

Transboundary conflict management of the Nile River Basin: Past, present, and future

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ABSTRACT

Nile, the longest transboundary river in the world is politically full of tension, mistrust, and diplomatic conflict between the Northeastern African countries for centuries. Today, cooperation between the main riparian states in the Eastern Nile Basin (Egypt, Ethiopia, and Sudan) is becoming more serious than ever in resolving emerging conflicts over the construction and filling of the Grand Ethiopian Renaissance Dam (GERD). Besides, in all basin states, there will be dramatic population growth and the demand for freshwater has increased, then the region's water supply per capita would be reduced by 50% in the next 20 years that will aggravate regional tension over water. Thus, as the Nile water is scarce and riparian needs are growing, conflict potential is real, and the author's recommended that future cooperation on how to use the Nile water in the principle of reasonable and equitable utilization for mutual benefit is the solution, because for one country better off and to other countries worse off makes the region more stresses for water. This study investigated the conflict management of the Nile River between the basin countries from the past, present, and future using different integrative literature review, which summarizes past and present research works, drawing overall conclusions, highlighting unresolved issues, and then provide directions for future research.

Keywords: Nile River; Transboundary river conflict; Hydro politics; GERD; Cooperation; Future water crisis

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I. INTRODUCTION

The Nile River or "Neilos" (the Greek word meaning river valley) [1] is the longest transboundary river in the world, and the father of rivers in Africa, which stretches 6,650 km [2]. The river passes through 11 riparian countries in Northeastern Africa [3] (**Figure 1**). Those riparian countries can be divided into upstream and downstream countries. The upstream countries include Ethiopia, Burundi, Kenya, Tanzania, Eritrea, Rwanda, the Democratic Republic of Congo (DRC), South Sudan, and Uganda. The downstream countries are Egypt and Sudan [4]. The Nile flows from South to North and ends at the Egyptian Delta, where it flows into the Mediterranean Sea and is fed by two main tributaries, the White Nile and the Blue Nile [5].

The White Nile comes from Lake Victoria (Central and Eastern Africa) [6], which is bounded by Kenya, Uganda, and Tanzania and flows into Sudan, where it joined the Blue Nile that starts at Lake Tana (Ethiopia) [7]. The White Nile and the Blue Nile merge close to Khartoum in Sudan and form the Nile River [4]. The Blue Nile contributes most water from the two tributaries [8]. About 86% of all the Nile water flowing into downstream countries originates from Ethiopia [9]. Since the White Nile lost half of its water in the Sudd, the percentage of its water eventually reaching Egypt is only 14% [10]. The Nile is a single river from Khartoum on its way [11] to the Mediterranean Sea through the Nubian Desert [6].

For a century, the Nile Basin is home to a permanent tension between the upstream riparian's,

the main contributors of the Nile water, and downstream riparian's, the main users of the Nile water [5]. The previous studies have shown that the Nile water resources have been dominated throughout history by the downstream riparian countries, particularly by Egypt and to some extent Sudan [12]. More than 97% of Egypt's freshwater emanates from the Nile. The remaining scant 3% is made up of slight rainfall and underground reservoirs. Sudan also receives 77% of its freshwater from the Nile. The upstream riparian countries rely on the Nile for a certain amount of freshwater, because, relatively, they have several water resources outside the Nile River. But for domestic use, agriculture, and industry, Egypt and Sudan have few other choices [13]. Recently, however, because of climate change,

economic development, population growth, and hydro-ecological degradation the demand for freshwater increases in upstream nations [4]. They are poised to withdraw more water and begun to control the Nile waters [14], in an attempt to initiate overall economic development and sustain their growing populations [11]. This article will assess some of the worldwide transboundary river's issues in general and examine the cooperation and negotiations between riparian nations of the Mekong River Basin in Southeastern Asia, the Senegal River Basin in West Africa, and the Colorado and Rio Grande River Basin in North America as a basis for suggesting a good lesson and a method of transboundary river cooperation to ease intensifying conflicts over water use in Northeastern Africa in particular.

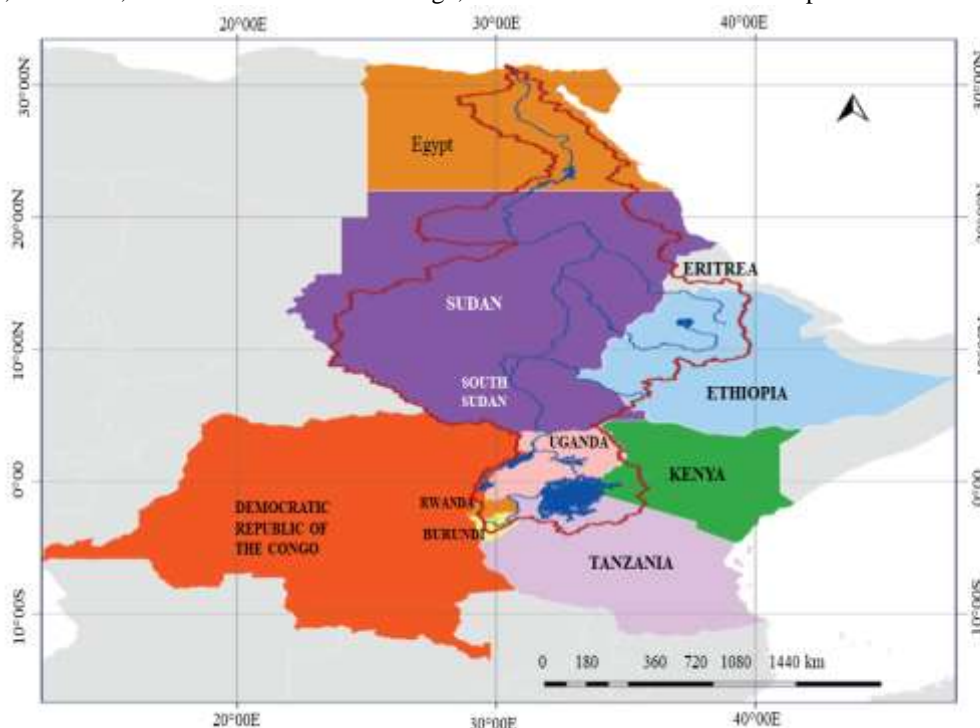


Figure 1. Nile River Basin and the eleven countries where the river flows.

II. TRANSBOUNDARY RIVER MANAGEMENT

1.1. Worldwide transboundary river issues

Transboundary rivers are rivers that can be shared by two or more independent countries [15]. Two or more countries around the world share more than 263 river basins and 269 aquifers [16] (Figure 2). The world's 263 international river basins cover almost half of its land surface [17],

accounting for approximately 60% of international water resources, and sustain around 40% of the world's population [10]. Since transboundary river crosses countries, it faces several management problems [18], due to population increase, innovations in agriculture and industry, climate change [19], hydro-ecological degradation, and river pollution [20].

