What the Grand Ethiopian Renaissance Dam means to Egypt

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Abstract: **The US-mediated meetings between Egypt, Ethiopia, and Sudan will chart the future of the three countries for decades. In April 2011 Ethiopia launched the GERD project, disregarding its significant repercussions on Egypt's water sources, electricity generation capacity, soil fertility and salinity, agricultural production and GNI levels. The historical enmity and charges exchanged between both countries have fueled a decade of contention that have now recently amounted to verbal threats. The first round of US-brokered negotiations was held on December 9, in which Egypt maintained her proposal to receive 40 BCM instead of a nominal 55 BCM every year and asked to keep the water level in the Aswan High Dam at 165 meters above sea level. Ethiopia continues to reject these demands, but some progress has been achieved. The second and third rounds of negotiations will reveal the arrangements for possible solutions, alternative water sources for Egypt, and means to ease the upcoming catastrophe. This paper examines GERD repercussions on Egypt and possible scenarios that could be addressed in the upcoming rounds. Desalination, alternative approaches to electricity generation, and new lines of an agricultural policy will mark a new phase of public policies, along with modifying the technical specification of GERD to follow a realistic estimate of electricity generation based on the Nile's mean water flow.**

Introduction

The discussion on GERD dates back almost a decade; the project was launched just a few weeks after the Egyptian revolution was launched in January 2011, fueling Egypt's allegation that Ethiopia has exploited Egypt's fragile political conditions. Egypt takes evidence from the progress of the GERD's project, moving from an initial 11 BCM to 145 m height and 67 BCM capacity, then to 70 BCM and finally to 74 BCM in 2012. The technical specifications of the final project are at the core of the ongoing conflict. Ethiopia's most ambitious brand of GERD has two complementary parts; the first is a concert Dam located near the Ethiopian-Sudanese border, 154 m high, 1.8 km long, with a storage lake whose surface area extends through 1,900 square kilometers. The second part is a saddle dam located a few kilometers away from the first installment. The lake and storage capacity of this saddle dam has been the focus of disputes over the last decade.

The focus of contention has moved from approving Ethiopia's right to build the Dam to the size of the reservoir, the impounding time-intervals, water level in Aswan High Dam (AHD), sediment, soil salinity, water levels in ground aquifers, and other issues.

Egypt has repeatedly condemned the Ethiopian side of leaving negotiations and launching a hate discourse over media outlets. The same accusation was exchanged against Egypt, ending up with numerous attempts to seek the mediation of international parties – the World Bank, the UN agencies, Russia, and finally, the USA.

The recent threats by Abiy Ahmed Ali to launch a war,[1] if needed, over the Dam introduced a new phase of the conflict. Finally, the US has mediated four scheduled meetings in a row to negotiate possible solutions. The first round ended with agreeing on a starting point with Ethiopia- two turbines of 720 MW and 4.9 BCM to be impounded in mid-2020.

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Now the bulk of contention focuses on water claims. Ethiopia promises to release around 30 BCM annually, while Egypt needs at least 40 BCM to reach her mainland and fill AHD at a 165 m high. [2]

The brief addresses a selected body of research on how GERD is expected to affect Egypt. It skims, compares, analyses, and connects the ideas of more than 20 studies to provide a short-handed and comprehensive view of what GERD means to the Egyptian side. Also, it surveys possible collective and unilateral solutions that mitigate the worst scenario and offer insight on how to resolve the present contention. The paper argues that two factors are decisive to negotiations. The economic feasibility of GERD and the amount of finance needed (1) for Egypt to undertake mitigation projects; and (2) for implementing rerouting and connection projects to maintain the amount of freshwater in the Nile past Ethiopia.

Background

A large part of the conflict over GERD started over historical and ideational competition between Egypt and Ethiopia. In the competition to the 'gift of the Nile', a growing Ethiopia has no less national and historical pride, being the source of the Blue Nile and origin of over 80 percent of its current water. Arguments of Ethiopia's hydropower-hegemony might be exaggerated, but some historical facts are undeniable.[3] The much sought-after political hegemony and expansion rooted the eruption of two wars during the 19th century when monarchical Egypt under Khedive Ismail sought to expand its political and military influence on the Nile basin in 1874 and 1876. Egypt lost in both battles known as 'Gura' and 'Gundert', but the conflict was further deepened when the British authorities accorded Egypt's water share and veto power in the 1929 and 1959 treaties.

