially circular, because the extreme north-south and east-west spans of the country cover comparable distances. You can easily see this approximate circularity in your school atlases and wall maps.

There are three theoretical indicators of the compactness of an area:

- *the boundary-circumference ratio (B/C)*
- *the area-boundary ratio (A/B)*
- *the actual area-area of the inscribing circle (A/A')*

Note

Each of these theoretical assumptions is based on a value of 1 as indicating a perfectly compact shape. They consider 0.5 – 1.5 values as deviating only slightly from circular/compact and therefore indicating approximate compactness. In contrast, smaller values indicate greater divergence from compactness, especially as they approach zero (0). These small values reflect tendencies to elongation or truncation.

For example, let's use the boundary-circumference ratio to measure Ethiopia's degree of compactness or index of compactness. In the ratio, circumference is based on an inscribing circle that touches the north, south, east and west boundaries of Ethiopia described earlier in the "Absolute (Astronomical) Location" section.

$$\text{Index of compactness} = \frac{\text{Boundary length}}{\text{Circumference of the inscribing circle}}$$

r – is not given, we have to find it.

Note

The inscribing circle is the circle drawn through the extreme points on the boundary of Ethiopia. The radius is obtained by taking half the length of the distance between the astronomical extremes of west and east of Ethiopia i.e.,
48°E – 33°E = 15°/2 = 7°30' (this is radius of the inscribing circle).

Then, change the obtained length (7°30') into kilometers:

$1^{o} = 110.5$ km

$7^{o}30' \times 110.5$ km $= 828.75$ km

Therefore, index of compactness $= \frac{5260}{2 \times 3.14 \times 828.75} = 1.01$

The value obtained, 1.01, indicates that Ethiopia's shape to be nearly a perfect compact shape.

The value obtained indicates that Ethiopia's shape deviates by only 32% from being perfectly compact. Therefore, Ethiopia's shape is closer to the compact type than to either of the other shapes.

Exercise 3.1

I ***Multiple Choice: Choose the appropriate answer from the given alternatives.***

1 Ethiopia experiences overhead sun twice in a year. This particular feature could be attributed to its

A geological location
B vicinal location
C astronomical location
D A and B

2 Which neighboring country shares the longest boundary line with Ethiopia?

A Somali
B Eritrea
C Sudan
D Djibouti

3 Which of the following towns is not a border town of Ethiopia?

A Bademe
B Metema/Galabat
C Moyallee
D Negelle Borena

4 Which of the following countries of the Horn of Africa does not have an outlet to the sea?

A Eritrea
B Djibouti
C Ethiopia
D Somalia

5 Which of the following geographical phenomena is not related to Ethiopia's astronomical location?

A relatively high temperatures throughout the year
B very little annual range of temperature
C its location within the range of GMT + 3 hours time zone
D its significant role in IGAD

3.3 GEOLOGICAL STRUCTURE AND RELIEF OF THE HORN OF AFRICA

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

- explain geological structure and major events of the Horn of Africa;
- describe major landforms of Ethiopia and the Horn;
- discuss the general characteristics of Ethiopian rivers and drainage patterns;
- classify the Ethiopian lakes as highland and rift valley;
- show appreciation for the significance of rivers and lakes of Ethiopia;
- show interest for the implementation of water-resource conservation and management policy.

Key Terms

- Era
- Period
- Epoch
- Transgression
- Regression
- Endogenic force
- Exogenic force
- Drainage system
- Relief
- Geology
- Orogenic
- Epeirogenic

3.3.1 Geological History of the Horn of Africa

Which geological era is significant regarding the formation of the various landforms in Ethiopia and the Horn?

The geological history of the Horn cannot be separated from the geological history of Africa. It deals with various geographic activities that have occurred for many millions of years in the past.

The geological history of the Horn shows us that four major geological eras have elapsed. Each era is divided into periods, and each period is subdived into epochs.

Each geological era is distinguished from the other's, based on grounds of the following three characteristics:

- *the relative positions of the continents*
- *the character of the prevailing climate*
- *the predominant life form*

Summary of Major Geological Events in the Horn

Let's begin by considering the different geological eras and then study the events that took place in those eras. Here are the geological eras, in chronological order.

- *the Precambrian Era – the oldest era (from 4.5 billion years to 600 million years ago;*
- *the Paleozoic Era (from 600 million years to 250 million years ago)*
- *the Mesozoic Era (from 250 million years to 70 million years ago)*
- *the Cenozoic era (from 70 million years to the recent time)*

The Precambrian Era (from 4.5 Billion to 600 Million years ago)

What do you understand by the term Precambrian?

- *the Precambrian Era is the oldest and longest geological era, covering about 5/6 of the earth's geological time. The following geological events occurred in the Horn during this era.*
- *frequent orogenic movements*
- *intensive volcanic activities*
- *denudation during the later periods*
- *formation of folded mountain ranges in a NNE – SSW direction*

Note

During the Precambrian era

- The first forms of life emerged, such as amoeba, and jellyfish.
- The oldest rock formed – the old crystalline basement. This rock underlies all other rocks.

Today, in a few areas of Ethiopia, outcrops of old crystalline basement complex rocks are found on the surface, due to continuous denudation.

Example:

- *In central and northern Tigray.*
- *In Mettekel, Assossa, Illubabor and the Abbay.*
- *In central Sidama, southern Omo, southern Bale and Borena.*
- *In central, western and northern Eritrea.*

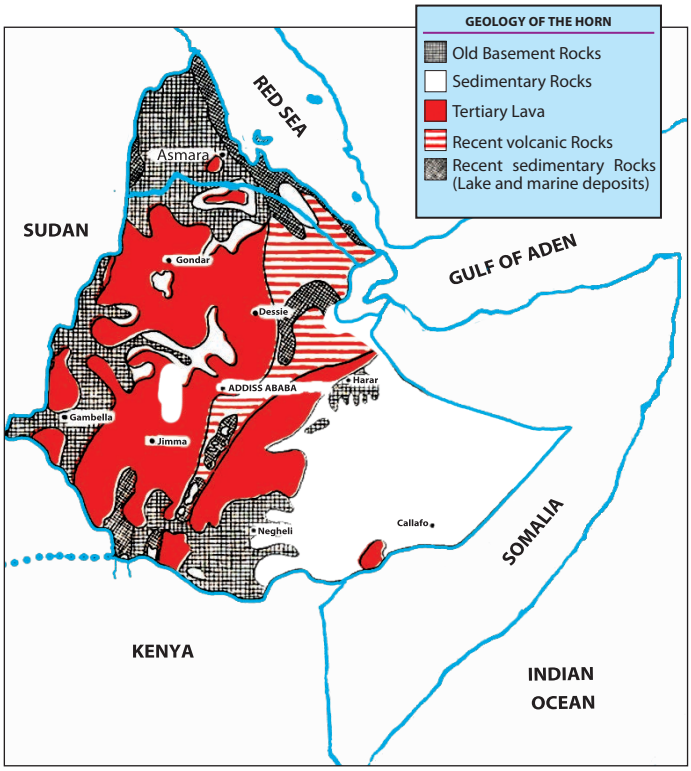


Figure 3.6: **Geological map of the Horn**

The Paleozoic Era (from 600 Million – 250 Million years ago)

Which life form was dominant in the Paleozoic era?

The main geological events of the Paleozoic era were *denudation* and *peneplanation*. No significant structural formation took place. The massive denudational activity resulted in the formation of inselbergs in some parts of Ethiopia and the Horn.

Note

The Paleozoic era is known for the predominance of invertebrates.

Mesozoic Era (from 250 Million – 70 Million years ago) an Era of Reptiles

Which life form was dominant in the Mesozoic era?

The most important geological occurrences of the Mesozoic era in the Horn were the sinking and uplifting of the landmass.

Periods	Geological time scale
Cretaceous	70 m
Jurassic	142 m
Triassic	250 m

The landmass sank during the Mesozoic's Triassic and Jurassic periods:

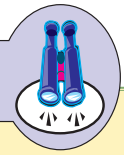
- *In the Triassic Period, the landmass sank due to internal forces. This event was followed by transgression of a nearby sea into the mainland of today's Somalia, and southeastern Ethiopia. During the Triassic Period, the oldest sedimentary rock known as Adigrat sandstone was formed.*
- *In the Jurassic Period, the transgression of the sea continued into the mainland in the northwest direction. This event deposited another sedimentary rock known as Hintalo limestone.*
- *In the Cretaceious Period, the landmass began to rise and the sea started to regress towards the southeast, depositing sedimentary rock known as Upper Sandstone. Upper Sandstone is the youngest sedimentary rock, and therefore overlies the rest.*

Because of the direction of the regression and deposition, Upper Sandstone is the youngest and thinnest in the southeast, and is the oldest and thickest in the northwest.

The Mesozoic Era was an era of sedimentary rock formation in Ethiopia and the Horn.

- The deposited sandstones vary in age and thickness from the north-west to the southeast direction.
- The Adigrat sandstone is older and thicker in the southeast and progressively decreases in age and thickness to the northwest.

Focus



The transgression of the sea extended up to northwestern Ethiopia, as far as central Tigray and the western slopes of the western highlands. The sedimentary rocks formed in the Mesozoic Era were later buried by overlying Cenozoic igneous rocks. However, the sedimentary rocks have

been exposed at the surface in some areas of Ethiopia. They are thinnest (because they are the youngest) in the southeast and thickest (because they are the oldest) in the northwest.

One can see them exposed at the surface mostly in the south eastern lowlands of Ethiopia, central Tigray, and in the Abbay and Wabishebelle gorges. (For more information, look at the geological map of Ethiopia.)

Biological Events of the Mesozoic Era

The Mesozoic is also known for the *predominance of reptiles*. Huge reptiles, such as dinosaurs, were dominant. However, at the end of this era, two other significant biological events occurred:

- *one was the disappearance of the dinosaurs, and*
- *the other was the emergence of mammals, birds and flowering plants.*

The Cenozoic Era (from 70 Million to Recent Years)

Do you know the era in which the human form of life appeared?

The Cenozoic is the most recent geological era. Very significant structural, climatic and biological events have occurred in the Horn.

In order to make things simple and easily comprehendible, we shall discuss only the geological events of this era into events of the Tertiary and Quaternary Periods.

Geologic Events of the Tertiary Period - (70 million - 2 million years ago)

In the Tertiary Period, the uplifting that began in the Cretaceous Period of the Mesozoic Era continued and reached its maximum height.

In Ethiopia and the Horn it formed huge blocks of dome over the greater part of the region. As the uplifting continued through time, great cracks opened in the crust and resulted in the pouring out of extensive basaltic lava (known as the *Trappean lava series*). The lava resulted in the formation of:

- *The Eritrean Highlands*
- *The Northwestern Highlands*
- *The Southeastern Highlands*
- *The Somali plateaus*

As the cracking continued during the period, it formed the Great East African Rift Valley System – of which the Ethiopian Rift Valley System is part.

Geologic Events of the Quaternary Period (2 million - recent years)

In the Quaternary Period, these structures were formed in Ethiopia and the Horn:

- *The Afar Horst that extends into Djibouti*
- *The active volcano of Ertalle in Afar*
- *The dormant volcanic mountain of Fentalle in Eastern Oromia*
- *The extensive lava field of Methara.*

Photograph 3.1 **Ertalle**

Photograph 3.2 **Mount Fentalle**

Photograph 3.3 **The Lava field of Methara**

Climatic Events in the Cenozoic Era

In addition to the geological events that happened in this period, a significant change of climate took place in the Horn and Ethiopia. A massive flood, called the pluvial period, occurred. This flood formed deep gorges, moraines and lacustrine deposits.

Note

One good example of the deep gorges formed as the result of the flood is the Abbay gorge.

Photograph 3.4 **The Abbay gorge**

It is believed that Lake Langano, Lake Abijata and Lake Shalla were one sheet of water during the time of the pluvia l period. The same is believed true of lakes Abbaya and Chamo.

Today these lakes are widely separated.

Note

The Cenozoic Era in its Quaternary Period is assumed to be the period in which modern man evolved.

Activity 3.4

By looking at a geological map of the Horn of Africa, identify the areas where these rocks are found on the surface as outcrops:

a metamorphic rocks
b sedimentary rocks
c quaternary lava deposits.

Here is a simplified presentation of the rock profile in Ethiopia and the Horn:

Quaternary lava (recent lava deposits – Aden lava series) Tertiary lava deposits	**Cenozoic era** Igneous rocks of various periods
Upper Sandstone (Cretaceous) Hintalo Limestone (Jurassic) Adigrat SandStone (Triassic)	**Mesozoic Era** sedimentary rocks of different periods
Basement complex or old crystalline rock	**Basement complex** rock of the Precambrian Era

Exercise 3.2

I *Choice*

1 Which of the following geological events did not occur during the Quaternary period?

A the uplifting of the Suez landmass
B the occurrence of the pluvial rain
C the emergence of modern man
D the formation of the Ethiopian Rift Valley

2 The Paleozoic is an era of:

A significant structural formation
B peneplanation and denudation
C uplifting in the central part of Ethiopia
D the dominance of reptiles

3 We cannot observe the outcropping basement complex rocks in one of the following areas of Ethiopia:

A in central Tigray
B around Assossa
C in the Abbay gorge
D in central Shoa

4 As Adigrat sandstone is to Triassic, Hintalo limestone is to

A Permian
B Cambrian
C Cretaceous
D Jurassic

5 The Mesozoic old marine deposits are today extensively found in which

A Northern and western Tigray
B Western Benishangul
C The Ogaden and Elkerie lowlands
D Western Gojjam

6 The most overlying rock in Ethiopia is the

A The cenozoic/igneous deposit
B Adigrat sandstone
C Old crystalline basement complex
D Upper sandstone

7 Below, four sets of Ethiopian geological events are listed. Which one is in correct chronological order?

A The formation of the old crystalline rock, Adigrat sandstone, Hintalo limestone, upper sandstone and the Aden volcanic deposits
B The formation of metamorphic rock, the Rift Valley, the Afar Horst and igneous rock
C The deposition of the Trappean lava series, the pluvial rains, the formation of Adigrat sandstone
D The formation of Adigrat sandstone, Hintalo limestone, Upper Sandstone and Metamorphic rock

8 Which geological era is known as an era of amphibians?

A Precambrain
B Paleozoic
C Cenozoic
D Mesozoic

9 One can associate the Mesozoic Era with the formation of

A Igneous rock
B Metamorphic rock
C Sedimentary rock
D A and B

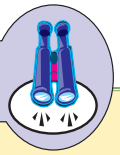
II ***Match the items in Column B with those in Column A.***

A		B	
10	Lacustrine deposits	A	Deposits of sediments by rivers along their banks
11	Fluvial deposits	B	Deposits of sediments by lakes
12	Pluvial rains	C	Heavy rain that occurred during the Quaternary period following the last Ice Age
13	Old crystalline basement rock	D	The most underlying rock in Ethiopia and the Horn
14	Aden lava series	E	Part of the surface of the earth that submerges due to tectonic activities
15	Marine deposits	F	The type of tectonic activity that is horizontal and often forms folds
16	Horst	G	Type of tectonic activity which is associated with uplifting or sinking of rocks
17	Rift Valley	H	An epeirogenic effect resulting in the formation of mountains and the like
18	Orogenic movement	I	Quaternary lava deposits along the Afar Triangle
19	Epeiroginic movement	J	Deposits of sediments by sea

3.3.2 Landforms of Ethiopia and the Horn

Figure 3.7: **The Relief of the Horn of Africa**

Focus



Lake Tana is found in the physiographic subdivision between the plains of Foggera in the southeast and Dembia in the north.