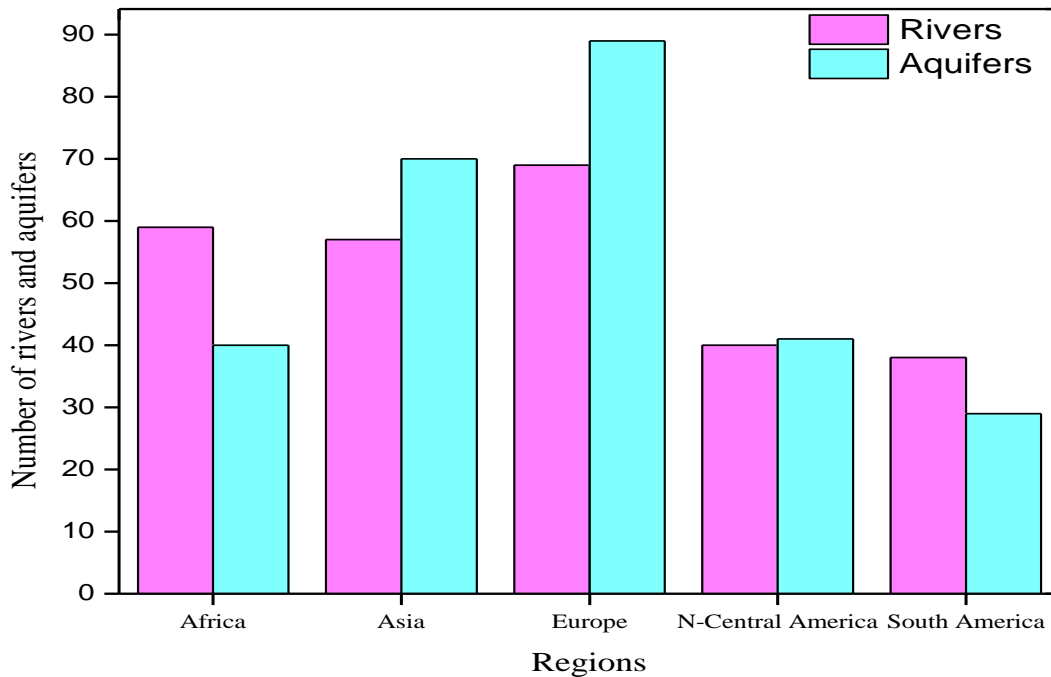


Figure 2. The world transboundary rivers and aquifers. Source: Transboundary river basins from Wolf et al. 1999 and revised in 2002; global aquifers from UNESCO 2009.

Recently, the increasing demand for freshwater has increased several disputes between the riparian nations [21]. This would lead to further tensions, disagreements, and conflicts in water-sharing agreements [22]. Conflicts over transboundary water division typically arise between the riparian nations on three matters: quantity, quality, and control. The imbalance of the last two problems (quality and control) is much easier to discuss with some financial and technological assistance [16]. For example, the quality matter, which had previously caused a dispute between the riparian nations on the Colorado and Rhine River in North America and Europe respectively, has resulted in a peaceful and friendly agreement [23]. However, water is not simply substituted, so the problem of its reduced quantity is more difficult to address. The quantity problem of river water has triggered conflicts between several riparian states in the dry regions of Africa and Asia [24]. In these two continents, the riparian conflict over transboundary rivers—Nile, Mekong, Zambezi, Jordan, Euphrates, Tigris, and the Ganges—are primarily on quantity issues [16]. Also, traditional grounds of the dispute over a transboundary river, for example, include the building of dams by an upstream state, which would reduce the quality or quantity of water access to the downstream state [25]. Potential dispute heightened in Northeastern Africa (Ethiopia, Egypt, and Sudan) on the Nile has nowadays

regularly more about quantity issues on filling the GERD that fears may reduce the water quantity of downstream nations. Previously, several prominent river clashes resulted in militarized conflicts, such as numerous events between Syria, Jordan, and Israel in the 1950s and 1960s, includes attempts to drain water from the Yarmouk and Jordan Rivers on both sides [24], and more recent threats between Syria, Iraq, and Turkey over dam building on the Euphrates River [26]. Other disputes have been treated more peacefully, including conflicts between the United States and Mexico over pollution in the Rio Grande River and the damming of the Colorado River [23]. The conflict between Hungary and Slovakia over control of the Danube River was recently settled by the International Court of Justice [16].

Several observers have indicated that disagreements over shared water supplies would be a key cause of disputes in the 21st century due to the value of water and its growing scarcity around the world [27]. In this century, there have been several agreements in the developed world to share the international river basins, but they have not been the same as the developing countries [28]. Currently, there are more than 300 agreements that have been signed concerning shared transboundary rivers between riparian countries (of the 145 treaties negotiated in the 20th century), and more than 3000 treaties bear provisions relating to water questions [29]. **Table 1** summarized a sample

overview of such agreements. The high number of treaties indicates that shared rivers can be a source of cooperation. Ashok Swain (2001) noted that about 67% of the overall water agreements signed among states on water issues are in Europe and North America. For example, Europe, has four river basins shared by four nations or more, but these are governed by 175 agreements, in comparison, the 12 African river basins shared by four or more nations are governed by only 34 agreements. Five Asian river basins (including the

Middle East) are shared by four states or more, but they are governed by only 31 agreements. Europe leads, among other continents to develop joint institutional frameworks to promote international sharing of rivers. The lack of international consensus or organizational settlement on common freshwater resources raises the chances for conflicts [16]. Both politicians and the media claim that water scarcity is a substitution for oil as a cause of disputes [30].

Table 1. Some of the international agreements on river basins [16, 18, 27, 31].

River Basin	Location	Countries sharing	Main issues cooperation	Status of cooperation
The Indus	Asia	India, Pakistan, China, Afghanistan	Water quantity, National security, dam building,	Bilateral accord
The Ganges-Brahmaputra	Asia	India, Bangladesh, Nepal, China, Bhutan	Water quantity, dam-building	India-Bangladesh bilateral accord
The Euphrates-Tigris	Asia	Syria, Turkey, Iran, Iraq	Water quantity, dam building, allocation	Turkey-Syria & Iraq bilateral accords
The Jordan	Asia	Israel, Jordan, Syria, Palestine, Lebanon	National security, water quantity	Israel-Jordan, Jordan – Syria, Israel - Palestine bilateral accord
The Mekong	Asia	China, Cambodia, Laos, Viet Nam, Thailand, Myanmar	Water quantity, dam-building, flood control	Multilateral accord
The Nile	Africa	Egypt, Sudan, Ethiopia, Eritrea, Kenya, Tanzania, Burundi, Rwanda, Uganda, DRC, South Sudan	National security, historical right, dam-building, water quantity	Several bilateral and multilateral accords
The Niger	Africa	Mali, Nigeria, Niger, Algeria, Guinea, Cameroon, Burkina Faso, Benin, Cote D'Ivoire, Chad	To promote cooperation and ensure development	Multilateral accord
The Senegal	Africa	Senegal, Mali, Mauritania, Guinea	Dama and Manantali dam building	Multilateral accord
The Colorado and Rio Grande	North America	USA, Mexico	Water quality, flood Control	Two bilateral accords
The La Plata	South America	Brazil, Argentina, Paraguay, Uruguay, Bolivia	Dam-building, water allocation	Multilateral accord

The Danube	Europe	Romania, Hungary, Czech Rep. Slovakia, Russia, Italy, Albania, Croatia, Macedonia, Slovenia	Serbia, Austria, Germany, Bulgaria, Switzerland, Poland, Ukraine, Moldova,	Dam-building, water quality, accords environmental protection	Several bilateral and multilateral
The Rhine	Europe	Switzerland, Germany, Netherlands, Luxemburg, Lichtenstein	France, Italy, the Austria, Belgium,	Water quality, flood control multilateral accords	Several bilateral and multilateral accords
The Columbia	North America	USA, Canada		Flood control, dam-building	Bilateral accord

1.2. Geography, population, and climatic condition of the Nile Basin

The Nile River occupies approximately 3.2 million km² of territory in 11 riparian states [32], equivalent to approximately 10% and 32% of the African continent and European Union landmass, respectively [33] (Table 2 and 3), and 2.3% of the world's land surface area [34]. The Nile is one of the most complicated of all the major river basins

in the world, due to its scale and range of topographies and climates [35]. The comparison between the Nile and other major rivers, such as the Amazon, Congo, Mekong, Zambezi, Danube, Niger, and the Rhine, shows that, relative to the basin area, the water discharged from the Nile Basin is very small (84 10⁹ m³), 2% of Amazon's annual flow (5518 10⁹ m³) [36] (Table 2).

Table 2. World's major transboundary river systems [33, 35].

