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# The Grand Ethiopian Renaissance Dam on the Blue Nile

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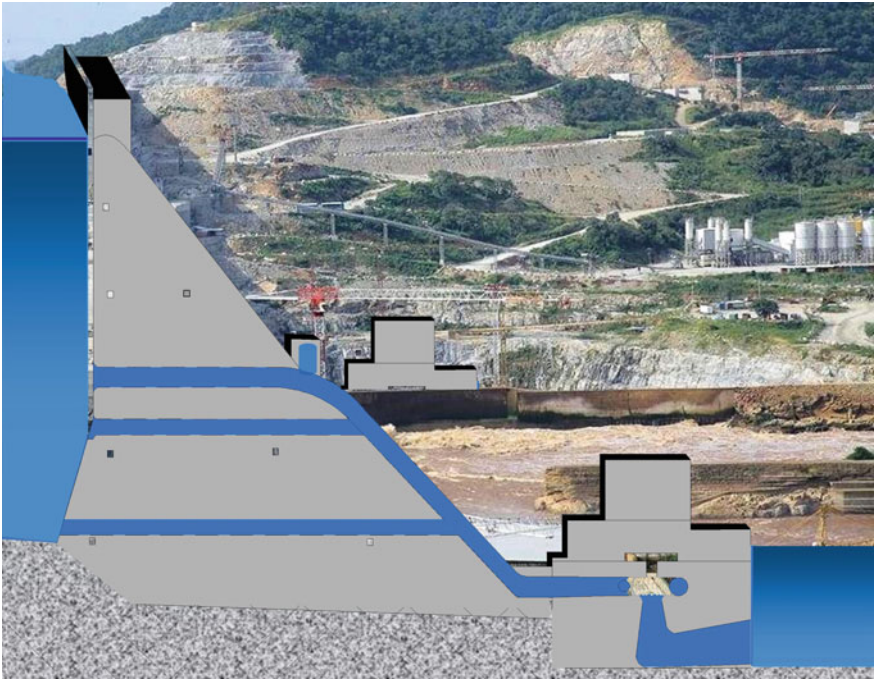
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# Preface

Global population growth is putting stress on land, water resources and the environment. Deforestation, soil loss, desertification and climate change compound the challenges in the Nile basin. Population growth and increase in food, water and energy demand and associated internal social pressures will inevitably lead to water conflicts within countries and between countries. Transboundary or international basins and rivers have potential for conflict between countries which share the resources. Transboundary water rights vary from basin to basin and water right is a function of power order. Indus River, India and Pakistan; Colorado River, United States and Mexico; Mekong River, China, Myanmar, Thailand, Laos, Cambodia and Vietnam; Parana River, Brazil, Paraguay and Argentina; Euphrates River, Turkey, Syria and Iraq; Ganges River, Nepal and India; and other transboundary river basins water rights are unique that developed through time. It should also be noticed that land and water conflicts within entities in a country are equally important. There are 261 transboundary basins covering 45% of the global land surface. About 146 countries share transboundary basins. The Nile basin lies within eleven countries with total population of over 450 million that will reach 700 million in less than 25 years. The Nile basin growing land and water demand is not limited to the population in the river basin. In the absence of water resources use and basin management agreement in the Nile basin, unilateral water control and use projects will continue to advance to mitigate food and power shortage and relieve social pressure in each riparian country. The water control projects include out of basin water transfer and may include water trading. Each country cites legal basis or treaties that support its water claims. The Grand Ethiopian Renaissance Dam (GERD) is a reflection of current stressors in the basin with far-reaching conflict potential within Ethiopia and with riparian countries. The current political system and constitution of Ethiopia are based on regional ethnic federal structure with constitutional right to secede. This arrangement creates internal water right issues as currently observed inter-ethnic conflicts on land and borders. The GERD has potential for ethnic conflict from inequitable sharing of benefits from trans-ethnic waters, the construction economy of the dam, its operation and associated economic outputs.

