WATER RESOURCE IN GENERAL AND ITS MANAGEMENT IN THE CASE OF ETHIOPIA

Mudesir Nesru, PhD*

* Department of Hydraulic and Water Resource Engineering Wolaita Sodo University, P.O. Box138, Wolaita Sodo, Ethiopia

Correspondence Email: marude03@yahoo.com

Abstract

Water is essential for all living organisms on earth. Human beings use water for transportation, irrigation, domestic use, recreation, power development, and industrial purposes. More pressure is being placed on the world's available freshwater as a result of increasing water demand for agriculture, industries, rapid urbanization, recreation, and environmental flow. Ethiopia is an entirely landlocked country, occupying a large portion of the Horn of Africa. Ethiopia is also a country with diverse landforms due to separating tectonic plates, including mountain highlands, the Great Rift Valley, and plateaus. Furthermore, the country has an abundance of annual rainfall as well as other significant water sources that might be established for irrigation and other purposes of development. Rainfall in the country exists in a variety of forms that conceivably utilized for irrigation and agriculture.

Key words: Agriculture, Ethiopia, Rainfall, Water

1. Introduction

Water is vital for all living organisms on earth. Human beings use water for transportation, irrigation, domestic use, recreation, power development, and industrial purposes. For centuries, people have been investigating the sources of water and its sinks, why part of it is salty, and part is fresh, why sometimes there is scarcity, and sometimes there is abundance. Water is also a major factor in food security. The world's freshwater is less than 3% (35 million cubic kilometers) of the total water resource (1386 million cubic kilometers), and its withdrawals from groundwater and surface water for agriculture are around 70% of the total amount. Owing to increasing water demand for agriculture, industries, urbanization, recreation, and environmental flow, more pressure is enforced on available freshwater in the world (Biradar et al. 2008). Irrigated agriculture is estimated to increase from 100 million ha in the year 1950 to 260 million ha. It accounts for about 17% of the world's arable land, supplying 40% of food and fiber. It also provides hunting areas and a source of food for wildlife in addition to local and migratory birds (Evans and Sadler 2008).

Agricultural development is one of the key elements for the survival and intensification/growth of civilization. At the beginning of the industrial revolution or in the year 1970s, the world population was 800 million (SDSN 2013); in the mid of 2015, the population reached 7.3 billion. Today the global population is growing more slowly than in the last decade. For example, in the past ten years, the world population has grown by 1.24% per year and recently reduced to 1.18% per year (addition of 83million per year) and is projected to be 9.7 billion in the year 2050 (Melorose et al. 2015). These show that an additional 2.4 billion population are expected between the year 2015 and 2050; more than half of the projected population is contributed from Africa (1.3 billion), Asia (0.9 billion), Latin America, Northern America, Oceania, and the Caribbean (0.2 billion). The majority of these population increase are in developing countries (Wallace 2000). Such an increase in population will need more and more irrigation water to meet increasing demands for food.

Since the 1960s, national and global food supplies have become more extensive through the contribution of irrigated agriculture; thus, irrigated agriculture plays a significant role in feeding the increasing number of population in the world. However, in the global and developing countries, water withdrawal for irrigation is considered 72% and 90%, respectively; due to the increase in water use for the non-agricultural sector, water availability forirrigation is reduced (Cai and Rosegrant 2003).

Shiklomanov (2000), Gleick (2003), and FAO (2003) estimated that the world freshwater ranges from 42700 to 44540 billion cubic meters. Out of which, 3784

billion cubic meters of water are withdrawn for agriculture, domestic, and industry in 2000. This indicates that the three sectors are the major water withdrawal sectors. The estimated water withdrawn for agriculture is 2675 billion cubic meters. From this, around 50% is consumed as evaporation and transpiration. Based on the available agricultural land area between 2010 and 2050, the irrigated agriculture water consumption would increase from 1563 to 1662 billion cubic meters, which shows that irrigation water consumption in the year 2050 would be 6% higher than in 2010 (Chartres and Sood 2013). Also, in the industrial and municipal sectors, water consumption increases from 434 to1807 billion cubic meters and 212 to 1497 billion cubic meters, respectively.

