

## CHAPTER FOUR

### DRAINAGE SYSTEMS AND WATER RESOURCE OF ETHIOPIA AND THE HORN

#### 4.1. Introduction

About 71% of the earth's total surface is covered by **water bodies with majority of seas and oceans**. Of the earth's total water surface, nearly **97.5% is alkaline** and **2.5% is fresh water**, of the fresh water nearly **68.7% is deposited in glaciers, 30.1% in ground water, 0.8% in permafrost and 0.4% in surface waters**. **Water in lakes, rivers, atmosphere, soils and wetlands are considered as surface waters**. **Surface and ground waters are by far the most abundant and easily available fresh waters**. However, fresh water is distributed unevenly throughout the world following **varied latitudinal locations, climatic and topographic setups**.

The diverse topographical setup, relatively higher rainfall and its nearness to equator made Ethiopia to have larger volume of ground and surface water. **Around 0.7 % of the total land mass of Ethiopia is covered by water bodies**.

#### 4.2. Major Drainage System of Ethiopia

The flow of water through well-defined channel is known as **drainage**. **A drainage system** is made up of a principal river and its tributaries (the rivers that flow into it). The general patterns of major river basins in Ethiopia are **determined by topographical structures** which can be clarified as:

- a. The topography of the outward sloping of the *Western and South eastern plateaus*
- b. The structural formation of the *Rift Valley* with its in-ward-sloping escarpments resulting mainly in an inland drainage system.
- c. Faults and joints that structurally influence part of the courses of many rivers.

#### The Major Drainage Systems

Based on physiographic setup and geological makeup, Ethiopia possesses three broadly classified drainage systems: **Western, Southeastern and Rift Valley Drainage Systems**.

##### i. The Western Drainage Systems

- ✓ Are the **largest of all drainage systems draining 40 percent of the total area** of the country and **carry 60 percent of the annual water flow**;
- ✓ The drainage system of this region: **Tekeze, Abay, Baro-Akobo, and Ghibe (Omo)**;
- ✓ Unlike Ghibe (Omo) river, Abay, Tekeze and Baro flow westward ultimately joining the Nile which finally ends at Mediterranean Sea.

### **Abay River basin:**

- ✓ Is the **largest river both in volumetric discharge and coverage** with an area of 199,812 km<sup>2</sup>;
- ✓ Carries **65 percent** of the annual water flow of the region.
- ✓ The source of Abay is Lake Tana or Sekela as of some source and it flows about 1,450 kilometers and joins the White Nile in Khartoum, Sudan to form the Nile River.
- ✓ More than 60 streams drain the Abay within elevation ranging between 500 - 4261 masl. The largest of these is Ghilgel Abay (Little Abay).
- ✓ Major tributaries of Abay river are **Dabus, Dedessa, Fincha, Guder, Muger, Jema, and Beshilo**

### **Tekeze River basin**

- ✓ Tekeze and its tributaries, carrying 12 percent of the annual water with 82,350 Km<sup>2</sup> area coverage and 8.2 billion m<sup>3</sup> annual flow;
- ✓ The basin has two main tributaries **Angereb and Goang** rises from central highlands;
- ✓ Is also known as **Atbara in Sudan**, which is a tributary of the Nile.

### **The Baro-Akobo and Ghibe/Omo rivers:**

- ✓ Drain in the wettest highlands in the south and southwestern Ethiopia.
- ✓ Baro (17%) and Ghibe (6%) of the annual water flow respectively.
- ✓ The Ghibe/Omo river basin drains an area of 79,000 km<sup>2</sup> with an estimated mean annual flow of 16.6 BMC and the Baro river basin has an area of 75,912 km<sup>2</sup>, with mean annual flow of 23.6 BMC.
- ✓ The Baro together with Akobo forms the **Sobat River in South Sudan**.
- ✓ The Ghibe/Omo River finally empties into the **Chew-Bahir** at the mouth of Lake Turkana thereby forming an **inland drainage**.
- ✓ **Gojeb and Akobo are main tributaries of Ghibe/Omo and Baro respectively.**

