CHAPTER ONE

INTRODUCTION

1.1. Geography: Definition, Scope and Themes

This chapter deals with the meaning, scope, themes and approaches of Geography. In addition, it discusses the location, shape, and size of Ethiopia and the Horn. It also introduces the tenets of basic map reading skills. Hence, this introductory part of the text paves the way for an understanding of the geographic issues presented in the succeeding chapters.

1.1 Meaning of Geography

It is difficult to forward a definition acceptable to all geographers at all times and places because of the dynamic nature of the discipline and the changes in its scope and method of study. However, the following may be accepted as a working definition.

Geography is the scientific study of the Earth that describes and analyses spatial and temporal variations of physical, biological and human phenomena, and their interrelationships and dynamism over the surface of the Earth.

1.2. Location, Shape and Size of Ethiopia and the Horn

The Horn of Africa, a region of eastern Africa, is a narrow tip that protrudes into the northern Indian Ocean, separating it from the Gulf of Aden. It is the easternmost extension of African land defined as the region that is home to the countries of Djibouti, Eritrea, Ethiopia, and Somalia, whose cultures have been linked throughout their long history. Although the countries of the region share many common features, there is also great diversity among them, rendering each country unique in many respects. In terms of size, Ethiopia is the largest of all the Horn of African countries, while Djibouti is the smallest.

The Horn contains such diverse areas as the highlands of the Ethiopian Plateau, the Ogaden desert, and the Eritrean and Somali coasts. Its coasts are washed by the Red Sea, the Gulf of Aden, and the Indian Ocean, and it has long been in contact with the Arabian Peninsula and southwestern Asia.

1.2.1. Location of Ethiopia

The location of a country or a place on a map or a globe is expressed in two different ways. These are astronomical and relative locations (Figure 1.1).

Astronomical location, also known as absolute or mathematical location, states location of places using the lines of latitudes and longitudes. Astronomically, Ethiopia is a landlocked country located between 3°N (Moyale) and 15°N (Bademe - the northernmost tip of Tigray) latitudes and 33°E (Akobo) to 48°E (the tip of Ogaden in the east) longitudes. The east west distance (15^0) is longer than the north-south distance (12^0). The latitudinal and longitudinal extensions are important in two ways. First, as a result of its latitudinal extension the country experiences tropical climate and secondly due to its longitudinal extension there is a difference of one hour between the most easterly and most westerly points of the country. It is only for convenience that the 3 hours-time zone is used in all parts of the country.

Relative location expresses the location of countries or places with reference to the location of other countries (vicinal), landmasses or water bodies. The relative location of Ethiopia is indicated in Table 1.1.

Table 1.1: The relative location of Ethiopia

Vicinal location	**In relation to water bodies & land masses**
□ Sudan to the west and northwest □ South Sudan to southwest □ Djibouti to the east □ Somalia to the east and southeast □ Eritrea to the north and northeast □ Kenya to the south	□ In the Horn of Africa □ Southwest of the Arabian Peninsula □ South of Europe □ Northwest of the Indian Ocean □ In the Nile Basin

The implications of the location of Ethiopia are described as follows:

a) **Climate**: The fact that Ethiopia is located between 30N and 150N (between the Equator and Tropic of Cancer) implies that the country has a tropical climate, though modified by its altitude. The location of Ethiopia relative to the Indian Ocean, the Atlantic Ocean and the African and Asian landmass has also various bearings on the climate of Ethiopia.

b) **Socio-cultural**: Ethiopia is one of the earliest recipients of the major world religions namely Christianity, Islam and Judaism due to its proximity to the Middle East, which was the origin of these religions. The linguistic and other cultural relationships, which Ethiopia shares with its neighbors, reflect the influence of location.

c) **Political:** The political history of Ethiopia has been considerably influenced by:

- Geopolitical considerations of superpowers.

- Adjacency to the Red Sea (a major global trade route).

- The Middle East geopolitical paradigms.

As a result, Ethiopia has been exposed for external invasions in a number of times; though the country resisted foreign intervention and remains free of external domination.

1.2.2. Size of Ethiopia

Ethiopia with a total area of approximately 1,106,000 square kilometers is the 8th largest country in Africa and 25th in the World. It extends about 1,639 kilometers East-West, and 1,577 kilometers North-South. About 0.7% of the country is covered by water bodies.

The size of Ethiopia also affects both the natural and human environment of the country. The advantages and disadvantages of the size of Ethiopia are indicated in Table 1.2.