Egypt's concern on potential flow reduction is demonstrated throughout the dam-related dealings between Ethiopia, Egypt and Sudan. Sudan appears indifferent or supporting the dam as it will benefit in many ways. Will there be enough water for all? The three countries have agreed for two French companies to undertake hydraulic and environmental studies to forecast the impact of the dam on downstream. The result of the study has the potential to ignite the conflict between Ethiopia and Egypt. One of Egypt's concerns is the number of years of initial filling of the dam as it will be a time of historical flow reduction unless the filling years are wet years. The longer the filling years, the lesser the flow reduction will be but the economic value of the dam will diminish. The dam is already overdue, and longer filling period could make it economic loss with all factors considered. Drought condition during filling will exasperate disagreements. Optimal power generation of the dam is questionable with unresolved upstream and downstream water right issues.

In this book, the hydrology of the Blue Nile basin is presented. The Nile River transboundary water rights; land and water rights in the Blue Nile basin, in Ethiopia; the GERD site and Ethiopian internal condition; GERD design analysis; GERD initial dam filling; dam operations for hydropower and upstream and downstream water rights; dialogue and diplomacy through GERD construction; finance sources of GERD; and aquatic weed potential on GERD reservoir are covered. This book is beneficial for students, academics, sociologists, engineers, policy-makers, water resources and environment professionals, the people of the Nile basin and everyone with interest on global land and water stress, population growth and water conflict.

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# Abbreviations

bcm	Billion cubic meter
BNB	Blue Nile Basin
CIA	Central Intelligence Agency
EPRDF	Ethiopian People’s Revolutionary Democratic Front
ESA	European Space Agency
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization
GCM	Global Circulation Model
GERD	Grand Ethiopian Renaissance Dam
GSE	Geology Society of Ethiopia
ha	Hectar
HAD	High Aswan Dam
HP	Hydropower
I	Irrigation
IFT	Illegal Fund Transfer
IPRC	International Pacific Research Center
m asl	Meters above sea level
MoWR	Ministry of Water Resources
NBI	Nile Basin Initiative
RCC	Roller Compacted Concrete
SGCC	State Grid Corporation of China
SOI	Southern Oscillation Index
SRTM	Shuttle Radar Topography Mission
SST	Sea Surface Temperature
TPLF	Tigray Peoples Liberation Front
USBR	United States Bureau of Reclamation
WUA	Water Use Association

# Chapter 1

## Introduction



**Abstract** The Nile Basin is one of the largest basins in the world shared by eleven countries. The principal tributaries of the Nile River are the White Nile, flowing from the Great Lakes region of Central Africa and the Blue Nile (Abay), Sobat (Baro-Akobo) and the Atbara (Tekeze), flowing from the highlands of Ethiopia. Ethiopia contributes close to 85% of the Nile river flow. The Nile basin is entering into a new era of challenges and opportunities primarily driven by population explosion, food and water shortage, increase in water demand and water use, climate change, and complicated water right issues. More importantly, upstream countries started to assert their right to develop the Nile water resources challenging the long-held water right hegemony of Egypt and Sudan. Ethiopia unilaterally launched the construction of Grand Ethiopian Renaissance Dam (GERD). The sheer size and storage capacity of GERD has initiated dialogue and diplomacy towards understanding of the current reality in the basin as well as the absolute need of co-operative water resource development. This chapter provides an overview to the Nile basin along with the social, economic, environmental and political implication of GERD. The book mainly focuses on the Blue Nile basin, the GERD design, filling and operation in association with the larger Nile basin.

**Keywords** The Nile · Blue Nile · Grand Ethiopian Renaissance Dam  
Ethiopia · Egypt · Sudan · Transboundary rivers

### 1.1 Overview of the Nile River Basin

As a result of geological processes, rivers cross political boundaries creating dependence for diverse societies with a chance for cooperation and potential for conflicts. The history of people and their relation to rivers transcends a mere dependence for livelihood. The Nile River flows from the wet equatorial lakes region and high lands of Ethiopia to the dry desert regions of North-East Africa creating historical dependence for survival in Egypt and Sudan and support the livelihood and rich ecosystem and society of the downstream countries. The River Nile is the longest river in the