### **ii. The Southeastern Drainage Systems**

- ✓ **Nearly the entire physiographic region of southeastern part of Ethiopia is drained by the southeastern drainage systems.**
- ✓ The basin which is mainly drained by Wabishebele and Ghenale, slopes southeastwards across large water deficient plains.
- ✓ Major highlands of this basin include plateaus of Arsi, Bale, Sidama and Harerghe.
- ✓ Wabishebele and Ghenale rivers cross the border into Somalia, carrying 25 percent of the annual water flow of Ethiopia.
- ✓ **Ghenale river** basin has an area of 171,042 km<sup>2</sup>, the basin flows estimated to be 5.8 BMC;
- ✓ Ghenale, which has fewer tributaries like (**Dawa, Weyb, Welmel, and Mena**) but carries more water than Wabishebele, reaches the Indian Ocean and within elevation ranging between 171-4385 masl..
- ✓ In Somalia it is named as **Juba River**.

- ✓ *Wabishebele with a total catchment area of 202,697 km<sup>2</sup>, is **the largest river in terms catchment area.***
- ✓ *It **drains parts of Oromia, Harari and the Somali regions.***
- ✓ *It is **the longest river in Ethiopia.***
- ✓ *Its tributaries are mainly left bank and, most of them, **are intermittent.** The major tributaries **are Ramis Erer, Daketa and Fafan***
- ✓ *Despite its size, the Wabishebele fails to reach the Indian Ocean where at the end of its journey it flows parallel to the coast before its **water disappears in the sands,** just near the Juba River.*

### **iii. The Rift Valley Drainage System**

- ✓ It is an area of **small amount of rainfall, high evaporation and small catchment area.**
- ✓ The Rift Valley drainage system is therefore left with the slopes of the escarpment;
- ✓ The **only major river basin is Awash with catchment area** of 114,123 km<sup>2</sup> and has an average annual discharge of 4.9 billion cubic meters.
- ✓ The Awash River **originates from Shewan plateau,** and flows 1250 kms.
- ✓ Awash is the **most utilized river in the country** and the major tributaries are **Akaki, Kesem, Borkena, and Mile**
- ✓ The Awash river finally ends in a maze of small lakes and marshy area; the largest of which is Lake Abe;
- ✓ The **Afar drainage sub-basin has practically no stream flow and it is an area of little rain, very high temperature and very high evaporation.**
- ✓ Lake **Afrera and Asale** are the only main surface waters in the basin which are not the result of any meaningful surface flow.
- ✓ The southern part of the Rift Valley sub-basin is characterized by a number of lakes and small streams and it is also described **as lakes region.**
- ✓ There are small streams that drain down from the nearby mountain slopes which supply water to the lakes. Eg, **Meki and Katar Rivers flow into Ziway; Bilate into Abaya; and Segen into Chew Bahir.**
- ✓ Likewise, some of these lakes are interconnected. Lakes **Ziway and Langano drain into Lake Abijata through the small streams of Bulbula and Horocolo respectively.**

## **4.3. Water Resources: Rivers, Lakes and Sub-Surface Water**

### **General Characteristics of Ethiopian Rivers**

Due to the highland nature of the Ethiopian landmass, surface ruggedness, the outward inclination of the highlands, and the climatic conditions, Ethiopian rivers have the following characteristics.

- ✓ Almost all **major rivers originate from the highlands elevating more than 1500 masl.**
- ✓ Majority of **Ethiopian rivers are trans-boundary,**
- ✓ Ethiopian rivers are characterized by extreme **seasonal fluctuation.**
- ✓ Due to surface ruggedness they have **rapids and waterfalls** along their course,

- ✓ They have **cuts, steep-sided river valleys and deep gorges** along their courses,
- ✓ Rivers in Ethiopia flow on steep slopes having **steep profiles**.
- ✓ Some of the rivers serve as **boundaries, both international and domestic administrative units**.