Table 1.2. Advantages and disadvantages of Ethiopia's large size

Advantages	**Disadvantages**
Possess diverse agro ecological zones	Demands greater capital to construct infrastructural facilities
Variety of natural resources	Requires large army to protect its territory
Own extensive arable land	Difficult for effective administration
Have larger population size	Difficult for socio-economic integration
Home for diverse cultures	
Greater depth in defense external invasion	

1.2.3. The shape of Ethiopia and its Implication

Countries of the World have different kinds of shape that can be divided into five main categories: compact, fragmented, elongated, perforated, and protruded. These shapes have implications on defense, administration and economic integration within a country. Whether some kind of shape is advantageous to a country or not, however, depends on many other factors.

- **Compact shape countries:** The distance from the geographic centre of the state to any of the borders does not vary greatly. It is easier for defence, socioeconomic and cultural integration.

- *Fragmented shape countries:* They are divided from their other parts by either water, land or other countries.

- *Elongated shape countries:* They are geographically long and relatively narrow like Chile.
- *Perforated shape countries:* A country that completely surrounds another country like the Republic of South Africa.
- *Protrude shape countries:* Countries that have one portion that is much more elongated than the rest of the country like Myanmar and Eritrea.

1.1. Basic Skills of Map Reading

What is a Map?

A map is a two-dimensional scaled representation of part or whole of the Earth surface on a flat body such as piece of paper, black board, wood or cloth.

Map reading encompasses a systematic identification of natural features and manmade features. Natural features include mountains, plateaus, hills, valleys, river, ocean, rocks, plain etc. On the other hand, manmade features include roads, railway, buildings, dam etc. Although many disciplines use maps, they have a special significance for Geographers as primary tools for displaying and analyzing spatial distributions, patterns and relations. Since these features cannot easily be observed and interpreted in real landscapes, maps are essential to Geographers.

Importance of maps

 Provide the basis for making geographical details of regions represented i.e. the geographical facts of an area such as relief, drainage, settlement etc.

- Maps are powerful tools for making spatial analysis of geographical facts of areas represented.
- Maps are useful for giving location of geographical features by varied methods of grid reference, place naming etc.
- Maps are used on various disciplines like land use planning, military science, aviation, tourism, marine science, population studies, epidemiology, geology, economics, history, archaeology, agriculture etc.

Types of Maps

There are many types of maps according to their purpose and functions. For the purpose of this course, topographical and statistical maps are considered.

a. **Topographical maps:** Topographic maps depict one or more natural and cultural features of an area. They could be small, medium or large scale depending on the size of the area represented. Contents of topographical maps depend on purpose of a map, scale of a map, date of compilation, and nature of the land represented.

b. **Special purpose/statistical maps:** These are maps, which show distribution of different aspects such as temperature, rainfall, settlement, vegetation etc.

Marginal Information on Maps (Elements of Maps)

Marginal information is shown on a map to enable the reading and interpretation of the geographical information of an area represented. This includes:

a. **Title:** It is the heading of the given map which tells what the map is all about.

b. **Key (legend):** It is the list of all convectional symbols and signs shown on the map with their interpretation.

c. **Scale:** It is the ratio between the distance on the map and the actual ground distance. Scales enable the map user to interpret the ground measurement like road distance, areal sizes, gradient etc. It can be expressed as representative fraction, statements/verbal scale, and linear (graphic) scale.

d. **North arrow:** It is indicated with the north direction on a map; used to know the other important directions of the mapped area like east, west, south, and west.

e. **Margin:** Is the frame of the map. It is important for showing the end of the mapped area.

f. **Date of compilation:** It is a date of map publication. This enables map users to realize whether the map is updated or outdated.

Basic Principles of Map Reading

In developing map reading abilities and skills, certain basic principles must be applied by the map-reader to translate map symbols into landscape images. Map Readers must have ideas about the symbol and also the real World (landscapes). Every map symbol must be visualized by the reader to read a map. The first symbols introduced should be those, which refer to landscape.

CHAPTER TWO

THE GEOLOGY OF ETHIOPIA AND THE HORN

The earth's continents were once bunched up together in to a single huge continent called ***Pangaea***. The large super continent was then split into Gondwanaland where Africa is a part and Laurasia; and later into smaller fragments over the last million years. These then drifted apart to form the present arrangement of continents

Australian Climatologist **Alfred Wegener** proposed the hypothesis that the continents were once assembled together as a supercontinent, called the Continental drift Theory. Wegener's Principal Observations Were:

- ***Fit of the continents:*** The opposing coastlines of continents often fit together.
- ***Match of mountain belts, rock types:*** If the continents are reassembled as Pangaea, mountains in West Africa, North America, Greenland, and Western Europe match up.
- ***Distribution of fossils:*** The distribution of plants and animal fossils on separate continents forms definite linked patterns if the continents are reassembled.
- ***Paleo climates:*** rocks formed 200 million years ago in India, Australia, South America, and southern Africa all exhibited evidence of continental glaciations.