The two agreements have set the line of water distribution along the Nile basin since 1929. The Anglo-Egyptian agreement treaty in 1929 between Egypt and the British colonial power has allocated 48 BCM of water to Egypt out of an estimated 84 BCM annual yield of the Nile. The other agreement in 1959 between the UK and independent Egypt has increased Egypt's water share to 55 BCM and gave her the Veto right to any construction projects over the Nile.

These agreements bear the seeds of today's conflict. On one side, all Nile countries have trouble abiding by the agreement and sustaining their people, especially since Egypt and Sudan's total population appear to be less than the population in some other Nile basin countries,

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according to 2050 demographic projections.[4] On the other side, a competent Ethiopian government has chased time since 2011 to ensure stable economic and commercial ties with China, Israel, and the USA and to support the country's geopolitical advantage.

Few gains and massive losses

Ethiopia has announced the plan for GERD in 45 km distance from its eastern border with Sudan, with a capacity of 74 BCM to produce 6,000 Megawatts (MW) and export energy to neighboring countries.[5] The project is intended to provide water to residents of "Bani Shankul Gomez" area which will meet domestic and irrigated agriculture needs; it will control irregulated floods at Sudan's 'Rusairis' Dam, store the Nile's valuable silt (measured around 420 BM annually) that extends the life span of Sudan's dams like 'Merowe' - which suffers from accumulated sediments in its reservoir; reduce the evaporation of water since the Dam's lake sits on a 570-650 m above sea-level height; and relieve the load of stored water in AHD which used to cause some weak earthquakes.

Nevertheless, the project has a range of severe impacts on the Egyptian side.

1- Change in water surface level

Around 96 percent of freshwater supply in Egypt comes from the Nile, which originates outside its borders. The Nile receives 68 percent of water from the Blue Nile (Abay), 14% from Atbara (also a tributary of the Blue Nile) and 18 percent from the White Nile in Khartoum. In short, 82 percent of the Nile at Aswan comes from Ethiopia's Highlands.[6]

Meanwhile, Egypt has no other source of freshwater and struggles to make do with less water share per person, since its population has increased three-fold since 1959. The international minimum water share per person stands at 1000 cubic meters per person annually, but each Egyptian has access to only 600 cm. In other words, Egypt is already 40 percent under the water-poverty line with the existing water share. The amount of surface water is insufficient neither for domestic nor for agricultural needs and the country suffers an actual shortage of over 20 BCM annually.[7]

GERD is expected to reduce Egypt's share from nominal 55 to 31 BCM (billion cubic meters), in one scenario, and by 25% if filled in a 3-5-year interval. In all cases, the actual water flow will be reduced when other factors are considered; the reservoir is expected to support irrigated cropping in Sudan,[8] which will increase Sudan's water use and affect the final amount of water being released to Egypt. Hence, Egypt advocates that the maximum reduction in her water share should not exceed 5-15% of the initial 55 BCM[9].

2- Limiting secondary water sources: Shallow aquifers

Because surface water is insufficient, people are usually forced to compensate by digging wells in shallow water aquifers at different depths. These aquifers are only sustainable

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so long as they are renewed and recharged with excess irrigation water, rainfall, and seepage from canals and drainage networks. A study has estimated the amount of infiltration between surface and groundwater in the western Nile Delta as of 28.1 million cubic meters/day.[10] The government policy to adopt non-rice crops in the Nile Delta will eventually render these aquifers depletable because the amount of excess water seeping down will be reduced. Hence, if GERD is impounded in three to six years, GWL (Ground Water Level) extraction rate should be reduced by 40 to 60 percent to maintain water freshness in the Nile Delta.[11]

3- Impeding the functioning of Aswan High Dam (AHD)

GERD is expected to decrease the level of discharge in Nasser Lake by 5 BCM/year,[12] and AHD is projected to reach its minimum operational level for four consecutive years, thus failing to satisfy Egypt's water needs.[13] The situation can hardly improve in future decades. Donia and others[14] conclude that the period between (2070 -2099) will be very critical for AHD functioning. In recent work, she examined the case of filling GERD in five years, indicating that the water level in AHD will fall to min. 147m; life storage will decrease to 33 BCM compared to 67 BCM before GERD; and energy generation through the reservoir will decrease to 24% (falling from 1,028 to a minimum 330 GWh).[15] Moreover, the AHD turbines are expected to quit operations below 160 m. Hence, by the third year of the filling, AHD's hydropower generation is expected to be terminated.