Look at the relief map of the Horn of Africa. It shows high mountains and extensive lowlands mostly found at the coasts and the Great East African Rift Valley that diagonally bisects the region and stretches to East Africa.

These landforms are the work of two opposite forces:

- *The endogentic force that originates from inside the earth. For example, volcanic activity and tectonic forces.*
- *The exogenic force that originates at the surface (denudation and penepalantion).*

It is a combination of these two forces that created the existing landforms of the Horn of Africa.

Have you had opportunities to travel to the different regions of Ethiopia? If you did, what did you notice along your routes?

If you have not had those opportunities, make an educational tour of your surroundings with your geography teacher. Then write a short report on what you observe.

The landforms of Ethiopia and the Horn are made up of river-cut gorges, valleys, plateaus, mountains and rolling plains. These landforms are the results of exogenic and endogenic forces that have acted alternately and, at times, simultaneously or the last sixty million years

Altitude varies from about 116 meters below sea level at the Dallol depression (Kobar sink) to 4620 meters above sea level at Ras Dashen in Semein. Between these extreme points lie a number of mountains. If 1000 meters is chosen as a demarcating contour line between highlands and lowlands, 56 percent of Ethiopia's land is highland. This fact has given Ethiopia the name "Roof of Northeastern Africa." It is the only country in the region with such a high proportion of elevated surface. This elevated surface is bisected diagonally by the Rift Valley which extends from Syria to Mozoambique across the East African lakes.

In terms of the geological and structural features that resulted from the two types of forces, the relief of Ethiopia and the Horn can be divided into three main physiographic divisions:

- Highlands
- The Rift Valley
- The lowlands

The Highlands of the Horn

Highlands are lands with altitudes of over 1000 meters above sea level (masl).

The Horn's highlands are:

1. The Northwestern Highlands
2. The Southeastern Highlands

1 *The Northwestern Highlands of the Horn*

Have you ever had a chance to go to Bahrdar, Gondar, etc.?

The Northwestern Highlands of the Horn stretch from Ras Kassar in Eritrea to the highlands of Gamo-Goffa in southwestern Ethiopia. They are separated from the southeastern highlands by the Rift Valley, which is part of the Great East African Rift Valley. They consist of:

- The Plateau of Eritrea
- The Plateau of Tigray
- The North Central Massifs
- The Plateau of Shewa
- The Southwestern Highlands

The Plateau of Eritrea

Are the Eritrean plateaus extensions of the Ethiopian plateaus?

The plateau of Eritrea is located between the course of the Barka River and the coastal plain of Eritrea. It is bisected by the upper basin of the Mereb River. The plateau is capped by basaltic rocks.

The Plateau of Tigray

Is the plateau of Tigray contemporary to the other plateaus of Ethiopia?

The Plateau of Tigray is the most northerly plateau in Ethiopia. It is separated from the Eritrean plateau by the Mereb River. It lies to the southeast of the upper course of the Mereb/Gash River and to the northeast of Tekkeze River Gorge.

It is an area composed largely of sandstones and limestones, as the overlying basalt have been eroded. As a result, the soils are poor and thin. The plateau has been exposed to severe erosion due to long periods of human inhabitation.

There are very high mountains on this plateau with elevations of over 3000 meters above sea level. Three of these are:

- *Mount Tsibet – 3988 m.a.s.l*
- *Mount Ambalage – 3291 m.a.s.l*
- *Mount Assimba – 3248 m.a.s.l*

The North-Central Massifs

What makes the Northern central massifs distinct from the massifs of central Ethiopia?

These are the most rugged and dissected plateaus of Ethiopia. They are capped by basalts and surrounded by deep gorges. Within each of the plateaus are small arable lands known as ambas. The ambas are isolated from one another by gorges. The Tekezze, together with its tributaries, is the main river that drains the region.

Tekezze River has divided the North Central Massif area into western and eastern massifs, which are connected by the Yejju-Wadla-Dilanta plateau. The western massifs make up the massifs of South Gondar (Semein), while the eastern ones make up the Lasta and Wollo Massifs. South of these is found the Gojjam Massif.

The Semein Massif is dominated by Ras Dashen, while the eastern forms the watershed of the Nile drainage basin.

The Gojjam Massif is the most extended tableland and is comparatively less dissected. It is formed on the core of the Amedamit-Choke mountains. It is carved by the Abbay river that effectively separated it from the Shewa plateau in the south and the Amahara Saynt Massif in the northeast.

The North-Central Massifs are made up of numerous high mountains. They are known for the production of cereals, such as teff, pulses and oil seeds.

Famous mountain peaks on these massifs are

- *MT. RAS DASHEN (in Semein) – 4620 masl*
- *MT. LEGEDA (in Gondar) – 4532 masl*
- *MT. ANALU (in Gondar) – 4480 masl*
- *MT. TEFAW LEZER (in Gondar) – 4456 masl*
- *MT. KOLO (in Lasta) – 4300 masl*
- *MT. GUNA (in Gondar) – 4231 masl*
- *MT. ABUNA YOSEPH (in Lasta) – 4190 masl*
- *MT. HEY (in Gondar) – 4154 masl*
- *MT. BIRHAN (in Gojjam) – 4100 masl*

The Plateau of Shewa

Have you ever had the opportunity to travel from Addis Ababa to Debre Markos or Bahir Dar? If yes, what do you recognize all the way through until you reach the Abbay Gorge?

The Shoan Plateau is a dome-shaped plateau that serves as a watershed between the Awash and Abbay River basins. It extends westwards into western Wellega through Horo Guduru and forms a crescent shape which causes the Abbay to swerve and drain northwards. The Shoan plateau is separated

- *from the plateau of Gojjam by the Abbay gorge in the north*
- *from the southeastern highlands by the Awash River and the Rift Valley.*
- *from the Highlands of Keffa by the Ghibe River.*

The Plateau of Shewa is drained by the tributaries of the Abbay River in the west and the Awash River in the east. Its high mountains are found on its northeastern and south eastern margins; they are:

- *Mt. Abbuye Meda (on the northeastern margin) – 4000 masl*
- *Mt. Guraghe (on the southeastern margin) – 3721 masl*

The Southwestern Highlands of the Horn

Which regional zones are found in the southwestern highlands of the Horn?

These include the highland areas of Wellega, Illubabor, Gamo Goffa and Keffa. These Ethiopian highlands lie south of the Abbay trough which is greatly eroded due to torrential rain that pours down on in the area for almost all of the year. It is the wettest region of the country with a total average annual rainfall of above 1500 mm.

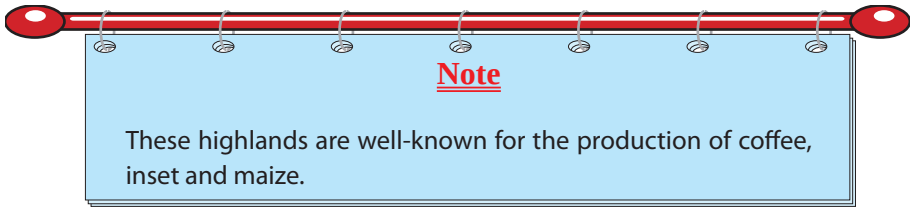
The region is drained:

- *northwards, by the Dabus and Diddeessa tributaries of the Abbay River*
- *westwards, by the headstreams of the Baro-Akobo River*
- *southwards, by the Omo-Ghibe River, which ends in Lake Turkana*
- *eastwards, by the right-bank tributaries of the Omo-Ghibe (the Gojeb-Ghibe River of Jima and Yem zone)*

The general elevation of these highlands is relatively low, when compared to that of the Northern and Eastern Highlands. Only a few areas are above 2500 meters. The highest points in the region are the:

- *Gamo-Konso Highlands (in GamoGoffa)*
- *Maji-Korma Highlands (in Keffa Zone)*
- *Kulo-Konta Highlands (Keffa zone)*
- *Benishangul mountain (in Benshangul Gumuz)*
- *Tullu Wallel (in West Wellega)*

Mt Gughe has the highest altitude: 4200 masl. It is found in the Gammo plateau.



Note

These highlands are well-known for the production of coffee, inset and maize.

The Southeastern Highlands of the Horn

Can you suggest what feature separates these highlands from the northwestern highlands?

Which highlands are said to be the components of southeastern highlands of the Horn?

The Southeastern Highlands of the Horn include the plateaus of

- Hararghe
- Sidama
- Arsi
- Bale
- Somali highlands

Their formation is similar to that of the North and Southwestern Highlands; and they are capped by basaltic rock. They are the main sources of the Wabishebelle and Genalle rivers.

They are bounded:

- *in the west, by the fault line of the Rift Valley*
- *in the east, by the Ogaden Lowlands*
- *in the south by the Elkerie and Borena Lowlands.*

These highlands are subdivided into the plateaux of Hararghe, Arsi, Bale and Sidama. Each is discussed in turn as follows.

The Plateau of Hararghe

The Plateau of Hararghe rises sharply from the fault line of the Rift Valley and extends gently to the east up to Jijiga. After Jijiga, a fall in elevation takes place, giving way to the Ogaden Lowlands. The Plateau is drained by the left-bank tributaries of the Wabishebelle River. The basaltic rocks have been worn away, exposing limestones and earlier sedimentary rocks.

The Hararge Plateau area and its foothills are significant producers of coffee, chat, sorghum and millet. The highest points of this plateau are Mount Gara Muleta (3381 masl) and Mount Jebel Tita (3122 masl).

The Plateau of Arsi

This plateau area consists of the Gugu and Chillalo Massifs. It is an extendingly rolling plateau; it is a very suitable plateau for farming. These features are due to the fact that erosion on the Arsi plateau has been comparatively low. The Arsi plateau is known for its wheat.

The highest points on the Arsi plateau are Mount Chillallo (4136 masl), Mount Bada (4139 masl) and Mount Kaka (4180 masl).

The Bale Massif

The Bale Massif is next to the Arsi Plateau but is separated from it by the headstreams of the Wabishebelle River (popularly known as the *Wabe*). In the north, the massif consists of a flat form that is similar to basaltic plateaus. In the south, the massif consists of huge mountains. The Bale Massif is dominated by

- *Mount Tulu Dimtu (4377 masl)*
- *Mount Batu (4307 masl)*

The Plateau of Sidama

This plateau area is next to the Bale Massifs, but is separated from them by the Genalle River. The area constitutes the southwest extension of the southeastern highlands. The plateau slopes away gently to the south and is drained by the Dawa River and its tributaries. The Jemjem is the dominant part of the plateau.

The Somali Highlands

The highlands are the extension of the southeastern highlands of Ethiopia. Their average altitude doesn't exceed 1500 masl. They rise gently in the west and descend sharply to the Indian Ocean coasts.

The Rift Valley System

What is the difference between a river valley system and a rift valley system? Can you give examples?

The Ethiopian Rift Valley System is part of the Horn's Rift Valley System, which is part of the Great East African Rift System. The Great East African Rift System is a set of fractures in the earth's crust that extend from the Dead Sea in the north, through the Red Sea, and then across East and Central Africa to Mozambique in the south.

Major faulting and rifting took place at the end of the Tertiary Period of the Pleistocene Epoch as a result of tectonic epeirogenic activity. These events formed the Great East African Rift System.

Let's now consider the Ethiopian Rift Valley System. It has been the scene of intense volcanic activity and minor faulting. Even today, active volcanic activity exists there. It is therefore, the most unstable physiographic division of the area.

As you can see in the following map, the Rift Valley runs diagonally from northeast to southwest and divides Ethiopia east-to-west. It covers a total length of 1700 kilometers in Ethiopia and Eritrea.

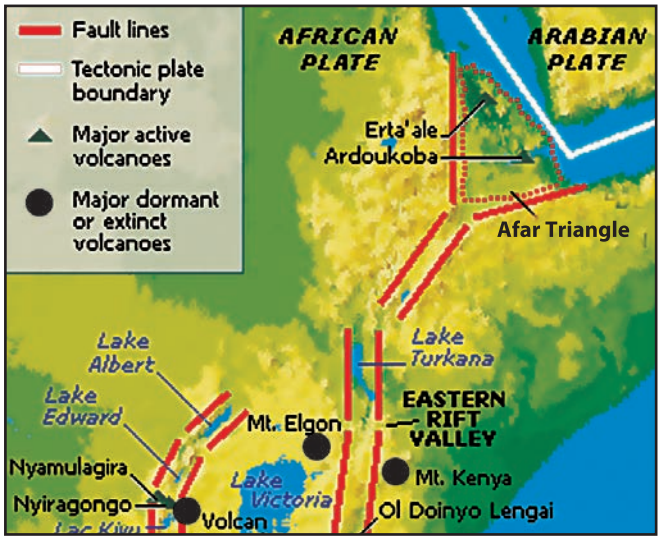
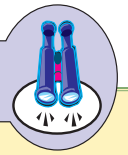


Figure 3.8: **The Rift Valley System of Ethiopia and the Horn**

Focus



From an economic point of view, the Afar Triangle is becoming increasingly significant for its great potential in the extraction of salt, geothermal energy and irrigable agriculture.

Subdivisions of the Ethiopian Rift Valley System

Can you forward the main natural/physical factors that make up the subdivisions of the Ethiopian Rift Valley?

Covering a length of 1700 km, the Ethiopian Rift Valley System comprises 18 percent of the country's total area. It is subdivided into three main parts:

- The Afar Triangle (northern)
- The Main Ethiopian Rift (central)
- The Chew-Bahir Rift (southern)

The Afar Triangle (Northern Subdivision)

The northern subdivision of the Ethiopian Rift Valley System, i.e., the Afar Triangle, is the largest and widest part of the system. Its altitude is generally low, ranging from 116 meters below sea level at the Kobar Sink to about 900 meters above sea level at Awash.

This part of the Ethiopian Rift System is characterized by

- *faulted depressions (the Dallol Depression) and grabens (also called troughs)*
- *volcanic mountains.*

Also, a large part of the area is covered by extensive salt plains and lakes (Lake Assale and Lake Afrera).