The Geologic Processes: Endogenic and Exogenic Forces

Geology studies of how Earth's materials, structures, processes and organisms have changed over time. These processes are divided into two major groups: i*nternal* and *external* processes. The internal processes (endogenic) include volcanic activity and all the tectonic processes (folding, faulting, orogenesis (mountain building), and epeirogenesis (slow rising and sinking of the landmass). These processes result in building of structural and volcanic features like plateaus, rift valleys, Block Mountains, volcanic mountains, etc.

The external (exogenic) processes are geomorphic processes. They include weathering, mass transfer, erosion and deposition. They act upon the volcanic and structural landforms by modifying, roughening and lowering them down.

The landmass of Ethiopia, as elsewhere, is the result of the combined effect of endogenic and exogenic processes. The brief geological history of Ethiopia and the Horn will be dealt chronologically starting from the oldest Era of the Earth"s history to the recent.

To describe the geology and history of life on Earth, scientists have developed the geological time scale. The geological time scale measures time on a scale involving four main units:

1. An *epoch* is the smallest unit of time on the scale and encompasses a period of millions of years.

2. Chronologically, epochs are clumped together into larger units called *periods.*

3. Periods are combined to make subdivisions called *Eras***.**

4. An *eon* is the largest period of geological time.

The division of time units in the geological time scale is usually based on the occurrence of significant geological events (e.g. mass extinctions). As such, the geological time categories do not usually consist of a uniform length of time. The geological time scale, illustrated in Table 2.1, is built largely on the basis of life and evolution.

Geological Processes and the Resulting Landforms of Ethiopia and the Horn

The Precambrian Era Geologic Processes (4.5 billion - 600 million years ago)

The Precambrian Era covers 5/6th of the Earth"s history. Due to its remoteness in time and the absence of well-preserved fossils, our knowledge of the events is limited. Nevertheless, some general description of the main geologic processes can be made.

The major geologic event of the Precambrian Era was *Orogenesis*. As a result, the land was subjected to intense folding. This was accompanied by intrusive igneous activity. The result was the formation of huge mountain ranges. In between the ***orogenic*** periods and after the last ***orogenesis***, there were long periods of denudation, which finally reduced these mountains to near-level (***peneplained***) rock surfaces. This “levelled” surface was later (in the ***Mesozoic*** and ***Cenozoic Eras***) covered by younger rock formations. Therefore, in most parts of Ethiopia rocks belonging to this Era are found beneath all other rocks, forming the basement rocks. Since, they had been subjected to pressure and heat from overlying weight, earth movements (folding, orogenesis) and to intrusive igneous activity; the original rocks (both *sedimentary* and *igneous*) were altered into metamorphic rocks of varying stages of metamorphism. Since these same processes have allowed mineralization and crystal formation, the rocks are also collectively described as *crystalline rocks*. The Precambrian rocks are overlaid by recent rock formations.

However, as surface rocks covering 25% of the land mass of the country; they are found exposed in the following areas:

In the northern part: Western lowlands, parts of northern and central Tigray.

A. In the western Part: Gambella, Benishangul-Gumuz (Metekel and Asossa), western Gojjam, western Wellega, Illuababora, and Abay gorge.

B. In the southern Part: Guji, southern Omo, and parts of southern Bale and Borena.

C. In the eastern part: Eastern Hararghe.

The Paleozoic Era Geologic Processes (600 million - 225 million years ago)

The Paleozoic Era lasted for about 375 million years. The major geological process of this Era was denudation. The gigantic mountains that were formed by the Precambrian orogeny were subjected to intense and prolonged denudation. At the end, the once gigantic mountain ranges were reduced to a “peneplained” surface. Undulating plain with some residual features (inselbergs) here and there was formed. The sediments were transported southward and eastward to form continental (in Africa) and marine deposits, respectively. Because of the limited deposition within Ethiopia, rocks belonging to this Era are rare in the country.

The Mesozoic Era Geologic Processes (225-70 million years ago)

This Mesozoic Era lasted for about 155 million years. It was an Era of alternate slows sinking and rising (epeirogenesis) of the landmass. This process affected the whole present-day Horn of Africa and Arabian landmass. At the same time the land was tilted eastward and therefore lower in the southeast and higher in the northwest.