Associated climatic changes are also expected to undermine AHD functions in Upper Egypt. In the case of full GERD storage capacity, AHD evaporation loss will be minimized because the surface area of Lake Nasser will shrink with lower water levels. However, GERD could waste 3 BCM of evaporated water a year, which is three folds Egypt's total rainfall and enough water to maintain the living of 500,000 people.[16] Also, water release will decrease by around 10.5%, since "net annual discharge of the Blue Nile downstream could be minimal, and the Nasser Lake would struggle to sustain the required water for all the Nile Valley and its Delta in Egypt."[17] In addition, as water level upstream in AHD will decrease, it is expected to affect the AHD outflow on irrigation pumps throughout the Nile course from Aswan to the Delta.[18] All these results can slightly change if the GERD was filled to 75% or even less of its total storage capacity, or if the impounding took place over a longer period of time, which Egypt suggests would be more suitable over 7 years.

> *Saltwater intrusion and increases in soil salinity will impose potential effects on crop patterns in the Nile Delta*

4- Increasing soil salinity

Ground water levels in shallow and deep aquifers are expected to witness significant changes in soil composition. Primarily, saltwater intrusion and increases in soil salinity will impose potential effects on crop patterns in the Nile Delta.

A study released on December 10th 2019, [19] has assessed the impact of GERD on the ground water level (GWL) and soil salinity in a pilot area East of the Nile. Results revealed that GWL and Surface Water level (SWL) are directly proportional to each other with a 0.99% measure. When compared to a case study in 2012, a 50% decrease in SWL was associated with a decrease in GWL from 5.0m to 2.0 m. The planting of low water consuming crops decreased GWL to 1.3m. The study also concluded a direct and significant relation between crop patterns and soil salinity; when non-rice crops are planted, salinity increased from 0.45 S/m to 0.48 S/m in a 10-year stimulation interval. These implications are furthered below.

5- Impact on Crop Yields and national income

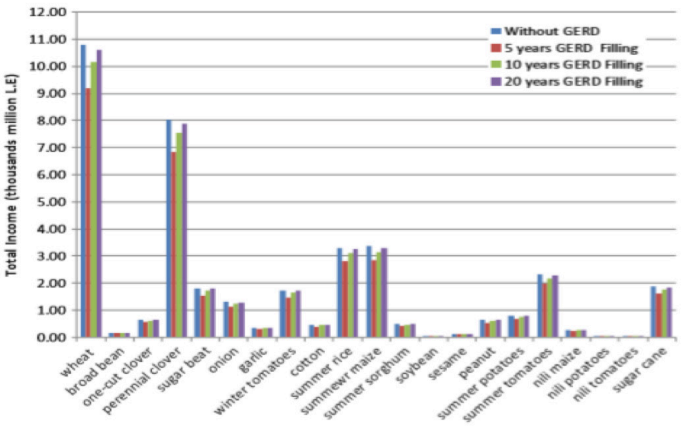
In April 2018, the government adopted a parliamentary law that bans the cultivation of water-intensive plants for a second year in a row. The Egyptian Agricultural and Irrigation Ministry has taken one of the most serious decisions by reducing the cultivation of voracious crops, mainly rice, in certain regions, and reducing the cultivated areas in other places. Thus, the rice-cultivated area was downsized from 1.8 million to only 724,000 feddans in nine Egyptian governorates. Farmers were encouraged to seek less-water consuming species of rice.

This provision has reduced the excess irrigation water that used to seep into shallow aquifers and thus reduced soil salinization, helped maintain its biodiversity, and provide a second source of freshwater. Applying two MODFLOW simulations for cases where rice and non-rice crops are cultivated, the study by Donia and Negm in 2018 revealed that GWL was decreased to 4.6 m with non-rice crops and that crops consuming less water, such as grapes, actually increased soil salinity[20].

6- Implication on water-return values for national crops

Based on CAPMAS data,[21] crop-return-value is expected to fall by 18% in the event that GERD was filled in five-year intervals. Wheat crop will witness severe effects, but the loss will decrease considerably if GERD is filled on 10 and 20 year intervals (Figure 1).

Figure1



Source: Donia and Negm. 2018. P.20.

Meanwhile, if filled to different storage capacities, the loss in return-value for water may significantly decrease as shown in the graph below (Figure 2).