Ethiopia is an entirely landlocked country in the world, occupying a significant portion of the Horn of Africa, located between 30-150N latitude and 330-480E longitude. It shares the North and South boundary with Eritrea and Kenya, in the East and West with Djibouti and South Sudan, in the North West with Sudan, and the South East with Somalia. The country covers about 1.1million km2 of area (around 1 million km2 land area and 0.1 million km2 water area). Ethiopia is the second-most populous country in Africa, followed by Nigeria, with a total population of 91 million (estimated for 2016 based on the 2007 census of CSA) and an annual growth rate of 2.6%. An increasing number of the population is a severe problem in the highland areas of crop farming. Only 17% of this population is estimated to live in urban areas of the country (Ethiopia Central Statistical Agency (ECSA) & World Food Program (WFP) 2014).

Ethiopia is a country with different land diversity due to separating tectonic plates; these include the highlands of mountains, the Great Rift Valley, and plateaus. There are also deserts along with tropical forests in the south and the eastern border though Ethiopia faces deforestation problems. The altitude ranges from 126m below sea level in Denakil depression in the Northern border to the highest mountain Rasdashen 4620m above mean sea level in Gonder North of Lake Tana.

2. Water resource in Ethiopia

As National Planning Commission [NPC] (2016) indicates, agriculture contributes to an average of 38.5% of the Gross Domestic Product (GDP), and the service sector and industry contribute to the remaining 46.3% and 15.1%, respectively in the year 2014/15 (Figure1). As the report indicates,agriculture is the major sector with regard to first export commodities for foreign exchange, accounting for up to86% of the total foreign exchange earnings. Also, agriculture is the principal sector with regard to its contribution to the overall development and economic growth by supplying raw materials for industries of domestic production and food supply for domestic consumption. The country's economic system, therefore, is much related to agricultural sector performance.Furthermore, the sector meets 70% of the raw material needs of indigenous industries and currently employs 85% of the workforce.

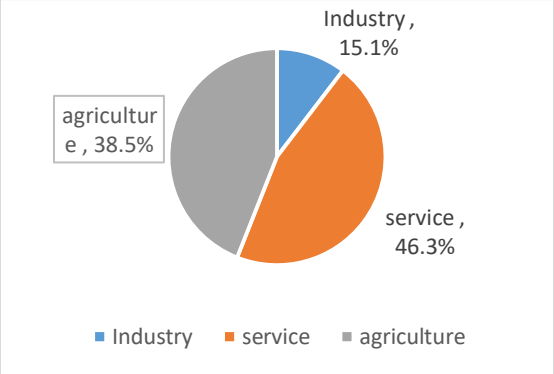

Figure 1: GDP share of different sector for economic development in Ethiopia

Ethiopia has plentiful annual rainfall as well as other substantial sources of water that might be established for irrigation and other purposes of development. In the country,rainfall comes in a variety of forms that conceivably utilized for irrigation and agriculture. Rainwater,surface water (which can include both seasonal and perennial rivers), soil moisture, wetlands and renewable groundwater are examples of these forms(Awulachew et al. 2010). Because of its high variability, both spatially and temporally, rainfall has an impact on land use and livelihoods. The unimodal rainfall season begins in February/March in the western parts of the country and ends in October/November.The bimodal rainfall seasons are more evenly distributed in the southern parts of the country, with one major and one minor season, whereas the major bimodal season in the country is found in the eastern parts(Asana Dawa et al. 2007).

There are twelve river basins in the four major drainage systems of Ethiopia (Figure 2, Table 1). Most of the rivers in these basins cross the national boundary (MoWR 2001). No additional water resources are entering the country, and therefore, Ethiopia is known to be the ' Water Tower of