The subsidence of the land began about 225 million years ago. As the land sank slowly the sea invaded it starting from Somalia and Ogaden and slowly spreading northwestward. This was in late Triassic. This phenomenon continued up to Jurassic period. As the shallow sea spread towards the land, sands were deposited over the peneplained Precambrian rock surface. As the depth of the sea increased, mud (shale), gypsum and later lime were deposited. The latter is associated with the flourishing of marine life and decaying and precipitating of their remains, as the sea stayed long. Hence, Mesozoic rocks are considered to have the greatest potential for oil and gas deposits.

Through time, compression by the overlying rocks and by cementing minerals, the sands and lime were compacted to form sandstone and limestone layers respectively. These are known as the Adigrat sand stone and Hintalo limestone layers. They are named after place names in Tigray where they might have been first identified.

In the Horn of Africa and Ethiopia, the slow rise of the land and consequently the regression of the sea began in the Upper Jurassic. It continued throughout the Cretaceous period. With the

retreat of the sea, another process of deposition occurred. In the country sedimentation ended with the deposition of clay, silt, sand conglomerate brought in from the land as the sea receded due to uplift of the landmass. Gypsum, shale and at last sands were laid over the Hintalo limestone. The uppermost layer is known as the Upper sandstone. By the end of the Mesozoic Era, when the land emerged out of the sea, three major sedimentary formations were laid and formed upon the Precambrian rock surface. These were the Adigrat or lower sandstone, Hintalo limestone and Upper Sandstone. As transitional formations, gypsum and shale were inter-bedded above and below the Hintalo limestone. The Mesozoic sedimentary rocks cover 25% of the land mass of the country.

Due to the tilting of the landmass during the transgression and regression of the sea, and due to the direction of the invading and retreating sea, the age and thickness of the Sandstone layers vary in a Southeast - Northwest direction. The Adigrat sandstone is older and thicker in the southeast and progressively decreases in age and thickness northwestward. The Upper sandstone, on the other hand, is thicker and younger (Upper Cretaceous) in the Southeast, while in the Northwest it is older and thinner.

The transgressing sea and Mesozoic sediments nearly covered the whole of Ethiopia. The northwestern limit was as far as central Tigray, and western slopes of Western highlands. In most parts of Ethiopia, the Mesozoic rocks are overlaid by the Cenozoic rocks. As surface rocks, these old marine sediments are extensively found in the Southeast lowlands. Other exposures include central Tigray, and along the gorges of Abay and Wabishebelle rivers

The Cenozoic Era Geologic Processes (70million years ago - Present)

The Cenozoic Era is the most recent of the geologic Eras. The tectonic and volcanic activities that took place in this Era have an important effect in the making of the present-day landmass of Ethiopia and the Horn of Africa. The land was subjected to two major geologic events and other geologic processes of lesser magnitude but still important. These geologic activities are:

a. Uplifting of the Arabo-Ethiopian landmass and outpouring of huge quantity of lava.

b. Formation of the Rift Valley.

c. Quaternary volcanism and deposition.

CHAPTER THREE

THE TOPOGRAPHY OF ETHIOPIA AND THE HORN

3.1. Introduction

The topography of Ethiopia is largely determined by the geologic activities of the Cenozoic Era. The uplifting of the Arabo-Ethiopian swell and the subsequent outpouring, spreading and thick accumulation of Trapean lava have given rise to an outward sloping highland plateau and mountains. The major faulting resulted in the division of the plateau into two broad units and the formation of a great structural valley. Faulting elsewhere and on the floor guided part of the course of some rivers. They also formed depressions on which lakes were subsequently created. Geomorphic processes brought some modification to the structural landform by river dissection and roughening on the highlands, and deposition on the lower areas.

General Characteristics of the Ethiopian Physiography

The Ethiopian landform is characterized by great diversity. There are flat-topped plateaus, high and rugged mountains, deep river gorges and vast plains. Altitude ranges from 125 meters below sea level (Kobar Sink) to the highest mountain in Ethiopia, Mount Ras Dashen (4,620 m.a.s.l), which is the fourth highest mountain in Africa. Ethiopia has the largest proportion of elevated landmass in the African continent. It is sometimes described as the Roof of East Africa because of its height and large area. More than 50% of the Ethiopian landmass is above 1,000 meters of elevation; and above 1,500 meters makes 44% of the country. Half of this, in turn, is at more than 2,000 meters above sea level. Most of the Ethiopian Highlands are part of central and northern Ethiopia, and its northernmost portion extends into Eritrea. The highland core, on the other hand, is encircled by semi-arid and lowlands. The Ethiopian Highlands are rugged mass of mountains, situated in the Horn of Africa. They are the most significant physical features of the country, which form the largest continuous area of its elevation in the continent. They have been dissected by several rivers and ravines which have cut deep gorges. They have been divided into several regions and mountain systems. Most of the country consists of high plateau and mountain ranges that are sources of many rivers and streams that made the country to be described as the “Water Tower of East Africa”.