The Afar triangle is bounded by parallel fault lines on the east and west. Its floor is made up of:

- *grabens such as the Tendaho Graben*
- *volcanic ash and lava deposits*
- *Lacustrian and fluvial deposits, and*
- *Volcanic mountains such as Mount Fentalle.*

What is more, the Afar Triangle has special characteristics that do not exist in other regions of Ethiopia do not bear. It consists of:

- *fossil rich sediments*
- *rich archeological sites which have shown us that the area was the home of the ancient ancestors of primates and hominids.*

The Main Ethiopian Rift (Lake Region or Central Part)

- *The central subdivision of the Ethiopian Rift system, i.e., the Main Ethiopian Rift, covers the area from the lower Awash basin up to Lake Chamo. This subdivision is the most elevated part of the Ethiopian Rift Valley. It is also the wettest, most densely vegetated, and most densely populated.*
- *Sedentary farming is practiced here. The area also includes numerous lakes of enormous aesthetic value.*

The Chew-Bahir Rift (Southern Subdivision)

The southern subdivision of the Ethiopian Rift system, the Chew-Bahir Rift, is also known as the Omo-Ghibe trough. It is the smallest section of the Ethiopian Rift System. It consists of an extensive shallow marshy area covered by tall grasses.

In the vicinity of Arba Minch, this part of the Ethiopian Rift valley system is split into the Ganjuli and the Galena Valleys by the Amaro mountain range.

Activity 3.5

1 Draw a map of the Rift Valley System in Ethiopia and demarcate its subdivisions.
2 For each subdivision, show two important towns.

The Lowlands of the Horn

These landform divisions occupy the peripheries of Ethiopia on its eastern and western sides, running from north to south. They are generally below the 1000 meter contour line and have relatively harsh and very hot climates. The lowlands constitute more than 35 percent of the total area of the country. They are inhabited mainly by pastoralists.

The lowlands of the Horn are subdivided into

- Western lowlands
- Southeastern lowlands

The Western Lowlands

These lowlands extend from western Eritrea in the north up to the Omo-Ghibe River in the south, bordering the Sudan. They have a general elevation of 500 – 1000 masl.

These lowlands are sub-divided into

- *The Setit and Barka Lowlands (in Eritrea)*
- *The Tekezze and Angereb Lowlands (in Tigray and Amhara regions)*
- *The Abbay Dinder Lowlands (in Benishangul and the Gumuz Region)*
- *The Baro-Akobo Lowlands (in Gambella)*
- *The Omo-Ghibe Lowlands (in SNNP)*

The Western Lowlands are characterized by arid and semi–arid conditions. The Baro-Akobo lowland is the wettest lowland.

Because of climatic hardship in most parts of these lowlands, the communities practice nomadic and semi-nomadic pasturalist ways of life. However, there are notable towns, such as Humera, Kurmuk, Omedla and Metema, that serve as business centers for the communities living along the Ethio-Sudanese border.

The Southeastern Lowlands

Like the Western Lowlands, the Northeastern and Southeastern Lowlands run from northwest to southeast. They begin in Djibouti and run all the way to Somalia in the southeast, bordering the Indian Ocean. They consist of

- *the Red Sea coastal plains (in Eritrea)*
- *the Afar plains (in Afar) which are included in the Afar Triangle.*
- *the Ogaden plains (in Somali region)*
- *the Elkeri plains (in Bale)*
- *the Borena plains (in Oromiya)*
- *the Benadir plains (in Somalia)*
- *Djibouti*

These lowlands are highly extensive lowlands. They are characterized by low annual rainfall-often below 500 mm. Most of these lowlands are covered by sandstones and recent marine deposits. The people practice a pastoralist way of life because of the harsh climate.

Activity 3.6

1 Draw a map of Ethiopia showing the major physiographic divisions.

2 Name three very important towns for each division.

3 Briefly explain the current economic significance of each division and, if you can, predict its future prospects.

4 Explain why the Baro-Akobo Lowlands are the wettest of all lowlands.

Exercise 3.3

I ***Tell whether the following statements are true or false.***

1 All the highlands of Ethiopia are the result of tectonic activity.

2 The Plateau of Shewa is a dome-shaped plateau with a crescent shape at the center.

3 The Southwestern Highlands are lower in altitude than the other highlands of Ethiopia.

4 The plateaus of Semein, Lasta and Wollo are the most dissected and rugged subdivisions.

5 The Plateau of Shewa is one of the sources for the water that flows to the Abbay

6 Lake Tana lies between the plateaus of Gojjam and Southern Gondar and has a crater shape.

II ***Choose the best answer among the suggested alternatives.***

7 The plateau of Tigray is separated from the plateau of Eritrea by the

A Tekezze River
B Mereb River
C Tributaries of the Setit River
D The Danakil Lowlands

8 The difference in altitude between the lowest and highest point in Ethiopia is

A 4736 meters
B 4504 meters
C 4760 meters
D 4620 meters

9 As the highest point is in the Semein, the lowest point is in the

A Western margins
C Afar Lowlands
B Elkere Lowlands
D Ogaden Lowlands

10 Imagine that you could travel in a straight line from Ras Dashen to the Dallol Depresion. You would encounter all of the following features except for one or two. Identify the exception(s).

A The Rift Valley escarpments
C The Tekezze gorge
B The Lasta Massif
D Lakes Shalla and Abijata

11 Which one of the following mountains is found to the north of Lake Tana Basin?

A Mount Guna
C Mt. Abuye Medda
B Mount Abuna Yoseph
D Mt. Ras Dashen

12 Mt. Kolo is found in

A Semein
C Amahara Saint
B Lasta
D Gojjam

13 The most extended tableland in the northern part of Ethiopia is the plateau of

A Shoa
C Southern Gondar
B Gojjam
D Tigray

14 Which one of the following appears to be different from the others?

A The Choke-Amedamit mountains
B The Gamo-Konso Highlands
C The Maji-Korma Highlands
D The Kullo-Konta Highlands

15 Which one of the following areas is not drained by the tributaries of the Tekezze?

A Southwest Wello
C Semein
B Southern Tigray
D Northern Shewa

16 All of the following are drained by the Abbay and its tributaries, except,

A The Southwestern Highlands
B The North and Western Highlands
C The Central Highlands
D The Southeastern Highlands

III *Short Answers*

17 Tell why sandstone and limestone are seen as surface outcrops in the Plateau of Tigray.

18 Assume that you are travelling from the Dallol Depression to Mt. Ambalage in a straight line. Create a graph of your trip using the x–y axis. The x–axis represents the travel line. The y axis represents elevation variation. Let point O be your origin, in distance. Let D stands for Dallol and point M stand for Mt. Ambalage.

3.3.3 Drainage Systems and Water Resources of Ethiopia

Are drainage systems and drainage patterns alike? What is Ethiopia's status with regard to water resources?

In geography, *drainage patterns* differ from *drainage systems*. The term *patterns* refers to the *fabric* or surface arrangement of the main rivers and their tributaries. These features are the result of factors of the underlying rock and slope. In contrast, the term *systems* refers to the direction and destination of the rivers.

For example, drainage patterns are expressed as radial, dendrite, trellis, etc., while drainage systems are expressed as endoric, exotric and aeric.

The drainage patterns and systems of Ethiopia are the results of various structural events that took place in the Cenozoic era.

Major Rivers of Ethiopia and their Characteristics

Do you know the major rivers of Ethiopia?

Ethiopia is among the few countries that have many rivers. Ethiopia has enormous potential water resources. As well as being numerous, Ethiopian rivers are energetic. They flow from the highlands of the interior to the peripheral lowlands and then to seas and lakes bouncingly. These conditions have made Ethiopia known as the "water tower of Northeastern Africa" and as the watershed between the Mediterranean Sea and the Indian Ocean drainage systems.

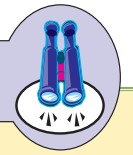
Characteristics of Ethiopian Rivers

Are all Ethiopian rivers perennial and non-fluctuating in their volume of water?

Ethiopian rivers are characterized by:

- *steep profiles; they arise from very high places and flow to the country's borders across lowlands.*
- *they gush through rapids and waterfalls along their courses.*
- *they show seasonal fluctuation in water volume.*
- *they run through steep-sided river valleys and gorges.*
- *they serve as boundaries, both international and domestic (administrative units).*

Focus



Some of the Ethiopian rivers are given new names after they cross the country's borders.

Examples:

- *River Abbay becomes Bue Nile in the Sudan.*
- *River Tekezze becomes River Athbara in the Sudan.*
- *River Ghenalle becomes River Juba in Somalia.*
- *River Baro becomes River Sobat in the Sudan.*

Table 3.4: **Major rivers of Ethiopia and their tributaries**

Rivers	Catchment area (km^2)	Length in km			Major Tributaries
		Inside	Outside	Total	
Wabishebelle	205,407	1340	660	2000	Ramis, Erer, Dakata, Fafen, Yerer, Gobelle, Galleti, Mojo
Abbay	198,508	800	560	1360	Dabus, Didessa Fincha, Guder, Muger, Jemma, Beshillo, Shinta, Dinder
Ghenalle	168,141	480	570	1050	Dawa, Weyb, Welmel, Mena
Awash	113,709	1200	-	1200	Akaki, Kessem, Borkena, Mille
Tekkezze	87,733	608	560	1,168	Tirari, Anghereb, Ghiba, Guang
Ghibe/Omo	77,205	760	-	760	Gojeb, Gelgel Ghibe
Baro	75,718	227	280	507	Akobo, Gilo

Sources: *Grade 12 Geography Students text, 2006.*

Drainage Systems of Ethiopia

What natural factor influences the drainage systems of Ethiopia? Where do most rivers of Ethiopia end?

The drainage systems of Ethiopia are basically divided into three major groups:

- The Western (Mediterranean) drainage system
- The Southeastern (Indian Ocean) drainage system
- The Inland (Rift Valley) drainage system

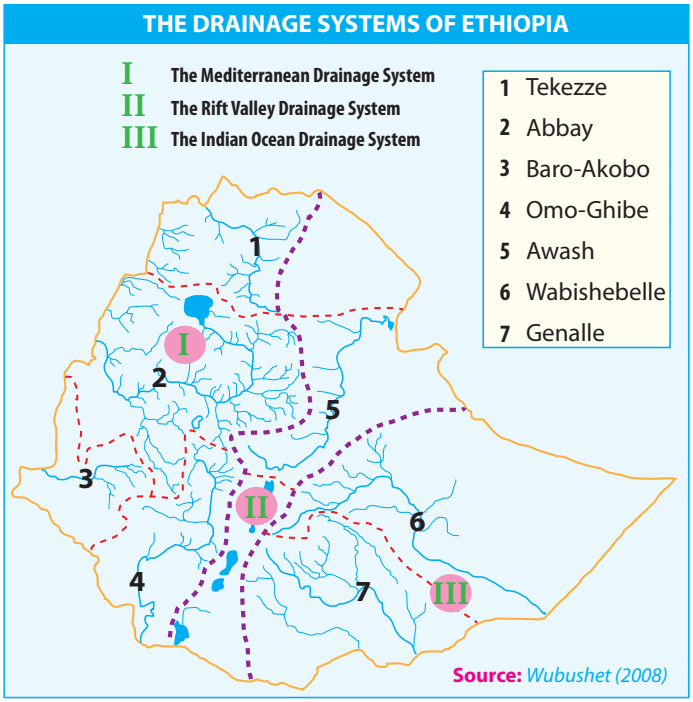


Figure 3.9: **Drainage Systems of Ethiopia**

The Western (Mediterranean) Drainage System

This system is the largest of all, both in aerial extent and volume of water outflow. It contributes sixty percent of the country's total annual water discharge. It consists of three major rivers and their tributaries:

- ***River Tekezze*** – *This river drains the massifs of western Lasta, northern Gondar/ Semein and southwestern, western and central Tigray.*
- ***River Abbay*** – *This one has its origin in the Gojjam plateau. A large number of streams join the river from the plateaus of western Shoa, southwestern Wello, northern Wollega, and northern Illubabor.*

It has a semicircular course from Lake Tana, separating southeastern Gondar from Gojjam and separating Gojjam from Shewa.

- ***River Baro-Akobo*** *– This water course drains the wettest highlands of the southwest and crosses the border to join the Nile.*

Photograph 3.5 **Abbay River**

The Southeastern Drainage System

Where do the rivers in this drainage system finally end? Which highlands are the main source of the rivers flowing in this drainage system?

This system is the second largest drainage system. It consists of the Genalle and Wabishebelle. These rivers collect waters from the highlands of Hararghe, Sidamo, Bale and Arsi. This drainage system flows southeast, across the Somali arid and semi-arid areas. It contributes about 32% of the country's total annual water flow.

The Wabishebelle, the longest river in the country, does not reach the Indian Ocean. It ends at the Benadir coast of Somalia. The Ghenalle, on the other hand, reaches the Indian Ocean. It joins the Dawa River at the Ethio-Somalia border, where it acquires the name Juba.

The Inland (Rift Valley) Drainage System

What do you know about the term in-land drainage system?

This system is the smallest of the three systems in terms of catchment area, discharge of water and volume of water. There are a number of lakes and smaller streams, like the Bilate and Gedabo, which flow into Lake Abbaya; the Segan, which flows into Chew Bahir; and the Meki and the Katar, which flow into Lake Ziway. The major rivers in this drainage system are the Awash and the Omo-Ghibe.

The Awash River basin is the most utilized in the Rift Valley. The basin covers a total area of 110 thousand square kilometers and serves as home to 10.5 million inhabitants.

Photograph 3.6 **The Awash River**

The river rises from the Shewan plateau near Ginchi town, a town at about 100 kilometers west of Addis Ababa, and flows along the Rift Valley. It terminates in the salty lake of Abbe on the border with Djibouti. The middle and lower courses are part of the Great Rift Valley system (the upper course is not part of the system). The lower Awash River basin comprises the deltaic alluvial plains of the Tendaho, Assaita, and Dit Behri areas, and of the terminal lakes area.

➪ *The Omo-Ghibe Basin in southwestern Ethiopia is filled with water and sediments carried by the rivers from the highlands.*

Activity 3.7

1 Draw a map of Ethiopia and divide it into the three drainage systems.

2 Identify the drainage pattern that prevails in each of the three drainage systems.

3 Your teacher will help you and your fellow students to form three groups – one group for each of the drainage systems of Ethiopia. In your group, write down every development-based project of the basin to which you are assigned for. Then present your findings to the class.

Lakes of Ethiopia

Does Ethiopia have many lakes when compared to other African countries?

Compared to other countries, Ethiopia is rich in lakes. They are found dispersed on the plateaus and clustered in the Rift Valley.