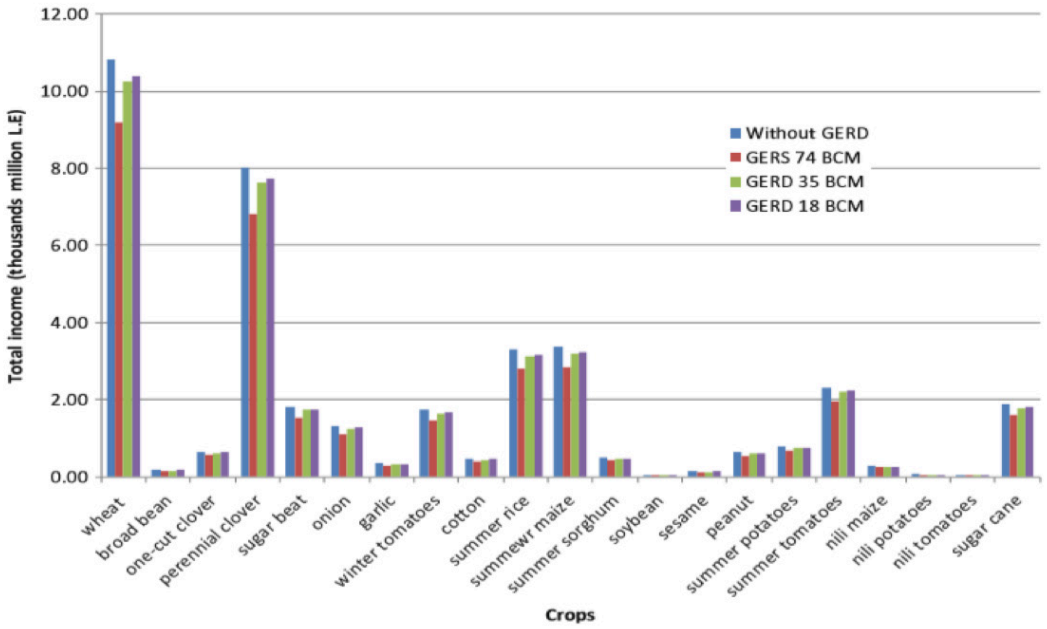


Figure 2
Source: Donia and Negm. 2018. P.22.

7- Environmental repercussions

The enlarged GERD capacity will impose serious implications on the natural landscape in Ethiopia-Sudan border areas. These include (1) the increased risk of collapse by geological factors and the Blue Niles rush speed that sometimes peaks to over half a million cubic meters per day falling from a 2,000m height; (2) earthquakes in the reservoir area due to the water weight reaching 74 billion tons and distributed over 1,800 square km of a shaky rock environment that withstands a max. stress of 145 tons per square meter from the lake bottom; and (3) Sudan losing silt and fertilizers that nourished the land around the Blue Nile. Moreover, Tayie' refers to the GERD's limited lifespan, (max. 50 years) due to severe siltation (triggered by a flow of 420 thousand cubic meters per year) and the technical limitation of power turbines that might challenge the Dam's efficiency.[22]

8- Sediment and water quality issues

Ever since the project came into daily politics, the 'International Rivers' panel of experts' report posed a few serious questions, including the sediment level in the Nile's freshwater once GERD comes into operation.[23] Experts indicate that the sediment flows downstream AHD and GERD will substantially decrease and thus inflict imperative consequences on 'farming productivity, navigation, Sudan's brick industry, riverbank erosion, and biodiversity'.[24] Moreover, the depletion of dissolved oxygen and methane gas production levels in the released water are expected to harm fisheries and biodiversity in the water as it reaches Sudan and Egypt.

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Negotiate or go to War? Possible solutions and alternatives

The grand Ethiopian ambition for development and self-sufficiency, with its natural resources, should be considered in all aspects. So is the economic and human livability situation in Egypt. Bearing both in mind, and based on expert papers, the following solutions can be followed:

– Slowing down the impounding pace of the GERD to 10 years at worst, and 20 years at best (although recent negotiations have already undergone 4 to 7 years impounding interval, depending on hydrology and rainfall)
– Limiting the storage capacity of GERD to its initial 14- 18 BCM – though Ethiopia had already closed this byway by executing a 74 BCM Dam.
– Tying water levels in AHD and GERD together to ensure a stable and adequate flow to AHD (rejected by the Ethiopian side on the grounds that it reflects 'colonial' times)[25]
– Seeking other water sources desalinations over the Red and Mediterranean seas and applying water conservation strategies in domestic and agricultural sectors.[26]
– Egypt builds additional dams on the Nile to capture floods and rainfall (this will partially redress the losses that Egypt will sustain at the beginning of GERD impounding process).
– Rerouting the Blue Nile to alternative courses as a means to mitigate GERD's catastrophic consequences on Egypt.
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Egypt's stand is fostered by additional two factors.