The diversity in topography is accompanied by differences in other natural features such as soil, climate, vegetation and wild life. Likewise, the socio-cultural and economic phenomena are also affected by the topography.

Taking the 1,000 meters contour line for the highland-lowland demarcation, one observes the following contrasting features between the Ethiopian highlands and lowlands:

- Characteristics of Ethiopian highlands:
- Moderate and high amount of rainfall (>600 mm per year).
- Lower mean annual temperature (<200C).
- The climate is favorable for biotic life.
- Rain-fed agriculture is possible.
- Free from tropical diseases.
- Attractive for human habitation and densely settled.

The cumulative effect of all this is that, the highlands have been significant throughout Ethiopian history in the economic, cultural and political life of the people. These highlands make up nearly 56% of the area of the Ethiopia. This is further subdivided into lower highland (1,000 - 2,000 m.a.s.l), which make up 35% and higher highland (>2,000 m.a.s.l) constituting nearly 22%.

- In contrast to the highlands, the remaining 44% of the Ethiopian lowlands are characterized by:
- Fewer amounts of rainfall and higher temperature.
- High prevalence of tropical diseases.
- Lower population densities.
- Nomadic and semi-nomadic economic life.
- Vast plain lands favorable for irrigation agriculture along the lower river basins.

3.2. The Physiographic Divisions of Ethiopia

Following the structural divisions brought about by the geologic processes of the Cenozoic Era, three major physiographic units can be identified in Ethiopia. These are:

1. The Western highlands and lowlands
2. The South-eastern (Eastern) highlands and lowlands
3. The Rift Valley

3.2.1. The Western Highlands and Lowlands

This physiographic unit includes all the area west of the Rift Valley. It extends from north to south encompassing nearly the whole western half of Ethiopia. It makes up about 44% of the area of the country. In the east the western escarpment of the Rift Valley bound it whereas westward, the land gradually descends in altitude until it merges into the western foothills and lowlands, along the Sudan and South Sudan border. This region is further subdivided into four groups of highlands (76.3%) and four groups of lowlands (23.7%)

The Western Highlands

a. The Tigray Plateau

It extends from the Tekeze gorge in the south to central Eritrean highlands. The Tigray plateau 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 Tekeze River Gorge. It constitutes about 13% of the area of the region. It is an elongated highland with most of the land being in between 1,000 and 2,000 meters above sea level. The right bank tributaries of Tekeze drain this plateau. Long period of denudation has created residual features of granite hills, rugged topography, and Ambas. There are high mountains in this plateau with elevations of over 3000 meters, namely Mount Tsibet (3988 m.a.s.l), Mount Ambalage (3291 m.a.s.l), and Mount Assimba (3248 m.a.s.l).

The famous monastery at Debre-Damo, a tableland that can only be climbed by a rope pulley is also located in this plateau region.

b. North Central Massifs

This Physiographic division is the largest in the western highlands. Much of its northern and southern limit follows the Abay and Tekeze gorges. The Abay, Tekeze and their tributaries have cut into this region a maze of gorges, steep sided river valleys, dividing the land into many

isolated plateau blocks, precipitous tablelands and other rugged surface forms. But much of these plateau and tablelands are still capped by the Trappean lava. In its central part, the physiographic unit also accommodates the Lake Tana basin surrounded by plains of Fogera and Dembia in the north and an upland plain in its south.

Fifty-eight percent of the region is at an altitude of more than 2,000 meters, making it, next to the Shewan Plateau, the second highest physiographic division. The region consists of the Gonder, Wello and Gojjam Massifs. Out of the 26 mountain peaks with altitude of more than 4,000m.a.s.l in Ethiopia, 19 mountain peaks are found in this physiographic region. Among these, the most popular ones include Mount Ras Dashen (4,620 m.a.s.l), Mount Weynobar/Ancua (4462 m.a.s.l), Mount KidisYared (4453 m.a.s.l), and Mount Bwahit (4437 m.a.s.l) in the Simen Mountain System. Mount Guna (4,231m.a.s.l) in the Debre Tabour Mountain System, Abune Yoseph (4,260 m.a.s.l) in the Lasta highlands of Wello and Mount Birhan (4,154 m.a.s.l) in the Choke Mountain System in Gojjam are also part of Simen Mountain System. These mountains have steep cliffs and rugged terrain that provide scenic views to climbers