East Africa,' a water tower providing water to neighboring countries with an estimated 96,500 million cubic meters of water each year (FAO 2016, Sundin 2017). The total annual surface runoff excluding groundwater is estimated to be 122 billion cubic meters in the twelve river basins. The three largest river basins (Abbay, Baro-Akobo, and Omo-Gibe) contribute 76 percent of the total surface runoff from a catchment area comprising only 32 percent of the total area of the country. As indicated in Table 1.1, those three river basins have much larger specific discharges than the other seven river basins (MoWR 2002). The country has 11 fresh, four crater and nine saline lakes and more than 12major wetlands. The majority of the lakes are found in the country's Rift Valley basin and are rich in fish. The total area of the lakes is 7,500 sq. km. The country has a lesser amount of groundwater compared to surface water resources and is estimated to be 2.6 billion cubic meters (Awulachew et al. 2007). Especially for the agricultural area, Ethiopia has merely used its groundwater resource due to hydrogeological complexity and cost (Awulachew et al. 2010), which makes an average of 1575 m^3 physically available water per person per year. However, due to large variations in rainfall distribution in space and time, as well as a lack of infrastructure for water storage, there is insufficient water for farmers to crop more than one crop annually.

Sustainable growth of food production can be achieved through the efficient use of water resources, land, and human resources development. The agricultural sector can influence Ethiopian economic performance. The government of Ethiopia has paid attention since the 1950s to the reduction of famine and drought through increasing agriculture production. These include traditional irrigation and construction of small-scale, medium-scale, and large-scale irrigation schemes (Awulachew et al. 2007). Ethiopia has large agricultural potential development of about 51.3 million hectares of arable land, whereas currently, the cultivated area being only 11.7 million hectares (Chanyalew et al. 2010).