Most of the lakes are the result of structures that occurred during the Quaternary Period; i.e., they are not outcomes of climate. This fact is proved by the location of these lakes in the drier parts of the country. The natural lakes found in Ethiopia can be classified into highland and Rift Valley lakes.

Highland Lakes

These lakes are found dispersed on the plateaus, either as crater or watershed lakes. These types of lakes resulted from different types of structural formations. A crater lake is formed after an explosive volcano breaks a mountain open, leaving a deep mouth. The mouth is filled with water – from either small streams or subterranean sources.

A watershed lake is formed when a sheet of lava dams up a shallow surface depression. For example, Lake Tana was formed during the Quaternary Period, when a sheet of flowing lava dammed the shallow depression that had already been formed between the Gojjam and Gondar massifs.

Example:

Crater lakes in Ethiopia:

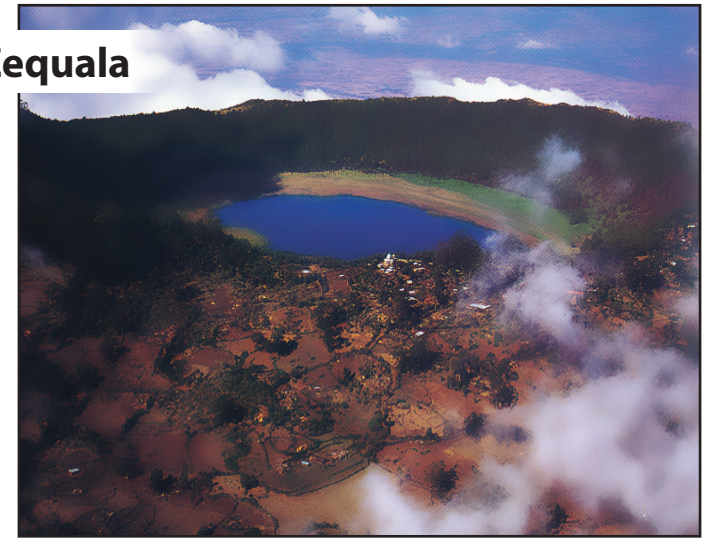
- *Bishoftu, Kuruftu, Babbo Gaya, and Arsedi, all around Bishoftu*
- *Wonchi and Dendi around Ambo, Ginchi and Wellisso*
- *Zequala near Bishoftu*
- *Hashenge near Korum in Tigray*
- *Haik, (some 30 kilometers away from Desse on the road to Woldiya*

Lake Wonchi

Lake Bishoftu

Lake Shalla

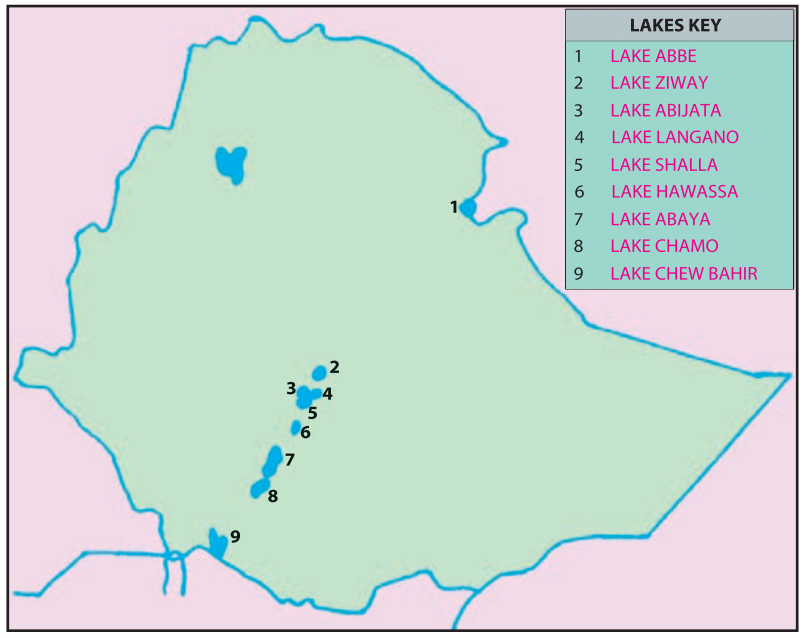
Lake Zequala



Rift Valley Lakes

What is the structural difference between crater lakes and Rift Valley lakes?

Unlike the highland lakes, the Rift Valley lakes are clustered. They are found in a linear pattern along the floor of the Rift Valley.



Source: *Grade 12 Geography Students text, 2000.*

Figure 3.10: **Major Rift valley lakes of Ethiopia**

Table 3.5: **Depth, area and location of Ethiopian lakes**

Lakes	Area (km^2)	Maximum depth (meters)	Location
Tana	3,600	9	Highland
Abaya	1,160	13	Rift Valley
Chamo	551	10	Rift Valley
Ziway	434	4	Rift Valley
Shalla	409	266	Rift Valley
Langano	230	46	Rift Valley
Hawassa	229	10	Rift Valley
Abijatta	205	14	Rift Valley
Haik	35	23	Highland
Hashenge	20	25	Highland

Source *Grade 12 Geography Students text, 2006*

Significance of Ethiopian Lakes and Rivers

Economic Functions of Ethiopia's Lakes and Rivers

What do you know about the concept of economic function? Are there rivers and lakes in Ethiopia that have non-economic functions?

Lakes and rivers are Ethiopia's main water resources. Their usefulness is measured in terms of their significance to current and planned economic development projects. Ethiopia's level of technology is a significant factor for developing these economic resources.

Here is a list of some important functions of Ethiopia's lakes and rivers.

- ⇨ *They are the main source of hydroelectric power (H.E.P.) supplies for the country*

Example:

River Ghibe – Gilgel Gibbe – 1, 2 and 3 H.E.P. plants
River Awash – Awash 1, 2 and 3 H.E.P. project
Rivber Fincha – Fincha H.E.P. project,

- ⇨ *They are also the country's main source of fish.*

Example:

Lake Chamo. Lake Abbay, Lake Tana, River Baro, etc

⇨ *They are again very important water sources for irrigation.*

Example:

River Awash is the most utilized in this regard; this is because of the flat plains it crosses for hundreds of kilometers.

⇨ *What is more, one river provides transportation services.*

Example:

The River Baro is the only river in Ethiopia used for transportation.

Photograph 3.7 **Cotton plantation served by Irrigation**

Activity 3.8

Make an educational trip to a nearby river or stream with your teacher and perform these tasks:

a Determine how far the river or stream is from your school, in kilometers.

b Draw a sketch map of the stream or river area. Then, answer the following questions:

- i does the stream or river have a steep profile?
- ii is it of a gentle profile?
- iii do the local people use the river for small scale irrigation purposes such as growing vegetables? How?
- iv if so, how? If not, why not? Present the case to your teacher and discuss it.

Ethiopia's lakes and rivers provide recreation resorts and aesthetic value. They are also important sources of the nation's fish.

Their scenic beauty emanates the rich variety of birds, fish and other wildlife, spectacularly deep gorges, waterfalls of all description and the mists these produce. These panoramic features win the affection of the Ethiopian people and tourists and are sites of the country's best recreational resorts. The economic potential of these scenic resources is enormous but is still not well developed.

3.3.4 Water-Resource Conservation and Management in Ethiopia

Why do we conserve water resources? Are our water resources running out? How do they support our existing needs? Are policy measures the correct solution to problems?

As you know, Ethiopia has been known as the "Water Tower of Northeastern Africa" for the last fifty to sixty years. Ethiopia is the second richest African country in terms of water-resource potential, following the Democratic Republic of Congo. However,

- ⇨ *drought is recurring every 3 to 5 years.*
- ⇨ *some highland lakes are disappearing or are on the verge of disappearance.*

Example:

Lake Haromaya in Hararghe zone and Lake Cheleklektu in Bishoftu.

- ⇨ *the volume and purity of Ethiopia's rivers is decreasing. Pollutants are increasingly contaminating the country's water resources.*
- ⇨ *due to the rapid growth of human population, there is a crucial growing demand for potable water.*

These and other factors have led to the need for the conservation and management of water resources in Ethiopia. In response to this need, the Federal Democratic Republic of Ethiopia has adopted a national conservation strategy for natural resources under the Ethiopian Environmental Protection Authority. The Authority has developed policy goals, objectives and guiding principles.

Overall Policy Goals

The overall policy goals are:

- *improve and enhance the health and quality of life of all Ethiopians*
- *promote sustainable social and economic development through sound management and use of*
  - *natural, human-made and cultural resources*
  - *the environment*
- *perform these tasks in a manner that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.*

Policy Goals Related to Water Resources

In relation to water resources, the goals of the Ethiopian Environmental Protection Authority are:

- *ensure that the control of environmental health hazards is a necessary condition in the design, constitution and use of dams and irrigation systems.*
- *recognize that natural ecosystems, particularly wetlands and upstream forests, are fundamental for regulating water quality and quantity, and integrate their rehabilitation and protection into the construction, development and management of water resources.*
- *ensure that any proposed introduction of exotic species into water ecosystems as subject to detailed studies and environmental-impact assessment.*
- *promote the protection of the interface between water-bodies and land (for example, lake shores, river banks and wetlands).*
- *involve water-resource users, particularly women and animal herders, in the local planning, designing, and follow up of water policies, programs and projects, in order to promote these activities without affecting the ecological balance.*
- *recycle waste water when it is found to be safe for health and the environment.*

- *promote, to the extent possible, viable measures to artificially recharge ground and surface-water resources.*
- *promote effective water-management techniques at the farm level for improved performance of medium-to-large-scale irrigation schemes.*
- *provide technical and credit support to the private sector in water-resource development activities.*

Note

The Hydro Politics of Ethiopia

Ethiopia is the main source of the Nile waters. More than 86 percent of the water of the Nile originates from Ethiopia. However, it is a country that has made the least use of it.

During the past forty years Ethiopia was engaged in internal wars and did not have the time to harness the Nile waters for development.

However, Ethiopia's interest in utilizing the Nile waters was clear. For example, in 1927, it sent Martin to the United States on a diplomatic mission to discuss the Lake Tana development project and recruit American engineers. However, the project failed to materialize due to opposition on the part of Britain and to the impending Italian invasion.

In the 1950s, Ethiopia contracted a US engineering firm to conduct a comprehensive study of the Abbay river. Sadly, at that time Egypt and the Sudan were engaged in negotiations regarding the full utilization of the Nile waters. Ethiopia was not included in the negotiations. It was in this context that the Ethiopian government protested, asserting Ethiopia's right to utilize the water resources within its borders.

Despite these setbacks, Ethiopia's rights to utilize its own water resources remain valid, reach on allocation has persisted the simple reasons that it is firmly committed to place and a win-win situation that can be derived from cooperation.

(Dr. Kinfe Abraham, 2000)

Exercise 3.4

I ***Are these statements True or False?***

1 In geography, *drainage pattern* and *drainage system* have the same meaning.

2 Most Ethiopian drainage patterns are dendritic.

3 One can confidently state that the plateau of Shoa serves as a watershed between the Abbay and Awash river basins.

4 Altitudinal factors cause the energetic flow of Ethiopian rivers.

5 The Abbay is the longest river in Ethiopia.

6 Almost all rivers in Ethiopia are navigable.

II ***Choose the best answer among the given alternatives***

7 All the rivers below drain the Southeastern Highlands except.

A Wabeshebelle
B Ghenalle
C Omo-Ghibe
D Juba

8 Ethiopia's largest surface water is found in the

A South and northwest
B Rift Valley System
C Western Lowlands
D A and B

9 The southeastern drainage system consists of

A Genalle and Wabeshebelle rivers
B Omo and Gibbe rivers
C Baro and Akobo rivers
D Tekezze and Angereb rivers

10 The Awash River rises from the plateau of

A Hararge
B Bale
C Shewa
D South Wello

11 Which of the following rivers does not end in a lake?

A Segen
B Awash
C Omo-Ghibe
D Baro-Akobo

12 The Ethiopian lakes are said to be the results of structural activity. This is proved by their

A location in wet areas
B location in dry areas
C location at high altitudes
D having less volume of water

13 Which one of the following lakes is not a crater lake?

A Lake Ashenge
B Lake Wonchi
C Hawassa
D Lake Arsedi

14 What distinguishes the Rift Valley Lakes from the highland lakes?

A the fluctuation of their volume of water
B their significance for transportation
C their richness in chemicals that produce soda ash
D their location along transport lines

15 The deepest and shallowest lakes of Ethiopia are, respectively:

A Ziway and Shalla
B Shalla and Zeway
C Tana and Shalla
D Abbaya and Abyatta

16 No Ethiopian river is navigable except

A Abbay
B Athbara
C Baro–Akobo
D Omo

17 The Awash River is the most utilized in Ethiopia for irrigation purposes. This is mainly due to its:

A surrounding terrain,
B flow to the Afar lowlands
C unfluctuating volume of water
D great number of tributaries

18 One of the following is not a strategy adopted by the FDRE in conserving and managing water resources.

A Rehabilitating wetlands and headstream areas
B Providing technical support to the private sector in participating in the conservation strategy
C Recycling waste water when it is found to be safe
D Paying little concern to women's role in the local involvement tasks.

19 Which of the following statements is not correct about Ethiopia's current water-resource status?

A Ethiopia is rich in rivers and lakes, but they are not utilized at all.

B Available water resources in Ethiopia are being widely used.

C Policy intervention is necessary to conserve Ethiopia's water resources.

D A number of development projects are underway regarding the major rivers of Ethiopia.

3.4 CLIMATE OF ETHIOPIA AND THE HORN

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

- discuss the factors that influence the spatial distribution of the climatic elements of Ethiopia and the Horn;
- describe the spatial and temporal variation of temperature in Ethiopia and the Horn;
- explain the spatial and temporal variation of rainfall in Ethiopia and the Horn;
- compare the rainfall regions in Ethiopia.

Key Terms

- Latitude
- Altitude
- Weather
- Climate
- Revolution of the earth
- Rotation
- Inter-Tropical Convergence zone
- Equatorial westeries
- North easterlies
- South easterlies

Are you aware of the weather information that is broadcast and televised by the Ethiopian Radio and Television Service Agency every morning and night?

These reports inform the people of the projected daily maximum and minimum temperatures, cloud cover, humidity and other air conditions for the coming day. This information about air condition relates to weather. In contrast, climate information gives us long-term data about the average weather conditions of a place or a region over a long period of time; such a period is typically as long as 30 years or more.

3.4.1 Factors Influencing the Spatial and Temporal Distribution of Climatic Elements in Ethiopia and the Horn

What do you know about the concepts of weather and climate? Do you watch weather broadcast every day? What is the significance of knowing the weather condition of a place?

Both weather and climate are composed of the following elements.

