The Nile River: Conclusions and Recommendations

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Abstract Instead of being a source of cooperation for sustainable development, it becomes a source of conflict. It is the Nile River which is the longest river in the world, although its discharge is less than 1.5% of the Amazon River discharge. The Nile River volume of the Handbook of Environmental Chemistry describes in detail several important aspects of the river. These aspects include the Nile journey from origin to end, the water and sediment qualities, the morphology and the stability of its promontory at its end, rainfed agriculture and fish and fisheries in the Nile Basin, climate change variability, vulnerability, mitigation and adaptation measures, legal and international aspects and its hydropolitics. These contents are covered in 23 chapters. On the other hand, the most highlighted conclusions and recommendations of the 23 chapters of the Nile River volume are presented in this chapter.

Keywords Climate change, Ecosystem, Hydropolitics, Legal aspects, Nile Basin, Rainfed agriculture, Sediment assessment, Sustainable management, Water quality assessment

Contents

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1 Summary

Recently, the international rivers like the Nile River have attracted the attention of the researchers. Although the Nile River is the longest river in the world, the area of its watershed comes at the 6th order, and its annual flow appears at the 24th order. In this volume, the Nile River journey is described from the Nile origin to its end. The lifetime span of the Aswan High Dam Reservoir (AHDR) is estimated using different approaches and the maximum deviation is found to be within 2–16%. The water quality of AHDR is reviewed. The morphology, the ecosystem, the water quality, and sediment quality along the Nile River are discussed and presented. The stability of Rosetta promontory via hydrodynamic modeling is proposed along with the estimated costs. Also the different methods for coastal zone protection zone are reviewed. Moreover, several international issues are discussed in detail. These issues include impacts of mega projects like GERD at the Upper Nile on the downstream countries. Fish and fisheries aspects in the Nile Basin and the challenges facing this important industry are discussed and several management issues are raised for improving the productivity. The climate change impacts and its variability, vulnerability, mitigation, and adaptation measures are emphsized. The extent of the required cooperation among the Nile Basin countries to face the climate changes' impacts is focused. The legal and international aspects that proof the rights of Egypt in the Nile River water share of 55.5 BCM are verified. The main hydropolitics of the Nile River Basin are discussed.

In the next sections, conclusions and recommendations of the different chapters are presented. Also, some others from recently published research works are stated for the purpose of updating.

2 Conclusions

The following conclusions could be stated:

1. The Nile River basin is very rich in its natural resources including water as the main source of life, but lack of cooperative management makes these as if they were not existing. Moreover, the absence of an organizing collaborative and integrated legal framework among all Nile Basin states increases the potential international conflicts among the Nile Basin states.
2. The Life Time Span of Dead Zone (LTSDZ) is equal to 254 years and the Life Time Span of Life Zone (LTSLZ) is equal to 964 years based on numerical simulation using CCHE2D. However, it should be noted that this lifetime span will not be significantly affected in the future because after the construction of the GERD the sediment will be retained in its reservoir. However, the pattern of the accumulated sediment in the AHDR will be modified as a result of the almost clear coming water to AHDR. On the other hand, the satellite remote sensing approach is used to estimate the lifetime of the AHDR. The LTSDS and

LTSLZ are estimated to be 478 years and 830 years. Moreover, the estimations based on the cross section method that was adopted by Aswan High Dam Authority are found to be 487 years and 833 years.

3. Results indicated that the Lake Nubia water quality status ranges from excellent to good, compared to the Egyptian water quality standards for fresh surface waterways. Also, results of the applied trophic status indices show that the Lake Nubia trophic status is eutrophic. The Carlson TSI, based on total phosphorus, indicates that the trophic status of Lake Nubia is hypereutrophic. Also, results indicated that reservoir zones should be assigned to different water use according to its water quality and trophic status due to the impact of the Lake morphology and water quality and trophic.
4. A 3-D model is built for the Lake Nubia using GIS and the collected data over an extensive period. Then, a satellite remote sensing approach is used to estimate the sediment amount in the AHDR. The estimated amount of sediment using RS/GIS deviates by 4% from the cross section methods which is utilized by the associated authorities of the Lake. This means that RS/GIS approach overestimates the accumulated sediment by 4% compared to the cross section method.
5. Rating curves for Nubia Lake are developed, and the accuracy of the developed relationships is assessed by comparing the results with the observed data and the current rating curves for the lake.
6. The study of the multi-temporal morphological changes in water surface areas of the first reach (from Aswan to Esna Barrages) and the second reach (from Esna Barrages to Naga Hammadi Barrages) of the Nile River is presented. The RS/GIS technologies based on using Landsat images indicate that total water surface area of the first reach of the Nile River over the period between the year 1984 and the year 2011 is decreased by about 2.39 km^2 (2.3% of total area). It is observed that the maximal changes are located around the reach islands. While for the second reach, the results show that the total decrease in the area of the second reach of the Nile River over the period (1984–2010) is about 13.14 km^2 (about 13% of the total water area in the year 1984). Moreover, the results illustrate that the maximum decrease of this studied reach water surface area occur through the period (2005–2010) is about 8.33 km^2. It should be mentioned that most changes in this reach occurred in the river banks due to the accumulated sediment annually (sedimentation process).
7. The use of the different change detection methods indicates the superiority of the NDWI method for water change detection compared with other methods. Its overall accuracy is 99.23% for the first reach while it is 99.13% for the second reach.
8. Results of the 2-D modeling of the bed morphology of the Nile River downstream of Naga Hammadi barrages show the importance of bed morphological simulations and demonstrate the requirement of having stochastic runs to supplement the deterministic analysis.
9. The distribution of the natural radioactivity in the sediments of the Nile River from downstream Aswan to El-Minia is reviewed. The results reveal that the