River	Length (Km)	Drainage Area (10 ³ Km ²)	Annual Discharge (10 ⁹ m ³)	Discharge/unit area (10 ³ m ³ /Km ²)
Nile	6,650	3,201	84	28
Amazon	6,436	7,050	5518	728
Congo	4,700	3,820	1248	326
Mekong	4,350	795	470	590
Niger	4,100	2,274	177	78
Danube	2,900	816	206	252
Zambezi	2,700	1,200	223	185
Rhine	1,320	224	70	312

The Nile is a vital resource used for economic growth in the basin nations, with 280 million people dependent on the Nile water and a total of over 500 million people living in the 11 riparian states [37] (Table 3). In the next 20 years, the population of the basin is estimated to reach 600 million, placing more pressure on water

scarcity [38]. The climate of the basin varies from tropical in the equatorial zone of the Great Lakes and highlands of Ethiopia, to arid in Sudan and Egypt. The Nile's flow is also highly seasonal approximately 80% of its flow occurs from June to October [15].

Table 3. Nile Basin countries repartition.

Basin countries	Country Area (km ²)	The population of 2020 (Millions)	Average annual population growth (2015-2020) %	An area in the Nile Basin (km ²)	% of the total Nile Basin Area	% of the country in the Nile Basin
Sudan	1,886,068	44	2.4	1,396,230	43.94	74.9
Ethiopia	1,127,127	114	2.6	365,318	11.7	31.93
Egypt	1,001,450	102	2.5	326,751	10.5	30.34
Uganda	236,040	46	3.6	240,067	7.4	99.51
Tanzania	945,090	60	3	118,507	2.7	12.69
South Sudan	619,745	11	1.2	620,626	19.54	97.71
Kenya	582,650	54	2.3	51,363	1.62	8.66
Eritrea	121,320	5	1.3	25,697	0.8	21.11
DR Congo	2,345,410	90	2.6	22,143	0.7	0.91
Rwanda	26,340	13	2.6	20,625	0.7	84.01
Burundi	27,835	12	3.1	13,860	0.4	49.39
Total	8,919,072	549	2.5	3,201,187	100	45

Source: NBI (2006); CIA World Factbook (2006); African Development Bank (2019).

1.3. Historical background of the Nile River hydro politics

1.3.1. The downstream riparian countries

In the Nile transboundary river, Egypt and Sudan are the downstream countries and almost depend on the Nile water for several purposes, but in different degrees [39]. More than 97% and 77% of Egypt's and Sudan's freshwater emanates from the Nile River respectively [13]. For the past 5000 years, the Egyptians have been the regional Hegemony and have enjoyed unchallenged access to the Nile River [4]. The Greek historian Herodotus, famously defined Egypt in the 5th century as the "gift of the Nile River" since its civilization was built on the fertile banks of the Nile [40], and an idea that has been appropriated by modern Egyptians [41]. Egypt is recognized as the most powerful of the 11 riparian states, economically and militarily [42], however, from previous civilizations, they rely heavily on the waters of the Nile coming from the upstream riparian states [43]. A combination of stronger bargaining, material, and ideational power has allowed, especially for Egypt to develop a hydro- hegemonic position in the basin [44]. Egypt the arid climate country considers the Nile as its source of sustenance life and 97% of this water comes from outside of its territory. Some Egyptians believe that there will be no Egypt without the Nile [45]. Thus, like Egypt, Sudan claims the absolute territorial integrity right to the Nile's River. Besides, it also argues that most of its land is either arid or semi-arid as opposed to that of the lands of upstream countries, which have a high rate of rainfall and thus capable of maintaining rain-fed

agriculture. More with its growing population and the desert climatic conditions, the Nile becomes Egypt's national security and strategic natural resource for centuries [13].

However, in the 19th century, Great Britain as a colonial power played an important role in manipulating Egypt's condition [4]. The Britain invasion of Egypt in 1882 can be seen as England moved to compensate for the loss of the American cotton production by expanding irrigated farming in the basin and securing the Suez Canal [46]. The colonial powers were interested in massive sugar cane growing plantations, and cotton to send back to Europe and other continents for the sugar and textile industry [9]. In an attempt to protect their interests in Egypt, the British supervised the signing of treaties concerning the use of the Nile River, which favored downstream water rights in Egypt over those of other riparian Nile's [15]. Nevertheless, the Nile is subject to many treaties relating to rights and water allocation. Of these, two bilateral treaties are probably the most important, both concerning scope and relevance for basin negotiations. Those are the 1929 Nile water treaty between Great Britain and Egypt, representing Sudan, and the 1959 Nile water full utilization treaty between Sudan and Egypt [4].

The Nile water resources were allocated between Egypt [47] for 48 billion cubic meters (BCM) and Sudan for 4 BCM by leaving 32 BCM unallocated first in 1929 when the two countries were under the British government, and second in 1959, when the two countries became independent [48]. The 1929 agreement was primarily intended to secure the Nile water for Egypt's rights by

restricting Sudan's rights and rejecting those of the other riparian states [49]. In 1956, Sudan challenged the validity of the 1929 agreement, leading to the negotiation and final signing of the 1959 agreement. Then, the 1929 agreement was replaced by the 1959 agreement of full control and utilization of the Nile water [50], raised Sudan's allocation from 4 BCM to 18.5 BCM (22%) while Egypt increased its allocation from 48 BCM to 55.5 BCM (66%) by considering 10 BCM (12%) were assumed to be lost to evaporation and seepage from the total of 84 BCM Nile River annual volume at Aswan High Dam, Egypt [26] (Figure 3). The 1959 agreement did not reserve any water for upstream riparian nations [51]. These two treaties, which underline the downstream countries' "natural and historic" rights, are the beginning of

domination of all waters of the Nile by the Egyptians and Sudanese [52]. The colonial-time agreement also gave to Egypt the veto power over any changes by upstream nations that would threaten its water share [53]. However, both agreements were opposed by the upstream states after they became independent based on the argument that they were bilateral (no upstream nations sign both agreements); they belonged to the colonial era and neglected the interests of those upstream states [48]. The agreements represent the backbone of the Nile Basin's hydro-political dilemma. The downstream riparian's want to retain it, while the upstream riparian's want to replace it with a multilateral agreement based on fair and reasonable sharing [54].

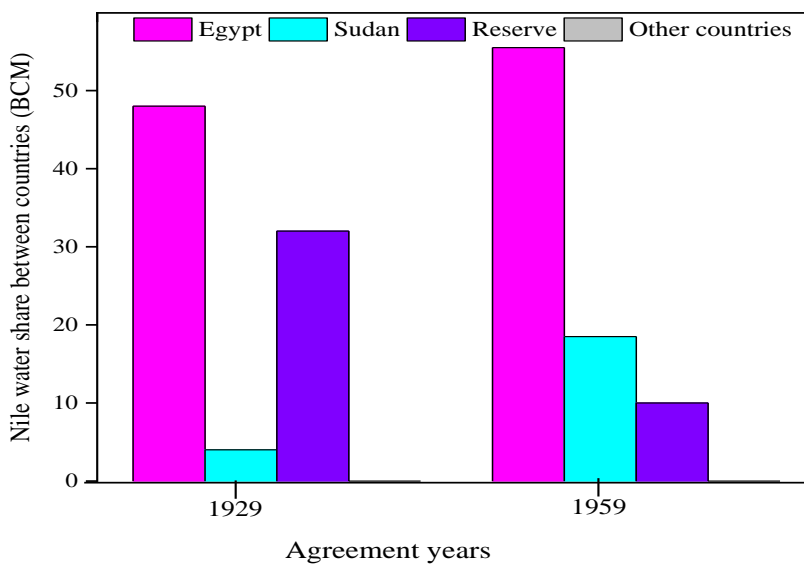


Figure 3. Water allocation from the 1929 and 1959 Nile River agreements.