- *precipitation*
- *humidity*
- *wind*
- *temperature*
- *air pressure*
- *sunshine, etc.*

The distribution of these elements over the surface of the earth is uneven in terms of magnitude and time. For example, Ethiopia and the Horn as a whole experience different temperatures on the same day or within a month. This spatial and temporal distribution of climatic elements is governed by the climate control factors described in the sections below.

The following factors influence the control of the spatial and temporal distribution of the climatic elements in Ethiopia and the Horn:

- latitude
- altitude
- revolution of the earth and the inclination of the earth's axis
- distance from the sea
- mountain barriers
- weather systems
- cloud cover

Latitude

Are latitudes and parallels the same?

Latitude, as a climate control, is the angular location of a place or point with reference to the direct rays of the sun. When we speak of the latitudinal impact on the climates of Ethiopia and the Horn, we are considering the intensity of temperature in the region.

Ethiopia's and the Horn's location within the tropical zone results in

- *high temperatures during most of the year*
- *high daily (diurnal) ranges of temperature*
- *relatively small annual ranges of temperature*
- *little difference between summer and winter in the ratios of daylight to night.*

Altitude

Do you have information about the altitude of the place where you are living? Is it a highland or lowland? Is the temperature mild or hot or cold?

Altitude is height above mean sea level. Ethiopia's altitudinal variation ranges from 116 meters below sea level up to 4620 meters above sea level. This altitudinal variation plays a significant role in temperature variation from place to place. If you travel from Addis Ababa to Awash Arba through Bishoftu, Adama and Metahara, you can recognize a variation in temperature due to altitudinal changes. You may also like to note similar variation in your area.

Note

Under normal conditions, there is a general decrease in temperature for increases in elevation. The average rate at which temperature changes per unit of altitudinal difference is known as lapse rate. This decrease in temperature upward from the earth's lowest surface is noticeable at every other 8 to 16 kms rise in the atmosphere. The rate of change is 6°C per 1000 meters. This change is called *environmental lapse rate* or *atmospheric lapse rate.*

Altitude is the main factor that determines the spatial distribution of temperature in Ethiopia. Different places that exist on the same plane or angle of the rays of the sun might be expected to experience equal temperatures. However, due to the impact of altitude, they do not.

For example, three Ethiopian cities, Bako, Addis Ababa, and Awash all lie on the 9°N latitude, and therefore they might be expected to receive equal magnitudes of direct rays from the sun and therefore equal temperatures. However, their altitudes vary, and therefore their temperatures vary, as shown in Figure 3.11.

Example:

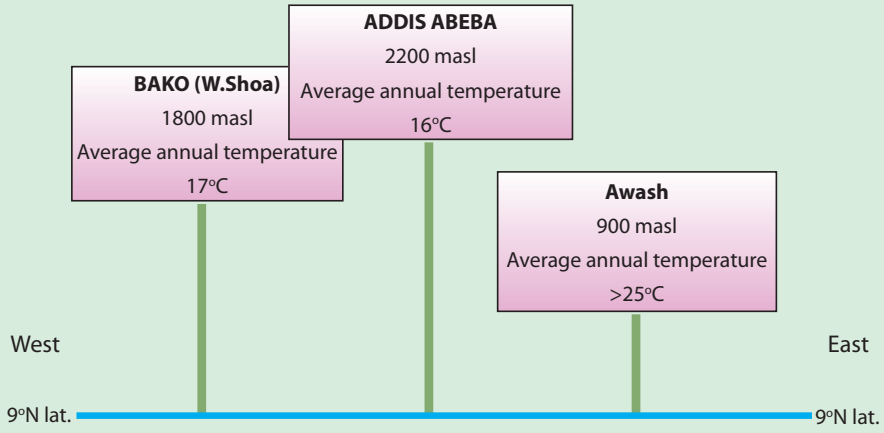


Figure 3.11: **The role of altitude in modifying temperatures**

The diagram illustrates the effect of altitude on temperature, confirming the fact that temperature decreases as altitude ascends from the lowlands towards the interior highlands.

Revolution of the Earth and Inclination of the Earth's Axis

The axis of the earth inclines 23½° to the normal of the elliptic. As the earth revolves around the sun, this inclination produces a change in the direction of the sun's rays, thereby affecting the length of time that the sun shines on the earth every other day.

Changes in the length of the day and in the directness of the sun's rays cause seasons. These different seasons result in the temporal variation of temperature in a year in Ethiopia and in the Horn as a whole.

Distance from water bodies

Don't you expect that water bodies or lakes (at local levels) have a moderating effect on the vicinal or adjacent land areas?

Water bodies and landmasses have different levels of heat absorption. Land masses absorb and release heat energy more quickly than water bodies do. Distance from the sea affects the Horn's climate only in coastal areas that are adjacent to the Red Sea and the northwestern Indian Ocean. In all other areas, the role of distance from the sea in climate control is insignificant.

Mountain Barriers

Mountain barriers can affect climate in that they exert influence on the spatial distribution of rainfall. Places located on the *leeward side of mountains (also called rain shadow)* receive little rain. This effect occurs in the northwestern and northeastern lowlands of Ethiopia and the Horn.

Weather Systems

Weather systems are actually the effects of spatial variation of the overhead sun, which in turn results in the variation of temperature, pressure and rainfall.

In the Horn of Africa, the apparent shift of the overhead sun between the Tropic of Cancer and Tropic of Capricorn contributes to the prevalence of different wind systems in different seasons. The major weather systems that impact over Ethiopia and the Horn are:

- *The Northeast Tradewinds (prevalent in December, January and February)*
- *The Equatorial Westerlies (prevalent in June, July and August)*
- *The Equatorial easterlies (prevalent in September and October, March and April).*

It is because of these weather systems that the rainfall period varies in Ethiopia and the Horn.

3.4.2 Spatial and Temporal Variation of Temperature in Ethiopia

What do we mean by spatial and temporal in the context of Geography?

A *Spatial Variation of Temperature in Ethiopia*

The two factors that most affect the spatial variation of temperature in Ethiopia are:

- cloud cover and
- altitude

Cloud Cover

Cloud cover, or cloud protection, as these names imply, is the covering of parts of the earth by clouds. The cover acts as temperature insulation for the earth, for both day and night hours. By day, it can prevent the full force of sun's rays from heating the earth. By night, it can prevent the heat absorbed by the earth from escaping into the atmosphere. Therefore, the presence or absence of cloud cover produces spatial temperature variations in Ethiopia and elsewhere in the Horn.

Altitude

Do you know what agro-climatic zone mean?

Is it different from the Greeks' classification of temperature zones?

Because altitude has such a large effect on temperature, it is a major determining factor of Ethiopia's agro-climatic zones. These zones have traditionally been defined in terms of temperature.

Table 3.6 presents Ethiopia's agro-climatic zone types, giving the altitude and mean annual temperature for each one.

Table 3.6: **Ethiopia's Agro-Climatic Zones**

Altitude in meters	Mean annual temperature in °C	Traditional agro-ecological name	Global equivalence
3,300 and above	<10	Wurch/Kur	Alpine or Afro-Alpine
2,300 – 3,300	10 – 15	Dega	Temperate
1,500 – 2,300	15 – 20	Woina Dega	Subtropical
500 – 1500	20 – 30	Qolla	Tropical
below 500	> 30	Bereha	Desert

Wurch-Zone Areas

Do you know that the term wurch has resemblance to temperature severity?

The Wurch-zone areas have the highest altitudes and lowest temperatures. Frequently they have temperatures of less than 10°C. These areas exist only in the very high mountains of South Gondar, Wollo, Shoa, Arsi and Bale.

Example:

Mt. Ras Dashen in Semine Gondar
Mt. Guna in South Gondar
Mt. Megezez in North Shoa
Mt. Batu in Bale, etc.

Dega-Zone Areas

What crops are grown in Dega areas?

The Dega-zone areas are highland areas with lower altitudes and higher temperatures than Wurch-zone areas. Historically, Dega-zone areas were the home of concentrated human settlement. They were chosen because of the features below:

i secure location (from which people could defend themselves from threats)
ii reliable rainfall
iii absence of diseases such as malaria, etc.

Note

Most of Ethiopia's medieval and later settlements are concentrated in Dega-zone agro-climatic areas.

Due to this high concentration of human population, the Dega zone has been intensively cultivated and has a high rate of soil erosion, overgrazing and deforestation.

Some of the humid areas of this zone support two growing periods per year under rain-fed agriculture.

Example:

- *Dinsho in Bale*
- *Chillallo in Arsi*
- *Hulla in Sidama*
- *Debresina in North Shewa*

Woina-Dega-Zone Areas

What is your understanding why the term Woina Dega comes after Dega? Does the term mean milder Dega?

The Woina-Dega-zone areas contain most of Ethiopia's agricultural land. They are the country's main areas producing:

- *Surplus grain*
- *Inset and its derivatives*

In the Woina-Dega zone, as in the Dega zone, there can be two growing seasons when rainfall reliability is high.

Qolla Zone and Bereha-Zone Areas

What are the dominant crops grown in Qolla areas? Can we grow crops in Bereha zone areas?

The Qolla and Bereha agro - climatic zones are largely confined to lowland areas with altitudes of 1500 meters and below. They are sparsely populated and their populations are primarily engaged in pastoralist activities. They occupy

- *The peripheral areas of Ethiopia and Eritrea*
- *Most of Somalia*
- *Djibouti*

B *Temporal variation of temperature in Ethiopia*

Can you identify the temperature differences in Ethiopia between the months of April/May and those of October/November? How do these differences occur?

In Ethiopia and elsewhere in the Horn, temperatures vary from season to season. For example, in most of Ethiopia, high temperatures are recorded from March to June. Conversely, low temperatures are recorded from November to February These variations are primarily due to.

- *the tilting of the earth at 23½° to the normal elliptic*
- *the distance of the overhead sun and its apparent north-south movement across the equator as the earth revolves around the sun*

The position of the overhead sun January

The position of the overhead sun July

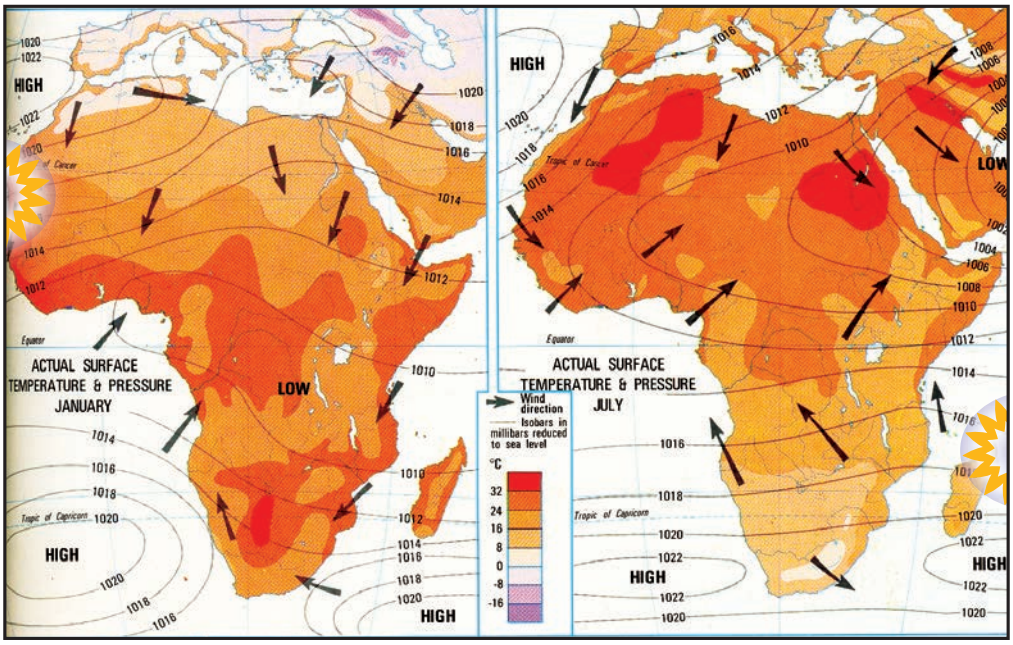


Figure 3.12: **The position of the overhead sun**

Activity 3.9

1 Identify your own agro-climatic zone by referring to your area's altitude. You might be able to obtain the masl (Meters Above Sea Level) value of your altitude from your area's kebele offices or from those of other agencies in your area. Your teacher may help you as you try to get that information so that you can use it to identify your agro-climatic zone.

2 Identify all the characteristics of your agro-climatic zone.

3 Write a report on your agro-climatic zone.

3.4.3 Spatial and Temporal Variation of Rainfall in Ethiopia and the Horn

Do you distinguish the two concepts spatial and temporal? Which of the two terms is very much explanatory in the distribution of rainfall in time series?

Rainfall is one of the main climatic elements, as we indicated in the preceding discussion on the effects of weather systems and the distribution of climatic elements in Ethiopia and the Horn. Let us now consider the variation in detail.

A *Spatial Variation of Rainfall in Ethiopia and the Horn*

Ethiopia and the Horn experience marked spatial and temporal variations of rainfall. The spatial variation is the result of the strength and nature of prevailing weather systems.

As described earlier, Ethiopia's and the Horn's weather systems result from

- *the apparent movement of the overhead sun*
- *prevailing winds*
- *the associated Inter-Tropical Convergence Zone*

The first two factors were described in detail earlier. Now let's focus on the effects of the associated Inter-Tropical Convergence zone.

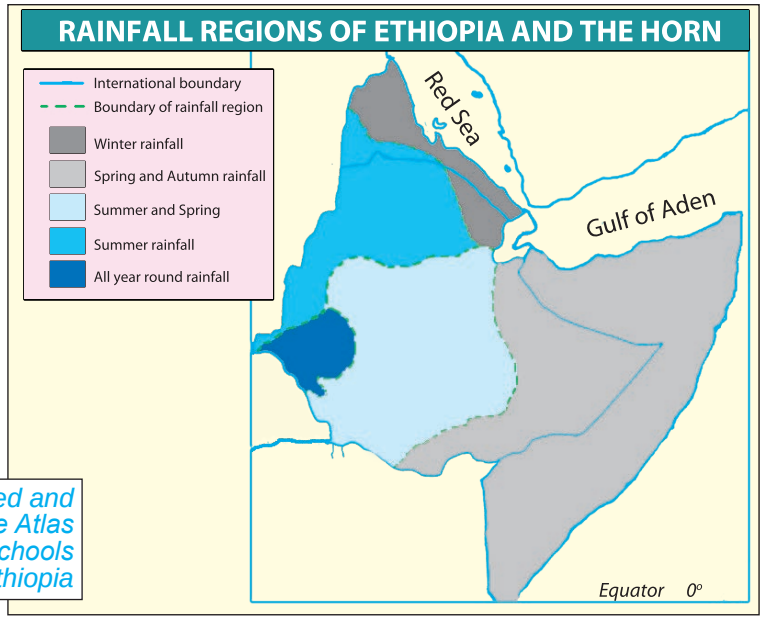
Inter-Tropical Convergence Zone (ITCZ)

It is a low pressure zone formed by the convergence of Northeast Tradewinds and the Equatorial Westerlies. It shifts north and south of the equator following the position of the overhead sun.