world stretching nearly 6700 km, covering more than 35° of latitude and draining an area of over 3 million square kilometers—one tenth of Africa's total land mass. The Nile River Basin traverses varied landscapes, with high mountains, tropical forests, woodlands, lakes, savannas, wetlands, arid lands, and deserts, culminating in an enormous delta on the Mediterranean Sea. For millennia, this unique waterway has nourished varied livelihoods, an array of ecosystems, and a rich diversity of cultures. The principal tributaries of the Nile River are the White Nile, which begins in the Great Lakes region of Central Africa; and the Blue Nile (Abay), Tekeze (Atbara), and Baro-Akobo (Sobat) flowing from the highlands of Ethiopia. The Sobat flows from southern Ethiopia to join the White Nile. The other sources are the equatorial lakes and the Bahir el Ghazal basin (Fig. 1.1). The most distant source is the Kagera River, which winds its way through Burundi, Rwanda, Tanzania, and Uganda into Lake Victoria. Eighty-five percent of the water of the Nile originate from the Ethiopian plateau and 15% for the Equatorial Plateau (Moges and Gebremichael 2014).

The Nile River is shared by 11 countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda with varying flows with time along its path (Fig. 1.2). It is home to world-class environmental assets, such as Lake Victoria (the second-largest fresh water body by area in the world) and the vast wetlands of the Sudd. It also serves as home to an estimated 160 million people within the boundaries of the basin, while about twice that number, about 443 million live in the 11 countries that share and depend on Nile waters projected to increase to 726 million in 20 years (Abteu and Melesse 2014a).

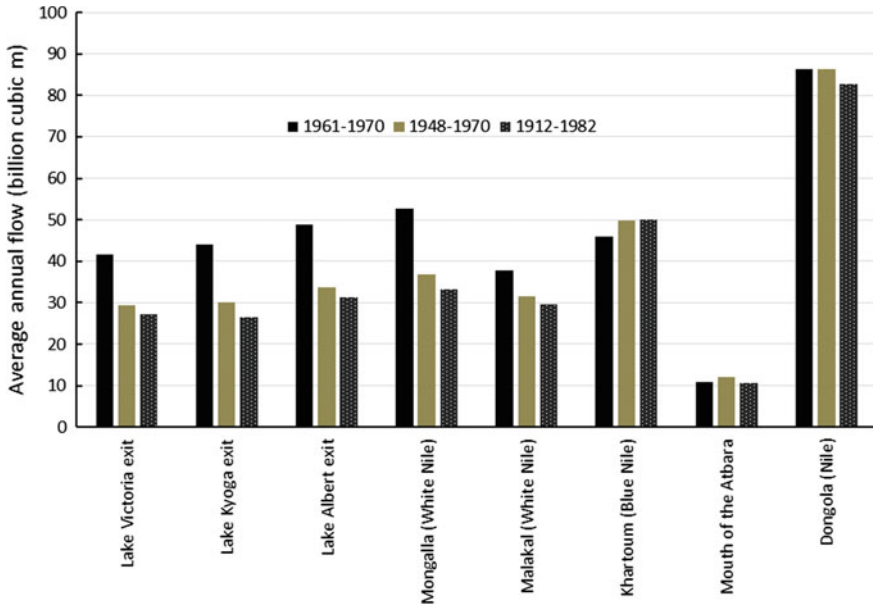
Upstream wetter riparian countries were not actively seeking to share water until population growth started putting pressure to utilize Nile resources and meet their growing water demand. At the same time, the development and access to technological knowhow on water control such as pumps, dams, canals, water harvesting and irrigated agriculture is increasing upstream water use. The construction of GERD is a reflection of the slow and often discouraging co-operation among riparian countries and the contemporary economic development and socio-political dynamics creating the need for an increasingly aggressive infrastructure development. The future of the Nile is increasingly scarce resource with a large population and infrastructure that depends on the Nile water. An open and transparent dialogue and co-operations are needed more than ever to set the right course towards equitable sharing of water and associated benefits before the fragile regional hydro-politics evolve into water conflict. GERD is about half the storage volume of the High Aswan Dam well above the annual yield of the Blue Nile River. Coordination of all the dams in series could lessen the impact of GERD filling for a shared common goal to reduce undesirable consequences and promote regional accord. The move by Egypt and Sudan to walk out of the Nile Basin Cooperative framework signed by the upstream countries may hinder such cooperation that would have set a precedence in future infrastructure development. The race for water right assertion through unilateral projects is likely to continue. Hence, initial filling and operation of the GERD impact could be minimized through synchronized dam operations along the Nile.