#### 4.3.1. The Ethiopian Lakes

- ✓ Almost all Ethiopian lakes are result of **tectonic process of Quaternary** period of *Cenozoic* era.
- ✓ Except few Ethiopian lakes, **majority of lakes are located within the Rift Valley** System.
- ✓ The lakes in the rift valley are **clustered along the system forming linear pattern**.
- ✓ Lake *Tana*, the largest lake in Ethiopia occupies a shallow depression in the highlands.
- ✓ Ethiopia is also gifted with crater lakes, (the lakes at and around *Bishoftu*, *Wonchi* (near *Ambo*), *Hayk* (near *Dessie*) and the Crater Lake on top of *Mount Zikwala*).
- ✓ *Lake Ashenge* (Tigray) is formed on a tectonic basin.
- ✓ Man-made lakes in Ethiopia are *Koka*, *Fincha* and *Melka Wakena*, See table 4.2 from the manual

#### 4.3.3. Subsurface (Ground) Water Resource of Ethiopia

In comparison to surface water resources, Ethiopia has lower ground water potential. Based on existing scanty knowledge, the groundwater potential of Ethiopia is estimated to be 2.6 - 6.5 BMC. However, this estimate is now considered underestimated. Considering various separate studies, Ethiopian potential of groundwater is believed to range between 12-30 BMC.

### 4.4. Water Resources Potentials and Development in Ethiopia

Potential development uses of water resource of Ethiopia are:

#### a) Hydro-electric Potential

- ✓ Ethiopian rivers have a very high potential for generating electricity.
- ✓ The exploitable **potential of hydroelectric power** is estimated at about 45,000 megawatts.
- ✓ Akaki hydroelectric power is the first (1932).
- ✓ **Grand Ethiopian Renaissance Dam** (GERD) is the country's largest dam under construction aiming to generate 6400 megawatts.
- ✓ **Gilgel Gibe III** hydropower project has gone operational generating 1870 megawatts.
- ✓ Ethiopia is administering 14 hydroelectric power plants constructed on **Lake Aba Samuel, Koka, Tis Abay, Awash, Melka Wakena, Sor, Fincha, Gibe/Omo, Tana Beles and Tekeze**, generating close to 4000 megawatts of energy.
- ✓ The country is also exporting electricity to the neighboring countries.
- ✓ The major problem related to the use of Ethiopian rivers for the generation of hydroelectric power is the **seasonal flow fluctuations and impact of climate change and variabilities and the sever erosion and sedimentation in the reservoirs**.

#### b) Irrigation and Transportation

- ✓ Irrigation
  - The rugged terrain limits the uses of rivers both for irrigation and transportation; **steep slopes, rapids, waterfalls, narrow and deep valleys and gorges are obstacles**.
  - But on the lowlands, their demand for irrigation is high.
  - Ethiopia's potential of irrigation is estimated to be 5.3 million hectares.
  - Baro-Akobo and Genale Dawa river systems have large irrigation potential than others.
  - More than 60% of the area under irrigation so far is located in Rift Valley Drainage System.
- ✓ Transportation
  - Majority of Ethiopian rivers are not suitable for transportation.
  - The Baro at its lower course is the only navigable river.
  - Comparatively, Ethiopian lakes are much suitable for transportation than rivers.
  - Lake Tana and Abaya are relatively the most used for transportation.

## **b) Fishing and Recreation**

### ✓ Fishing:

- The majority of Ethiopian lakes are rich in fish.
- Currently the annual production of fish is estimated to be 31.5 thousand tons.
- Currently Lake **Tana leads the potential** by estimated 8,000-10,000 tons per year followed by Lake Chamo with estimated 4,500 tons per year.
- More than 60% of fish supplies are coming from Ethiopian main Rift Valley lakes.
- Some of the lakes are currently threatened by **sedimentation, invasive species (water hyacinth), over exploitation and expansion of investments** around lakes.

### ✓ Recreation:

- **Variety of fish, birds and other aquatic life, the scenic beauty of the lakes, the hot springs around them, the spectacular river gorges and the most impressive waterfalls** make Ethiopian rivers and lakes important recreational and tourist attractions.
- As they are the natural habitat of a variety of wild life, some of which are only endemic to Ethiopia, their value for scientific purposes is immense.