In July, its position is at the Tropic of Cancer. During this time, Ethiopia and the Horn come under the influence of the Equatorial Westerlies and Easterlies. These winds bring moisture to the highlands but decrease their magnitude and length of rainy periods northwards.

In January, its position shifts to the Tropic of Capricorn leaving the region for the prevalence of the Northeast Tradewinds that are non-moistrue-laden. During this time only the Eritirean coastal lands and the Afar region receive rain. In most of Ethiopia, western Eriteria and Somalia, it becomes dry season.

In March and September, the position of the ITCZ is around the equator. Hence, the Equatorial Easterlies provide rain to the highlands of Somalia, and to the Central and Southeastern lowlands and highlands of Ethiopia.



Source: *Adjusted and modified from the Atlas for secondary schools in Ethiopia*

Figure 3.13: **Rainfall regions of Ethiopia and the Horn**

B *Temporal Variation of Rainfall in Ethiopia*

Ethiopia's rainfall is characterized by seasonal variation. There are two main rainy seasons: "Kiremt (summer) and Belg (spring)". These two rainy seasons contribute more than 90% of the country's rain supply. There are two other rainy seasons – the autumn rains, called the *Metsew*, and the winter rains. Compared to the two main seasons, the duration, volume, and aerial coverage of Metsew rains are less. The winter rainy season is insignificant for the highlands. It supplies rain only to the Afar lowlands, the Red Sea coastal areas and the eastern escarpment of the Eritrean highlands.

Activity 3.10

1. Identify your locality, based on its rainfall seasons. In which seasons do you experience rain?
2. What moisture-bearing winds prevail over your area?
3. What is the attractive factor for the moisture coming as rain to your locality?
4. Identify the hottest and coldest months in your area.

3.4.4 Rainfall Regions in Ethiopia and the Horn

Does rainfall regions indicate variation in rainfall magnitude and duration within Ethiopia and the Horn?

Based on rainfall distribution, both in space and time, five types of rainfall regions can be identified in Ethiopia and the Horn. These are:

- *year-round rainfall region (wet in most months)*
- *summer rainfall region*
- *autumn-and-spring rainfall region*
- *winter rainfall region*
- *merged spring, summer, and autumn rainfall region*

Let us consider each region in turn.

Year-Round Rainfall Region

In Ethiopia, the area of year-round rainfall:

- *includes the southwestern plateau comprising the highlands of Wellega, Keffa, Illubabor and Gamo Goffa.*

This region can be represented by the following stations:

Gore, Mizan, Metu, Bonga, Gambella, etc.

The region has more rainy days than any other part of the country. The average rainfall varies from 1400 mm to 2200 mm.

The year-round rainfall region is represented by the letter B on Figure 3.14.

Summer Rainfall Region

The summer rainfall region is the largest in the country. This region consists of the Northwest Highlands and Western Lowlands, and can be represented by the following stations.

Debremarkos, Fitche, Gondar, Bahrdar, etc.

Its moisture-bearing winds are the Equatorial Westerlies and Easterlies. The summer rainfall region is represented by the letter A in Figure 3.14.

Autumn-and-Spring Rainfall Region

The autumn-and-spring rainfall region covers the southeastern highlands and associated lowlands up to the Somalia coasts. They can be represented by the following stations:

Gode, Moyalle, Jijiga, Yabello, Baydhabo.

The region's moisture-bearing winds are the Equatorial Easterlies. They pick up moisture from the Indian Ocean, and they blow over the autumn and spring rainfall region when the Northeasterlies and Equatorial Westerlies are weak. The region's average rainfall varies from less than 500 to 1000 mm.

The autumn-and-spring rainfall region is represented by E in Figure 3.14.

Winter Rainfall Region

The winter rainfall region consists of the eastern escarpment of the western highlands, the middle Rift Valley section, the Afar subdivision and Eritrea. The winter rainfall region can be represented by the following stations.

Mitswa, Assaita and Djibouti.

The region's moisture-bearing winds are, for the most part, the North Easterlies. The air mass is continental (dry) and has only a short sea trajectory (that is the Red Sea).

It is represented by letter D in Figure 3.14. The region's total annual moisture is very low and of short duration.

Note

In Ethiopia, highland rainfall is more dependable than lowland rainfall. However, highland dependability decreases from the southwestern highlands in all directions. In short, rainfall variability (deviation from the expected amount and time) decreases from areas of heavy rains to areas of low rainfall.

Merged Spring, Summer and Autumn Rainfall Region

The merged spring, summer and autumn rainfall region is the smallest in the country. It consists mainly of the western foothills of the Southeastern Highlands.

The region's total annual rainfall varies from 1500 mm to 1000 mm. It covers a corridor that stretches from the Sidama Highlands to the Hararge Plateau.

The merged spring, summer, and autumn rainfall region is represented by the letter C in Figure 3.14: stations-Assaita, Awash, etc.

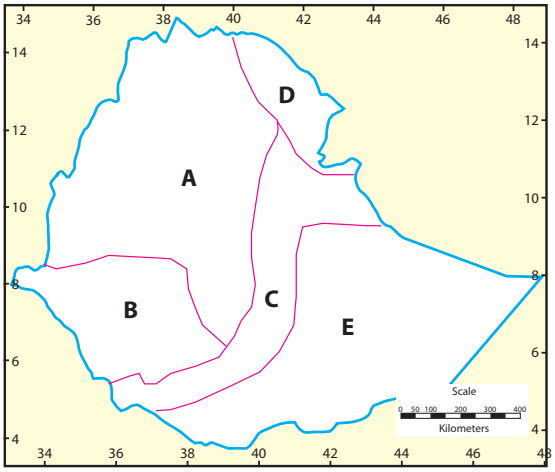


Figure 3.14: **Rainfall Regions of Ethiopia**

Exercise 3.5

I ***Match the items of Column A with the items of Column B.***

A		B	
1	Experiences rain almost all year round.	A	Northeasterlies
2	Experiences mostly summer rains.	B	The highlands of South Gondar
3	Temperature zones that are largely confined to places over 3,300 masl.	C	Bereha
4	Temperature zones that are largely confined to the southeastern lowlands.	D	Alpine or Afro-Alpine
5	Moisture-bearing winds to the central and northern parts of Ethiopia.	E	The Equatorial Westerlies
6	Pools for the autumn and spring rains of Ethiopia.	F	The Indian Ocean
7	Pools for the summer rains of Ethiopia.	G	The Atlantic Ocean
8	The continental winds that prevail in winter over the greater part of the Red Sea and central Ethiopia.	H	The plateaus of Illubabor and Western Wellega

II *Questions to Think Over.*

9 What natural factors are responsible for the all year round wet conditions of the southwestern part of Ethiopia?

10 What do we mean by the Inter Tropical Convergence Zone? Why does it apparently shift north and south of the equator?

11 If the axis of the earth were perpendicular, what effect would it have on temporal variation of temperature?

12 By referring to the rainfall regions of Ethiopia and the Horn,

a Identify the rainfall region in which you live.

b Suggest the total annual rainfall that your area experiences referring to the theoretically proposed amount in the text.

c For each rainfall region, select a representative town. Then draw a bar graph that shows the rainfall of each of the towns you have chosen. For source materials, use references such as your school atlas, the National Atlas of Ethiopia, textbooks, and other sources of information.

d Which region has the least rainfall variability?

3.5 NATURAL VEGETATION AND WILD ANIMALS OF ETHIOPIA

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

- relate types of natural vegetation to climatic regions;
- identify the wild animals of Ethiopia;
- discuss the effects of human intervention on forest lands;
- show interest to participate in the conservation of natural vegetation and wild animals.

Key Terms

- Afro alpine
- Forest
- Desert
- Gallery forest
- Coniferous trees
- Deforestation
- Overgrazing
- Endemic
- National park
- Game reserve
- Overcultivation
- Soil conservation

3.5.1 Types of Natural Vegetation of Ethiopia

What are the major types of natural vegetation in Africa? Which type of vegetation is dominant in Ethiopia?

Please go to a nearby church, mosque, or other sacred place. Observe the predominant trees among the natural vegetation. If there is a forest nearby, visit that too, and identify the predominant trees. They indicate the natural vegetation of the area.

Natural vegetation refers to any original plant grown in and covering an area. The distribution of natural vegetation is influenced by many factors. The most important ones are:

- *altitude*
- *climate*
- *soil type, and*
- *drainage*

The types of natural vegetation in an area are strongly determined by temperature and rainfall. That is why the natural vegetation of an area is a good indicator of the area's climatic conditions.

Natural Vegetation's Relationship to Altitude and Rainfall

In Ethiopia, the types of the natural vegetation of an area are highly correlated with altitude and rainfall, as they are with temperature. The lowlands have harsh environments due to low rainfall and are characterized by xerophytic plants, while the highlands are chracterised by different types of tree stands and forests.

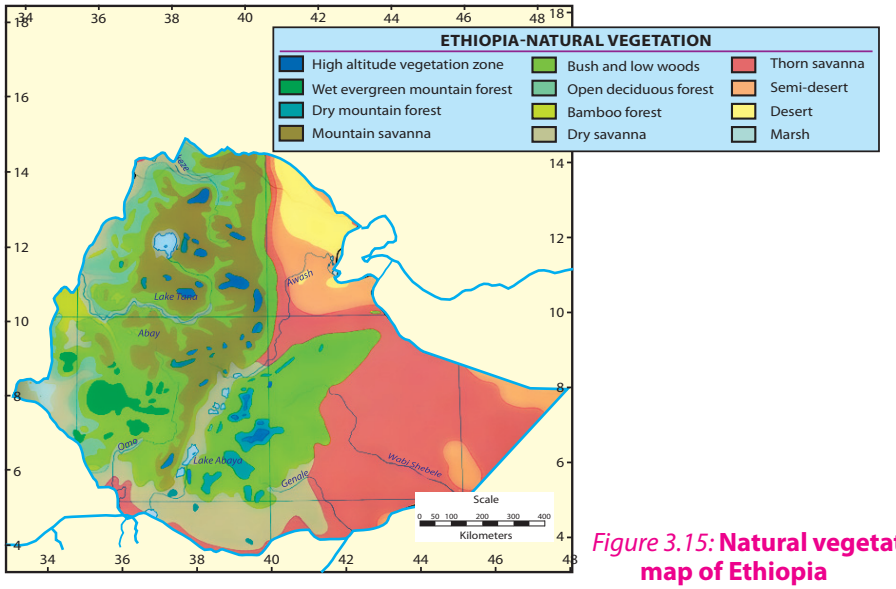


Figure 3.15: **Natural vegetation map of Ethiopia**

Based on altitude, we can classify the natural vegetation of Ethiopia into the following five types:

- Afro-alpine and sub-Afro alpine
- Forests
- Woodland savanna
- Steppe vegetation
- Desert and semidesert vegetation

Afro-Alpine and Sub Afro-Alpine Vegetation

What do you know about the difference between Afro - Alpine and Sub Afro Alpine?

This type of vegetation is found at very high altitudes (above 3300 meters). Afro-alpine and sub-afro-alpine vegetation is very similar to European alpine vegetation. Sub-afro-alpine vegetation is found between 3000 – 3300 m, while Afro-alpine vegetation is found at higher altitudes than these. In Ethiopia, Afro-alpine and sub-Afro-alpine vegetations are found in the:

- *Highlands of Semein and*
- *Highlands of Bale*

Afro-Alpine vegetation consists of tussock grasslands, serules, scattered mosses and lichens. SubAfro Alpines are predominantly woodland scrubs. Gibra (Lobelia rhynchopetalum) and Asta (Erica arborea) are dominant plant species in this region of natural vegetation.

Forests

What is the present status of Ethiopia's forest resources when compared to the other countries of the Horn?

In Ethiopia, forests are characterized by broad altitudinal ranges (450 – 3300 m) and large variations in mean annual rainfall (200 – 2200 mm). This wide variation in altitude and rainfall results in the formation of highland and lowland forests. These two types of forests have very different characteristics since they are the results of altitudinal zonation.

A Highland Forests (forests that grow between 1500 - 3300 masl altitude)

Ethiopia's highland forests consist of

- ⇨ *Kerkha (Arundinarial) 2800 – 3000 masl*
- ⇨ *Tid (Juniperous Procera) or Coniferous trees 2200 – 2800 masl*
- ⇨ *Zigba (Podocarpus) 1800 – 2200 masl*
- ⇨ *Woira (Oliia Africana) and Kosso (Hagenia Abbyssinia (1500 – 1800)*

B Lowland Forests (forests that grow below 1500 m altitude)

What are the temperature and rainfall limits for the formation of forests?

Is there a strong relationship between altitudinal variation and types of forests?

Which part of Ethiopia is currently under dense forest cover?

These forests are known as *gallery/riverine forests.* In Ethiopia, they grow along the banks of the Awash, Wabishabelle, and Ghanalle Rivers where moisture is available in the soil. The predominant trees are Sholla and Warka. In areas where mean annual rainfall exceeds 500 mm, Baphia forest predominates.

Woodland Savanna

Can you remember the sub-divisions of the African Savana? Do you expect certain similarities between woodland Savana and proper Savana?

Like forests, Savanna woodlands are found in both highland and lowland areas. Their altitudinal range is 250 – 2300 m, and their mean annual rainfall range is between 200 – 1400 mm. (Example: acacia, grass etc.)

However, such vegetation is dominant at lower elevations and drier climates than the forests.

Savanna grasslands experience marked seasons and are characterized by scattered acacia trees.

In areas where mean annual rainfall is more than 1000 mm, these grasslands can form attractive park-like areas with acacia, wild fig, sycamore and kosso trees. Ethiopia's savanna grasslands are found in the southern half of Ziway, Langano, Abiyatta and Hawassa.