1.3.2. The upstream riparian countries

In most transboundary river basins, the upstream states can monitor the flow of water, because they have the supreme geographical position, but in the case of the Nile riparian's it is different. The downstream nations have always dominated hydro-politics in the basin for decades [4]. Historically, the upstream countries and the main source of the Nile water have been mainly characterized by colonial law (except for Ethiopia), under deep-rooted poverty, internal conflict and political instability, lack of tangible water organizations, lack of external financial support, and combined with weak bargaining strategies for decades [55]. Large amounts of their national budgets have been expended for military

expenditures [54]. These overall weaknesses have destabilized their status in the basin hydro-politics and have impacted their use of the Nile water [56]. As a result, the upstream water of the Nile has largely stayed unutilized until recently when compared with the downstream nations [54].

For example, Ethiopia the most geographically powerful country in the basin, and the source of 86% of the total Nile water have 124 BCM river water, 30 BCM groundwater, and 70 BCM lake water resources. However, the country has only developed a limited amount of available water resources in its territory [43], and very few water control infrastructures have been constructed, the rest flows to neighboring countries [57]. The major dams are constructed by the downstream

states and some by Ethiopia and Uganda from the colonial era on the Nile River and its tributaries [42] (Table 4). Relatively the upstream nations have a large and stable amount of rainfall, and several water resources outside the Nile River [13]. Some of these countries, in other words, are not dependent on the Nile as the other two downstream riparian's and they were less interested in the Nile waters in the past decades (for example, Rwanda and Burundi) (Figure 4a). However, the last three decades have witnessed significant major two changes in the upstream nations [45]. First, the upstream countries are today more economically and politically secure than a decade ago, and riparian's are gradually willing to develop the Nile water resources to meet national development needs. Second, upstream riparian's currently have access to key external financial support, primarily from China. A decade ago, such assistance was not available [54]. Recently, because of population increase, economic development, and climate

change past Nile water less interest situation is slowly changing as the demand for freshwater increases in the basin [4]. Nowadays, upstream nations are poised to withdraw more water and have begun to control the Nile waters [14], to initiate general economic growth, and maintain their increasing populations [11]. Ethiopia, for example, plans to use Blue Nile water for irrigation projects and power generation (for example, GERD). Tanzania and Kenya plan to use Lake Victoria for irrigation projects that drain 1,860 cubic meters yearly from the current supply of the White Nile. Uganda, Burundi, and Tanzania have also united together to develop the Kagera River that flows into Lake Victoria. Generally, in all upstream nations, the demand for freshwater is increased that aggravate water stress between upstream and downstream nations, cooperation for mutual benefit is the only way forward in the basins [13].

Table 4. Major Nile River Basin dams (on main river and tributaries) [9, 46, 58, 59].

Description	Aswan Old Dam	Aswan High Dam	Merowe	Gebel Aulia	Sennar	Roseires	Khasm el Girba	Owen falls Dam	GERD	Tekeze Dam
Nile tributary	Main Nile	Main Nile	Main Nile	White Nile	Blue Nile	Blue Nile	Atbara River	White Nile	Blue Nile	Tekeze River
Country	Egypt	Egypt	Sudan	Sudan	Sudan	Sudan	Sudan	Uganda	Ethiopia	Ethiopia
Year of started	1898	1960	2004	1933	1920	1961	1960	1954	2011	1999
Year of completed	1902	1971	2009	1937	1925	1966	1964	1968	80% (2021)	2009
Total storage (BCM)	5.3	163	12.5	3.3	1	7.4	1.3	5	74	9.3
Initial live storage (BCM)	N.A.	137	5.7	2.8	0.9	5.4	1.2	3	31	5.3
Installed hydropower (MW)	592	2,100	1,250	30	48	400	10	380	6000	300

1.4. Agreements on transboundary water resources

1.4.1. The international legal aspect of water resource management

The laws of Helsinki on the use of international rivers, adopted in 1966, by the International Law Association [60], offer guidance on the appropriate use and management of transboundary rivers in cases where there is no specific treaty or traditional understanding prevails. The rules defined the principle of "reasonable and equitable utilization" of the rivers of an international drainage basin between riparian states as the fundamental principle of international water

law [61]. It sets fair allocations between the basin countries not by equal, but by specific variables that help prioritize their different needs such as (i) the geography of the basin, including the size of the drainage area; (ii) basin hydrology, including the contribution of water by each state of the basin, in particular [60]; (iii) history of water utilization, up to present-day utilization; (iv) the social and economic needs of each nation in the basin [11]; (v) the population dependent on waters in every state; (vi) avoiding undue wastage and unnecessary damage to other nations [21]. Although these rules are recognized internationally in general, in the Nile Basin nations this international law is still not

implemented [56]. Even today, there is competition, diplomatic conflict, and political tensions, especially between Ethiopia, Egypt, and Sudan. Implementing international water laws for equitable water utilization in the region is a way forward [61].

1.4.2. The beginning of multilateral cooperation in the Nile Basin

In the Nile Basin, the leading cause of tensions is competing views on the principle of equitable and reasonable utilization. The core question is how to allocate the water resources among the basin states. Many African countries gained their independence from colonial powers in the late 1950s and early 1960s [62]. Before the 1960s, the Nile water allocation has been dominated by bilateral agreements (between Egypt and Sudan). Despite the arguments surrounding the 1959 agreements, however, since the late 1960s, Nile riparian's have decided to establish multilateral cooperative initiatives [54]. Examples include the Hydromet (1967), the Undugu (1983), and the TeccoNile (1992) [63]. However, the achievements of these cooperative initiatives remained very limited and failed to meet their targeted objectives since they did not include all of the Nile riparian's [54], given the refusal by key upstream riparian's including Ethiopia, Kenya, and Tanzania, to become a member. Although these states have variously acted as observers to the initiatives. However, it showed for the first time the spirit of cooperation in the basin [64].

It was only in the mid-1990s, that all the Nile riparian's prepared themselves to establish a multilateral cooperative organization to deal with a shared vision: "to achieve sustainable socio-economic development through equitable use and benefit from the common water resources of the Nile Basin" [54]. Not only the riparian states themselves but also the international community strongly supported this process [65]. In February 1999, ten Nile riparian countries established the Nile Basin Initiative (NBI) [66], the first cooperative institution in the basin to include all riparian states [14], Eritrea attended as an observer, and at that time South Sudan wasn't a sovereign state [67], to certify collaboration and mutual trust between the riparian nations and looking for win-win gains in the basin [68]. The NBI Secretariat was formally opened in Entebbe, Uganda, in September 1999 [38].

Some previous treaties between the Nile riparian nations have been signed under the rule of colonialists and there has been no legitimate treaty between all the Nile riparian nations [4]. For upstream countries, it is hoped that these

negotiations ultimately eliminate the colonial agreements, and bring equitable water utilization in the basin [14]. The downstream riparian contends that multilateral cooperation is feasible without resolving previous water agreements and their "historical and acquired rights" [69]. Upstream countries believe that cooperation cannot be accomplished without a revision and renegotiation of past treaties (1929 and 1959) and the adoption of a new multilateral treaty [46]. Then, upstream states accepted a version that "water security" (Art 14b) be based on- the light of impartial utilization and no substantial harm. Article 14 (b) an obligation "not to have a major effect on the water security of any other basin states" (all agreed except Egypt and Sudan) [9]. Sudan and Egypt stated that this would be replaced by a clause requiring riparian states to accept that, "the water security and existing uses and rights of any other basin state should not be adversely affected" reservation made by Sudan and Egypt [37]. After several talks, the hopes of reaching an agreement on the "water security" clause failed [70].