The Mountain systems in Gonder and Gojjam are separated from the eastern group of mountains in Wello by impenetrable and deep gorges. At one point though, they are connected by Yeju-Wadla Delanta land bridge (ridge). This land bridge has been significant in history. It served as a route of penetration by the Turks, Portuguese, and Italians etc. The Woreta-Debre Tabor-Woldya road constructed to link the northwestern region with Asseb through Woldya and Dessie took advantage of this land bridge.

c. The Shewa Plateau/central highlands

The Shewan plateau is bounded by the Rift Valley in the east and southeast, by the Abay gorge in its northern and western limit, and the Omo gorge in the south and west. This plateau occupies a central geographical position in Ethiopia. With only 11% of the area of the whole physiographic region, the Shewa Plateau is the smallest of the Western highlands. Nearly three-fourth of its area is at an altitude of more than 2,000 meters above sea level. It has, therefore, the largest proportion of elevated ground.

The Shewa plateau is drained, outward in all directions by the tributaries of Abay, Omo, and Awash. It, therefore, forms a water divide for these three river basins. The tributaries of Abay-

Guder, Muger, Jema etc. have cut deep gorges and steep sided river valleys. They have created several tablelands and isolated plateau units in the north. Similarly, the tributaries of Omo and Awash have dissected the other sides of the plateau. Otherwise, this plateau has relatively extensive flat-topped uplands, giving it the appearance of a true plateau. The highest mountain in the Shewan plateau is Mount Abuye-Meda (4,000 m.a.s.l) in Northern Shewa, Mount Guraghe in the south is 3,721 meters high.

d. The Southwestern Highlands

This Physiographic subdivision consists of the highlands of Wellega, Illuababora, Jimma, Kaffa, Gamo and Gofa. This region is separated from the adjacent highlands by the Abay and Omo river valleys. It extends from the Abay gorge in the north to the Kenya border and Chew Bahir in the south. It accounts for 22.7% of the area of the region. The region is the second largest in the Western highlands. About 70% of its area is lies within 1,000-2,000 meters altitude.

The southwestern plateau is the wettest in Ethiopia. It is drained by Dabus, Deddessa (tributaries of Abay), Baro, Akobo and the Ghibe/Omo rivers. The numerous streams have cut these highlands to produce the most dissected and rugged terrain that accommodates the most numerous and diverse ethnic linguistic groups in Ethiopia. With a height of 4,200 meters above sea level, Guge Mountain is the highest peak in this physiographic subdivision.

The Western Lowlands

These are the western foothills and border plains that extend from Western Tigray in the north to southern Gamo-Gofa in the South. In certain places, ridges or part of the highlands protrude into the lowlands, interrupting their continuity. They make 11% of the area of the physiographic region. The general elevation ranges between 500 and 1000 meters above sea level.

This physiographic sub-region is further subdivided into four by the protruding ridges. These are Tekeze lowland, Abay-Dinder lowland, Baro lowland, and Ghibe lowland from north to south.

With the exception of the *Baro* lowland, the region is generally characterized by arid or semi-arid conditions. Pastoral or semi-pastoral economic activities dominate the area. As one moves northwards, the degree of aridity increases, making rain-fed agriculture more difficult. Since one or two rivers cross all of these lowlands, irrigation agriculture is highly feasible. For example, the *Baro* lowland has an extensive flat area suitable for mechanized agriculture.

The *Ghibe/Omo* lowland, which includes the lower *Ghibe/Omo* Valley and the northern section of the Turkana basin, is classified in the Western lowlands from its geographical location. But structurally it also belongs to the Rift Valley. It is an area, which is both faulted and tectonically depressed.

In the Western lowlands, there are small but important towns. Their importance could be related to agriculture, history, or are simply border towns and frontier ports. These are *Humera, Metema, Omedla, Kurmuk, Gambella* etc.

3.2.2. The Southeastern Highlands and Lowlands

This physiographic region is the second largest in terms of area. It accounts for 37% of the area of Ethiopia. The highlands make up 46% of the physiographic division while the rest is lowland. In the west and north, the eastern escarpment of the Rift Valley makes the western and northern limit. In many places the land raises so abruptly that from the edge of the plateau one literally looks down the Rift Valley. From here, the land gradually descends southeastward into the southeastern lowlands and then to the plains of Somalia. These are further subdivided into two units of highlands and two units of extensive lowlands. These are briefly discussed as follows.

The Southeastern Highlands

A. The Arsi-Bale-Sidama Highlands

These highlands are found to the east of the Lakes Region. They are located in the south western section of the physiographic region. They make up 28.5% of the area of the region and 62% of the south - Eastern Highlands.