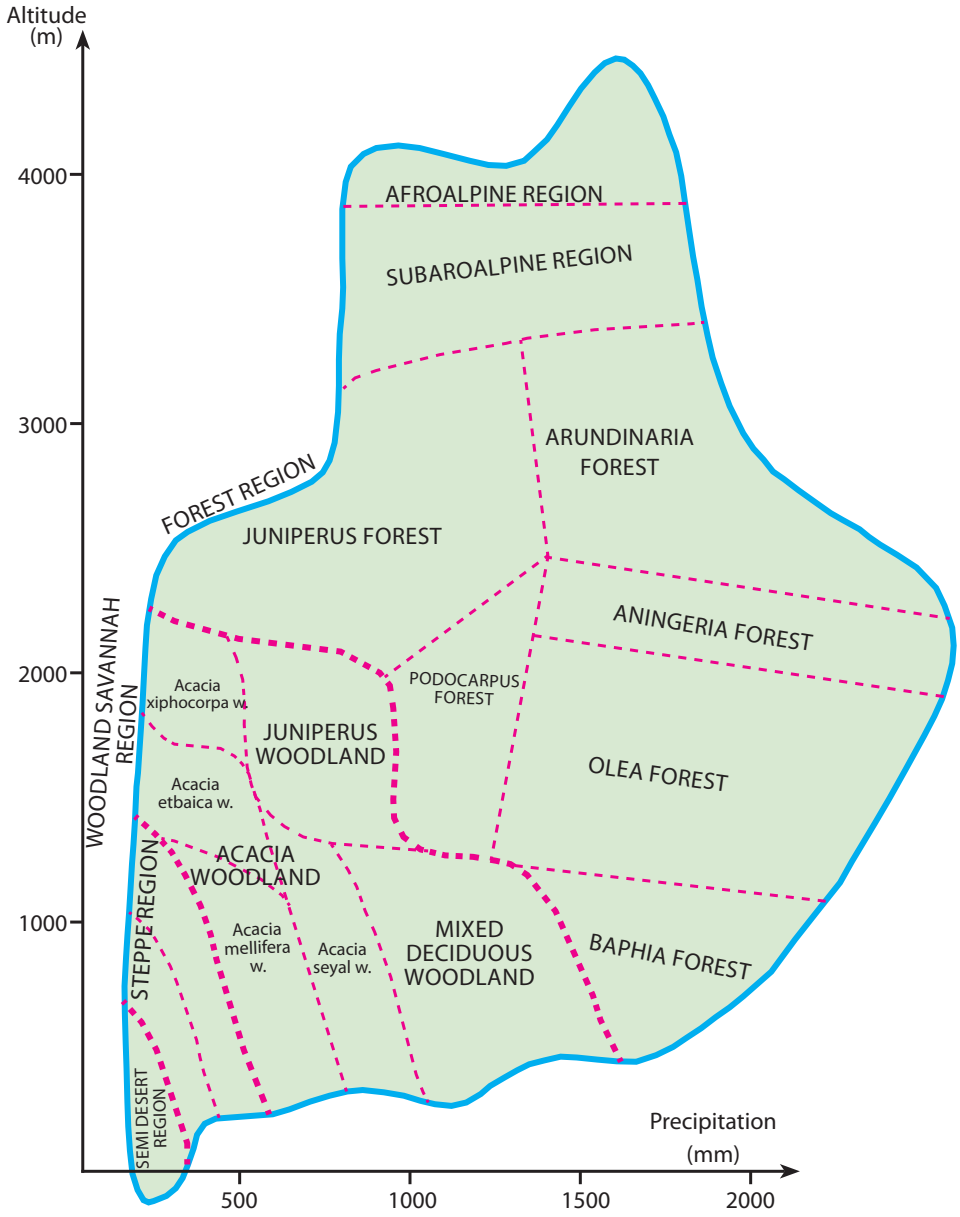


Figure 3.16: **Vegetation regions correlated to altitude and mean annual rainfall**

Semi-desert and Desert Vegetation

Is there a remarkable difference between semi desert and desert vegetation? How can you differentiate the two?

Sem-idesert and desert vegetation consists of short acacia, thorn bushes, succulent plants and a few rough grasses. In Ethiopia, vegetation of this kind is found in the Eastern, Northwestern and Southeastern Lowlands, i.e., in areas where annual rainfall is below 500 mm and drought persists for a long period of time.

Note

Concern for the preservation of Ethiopia's forests must be a major issue on the public agenda. Communities and individuals must participate in the conservation and management of the country's forest resources. Our pressing needs to perform these tasks is a call to every citizen.

Activity 3.11

1 With your teacher, schedule an educational trip to nearby natural areas. If possible, the teacher will have a camera or video camera to use during the trip.

2 Draw a sketch map of the target area.

3 Write a short report describing the area's

- ⇨ predominant trees
- ⇨ rainfall seasons
- ⇨ temperature

4 With your classmates, discuss and then list the area's natural vegetation.

Exercise 3.6

Match the items in Box A with those in Box B

Box A	1	Natural vegetation
	2	Baphia forest
	3	Juniperous procera
	4	Arundinaria forests
	5	Riverine forests
	6	Afro-alpine forests
	7	Practicing agro-forestry
	8	Developing school curricula in forestry management
	9	Promoting the role of youth in conserving local forest resources
Box B	A	Forests found in humid areas of about 1000 masl or below
	B	An indicator of an area's climate
	C	A highland forest similar to forests of coniferous trees
	D	Institutional development to conserve forest resources
	E	Community capacity building to conserve forest resources
	F	A highland forest that grows between 2500 – 3000 meters
	G	Gallery forests
	H	Type of forest that grows above 3000 meters
	I	Community practices to conserve or reduce the destruction of forests

3.5.2 Wild Animals of Ethiopia

Do you think that wild animals have significance to the national economy? If so, can you mention some?

The diversity in Ethiopia's topography, climate, and vegetation has given the country a wide variety of wild animals. Ethiopia's wild-animal stock is generally similar to that of East Africa as a whole, due to topographic similarity and other aspects.

Ethiopia has about 277 species of mammals and 862 species of birds. Of these, seven species of mammals and twenty five species of birds are endemic to Ethiopia.

Types of Wild Animals in Ethiopia

Can you identify or state some of the common and endemic wild animals of Ethiopia? Which type is prevalent in your wereda or zone?

The many types of wild animals found in Ethiopia can be grouped into the following broad categories.

- **Common wild animals:** *These ones are animals commonly found in many places of the world. Many areas of Ethiopia have many common wild animals, including the hyena and the jackal.*
- **Game animals:** *These are animals that are killed for sport. Ethiopia's game animals include herbivores and carnivores. They are found in the lowlands.*

  Here are some examples of Ethiopia's game animals:

  - *Herbivores* → *browsers – giraffes*; *grazers – wild asses, zebras, etc.*
  - *Carnivores* → *lions, leopards, cheetahs etc.*

- **Arboreals:** These animals *are animals that climb up trees. Ethiopia's arboreal animals, such as the Colobus monkey and baboons, are mostly found in the rainforest regions of Ethiopia.*
- **Aquatic animals:** *These creatures are animals that live in lakes and rivers. Example: Fish, crocodiles and hippopotamus.*
- **Birds:** *Ethiopia has different kinds of both endemic and migratory birds; for example, Pelicans and flamingoes.*
- **Rare/Endemic animals:** *These are wild animals found only in Ethiopia. These days Ethiopia's endemic animals exist in only very small numbers. They inhabit highland and other areas. They are at great risk of extinction. The following are some of them.*
  - *Walia Ibex (wild goat), found in the Semein highlands.*
  - *Mountain Nyala (Dega Agazon), found in the Bale mountains.*

- *'Gelada' or 'Chelad' baboon, found in the Semein highlands.*
- *Menilik's Bushbuk ('Dikula') in the Shoan and Bale highlands.*
- *Swayne's Hartebeest ('Korkay'), found in the Nechsar park and the Sankalle sanctuary.*
- *Semein Fox ('Key Kebero'), found in the Bale and Semein Highlands.*
- *Wild Ass (Yedur Ahiya), found in the Afar and Southeast Lowlands.*

Photograph 3.8 Wildlife of Ethiopia

These rare animals, especially the Walia Ibex and Semien Fox, are approaching extinction.

Causes of the Extinction of Wild-Animals

What does the concept or term extinction mean? Have you ever thought of the situation?

The main reasons for such conditions are the shrinking and destruction of habitats, which are mainly forest land by way of:

- *rapid expansion of farmland, settlements, and industrialization*
- *expansion of grazing land*
- *wide spread practices of illegal hunting by the local people in search of meat, skin, fur, horn and ivory.*
- *frequent wild fires*

What is more,

- *migration of the wild animals to neighboring countries, due to shortages of food and water in Ethiopia adds to their perpetual disappearance.*

Conservation Measures

What can we do to save, sustain and protect wildlife resources?

Here are some conservation measures that have been recommended:

- *establish national parks, game reserves and sanctuaries.*
- *Monitor and administer existing conservation areas properly.*
- *establish and implement strong laws that effectively prohibit illegal hunting.*
- *educate the public about environment protection.*
- *protect habitats.*
- *educate and encourage local communities to protect their animals' habitats and resources.*

As you can see, some of these mitigation measures involve direct protection of the animals – for example by establishing and properly administering protected areas; and by training people in how to protect these areas.

Establishing Protected Parks, Reserves, and Sanctuaries.

National Parks

Are there national parks in your region? Have you had an opportunity to participate in educating the community about the conservation of wild animals?

National parks are conservation areas for wild animals in which legal hunting is allowed, with some restrictions. The Ethiopian National Parks are.

Table 3.7: **Ethiopian National Parks**

Name	Area in km	Location
Gambella	5,061	Gambella
Yongudirasa	4,731	Afar
Omo	4,068	SNNPR
Gerallea	3,858	Somali
Allattish	2,665	Amhara
Bale Mountains	2,471	Oromiya
Maggo	2,162	SNNPR
Cheberra churchura	1,215	SNNPR
Abiyatta – Shalla Lakes	887	Oromiya
Awash	756	Oromiya-Afar
Nech Sar	514	SNNPR
Semein Mountains	225	Amhara

Photograph 3.9 **Awash National park**

Game Reserves

Game reserves are wild-animal conservation areas where tourists are allowed to practice licensed hunting. The game reserves of Ethiopia are listed in Table 3.8.

Table 3.8: **Ethiopian game Reserves**

Name	Area in km	Location
Borena	45,366	Oromiya
Lower Wabishebelle	23,788	Somali
Arsi	10,876	Oromiya
Bale	9,663	Oromiya
Western Shoa	9,136	Oromiya
Afdim Gewane	5,932	Afar-Somali
Akobo	5,049	Gambella
Mursi	4,561	SNNPR
Mizan Teferri	4,172	SNNPR
Jikawo	3,375	Gambella
Western Omo	3,200	SNNPR
Chercher-Arbagugu	3,045	Oromiya
Erer – Gotta	2,386	Somali
Geddeo	2,347	SNNPR
Dabus Valley	2,127	Benshangul-Gumuz
Boyyo	58	SNNPR
Segan Valley	N:A	SNNPR

Sanctuaries

Sanctuaries are wild-animal conservation areas where hunting is strictly prohibited. Example: Afar Gewane.

Table 3.9: **Sanctuaries of Ethiopia**

Name	Area in km²	Location
Babille	6982	Oromiya
Sankele	54	SNNP
Yabello (yavello)	2500	Oromiya

3.5.3 Human Intervention in Forest Lands

How do human beings interfere with forest lands?

One intervention is in deforestation. At the beginning of the 20th C, the forest cover of Ethiopia was estimated at 40 percent of the entire country. Now it is less than 3 percent. This deforestation rate is alarming. We estimate that Ethiopia loses 100,000 – 200,000 hectares of forestland every year.

Causes of Deforestation

What are the major causes for this drastic rate of destruction?

The main causes are:

- *unwise tree cutting for supplies and materials*
- *overgrazing*
- *slash-and-burn practices*
- *fuel wood*
- *furniture*
- *construction etc.*

Overgrazing: This is the practice of placing too MANY livestock on a given piece of land. The activities of these animals strips the land bare.

In addition to overgrazing pasture areas, people are increasingly converting forest land to pasture land. This practice has expanded grazing land at the expense of forest land – in other words, through deforestation.

Slash and burn practices: People are involved in slash-and-burn practices to clear forestland in order to prepare it for farming. This practice essentially strips the forest bare by slashing (cutting down and digging up) all or most of the trees and other vegetation and then burning the piles away.

Slash-and-burn is also used to periodically strip an area of farmland in order to leave it lying fallow to regain its nutrients.

In Ethiopia, slashing and burning forests destroys a large area of forest annually. This approach to gaining farmland is commonly practiced in southwestern Ethiopia.

Expansion of built up areas: *Built-up areas* are areas occupied by factories, residence, recreational sites etc. Ethiopia's expanding human population increasingly requires more area for housing and other services. Some of the land that is converted to built-up areas is forestland.

Mitigation Measures

What should be done to protect, rehabilitate and achieve sustainable use of forests in Ethiopia?

The following approaches have been suggested for slowing down and/or mitigating Ethiopia's rapid deforestation rate:

- conservation
- capacity building
- institutional development

These approaches are described below. However, despite their having great potential, these approaches alone are not enough. More ideas are needed, and sustained effort must be applied to enhance the mitigation effort.

Conservation of Natural Vegetation

Have you developed attitude of conserving resources?

What measures do you often take to conserve resources at household level?

These conservation measures have been suggested for preserving Ethiopia's forests:

- *Reforestation – planting trees after every tree harvest.*
- *Afforestation – planting trees on bare and unproductive lands.*
- *Controlling burning practices (i.e., the slash-and-burn activities).*
- *Practicing agro-forestry.*
- *Reducing the use of fuel wood by adopting alternative sources of energy for household consumption.*
- *Controlling overgrazing.*

Photograph 3.10 **Reforestation**

Capacity Building and Institutional Development

Here are some approaches to preserve Ethiopia's forests through capacity building and institutional development:

- *Providing environmental education to enhance public awareness about the use and management of natural vegetation.*
- *Developing forest-related curricula for schools, colleges, universities, forestry institutions, and forestry-management institutions. Then implement those curricula.*
- *Supporting and protecting community forests by applying strict legal measures.*
- *Moderating the existing rapid rate of population growth*
- *Facilitate community participation in combatting deforestation.*
- *Changing the life style of the people in terms of ongoing deforestation activities.*

These goals must be vigorously implemented if we are to attain the country's ongoing goal of defeating deforestation. For example, the anti-deforestation rules and laws must be vigorously executed by relevant agencies.

3.6 SOILS OF ETHIOPIA

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

- relate formation of soils of Ethiopia with geological events of the past;
- distinguish major soil types in Ethiopia; and
- realize soils problems and its conservation in Ethiopia.

Key Terms

- Parent material
- Humus
- Conservation
- Leaching
- Soil

3.6.1 Formation of Soils in Ethiopia

Why is soil erosion a serious issue in Ethiopia?

Soils are the uppermost loose or unconsolidated material overlying the earth's crustal rocks. Its major components are water, air, organic and inorganic minerals. It is a dynamic, natural and complex substance which can support animals and plants.

Soils of Ethiopia owe their origin to:

- *parent rock material, which has been broken into small particles by way of weathering and natural decomposition*
- *climatic conditions, which largely determine the speed and nature of the processes that form the soil; for example, extreme heat, or cold, could stop the work of bacteria, and the amount of moisture influences on several aspects of soil formation.*
- *vegetation cover, which adds humus to the soils and renders support to the soil making animals and bacteria*

On the plateaus that make up extensive areas in north, north western, south western, and central and south eastern Ethiopia the parent rocks are volcanic origin and experience sufficient rainfall. The soils formed in these areas are red basaltic and black basaltic soils. Unlike the red basaltic soils, the black soils have high clay content that makes the soil difficult for farming.