By reinforcing Egypt and Sudan, all of the upstream nations agreed to sign the agreement by opening the Cooperative Framework Agreement (CFA) in Entebbe, Uganda, on 14 May 2010 [71]. To date, six states have signed the CFA (Tanzania, Rwanda, Ethiopia, Kenya, Burundi, and Uganda), which asserted that they would no longer ask Egypt's and Sudanese permission to divert water for their use [1]. However, Egypt and Sudan refused and opposed the framework, because it challenged their historic rights, and thus their domination of the Nile, not yet signed [37]. Both Sudan and Egypt froze their involvement in all NBI activities as a response to the CFA signature [65]. The DRC has remained neutral, Eritrea was acting as an observer, and South Sudan was not in the negotiation [9].

As their historic water monopoly and allocations have been challenged, the Entebbe agreement has changed power over the Nile away from Sudan and Egypt [46]. The downstream riparian's want any new agreement to acknowledge previous agreements, namely the 1959 agreement and its water allocations; and the upstream riparian's want a new agreement based on the concept of "equitable and reasonable utilization" that could potentially lead to a renegotiation of the volumetric allocations of water in the basin [54]. However, it couldn't resolve the Nile question, but it has significant implications to articulate upstream interests in bargaining power [46]. While the Entebbe treaty is not legally compelling for Egypt and Sudan, but it shows that upstream countries,

especially Ethiopia, pose a challenge to the Hegemony of Egyptian hydro politics [71], and determine to impose the facts on the ground concerning the building of the GERD in 2011 [3]. After more than 10 years, the NBI-CFA aims to negotiate a new deal, but Egypt and Sudan reject it outright [14]. Historically, one of the key obstacles to regional cooperation within the NBI has been the presence of traditional, legitimate water agreements, particularly the 1929 and 1959, agreements that no other upstream countries signed both agreements. The other challenges are political dispute, lack of cooperation and partnership with other regional bodies, and not regarded as an entity of the river basin, which is only a transitional institution [38].

1.4.3. Grand Ethiopian Renaissance Dam and current disputes in the Eastern Nile Basin

At the beginning of 2011, when the Ethiopian government officially announced its plan to build the GERD, the cooperation phase in the basin was already in a state of flux and the upstream nations were experiencing a new and unparalleled economic, socio-political, and hydro-political dynamism [65]. Two decades of multilateral cooperation contributed to enhancing the upstream nation's potentials in many ways, including ideational and bargaining powers [54]. By using such opportunities in 2011, Ethiopia surprised northeastern African countries by declaring its plan to build the first hydroelectric dam, about 750 km north-west of Addis Ababa and 45 km from the Sudan border on the Blue Nile River in a place called Guba [72]. The GERD is designed to hold about 74 BCM storage capacity and will generate 6000 megawatts [42], and the budget was estimated by the Ethiopian government at nearly \$ 5 billion [9]. The GERD is expected to become Africa's largest hydroelectric power plant and the 8th largest in the world that is projected to be completed by 2017, but this date was not achieved [45]. Currently, (Mid 2021), 80% of GERD were completed and parallel negotiation is going about the filling and other related issues between Ethiopia, Egypt, and Sudan [73].

The building of the dam on the Blue Nile created considerable controversy mainly from Egypt, which is highly dependent on the Nile River flows originating from Ethiopia [3]. The Nile for the Egyptian people is much more than just a river and see the river as a security matter [45]. Ethiopians, too, see the river in a symbolic light: their inability to utilize the Nile water so far reflects the political and economic underdevelopment of the country [42]. The Ethiopian government also believes that the GERD will become an image of national sovereignty, and

a symbol of recent development [45]. However, Egypt threatened war from the beginning if Ethiopia tried to block the flow of the Nile [74], and the Ethiopian government stated that the dam would supply electricity for Ethiopians and neighboring countries including Kenya, Uganda, Somalia, Eritrea, Djibouti, Sudan, and South Sudan [75], and would generate positive externalities for downstream nations by reducing floods and providing more constant and predictable flows [76]. Ethiopia and Egypt have struggled to control the Nile for a long time [42]. Both countries don't share a boundary, the Nile's ecological relationship has, for worse or better, connected the two states intricately [77]. From the Sudanese viewpoint, relatively they understand and support the GERD from the beginning due to sediment management, water regulation and flood control, and the regional power market offered by the GERD [78]. Especially, following the devastating floods that destroyed over 100,000 houses, killed at least 100 peoples, and displaced tens of thousands in August 2020 Sudanese government were more planned to support the building of GERD in Ethiopia as the best solution to solve the problem of flooding.

The first bilateral cooperation "the General Cooperation Framework Agreement" was signed between Ethiopia and Egypt in 1993, on the Nile issues, after the colonial period, and before the planning of the GERD construction [79]. Both countries agreed that neither country would do anything to the Nile that would cause "appreciable harm" to the other countries [9]. Besides Egypt, Ethiopia, and Sudan worked together under the umbrella of the Eastern Nile Technical Regional Office (ENTRO)/NBI to plan an ambitious Joint Multipurpose Project (JMP) from 2000-2009, which included possible hydraulic infrastructure construction in the Blue Nile Basin, which was the precursor of the GERD project [65]. However, the JMP project plan was losing political momentum in trilateral initiatives, and there is a failure of multilateral cooperation between upstream and downstream nations due to disagreements within the political cooperation in 2010 when the signing of the Nile CFA by key upstream riparian's when Ethiopia proposed the building of GERD. It was in this situation when the huge project proposed for building and launched after some months in the politically sensitive river basin.

On 23 March 2015, to increase trust between the three countries, Ethiopia, Egypt, and Sudan signed the agreement of "Declaration of Principles" in Khartoum, Sudan, for equitable and fair use of the Nile, which would not cause significant harm to other riparian countries [45].

Despite years of discussions, however, they have made little progress in agreeing to the technical details on the dam filling, dam security, operations policy, and exchange of information [75]. However, after four years, the controversy over the allocation and use of the Nile water among Ethiopia, Egypt, and Sudan has come into a new chapter. The problem is about what time and how the reservoir of the GERD dam should be filled are taking focus points [80]. The talks began after Egypt's president, Abdel Fattah Al-Sisi, invited the United States of America to be a broker in November 2019. Although America and World Bank start as observers in the initial tripartite negotiation, later the condition changed and America takes the position of a mediator [81]. Earlier, this year, the U.S tried to negotiate an agreement, but Ethiopia has not agreed to the U.S mediators [82].

The dam was built 80% at the time of writing and Ethiopia plans to fill the dam in 4 to 7 years to avoid water shortages in downstream countries [45]. Egypt disputes that the dam would reduce downstream water flows by 25% over the filling period (4 to 7 years) and prefers to take the filling period 12 to 21 years, but Ethiopia refuses [80]. According to Egyptian government studies, "every reduction of 1 BCM of water, 200,000 acres of farmland would be lost and livelihoods of 1

million people affected". The power generated at the Aswan High Dam will also be reduced [45]. However, Ethiopia announced that the first and second stage of filling the dam with 4.5 BCM scheduled was successfully achieved during July 2020 which is Ethiopia's main rainy season [83]. But Egypt instead of agreeing to use the water with Ethiopia appeals to the United Nations Security Council and again to the U.S after the latest round of talks in progress [84].

Finally, officials from the European Union, the United States, the African Union, and South Africa, President Cyril Ramaphosa, the current chairman of the African Union, participated as observers in the recent negotiation [82]. It is in this period, that the 3 states have agreed to reach a final treaty underscored that "African issues must be given African solutions" [45]. At the time of writing, the round table negotiations between Ethiopia, Egypt, and Sudan over the building and filling of the dam are sometimes on-again and off-again [73] and Ethiopia announced that the second stage of filling the dam with 13.5 BCM scheduled was successfully achieved during July 2021 which is Ethiopia's main rainy season. The GERD situation is an example from which lessons can be learned in the politically sensitive and disputed river basins for future dam construction.