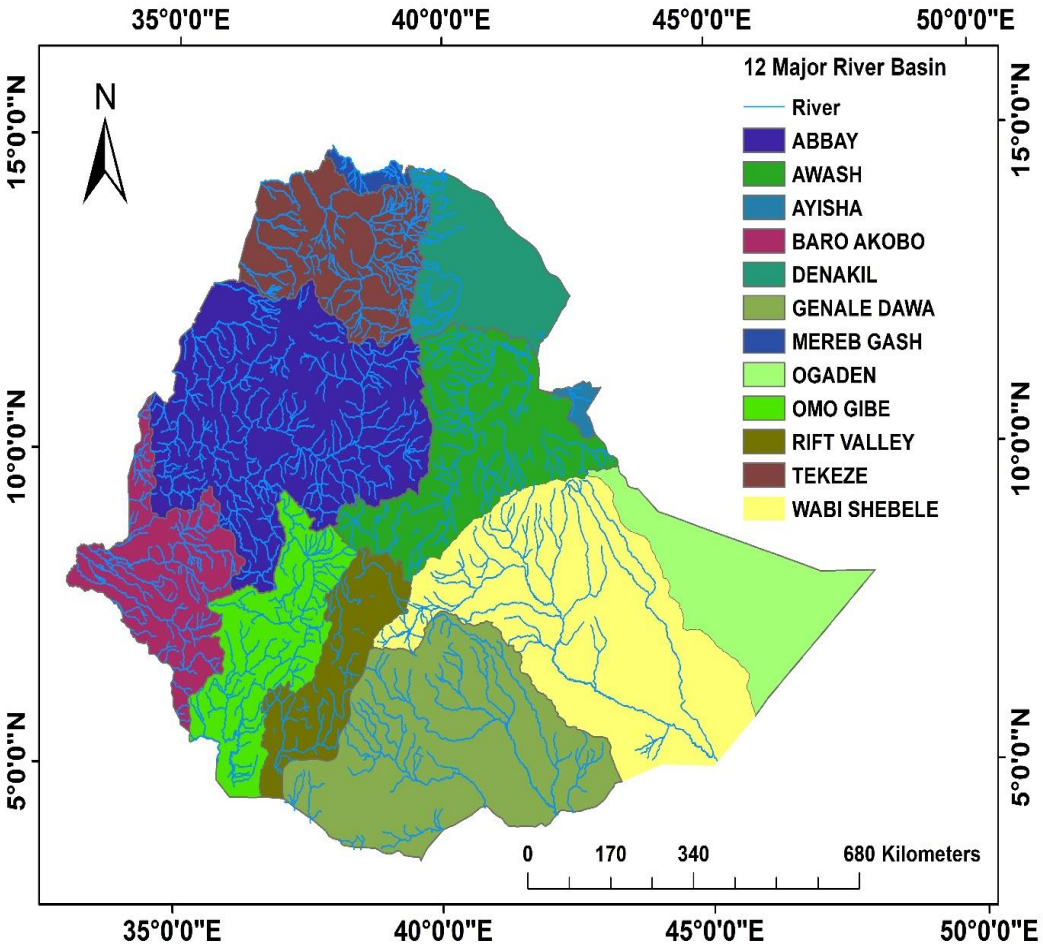

Figure 2 The 12 River basin and streams of Ethiopia

Table 1 Area and surface water resource by major river basin

S. No	Major Drainage System	River Basins	Catchment area (km^2)	As % of the total area	Annual surface runoff (BM^3)	As % of surface runoff
1	**Nile Basin**		**368612**	**32.4**	**84.09**	**69**
		Abbay	199 812	17.6	52.6	42.9
		Baro-Akobo	74 100	3.5	23.6	19.3
		Tekeze	89 000	7.8	7.63	6.2
		Mereb	5 700	0.5	0.26	0.6
2	**Rift Valley**		**317640**	**27.6**	**28.96**	**23.7**
		Awash	112 700	9.9	4.6	3.7
		Afar-Danakil	74 000	6.5	0.86	0.7
		Omo-Gibe	78 200	6.9	17.90	14.7
		Rift Valley	52 740	4.6	5.60	4.6
3	**Shebelli-Juba**		**371264**	**32.7**	**8.95**	**7.3**
		Wabe Shebele	200 214	17.6	3.15	2.6
		Genale – Dawa	171 050	15.1	5.80	4.7
4	**North- East coast**		**79300**	**7.0**	**0.0**	**0**
		Ogaden	77 100	6.8	0	0
		Aysha	2 200	0.2	0	0
		Total	1 136 816	100.0	122.0	100

Source: MoWR 2002 Water Sector Development Program Volume II, FAO 2016

3. Water resource management

Water resource management is the movement and control of water resources to reduce destruction to property and life, and to exploit well-organized, and profitable use.

Sometimes management of water resource encompasses changing practices, as for instance allocating water and/or groundwater withdrawal rates for different purposes(USDA 2017). Rockström et al. (2005) stated that irrigated and rain-fed agriculture water consumption based on 92 developing countries' data is estimated to be 4500 billion cubic meters per year in 2002. An additional 2200 billion cubic meters per year of fresh water used is needed in 2015 to feed 50% of under-feeding people in the world. Furthermore, an additional 3000 billion cubic meters per year of freshwater is required for irrigation to eradicate hunger in the year 2030. If water is managed efficiently in agriculture, there will be enough water and land to fulfill the world's food needs for the next 50 years (DeFraiture and Wichelns 2010). Therefore to increase the required agricultural production, it is clear that effective management for water is a must.

4. Conclusion

Water is a critical component of food security. Freshwater accounts for less than 3% (35 million cubic kilometers) of the total water resource (1386 million cubic kilometers), with agricultural withdrawals from groundwater and surface water accounting for roughly 70% of the total amount. Ethiopia has plentiful annual rainfall as well as other substantial sources of water that might be established for irrigation and other purposes of development. Rainfall in the country comes in a variety of forms that conceivably utilized for irrigation and agriculture. The country has 11 fresh lakes, four crater lakes, nine saline lakes, and over 12 major wetlands. In the country the Rift Valley basin covers the majority of the lakes and are rich in fish. The lakes cover an area of 7,500 square kilometers. Groundwater resources in the country are estimated to be 2.6 billion cubic meters, which is less than surface water resources. Ethiopia's government has focused on reducing famine and drought since the 1950s by increasing agricultural production. These include traditional irrigation as well as the design and construction of small-, medium-, and large-scale irrigation schemes. Water resource management is the movement and control of water resources to reduce destruction to property and life, and to exploit well-organized, and profitable use. Sometimes management of water resource encompasses changing practices, as for instanceallocating water and/or groundwater withdrawal rates for different purposes.There will be enough water and land to meet the world's food needs for the next 50 years if water is managed efficiently in agriculture.

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