In areas where the hard crystalline rocks are the parent rock, the soils are poor and thin. They are also rocky and acidic. They range in colour from grey to brown. They are found in Hararghe plateaus and Borena lowlands.

In the Afar region where recent volcanic deposits and dried-out lake deposits had occurred, very shallow and saline-dominated soils are formed. Due to time and climatic effects, these soils are not deep and fertile.

In the southeastern lowlands where the parent rocks are sedimentary rocks, the soils lack humus but are rich in phospherous and potash. They are also low in nitrogen content.

In the lower course of the major rivers, transported soils often known as alluvial soils are dominant. These soils because of their volcanic origin and continuous nourishment of water, are fertile.

People depend on soils; conversely, the quality of the soils depends on how wisely people use the land. Not only in countries like Ethiopia, whose economy is largely agrarian, but also in highly industrialized countries like the USA, soil is one of the most important bases of life.

3.6.2 Types of Soil in Ethiopia

Can you describe what soil is and how it is formed?

The soils of Ethiopia are basically derived from crystalline, volcanic and Mesozoic sedimentary rocks. According to the latest classification made by the FAO, there are eighteen classes of soil in Ethiopia.

Here are the main soil types. They cover more than 85 percent of the country.

- **Nithosols (red basaltic soils):** These soil types:
  - *cover about 12 percent of the country.*
  - *are basically associated with high rainfall and are found in areas that were previously covered with forest.*
  - *are predominant in the Western Highlands of Wellega, Keffa, Illubabor, the Southern Highlands of Sidama, the Central and Western Highlands of Shoa, the Highlands of Gojjam and the Eastern Highlands of Hararghe.*

- *are matured soils with deep profiles. They are highly leached and lack soluble minerals like Sodium, Calcium, etc., but they are rich in iron and aluminum.*
- *are potentially good for farming and other agricultural practices since they are friable, and have a stable structure; as a result,*
- *are the most widely cultivated soil type. They are the best soils for coffee, inset and cereals.*

- **Vertisols (black Basaltic soils):** soil types of these sort:
  - *cover about 10 percent of the total land of Ethiopia.*
  - *have high clay content; so, are sticky. For this reason and for poor drainage qualities, such soils are difficult to be used for farming purposes.*
  - *have excellent nutrients that could provide support for agriculture, but their poor drainage qualities limit their use for grazing purposes.*
  - *are largely found in Arsi, Bale and central Hararghe, where there are pronounced wet and dry seasons.*
- **Acrisols:** These soil types:
  - *are found associated with Nithosols.*
  - *cover about 4.5 percent of the country.*
  - *are widely found in the Southwestern Highlands of Ethiopia,where there is high rainfall.*
  - *are extremely leached; and therefore, have low productivity capacity.*
- **Cambisoils:** Such soils:
  - *are soils that developed from the recent lava deposits of the Quaternary Period.*
  - *are young and shallow.*
  - *are found on the rugged and sloping terrain of the Plateau of Shoa (eastern escarpment) and Chercher Highlands.*
- **Regosols:** These types:
  - *like the cambisols, are shallow and young; but they are coarse-textured.*
  - *have low agricultural value.*
  - *are found in the Danakil and Ogaden plains.*
- **Xerosols:** These soils:
  - *These soils are generally young and shallow, and are found in arid and semi-arid regions. They have a weakly developed profile.*

- *are found extensively in the Northeastern escarpment, Northwestern and Southeastern Lowlands.*
- *are characterized by high salt content and humus deficiencies.*
- *have little significance for agriculture except places where they could be irrigated.*

- **Yermosols:** Soils of this sort:
  - *are found in desert and semi-desert areas, as are xerosols.*
  - *are salty, acidic and have a weakly-developed profile.*
  - *are not suitable for cultivation, even when irrigated, due to their salty and acidic nature.*
- **Luvisols:** These soils:
  - *are well-developed in areas where there are clearly marked wet and dry seasons and when leaching is not very high.*
  - *are among the best soils, since they have good chemical nutrients.*
  - *are intensively cultivated, except in areas that are steeply sloped or water-logged.*
  - *are found around Lake Tana, and in the eastern part of the Northern Central Highlands and in the Southern Lowlands.*
- **Lithosols:** Such soils:
  - *are similar to cambisols and regosols in their poor maturity and their location on steep slopes.*
  - *are found in areas of low precipitation.*
  - *cover the escarpments of the Northeastern and Chercher Highlands.*
- **Fluvisols:** This type of soils:
  - *are soils that rivers have transported from highlands to lowlands.*
  - *cover about 10 percent of the country's total area.*
  - *are associated with river, sea and lake deposits.*
  - *have very good agricultural potential.*
  - *are found extensively in the lower regions of the Omo, Awash, Abbay and Baro-Akobo Rivers.*

Exercise 3.7

1 Compare and contrast
   a cambisols with regosols and xerosols
   b nithosols with vertisols
   c luvisols with fluvisols

2 List the soils of Ethiopia in order of their suitability for agriculture from the best to the worst.

Match the items under Column A with those under Column B.

A		B	
3	Extremely leached soils	A	Fluvisols
4	Young and shallow soils found in arid and semi-arid areas	B	Vertisols
5	Young and shallow soils covering the rugged slopes of the Shoa Plateau and the Chercher Highlands.	C	Nithosols
6	Plentiful along the lower regions of the Omo, Awash, Rivers etc.	D	Xerosols
7	Black soil that is hard to plough during the rainy season	E	Cambisols
8	Red basaltic soil	F	Acrisols

3.6.3 Soil Problems and Conservation in Ethiopia

Ethiopia's Soil Problem – Erosion

What is the basic difference between soil erosion and leaching?

For countries like Ethiopia, where the mainstay of the peoples' livelihood is agriculture, issues related to soil are extremely important. Therefore, whatever setback happens must be carefully handled. One such setback is erosion.

Soil Erosion by Running Water

Every year enormous quantities of soil are carried away by Ethiopia's rivers to neighboring countries. As a matter of fact, the main problem related to soil in Ethiopia is erosion by running water.

Examples:

- ⇨ *River Abbay alone carries away 3000 – 4000 million cubic metric tons of soil annually.*
- ⇨ *The Ethiopian highlands experience a loss of about 2000 tons of soil per square kilometer per year.*

Factors that Accelerate Soil Erosion in Ethiopia

It is known that natural and human-made factors accelerate soil erosion. Which of the two factors is prevalent in your locality?

Both natural and human-made factors play a role in accelerating erosion.

Natural Factors

Two main natural factors contribute to soil erosion in Ethiopia.

- ⇨ ***Topography:*** *Many Ethiopian rivers set in motion from high places and have steep profiles as they progress to lower altitudes. These conditions are highly conducive for erosion to take place at ease.*
- ⇨ ***The heavy summer rains:*** *Although most of Ethiopia's rivers have very low flows during the dry season, the heavy summer rains turn them into rushing torrents. The cracks that have appeared during the dry seasons turn rapidly into deep gullies. These conditions greatly facilitate the mechanical action of raindrops to wear away the surface soil, eroding it deeply.*

Human-Made Factors

Human activities accelerate the soil erosion that is caused by the natural factors that we have just considered. Here are some of the many ways in which people have contributed to the erosion of the land that they depend on.

- ***Deforestation:*** *Most of the highlands of Ethiopia were once covered by forests. These forests provided cover for the land and protected the soil from the physical action of rainfall. Deforestation is progressing at a rapid rate and has become one of the main causes for Ethiopia's hastened erosion rate.*

- ***Bad cultivation practices:*** *Bad cultivation practices also speed up erosion by making the soil vulnerable to the natural forces that we have just described a few lines above. For example,*

  - ***Overcropping*** *– This is one bad cultivation practice. It is the act of planting an area too densely. This approach to farming uses up the soil's nutrients faster than natural processes can replenish them and destroys the land's fertility.*

  - ***Overcultivation*** *– This one entails tilling land every year. For example, in order to keep up with increasing food requirements, people overcultivate their lands. Too frequent tilling can remove nutrients from the soil faster than natural processes can replenish them.*

  - ***Slash and burn*** *– With such a practice, people slash (cut down and dig up) all or most of an area's vegetation and then burn the results. In farming, this practice is sometimes used periodically to strip an area before leaving it to lie fallow to regain its nutrients. However, since the soil is now bare and therefore unprotected, the land is vulnerable to the forces of erosion. Slash-and-burn techniques are also used to clear forestland in order to prepare it for farming, but unwittingly exposing the soil for erosion.*

- ***Keeping too many livestock (overgrazing):*** *Most areas used for pastoral activities are overgrazed because too many animals have been kept there relative to their grass. The livestock destroys the vegetation faster than it can replenish itself. When the vegetation is destroyed, the land is laid bare and is therefore vulnerable to erosion. Goats are particularly damaging. They destroy all kinds and parts of an area's vegetation, including the roots.*

- ***Unscientific tilling:*** *Most peasants do not use (being unaware) scientific farming techniques, such as terracing and contour ploughing, which serve as checks against soil erosion.*
- ***Using inadequately maintained tracks and trails:*** *Without adequate maintenance, frequently used routes across the countryside can gradually change into deeply eroded gullies and eventually make them impassable, for they are partly eroded. Most of this destruction is caused by the action of rain and other running water on the soil, which has been laid bare by continual foot and vehicle traffic.*

Conservation Measures to Combat Soil Erosion

What does conservation of resources mean? What are the problems encountered by soil erosion?

Here are some conservation measures that have been recommended for minimizing soil loss by erosion in Ethiopia.

- *Reforestation – replanting trees immediately after tree harvesting;*
- *Afforestation of areas that are not used for cultivation, are along steep slopes that are exposed to erosion.*
- *Proper terracing of slopes and are set a side for cultivation.*
- *Intercropping – this is the practice of growing two or more crops on the same field so that the land is not exposed to erosion.*
- *Controlling livestock populations.*
- *Developing improved grass types that can feed more livestock.*
- *Installing fences to control the movement of grazing animals, thereby restricting their activities and protecting the areas outside of the fences.*
- *Proper construction of tracks and routes so that drainage could not wash them easily.*
- *Constructing check dams.*
- *Installing shelter-belts and windbreaks in arid and semi-arid areas.*

⇨ *Extending irrigation schemes along the major river basins and their tributaries so that water will be available in proper quantities at proper times. This measure would alleviate both drought and flood conditions. Stored water would be used during dry periods, and flood waters would be controlled and therefore would no longer be destructive or wasteful.*

Activity 3.12

1 Collect a sample of your locality's predominant soil type in a small plastic container. Then examine it so as to:

   a Identify its color.

   b Check whether it has high clay content. Use your saliva to perform this check, as follows: Wet it and press it with your finger. If you find that the soil is sticky then it has significant clay content.

   c Is it friable? Ask your community's farmers.

   d What crops are widely grown in your area?

2 Are there gullies near your school? How wide are they? Ask older members of your community whether the gullies have changed in size over the years. What do you think will happen to them after ten or eight years?

3 Are attempts being made to check soil erosion in your locality? If not, organize a conservation club with your friends, classmates or community members with the goal of planting trees in your area. Locate trees to plant, and then create a schedule for planting them. You will be performing a noble task.

Unit Review

UNIT SUMMARY

- Ethiopia and the Horn countries occupy a tropical location in Eastern Africa within the 1°S – 18°N latitudes and the 33°E – 51°24' E longitudes.
- The countries of the Horn vary in size. Ethiopia is the biggest while Djibouti is the smallest. This variation of size among the countries has resulted in advantages and disadvantages.
- Regarding shape, Ethiopia and Djibouti have more or less compact shapes, while Somalia and Eritirea have elongated shapes.
- Ethiopia and the other Horn countries have experienced four geological eras. The geological structure of the region is the result of the geological events that occurred during these eras.
- The landforms of Ethiopia and the Horn are largely the results of the geological forces that took place in the Cenozoic era's, Tertiary and Quaternary periods. Altitudes increase from the peripheries to the centers. The highest peak is Ras Dashen (4620 meters) in Ethiopia.
- The altitude plays a significant role in determining the climate, natural vegetation, drainage systems as well human activities in the region.
- Due to the altitude effect we see spatial variation of
  - ⇨ *Temperature;*
  - ⇨ *Rainfall*
  - ⇨ *Vegetation*
  - ⇨ *Population density*
- The drainage system itself is the altitudinal effects, rivers as flow out from the central highlands to the peripheral lowlands. This has made the rivers flow swiftly.
- The highlands are homes of different wild animals of which some are endemic. These endemic animals are at the risk of extinction.
- Although the forests are confined to the highlands, human intervention for both economic and other purposes is destroying it at an alarming rate. The forest resource stock that had covered 40 percent of the country has come to less than 3 percent these days.
- Ethiopia has different types of soils. The volcanic soil, especially nithosol, is the most widely utilized soil. The country's cereals, coffee, inset, etc. are grown on this soil type. However, the topography, climate and traditional practices have become major accelerants of its removal. Attempts have

been underway to check erosion. Awareness is being created at all levels through school syllabi and extension services to mitigate the problem.

- Soils are the upper most loose or unconsolidated material overlying the earth's crustal rocks. Soils of Ethiopia owe their origin from their parent-materials. They are basically derived from crystalline, volcanic and mesozoic sedimentary rocks. The main types of soil in Ethiopia are nithosols, vertisols, acrisols, cambisols, regosols, xerosols, yermisols, luvisols, fluvisols and lithosols.
- The major problems of Ethiopia's soils is erosion by running water. Both human-made and natural factros are responsible for erosion.

REVIEW EXERCISE FOR UNIT 3

I *Short Answers*

1 Describe the major geological events that occurred during the Cenozoic Tertiary Period in Ethiopia and the Horn.

2 Identify the dominant factors that determine the drainage systems and change patterns in Ethiopia and the Horn.

3 Name two areas in Ethiopia with

a high rainfall variability b very low rainfall variability

4 Which soil classes in Ethiopia are very unproductive? What are the reasons for this unproductivity?

5 Which regional administration is involved in the protection of wild animals and conservation of areas for them? Name at least four of Ethiopia's protected wild animals.

II *Completing Sentences: Complete the sentences below by filling in the spaces left blank.*

6 The two non-anthropogenic factors that accelerate soil erosion in Ethiopia are _____ and _____.

7 One of the attainable measures for reducing soil erosion is afforestation. It is the _____.

8 The year-round rainfall region corresponds to _____.

9 The current economic potential of the Ethiopian Rift Valley is assumed to be _____.