Table 5. Comparison of GERD and AHD with other hydropower projects of global significance [58, 85].

Description	Three Gorges (China)	Itaipu (Brazil)	Nam Theun II (Laos)	AHD (Egypt)	GRD (Ethiopia)
Dam height (m)	101	225	39	110	145
Annual flow (bcm)	451	368	8	65	48
Installed capacity (MW)	22,500	14,000	1,070	2,100	6,000
Total storage volume (bcm)	39	29	7	163	74
People displaced	1.2 million	35,000	5,000	120,000	>14,000

1.5. The future water crisis in the Nile Basin countries

In 1996, the UNEP Executive Director reported that in the future, the disputes and difficulties caused by the scarcity of water will be a source of conflict between countries [86]. The world is heading towards a water crisis in several regions, particularly, in the Middle East and North Africa, (where some of the Nile Basin nations found), where the per capita water availability is 1,247 m³/year, one of the lowest in the world, compared to 18,742m³/year in North America and with the 23,103 m³/year in Latin America [35]. A study by the World Bank projected that by 2025,

the amount of water available to each person in North Africa will have decreased by approximately 80% in a single lifetime [9].

The Nile River is considered by many the greatest significant rivers in the world [87]. The Northeastern African nations depend on the Nile water for their development, but in different degrees [88] (**Figure 4a**). From North Africa, using Egypt's arid climate country as an example, the Nile is Egypt's main source of water and depends on the waters of the Nile River, thus there is no practical rainfall in Egypt [89]. However, water demand in the upstream states is rising fastest in line with current trends as a result of the

drastic population increase, industrialization, and agricultural activities [1]. But the longest river in the world is usually sick and getting sicker [90]. Several explanations were given to the Nile's illness, for the ongoing decline in its waters, the main reason is the population increase in virtually all basin states [60] (Figure 4b), climate change [24], and hydro-ecological degradation [45]. The Nile averaged 110 BCM annually at the Aswan Dam in the late 19th century was decreased significantly over the past 150 years (84 BCM) [14]. The concern that the Nile may dry up is not a new thing [45]. In 2020, the population of the basin countries is about 549 million, and the estimated population is projected to be 694 million in 2037 (Figure 4b) and water availability per capita will be decreased [59] by 50% in all riparian countries [91] (Figure 4d). As more of the upstream nations witness economic development (Figure 4c) the

increasing interest for major water infrastructure projects, and maybe scarce is high in downstream countries, especially in Egypt [6] (Figure 4d). The United Nations warns that by 2025, Egypt will run out of water [3]. According to one index, in 2011 Egypt was ranked number four among the world's most water-scarce countries and the World Bank ranked Egypt along with Kuwait, United Arab Emirates, Libya, and Saudi Arabia as the top five countries at higher risk of surface water stress [92].

The upstream countries' potential has now shifted; they can now embark on major projects and directly challenge downstream states. The Ethiopian GERD is an example of the transition [45]. Because of rapid population increase and growing water consumption in industry, agriculture, domestic use, etc., all basin countries are expected to rely to some degree on groundwater to develop their countries [93].

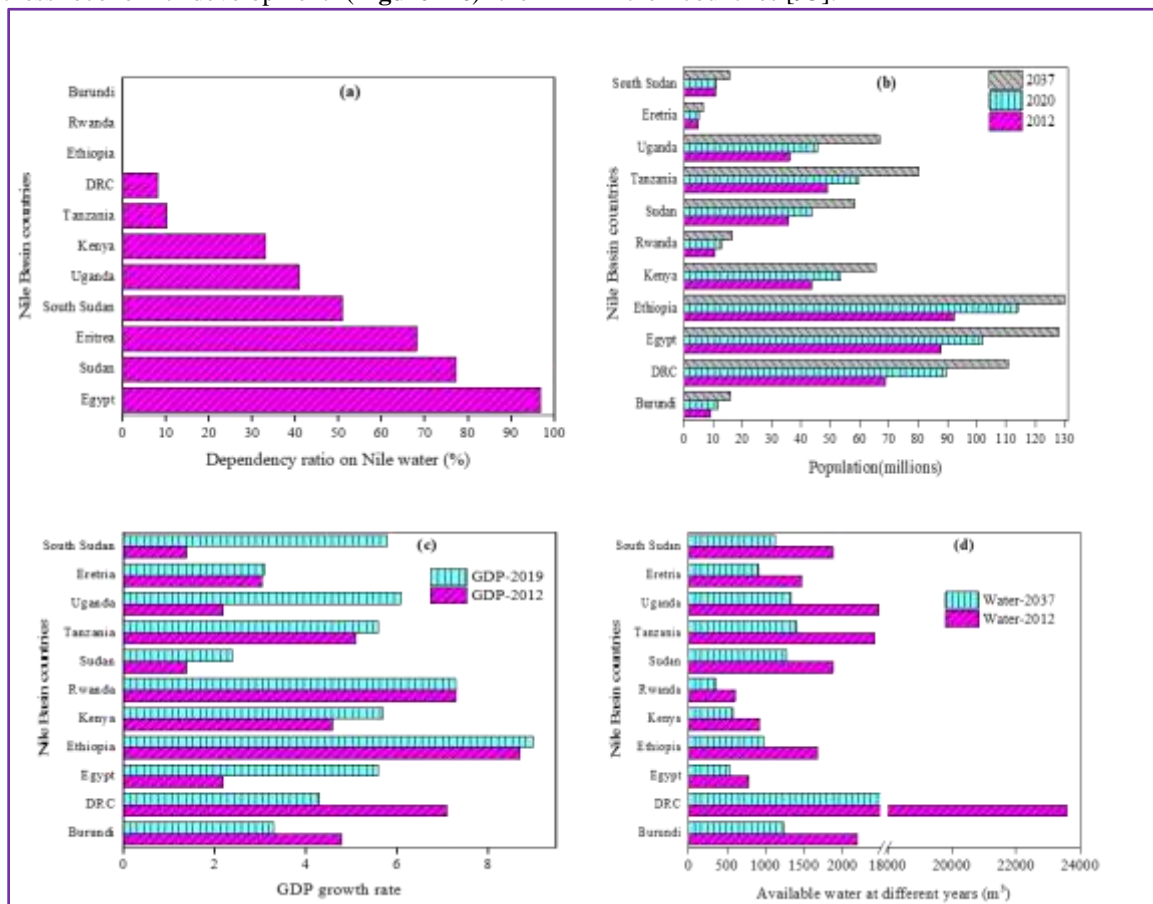


Figure 4. Nile Basin countries' status at different years (a) the water dependency ratio (b) a population growth rate (c) the GDP growth rate, and (d) per capita water availability decrease. Source: FAO (1997); World Bank (2012, 2019); African Development Bank (2012, 2019); UN World Water Report 2 (2012).

Besides, agricultural activities in the Nile tributaries with no well-buffered zone led to the enrichment of nutrients (phosphorus and nitrogen)

resulted from fertilizer application cause eutrophication in the water bodies to have a direct consequence on the water quality of the Nile River.

For instance, the current invasion of water hyacinth (*Eichhornia crassipes*) problem encounter by Lake Tana is a critical issue that needs, a collaborative effort to address the problem before the crisis comes and the lake water dry up. As shown in **Figure 5a** a year ago, Abiy Ahmed, the Ethiopian Prime Minister visited the problem of water

hyacinth expansion rate and said he was trying to battle the weed either manually or using machines. Moreover, as shown in **Figure 5b-d** following the calling of the Prime Minister when the local people cooperated to combat water hyacinth that colonized Lake Tana for the last 6-7 years.



Figure 5. Lake Tana (the main source of the Blue Nile River) and its fight with water hyacinth.