The Arsi Highlands are made up of flat rolling uplands and dissected mountains. The well-known mountains in this area are Mount Kaka (4,180 m.a.s.l), Mount Bada (4,139 m.a.s.l) and Mount Chilalo (4,036 m.a.s.l).

The Bale highlands are separated from the Arsi highlands by the head and main stream of Wabishebelle. They consist of a platform looking basaltic plateau in the north-central part and high mountain massif to the south. The Afro-Alpine summit of Senetti plateau is found on the latter group. The highest mountain peaks in this region are Tulu-Demtu (4,377 m.a.s.l) and Mount Batu (4,307 m.a.s.l). Erosion features belonging to Pleistocene glaciation but later modified by fluvial processes are seen in the trough-like gorges, hanging valleys, and depressions. The Arsi-Bale Highlands are important grains producing areas with still high potential.

The Sidama Highlands are separated from the Bale Highlands by the Ghenale river valley. They occupy the southwestern corner of this region. The prominent feature here is the Jemjem plateau, an important coffee growing area.

Rivers Wabishebelle and Ghenale along with their tributaries have dissected this physiographic region. Specially, Weyb River, tributary of Ghenale, has cut an underground passage (Sof Omar cave) through the Mesozoic Limestone rocks. The cave is found near Bale Mountains. It is one of the World's most spectacular and extensive underground caverns creating a magnificent view accessible only by an underground stream.

B. The Hararghe Plateau

This plateau is a north-easterly extension of the south-eastern highlands. It extends from the Chercher highlands in the south-west to Jigjiga in the east. It makes up 38% of the South Eastern highlands and 17.4% of the whole physiographic region. It has the smallest proportion of upper highland (>2,000 meters). It is a low lying and elongated region.

Rising sharply from the Rift Valley floor, it immediately but gently descends east and southeastward. The left-bank tributaries of Wabishebelle drain it. Much of the Trappean lava is removed and the Mesozoic rocks are extensively exposed. The highest mountain here is Mount Gara-Muleta (3,381 m.a.s.l).

The Southeastern Lowlands

The Southeastern lowlands are located in the southeastern part of the country and they are the most extensive lowlands in Ethiopia. They make up 54% of the area of the physiographic region and around one-fifth of the country. This region is divided into Wabishebelle plain (60%) and the Ghenale Plain (40%). They include the plains of Ogaden, Elkere, and Borena. Southeastward sloping plains characterize these lowlands. These extensive plains are interrupted here and there, by low hills, low ridges, inselbergs and by shallow and broad river valleys and depressions.

Because of the harsh climatic conditions, these lowlands are little used and support very small population. They are sparsely inhabited by pastoral and semi-pastoral communities. The economic potential for this region includes animal husbandry, irrigation, agriculture and perhaps exploitation of petroleum and natural gas.

3.2.3. The Rift Valley

The Rift Valley is a tectonically formed structural depression. It is bounded by two major and more or less parallel escarpments. The formation of the Rift Valley has separated the Ethiopian Highlands and Lowlands in to two. It extends from the Afar triangle in the north to Chew Bahir for about 1,700 km2. It covers 18% of the area of Ethiopia. It is elongated and funnel shaped, with a NE-SW orientation. It opens out in the Afar Triangle, where it is the widest, and narrows down to the south.

The floor of the Rift Valley is made up of interconnected troughs, grabens and depressions. Volcanic rocks, fluvial and lacustrine deposits cover the floor. In many places, numerous volcanic domes, hills and cinder cones rise from the floor. Altitude in the floor ranges from 125 meters below sea level at Dallol Depression, to as high as 2,000 meters above sea level in the Lakes region. The bounding escarpments are also of varying heights. From the floor to the edge of the escarpment, the heights vary from 200 to 1500 meters. Because of its altitudinal variation and positional differences, the climate also varies from warm, hot and dry to cool and moderately moist conditions. Similarly, the social and economic life reflects this pattern. There are places, which are desolate and sparsely inhabited by pastoralists where as in others parts people practice some rain-fed agriculture.

The Rift Valley is further subdivided into three physiographic sub-regions. These are the Afar Triangle, the Main Ethiopian Rift, and the Chew Bahir Rift. A brief description of each sub-division is given below.

i. The Afar Triangle

The Afar Triangle is the largest and widest part of the Rift Valley. It makes up 54% of the Rift Valley area. It is bounded by the high western and eastern escarpments in the west and east respectively, and by the Afar and Aisha Horst in the northeast. The area is generally of low altitude (300-700 meters).

Quite different is the morphology of the Afar depression, triangular-shape lowland, where elevation drops uniformly from approximately 1,000 meters in the southwest to below sea level in the north (**Danakil depressio**n) and in the east, where the shores of Lake Asal, fluctuating at around 125 meters below sea level, represent the lowest subaerial point of the African continent.