(1) Sudan's Loss of fertile agricultural land and migration of local people

According to Tayie', the GERD lake will dump half a million acres (1,680 square km) of forest land and irrigated agricultural land, which are "difficult to compensate due to their geological characteristics- i.e., the mountainous and rocky nature of land and the absence of close irrigable and arable areas".[27] Moreover, 2,000 people will be resettled for the project to take place.

(2) Limited ability to meet Ethiopia's energy needs

Experts highlight the fact that GERD has been oversized, meaning that more than half of the turbines will rarely be used. The GERD average power output is 2000 MW, while the GERD height is 145 m. The system, and expected energy generation, have been designed according to near-peak flow which only occurs during the 2-3 rainy months of the year. Asfaw Beyene, professor of Mechanical Engineering at San Diego State University, argues that targeting the peak flow makes no economic sense, because the load factor for the Dam designed to produce 6,000 MW would be only 30%.[28] If the Dam was designed to produce 2,000 MW only, it would have reached a 90% load factor.

This is significant. Because the Dam is located near the borders with Sudan and hundreds of

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kilometers away from the nearest Ethiopian city. The cost of transferring energy to Ethiopia's heartland is high and the reward is almost insignificant because local electricity is highly subsidized by the Ethiopian government.[29] Safety is another consideration. With 145 m height, GERD can produce over 7,000 MW during the Nile's peak flow but will turn off during the rest of the year. Inconsistent power supply has significant safety repercussions. A consistent supply is only feasible if the Dam is designed according to the mean flow which is 1,456 m/sec. Elsewise, some extra 10 turbines will be parked for 9 months a year. Hence the appropriate design should not exceed 2,800 MW, still greater than energy produced by AHD.[30]

Ethiopia's success in neutralizing Sudan has harmed the Egyptian-Sudanese relations over GERD and rendered the proceeds of negotiations unpromising. After its initial siding with Egypt, the Sudanese government has supported GERD since 2015 as the project will provide cheap energy, allow the irrigation of cropped lands around the Nile, and remove 86% of sediment that limits the local dams' life cycle.[31]

After isolating Egypt, Abiy Ahmed Ali's recent warnings of his country's readiness to go to war over the Dam drew attention to the military option that has not been absent from Egyptian statemen's mind- as well. Egypt considers the GERD crisis a pure political conflict in which Ethiopia follows a long-rooted dream of hydro Hegemony that rests on historical claims and geographic facts. Even before ex-general Sisi comes to power, Ex-president Mohamed Morsi's phone was tapped while exchanging discussions with a senior military figure in the SCAF (Supreme Council of Armed Forces) over attacking the Ethiopian Dam. Later, the Egyptian government apologized but the thought of war has not yet faded away, because of (1) the severe repercussion GERD will inflict on Egypt's economy and political stability, (2) the high possibility of inciting other African countries with long interests in Damming the Nile, such as Uganda, Tanzania, the DRC, Eritrea and Rwanda to undertake similar projects and terminate the working AHD, and (3) Egypt's recent purchase of a USD 2 billion SU 35 warrior planes from Russia, all of which bring the war option to the forefront of daily talks.

Also, the Egyptian side has been rightfully disheartened of the possibility to have effective negotiations with Ethiopia. The Ethiopian stand on the GERD is not an isolated instance of compromising on the 'no harm principle' when building Gibe III Dam and extending large-scale plantations that inflicted considerable damage to Kenya's Lake Turkana.[32] This explains why Ethiopia sticks to flaring allegations of Egypt for following the 'colonial heritage' route instead of considering the consequences and working on joint solutions.

Hence, the potential of the Egypt-Ethiopia conflict to cause another African war with serious consequences is not unlikely, but parties must seek out every other alternative option before resorting to this point, even if it requires Egypt to accept significant, but bearable, damage

Hence, the potential of the Egypt-Ethiopia conflict to cause another African war with serious consequences is not unlikely, but parties must seek out every other alternative option before resorting to this point, even if it requires Egypt to accept significant, but bearable, damage. To bring Ethiopia back to negotiations, Egypt has sought the help of the UN, US mediation, and even threatened to bring the case to the UN security council.[33] The month of October has passed with contentious announcements and statements from both sides but concluded with the USA's initiative for fresh talks in Washington. Also, Russia has backed another meeting in Sochi to ease the accelerating conflict.