By 2025, 1.6 billion people in the world will live under water scarcity (Eliasson 2015). Water conservation and watershed management, basin planning and basin



Fig. 1.1 The Nile River Basin and major dams





**Fig. 1.2** Averaged annual flow (billion cubic meters, bcm) at selected stations on Nile River (Abteu and Melesse 2014a, b; original data source Karyabwite 2000)

wide cooperation would make the most use out of the water and minimize conflicts. Water transfer outside the basin may expand. To reduce vulnerability to climate change water cooperation for the Nile basin is advised (Hammond 2013).

## 1.2 Water Resources of the Nile Basin

The Nile Basin comprises of countries with an average annual rainfall of more than 1300 mm and others almost none throughout a given year. The economic status of the riparian countries also varies from a capacity that enables an almost full utilization of available water resource to countries with no significant project implementation in their part of the Nile basin.

Water resource potential of a country in the Nile basin could be viewed, assessed and reported from different viewpoints. For instance, 98% of Burundi is in the Nile basin while the major contribution in terms of flow quantity comes from the highlands of Ethiopia where about 32% of the land is in the Nile basin. Hence, the water resource potential of the riparian countries has an absolute as well as relative expression in the context of the respective nations and the Nile basin as a whole.

### 1.3 GERD and the Blue Nile Basin

Even though Nile Basin is shared by eleven countries; Sudan and Egypt highly depend on the flow from the Ethiopian Blue Nile with contribution up to 60% of the Nile flow while covering only 10% of the Nile basin drainage area. The Blue Nile River starts from the Highlands of Ethiopia and flows to Sudan joining the White Nile River in Khartoum (Fig. 1.3). GERD is the first major dam on the Blue Nile (Abay) River of Ethiopia, whereas Sudan has the Rosaries and Sennar dams on the Blue Nile.

GERD is a combination of 1.8 km long high gravity dam, 5 km long rockfill saddle dam, and a 300 m long separate spillway between the main and saddle dam, on the Blue Nile (Abay) River of Ethiopia. It is about 20 km from Ethio-Sudan boarder (Fig. 1.4).

### 1.4 The GERD, Ethiopia, Egypt and Sudan

The promising cooperative effort among riparian countries with the launch of the Nile Basin Initiative in 1999 fall short of its goal when co-operative framework agreement was signed by upstream countries with strong opposition from Egypt (Hammond 2013). The fallout from the negotiation of Eastern Nile riparian countries (Ethiopia, Sudan, and Egypt) on the commissioning of cascade dams in Ethiopia was a major driver for the Ethiopian government to take a unilateral step towards the construction of GERD. The proposed dams were Kara Dobi, Mabil, Mendia and Border. GERD is located within a few kilo meters from the most downstream Border site close to the border with Sudan. Afterwards, the Ethiopian government has surprised the Nile riparian countries with the launch of GERD construction in 2011. The planning and design of the dam was kept secret and the construction was portrayed as a national land mark to symbolize economic success, and national security and to some extent score political advantages bringing internal unity through nationalism. However, the GERD has also been marred with domestic challenges from political oppositions and fallouts of international and regional diplomacy particularly in securing funds.

Ethiopia has repeatedly attempted to give assurance that downstream flow will not be reduced by GERD. Ethiopia argued the choice of the GERD site as a token of consideration to downstream countries where the dam can only be used to generate hydroelectric power with practically no consumptive withdrawal of water for irrigation. However, the dialogue has shifted over the last five years from Ethiopia's considerations on site selection to the size of the dam and the potential impact during the initial filling of the dam. The Ethiopian government argues the filling will have minimal impact rather benefits downstream riparian countries with regards to flooding, siltation, irrigation and water conservation (<http://www.mowie.gov.et/dams-and-hydropower> accessed on 11/12/2017). These benefits and Ethiopia's right to develop its water resources for the development and prosperity of its people has been