The depression, which hosts one of the most hostile environments on Earth (maximum temperatures can exceed 50°C during the summer wet season; Dallol, at the northern tip of Afar.

The area is characterized by faulted depressions (grabens), volcanic hills, active volcanoes, volcanic ridges, lava fields and low lava platforms. Lakes (*Abe, Asale*, and *Afrera)* occupy some of these basins. A prominent feature in this region is the *Denakil Depression* (*Kobar Sink*). Separated from the Red Sea by a 200 meters high land barrier, much of it lies below sea level. A larger part of this is covered by thick and extensive salt plain. Lake Asale and Lake Afreraoccupy the lowest parts of this sunken depression.

The Afar Triangle is generally hot and dry. The only respite one gets in the Southern part is from the waters of the Awash River. The economic importance of this region includes salt extraction, irrigation along the Awash River and electric potential from geothermal energy.

ii. The Main Ethiopian Rift/Central Rift

It refers to the narrow belt of the Rift Valley that extends from Awash River in the north to Lake Chamo in the south. It is bounded by the western and eastern escarpments. With the exception of the Arbaminch area, the bounding escarpments are generally low. This part of the Rift Valley is the narrowest and the highest. It has an average width of 50-80 kilometers and general elevation of 1,000-2,000 meters above sea level.

The floor in many places is dotted by cinder cones and volcanic mountains. The big ones include Mount Fentale, Boseti-guda (near Adama), Aletu (north of Lake Ziway) and Chebi (north of Lake Hawasa). The northern section has more of these cinder cones and lava fields. The prominent features, however, are the numerous lakes formed on tectonic sags and fault depressions.

Because of altitude, the lakes region of the Main Ethiopian Rift is generally milder and watery. Here rain-fed agriculture is practiced. Other resource bases include the recreational value of the lakes, the agricultural importance of some streams and lakes, and the geothermal energy potential.

iii. The Chew Bahir Rift

This is the smallest and the southern-most part of the Rift Valley. Gneissic highlands of Konso and the surrounding highlands separate it from the Main Ethiopian Rift to the north. The characteristic feature of this region is the broad and shallow depression, which is a marshy area covered by tall grass, in to which the Segen and Woito streams empty.

3.3. The Impacts of Relief on Biophysical and Socioeconomic Conditions

1. Agricultural practices

Relief influences farm size and shape in that in an area of rugged terrain the farmlands are small in size and fragmented and tend to be irregular in shape.

- Choice of farming techniques and farm implements are highly influenced by relief as in rugged terrain mechanized farming techniques are difficult to practice.
- Relief influences crop production as some corps are well adapted to higher altitudes (barley, wheat) and others to low altitude (sorghum, maize).
- The practice of animal husbandry is also influenced by relief as most equines and sheep are reared in the higher altitudes and camels and goat are well adapted to lower altitudes

2. Settlement pattern

- Highlands of Ethiopia that experience a temperate type of climatic condition that are mainly free from most of the tropical diseases are densely settled.

- Rugged and difficult terrain hinders the development of settlement and its expansion.

- The highlands of Ethiopia are characterized by sedentary life and permanent settlements while lowlands that are inhabited by pastoralists have temporary settlements.

3. Transportation and communication

- The highly dissected nature of the landscape is a barrier to the development of internal surface transportation that resulted in the long-term isolation of many communities

- The difficult terrain makes infrastructure development and maintenance costly.

- TV and radio communications are also highly influenced by relief.

- The rugged topography rendered rivers less navigable due to the waterfalls, deep gorges and steep cliffs.

4. Hydroelectric power potential

The great difference in altitude coupled with high rainfall created suitable conditions for a very high potential for the production of hydroelectric power in Ethiopia.

5. Socio-cultural feeling

The rugged terrain as a result of excessive surface dissection resulted in the long-term isolation of communities that led to the occurrence of cultural diversity.

People who live in the highlands have been identifying themselves as *degegnas* (mountaineers) and those who live in the lowlands as *kollegnas* (lowlanders).

6. Impacts on climate

The climate of Ethiopia is a result of the tropical position of the country and the great altitudinal variation of the general topography.

Highlands with higher amount of rainfall and lower rate of evapo-transpiration tend to be moisture surplus compared to the moisture deficit lowlands.

7. Impacts on soil

Steep mountain slopes provide low angle of rest, unstable surface materials and subject to degradation processes and relatively form shallow and little developed soils.

8. Impacts on natural vegetation

Relief through its effect on climate and hydrology affect the type of natural vegetation grown in an area.