When the water in the Nile is scarce and riparian needs increase, the potential for conflict may be real in the future [86]. Although the authors don't agree happening right now in this century, previous reports stated that water wars are expected over the Nile River water allocation [16]. The authors believe that the water supply of the Nile River is sufficient if the cooperation of the basin nations is strong and the region's ecosystem is maintained to encourage the efficiency of water use in the basin.

III. LESSON FROM OTHER TRANSBOUNDARY RIVERS FOR THE NILE RIVER BASIN COUNTRIES

There are several good examples of cooperation, which profits economically and politically from the transboundary rivers in the world. In this study, the lesson from the Mekong, Senegal, Colorado, and Rio Grande River Basins were assessed to inspire the good lessons that might be important for the Nile River Basin nations.

1.6. The Mekong River Basin

The Mekong River, which is approximately 4350 km in length is the 12th and 7th longest river in the world, and Asia respectively [94]. The river originates from the south-eastern Himalaya Mountains of China's Tibetan region before discharges into the South China Sea [95], and passes through six states of Southeastern Asian countries with separate water contributions: China (16%), Myanmar (2%), Cambodia (19%), Laos (35%), Thailand (17%), and Vietnam (11%) [96]. Those states are divided into the upper (China and Myanmar) and the lower (Thailand, Cambodia, Laos, and Vietnam) Mekong River Basin countries [26]. The basin is home to over 80 million people living along the river and about 85% of the inhabitants are dependent on the river for their livelihoods such as fishing, rice production, aquaculture, and crop production [97].

The Mekong River has traditionally played an important role in regional development, but it has also been at the core of human conflicts and disputes for several centuries [98]. However, to reduce the conflict between riparian states, cooperation in the basin starts in the mid-20th

century with the formal signing of the Geneva Agreements (1954), when the newly sovereign states of Laos, Cambodia, Vietnam, and Thailand took their places on the world stage to end hostilities in the region (**Table 6**). The Mekong River Committee was established by the United Nations Economic Commission for Asia and the Far East in 1957 to address the comprehensive development of water resources by downstream nations in the Lower Mekong Basin [99]. The organization was restricted to the members of the nations of the Lower Mekong Basin only because, in the early 1950s, China was not a member of the United Nations and Myanmar were simply not interested in participating [96].

In 1977, Thailand, Laos, and Vietnam formed the Interim Mekong Committee in the absence of Cambodia [100]. In 1991, when Cambodia finally asked for readmission, extensive conversations started which lead to a massive transformation of the Mekong Committee to the 1995 Mekong River Commission (MRC) [94]. In 1995, the MRC replaced the Mekong Committee [101]. The four states signed the Mekong Basin sustainable development cooperation agreement and agreed to joint management of their mutual water resources and to improve the river economic potential [102]. In 1996, China and Myanmar became MRC Dialog collaborators, and the states are already working together in a cooperative

framework. China the basin Hegemony for the first time signed a treaty on 1 April 2002 to provide hydrological details on the Mekong River for mutual benefit [103].

This area of Southeastern Asia has been affected by colonization, the cold war, and is now working together to develop this most unutilized river in the world [104]. All of the “countries in the Mekong sub-region today have achieved political peace [50], social stability, and economic gains” [95]. Most of these socio-economic development advances within the region has been promoted through the river agreement cooperation [17], including transport, commerce, telecommunications, agriculture, and tourism. All nations have become highly integrated, assisted in part by completing the Trans-Asian Railway, building new highways that connect major cities, and direct flights to the capital cities [105]. Learning from the MRC agreement that brings all Mekong riparian’s for sustainable development, there will be a change in the Nile Basin, if all-riparian nations cooperate to implement CFA or establish other strong Nile Basin institutions that tie all basin nations for mutual benefit. Still today, some of the Nile Basin nations are the poorest nations in the world, but they have abundant resources like the Nile River, their challenge is lack of cooperation for win-win water allocation.

Table 6. Chronology of cooperation in the Mekong River Basin [94, 96, 97].

Year	Agreement	Countries involved	Main aspects
1954	The signing of the Geneva Accords	Thailand, Laos, Cambodia, Vietnam	Mekong cooperation begins
1957	Mekong Committee formed	Thailand, Laos, Cambodia, Vietnam	The comprehensive development of water resources was developed and discussed by the Mekong Committee
1957	Mekong Project	ECAFE, United States Bureau of Reclamation, and LMB countries	Mekong Project planning
1977	Interim Mekong Committee formed	Laos, Vietnam, and Thailand	Interim Mekong Committee formed
1991	Cambodia asked for readmission in the Mekong Committee	Cambodia, Laos, Vietnam, Thailand	The Mekong Committee's transformation into the Mekong agreement of 1995
1995	Mekong Agreement	Cambodia, Laos, Vietnam, Thailand	The cooperation agreement on sustainable development in the basin
1995	MRC established	Cambodia, Laos, Vietnam, Thailand	Formed the Mekong Agreement
1996	China and Myanmar became Dialogue	China, Myanmar, Thailand, Laos,	The countries are starts working together within a

	Partners of the MRC	Cambodia, Vietnam	system for cooperation
2002	China signed an agreement of MRC	China	China provides water level data in the flood season from Upper Mekong in China
2001-2006	Basin Development Plan (BDP) (Phase I)	Cambodia, Laos, Vietnam, Thailand	The first phase achieved much in terms of establishing processes and creating a framework
2006-2010	BDP (Phase II)	Cambodia, Laos, Vietnam, Thailand	Planned to institutionalize the basin's participatory planning
2000-2008	Water Utilization Program (WUP)	Cambodia, Laos, Vietnam, Thailand	Developing water use 'procedures' that could be agreed upon by the four LMB governments
2010	IWRM planning	Cambodia, Laos, Vietnam, Thailand	To move towards sustainable MRB development and management
2016	Lancang-Mekong Cooperation Mechanism	China, Myanmar, Laos, Cambodia, Vietnam, Thailand	Three cooperation pillars: political and security issues; economic and sustainable development; and social, cultural and people-to-people exchanges.

1.7. The Senegal River Basin

The Senegal River, 1800 km long, is the second-longest river in West Africa after the Niger River, with tributaries, including - the Bafing, Bakoye, and Faleme rivers, and ends at the Atlantic Ocean [106]. The basin is shared by four riparian countries: Senegal, Mali, Mauritania, and Guinea. The basin has an overall population of approximately 3.5 million peoples, 85% of whom reside near the river [107]. Following the independence of the basin states, water conflict persisted in the region because of the instability of political forces [108].

To reduce water conflict, in 1963: Senegal, Mauritania, Mali, and Guinea, signed the Bamako Convention on the development of the Senegal River and formed an intergovernmental committee to monitor its development [109]. A few years later (in 1968), the Labe Convention formed the organization of the Senegal River Basin countries and expanded its goals through water management to include political and economic cooperation [106]. In 1972, Senegal, Mauritania, and Mali established the Organization for the Development of the Senegal River, known as Organization Pour la Mise en Valeur du Fleuve Senegal (OMVS) [107]. One of the most relevant aspects of this convention,

however, is that Guinea did not participate, but it did not protest either, which made it possible for the process to proceed less difficult. Even though, it is working with the member countries to find ways of jointly developing the basin [109].

The OMVS member states enhanced their electricity and water supply through joint ownership and operation of the Manantali and Diama dams [110]. Mali receives 104 megawatts (52%), while Senegal received 66 megawatts (33%), and Mauritania received 30 megawatts (15%). The joint property of the Manantali Dam indicates a common interest to increase electricity production. The dam is located in Mali but belongs to all three countries. The costs and operating costs divide between three states based on the benefits as specified by the OMVS [26]. The cooperative development of the Senegal River has benefited the economies of Mauritania, Senegal, and Mali by improving the efficiency of main inputs such as electricity and irrigation, this is a good example of transboundary water cooperation in Africa. Besides, their experience shows that regional cooperation rather than unilateral development of a shared benefit and costs, that help to tackle poverty from the region. It is very useful for the Nile Basin nations to share the experience of the Senegal

Basin nation's cooperation (the same continent) to eradicate poverty.
 tie the region with power generation and to

Table 7. Chronology of cooperation in the Senegal River Basin [107-109].