According to Al Ahram magazine,[34] the first of four scheduled tripartite meetings in Addis Ababa took place on November 15 2019 and was attended by the World Bank and American observers. Results included (1) Egypt's approval of GERD starting to impound 4.9 BCM in mid-2020 and Ethiopia's launch of two power-generating turbines that will produce 720 MW; (2) GERD reservoir to be filled in 4 years conditioned by adequate rainfall and extendable to seven years if otherwise; (3) Egypt demands a minimum of 40 BCM water flow and Sudan requires a minimum of 35 BCM every year, however Ethiopia suggested the release of just 31 BCM between the two countries, and the rest of the water quantity in case of a rainfall shortage.

The third meeting in a row is scheduled for January 15 2020 and the three countries have agreed to attend two meetings in the USA on December 9th and January 13th to assess progress. The US Treasury Department announced a diplomatic statement by the three parties[35] but technical concerns remain in place, particularly, the amount of water reaching Egypt, and the water level in AHD.

Possible Scenarios

1- Cooperation: establishing an integrated water resources management council between Egypt, Ethiopia, and Sudan.

This will mitigate 'nationalism' and 'regional hydro-hegemony' claims on both sides by enforcing a collective and mutually informed decision-making regarding water policies, the filling and releasing of water, and production/use of water, energy, and land in the three countries. Cooperation mechanisms must address the strategic plans and financial needs for joint projects and negotiate relative weight and gain for each partner (e.g., in Ethiopia the energy need can be traded with Egypt's need for freshwater).

2- Unilateral mitigation policies

Given the present situation, Egypt will have to establish an Aquifer Storage Recovery (ASR) scheme, artificial recharge and scheduled water extraction, and more dams on the Nile. Meanwhile, also needing to follow a desalination investment and water-saving

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drip irrigation policies, to mitigate soil salinization and maintain 60% less use of ground water. The huge financial cost of these measures legitimizes the Egyptian claim for (time)- that GERD be impounded on longer timing intervals.

3- Re-designing the GERD Project

The economic infeasibility of the GERD project lays the ground for re-designing the reservoir space and reducing the number of turbines to ensure a consistent flow of energy to Ethiopia throughout the year. Also, Ethiopia needs to consider the value-for-money of this hydropower project because eventually the roughly USD 5 billion will need to be repaid. Power transmission to the heartland, the reduced price of local electricity, and the project's inconsistent production of energy (due to the Nile's natural flow) all call for the need to turn GERD into a more feasible project that targets 2.800 MW instead of 6,000 MW. Meanwhile, this will relieve Egypt's concerns over the Dam's repercussions on AHD. A smaller GERD reservoir means that the water levels in both GERD and AHD are easily attachable. With mild mitigation policies, Egypt can overcome the water shortage. International financiers of GERD can bring Ethiopia to terms, using pure economic logic. This will also reduce the financial needs of Egypt's unilateral mitigation policies- mentioned in Scenario (2) and will avert a crisis that will affect almost 100 million people.

4- Seeking International Funds

Connecting the Nile and Congo water systems or diverting the course of the Blue Nile could serve as secondary alternatives. But they both come at a rising cost. Engineering challenges are inevitable and a massive infrastructure will be needed, including the digging of a 600-km canal and setting-up pumping stations and huge dams to transport water from the Congo to the Nile basin.

In short, the timing and finance make the third scenario the most feasible one, unless other factors come into effect. Neither Ethiopia nor Egypt has significant leverage over the other. The geopolitical strength of Ethiopia is balanced with a rising military and human capability in Egypt, while the contention may open the door to seemingly unending conflicts over the Nile basin. In all cases, Egypt will need to finance mitigation projects and seek alternatives to the Nile water, which might be a better investment rather than burying funds in the new Administrative Capital.

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The Sharq Forum is an independent international network whose mission is to undertake impartial research and develop long-term strategies to ensure the political development, social justice and economic prosperity of the people of Al-Sharq. The Forum does this through promoting the ideals of democratic participation, an informed citizenry, multi-stakeholder dialogue, social justice, and public-spirited research.

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