Year	Agreement	Countries involved	Main aspects
1963	The Convention of Bamako signed	Mali, Guinea, Senegal, and Mauritania	Establish the Interstate Committee and declare the Senegal River an international river
1968	Formed Labe Convention	Mali, Guinea, Senegal, and Mauritania	Form the Organization for the Coastal States of the Senegal River (OERS) and define a basin-wide development program.
1972	Create the Senegal River Development Organization (OMVS)	Senegal, Mali, and Mauritania	To implement the development program outlined by the OERS.
1978	Sign a convention	Senegal, Mali, and Mauritania	Establishing the legal status of common works.
1982	Financial agreement	Senegal, Mali, and Mauritania	Sign a convention on financing the common works
1992	The OMVS-Guinea protocol is signed.	Mali, Guinea, Senegal, and Mauritania	Guinea again joined the mutual agreement
2000	The dam's management agencies established	Senegal, Mali, and Mauritania	The Diama Dam Management Company (SOGED) and the Manantali Dam Management Company (SOGEM), the dam's management agencies, are established.
2002	Sign and ratify the water charter.	Senegal, Mali, and Mauritania	Electricity generated at Manantali is transmitted to Bamako, Dakar, and Nouakchott
2004	Inter-ministerial meeting	Mali, Guinea, Senegal, and Mauritania	The first inter-ministerial meeting between Guinea and the OMVS member states is held, in Nouakchott

1.8. The Colorado and Rio Grande River Basin

The United States and Mexico share the waters of Colorado and the Rio Grande Rivers. Several concerns emerged in the 19th century regarding the borders and the sharing of transboundary rivers between two nations [23]. However, a 1944 bilateral water treaty guides how the two states allocate the flows of these rivers. The Colorado River passes through seven U.S. states before arriving in Mexico; 97% of the basin is in the United States. In 1944, both countries signed a treaty on "Utilization of Colorado and the Rio Grande Rivers" [26]. Under the water treaty of 1944, the United States is required to supply Mexico with 1.5 million acre-feet of the Colorado River water annually, representing about 10% of the average flow of the river [111]. The Rio Grande headwaters are in the USA, and its major tributaries are in both countries. Mexico has access to two-thirds of six Mexican tributaries of the Rio Grande originating from Mexico under the 1944 water treaty [23]. Under the terms of the deal, the United

States receives all flows from the Rio Grande tributaries in the United States and one-third of flows from the six Mexican tributaries, equivalent to at least 350,000 acres annually [30].

The 1944 treaty stipulates that if there is an "extraordinary drought" situation, Mexico may postpone water payments for the next five-year period, but are not specified in the treaty as "extraordinary drought" [111]. This absence leaves the decision [about who gets the water] in the hands of the upstream party because the negotiators of either country cannot agree. These uncertainties ignited controversy about the true nature of the drought and prompted criticism of the treaty, and the treaty of 1944 was defiled from the beginning [30]. The 1944 treaty allocated 1.5 million-acre feet of the Colorado River annually to Mexico but did not discuss the water quality that Mexico would receive. Improved water diversions in the US increased the salinity of the water that flows to Mexico. The amount of total dissolved solids is increased from 800 to 1500 ppm between 1960 and 1962. The salinity of Colorado during the 1960s

and early 1970s was the most controversial water conflict between the U.S and Mexico. To solve the dispute of the 1944 treaty, in 1973 both countries reached an agreement on a permanent and definitive solution to the question of salinity in the international Colorado River by amendment of agreement [111]. In 1973, the two states signed an international boundary and water commission Minute of 242 No. 261 to address the problems of salinity. Recent talks between North American countries have peacefully ended a fifty-year dispute over the Colorado River's mutual water utilization and sanitation problems [26]. It is a good advantage if the Nile Basin countries take the experience of the United States and Mexico on Colorado and the Rio Grande River treaty of 1944, that amended in 1973 to bring peace between two countries, to cooperate on the amendment of the 1959 Nile water-sharing agreement, which poses significant challenges to the achievement of the objectives of the NBI and the implementation of the CFA and the source of disagreement between riparian nations. But both North American nations are allies and much more politically stable than the 11 riparian nations of Northeastern Africa.

IV. CONCLUSION

Transboundary rivers can cause cooperation or conflict in the world. However, the Nile River has been viewed for centuries as a source of conflict, rather than cooperation. The basin is home to a permanent tension between the upstream riparian's, the main contributors of the Nile water, and downstream riparian's, the main users of the Nile water. The basin resources have been controlled by the downstream riparian countries particularly by Egypt and to some extent Sudan. Egyptians believe that there will be no Egypt without the Nile and see the river as a security matter. Thus, like Egypt, Sudan claims the absolute territorial integrity right to the Nile's River. Ethiopians and some of the other upstream riparian's too, see the river in a symbolic light. However, the upstream water of the Nile has largely stayed unutilized until recently when compared with the downstream nations. The allocation of the Nile is regulated by various international agreements, of which the 1929 and 1959 bilateral agreements between Egypt and Sudan, and the 1999 multilateral agreement that includes all basin nations represent key tipping points in the hydro political relations between riparian countries. However, both bilateral agreements were opposed by the upstream countries after they became independent countries based on the argument that they were bilateral,

belonged to the colonial era agreements, and ignored the interests of those upstream states. The agreements represent the backbone of the hydro political dilemma in the basin. The multilateral cooperation of 1999 is also failed due to disagreements within the political cooperation between upstream and downstream nations in 2010.

Now cooperation between main riparian nations in the Eastern Nile Basin (Egypt, Ethiopia, and Sudan) is more serious than ever in resolving emerging disputes around the filling of the GERD. However, At the time of writing, the round table negotiations between three countries over the building and filling of the dam are sometimes on-again and off-again. Besides, because of population increase, economic development, and climate change, the upstream demand for freshwater is increased, and the previous situation is changed, they are poised to withdraw more water from the Nile to develop the mega project and overall economies, GERD is a good example. In line with current trends, in all basin states, there will be dramatic population growth, and economic dynamism, then the region's per capita water availability would be decreased by 50% over the next 20, years which will aggravate regional tension over water. Thus, as the Nile water is scarce and riparian needs are growing, conflict potential is real and future agreement on how to use the water in a win-win situation is necessary for the region. Overall, following the international water law, implement the CFA of NBI or establish another strong institution, and looking for transboundary water management those having a good lesson are important for sustainable water management in the Nile Basin that leads to social, environmental, and economic developments.

Future direction for the Nile Basin countries

There are several challenges to manage common-pool resources efficiently and equitably, such as transboundary river basins with multiple riparian states, but there are solutions that can help, cooperation is the key rather than conflict. However, as water is scarce, cooperation does not occur easily; to achieve this, the Nile Basin countries need to cooperate, resolve conflicts, plan, establish a strong water organization that includes all riparian's like that of the MRC of the Mekong River Basin and OMVS of Senegal River Basin and manages the water resources jointly to achieve sustainable development, and regional stability. The basin nations must use water as an instrument of negotiation, which possibly will only occur if all the riparian's have reached a legal treaty among all of them based on trust, shared interests, and a

common bond. The Nile water is enough for all if riparian states are managed and used sustainably in the future. The present competition on water allotment may sacrifice the region on water resources. It is a good advantage for Ethiopia, Sudan, and Egypt to solve their current political dispute in their continent to make sure there is an African solution to African problems. Generally, the governments of the basin countries must cooperate for equitable and reasonable water utilization for mutual benefit.

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