natural radioactive elements such as ^{238}U, ^{232}Th, and ^{40}K have been detected with spatial variation along the study area. However, the variation of the distribution of the detected elements depends on many factors as listed in the relevant chapter.

10. In general, the Nile water is suitable for human consumption after regular treatments in water treatment stations. However, during the low flow periods, some harmful pollutants might be recorded such as heavy metals and fecal coliform bacteria.
11. The water quality along the Nile River from Aswan to Assiut changes from low to high flow and from one place to another according to human activities based on the measured water quality parameters for two successive years 2011 and 2012 at ten sites. The measured physical and chemical parameters include temperature, turbidity, water electrical conductivity (EC), total suspended solids (TSS) and total dissolved solids (TDS), pH value, dissolved oxygen (DO), nutrients, biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC), major anions and cations, hardness, heavy metals, and fecal coliform bacteria. Results indicate that the water pollution increases with distance from the Aswan High Dam to the north due to untreated agricultural drainage water flowing by gravity back to the Nile. Industrial and sewage water are controlling factors in polluting the Nile River water. The water quality of the Nile Water is classified as medium. Moreover, eutrophication of the water caused by organic and inorganic pollutants cause the overgrowth of some algae that secrete toxins which affect water quality and especially drinking water from the Nile. Some specific algae cause odor, smell or taste problems.
12. The results of the hydrodynamics simulation of the Nile River (Damietta Branch reach) from 26.5 to 116.5 km downstream EL-Roda Gauge with a total length of 90 km due to excess flow of 20 million m^3 reveal that dredging is required at some cross sections to maintain the reach and to keep the navigation path sustainable.
13. Hydrodynamics simulation is conducted at Rosetta promontory. Testing several combinations of hard and soft protection measures using the Coastal Modeling Software system is performed. It is concluded that optimum solution is to use a combination of an eastern jetty of 360 m length and western jetty of 800 m, in addition to sand nourishment (with amount of 300,000 and 200,000 m^3) in front of the eastern and western revetment, respectively. The chosen scenario has the merits of (a) the sand nourishment will be added every 2 years for the western part and every year for the eastern side; (b) an annual dredging work of 36,000 m^3 behind the eastern jetty is required; (c) the construction cost is estimated to be about \$9,920,000 while the annual maintenance cost for the sand nourishment is estimated to be about \$2,700,000 every year for the eastern part of the promontory and about \$1,800,000 for the western part. (These costs are calculated based on a currency change rate of \$1 = EGP8).
14. The study of ecosystem and biodiversity in the Nile Basin indicated that the Nile Basin countries face several problems including (but not limited to)

inefficient water use, water pollution, population stress and land degradation, deforestation and soil loss, over hunting, and fishing and sedimentation problems. Also, the study concluded that the main sources of biodiversity degradation in Lake Nasser include the development of land around the lake, expansion of agricultural land, and disappearance of habitat from excessive grazing or application of agrochemicals. Also, it is concluded that habitats are affected by pollution, and hunting, fishing, and tourism activities are disturbing the natural habitat especially within the shoreline zone.

15. The biggest challenges and threats facing fisheries resources in the Nile Basin include species introductions; degradation of aquatic habitats and biodiversity; unsustainable fishing practices; pollution and eutrophication resulting from human populations and invasive weeds. The constraints that hamper the development of aquaculture in Africa, including Nile Basin countries are introduced. Management plans and necessary measures are suggested in the chapter titled fish and fisheries, and the implemented efforts to develop the industry are presented.
16. Considering the Blue Nile watershed hydrological modeling, the use of GSMAP_MVK rainfall data set underestimates considerably annual precipitation and seasonal precipitation as well due to missing data values which could be substituted by TRMM (GSMAP_MVK_T) data to provide comparable performance to other satellite-based products, with a slightly better probability of detection during the flood season. Moreover, the performed statistical analysis of annual and seasonal rainfall of 22 ground-based meteorological stations in the upper Blue Nile River basin for 49 years indicated that a mix of insignificant positive (increasing) and negative (decreasing) trends in seasonal, and annual rainfall at the stations is identified. Generally, out of the 22 stations surveyed, significant trends in annual series are evident only at one station at the rate of -2.9 mm/year, and the significant decreasing trend in rainy seasonal series at the same station was at the rate of -1.9 mm/year.
17. Rainfed agricultural production systems and irrigated agriculture are the two main irrigation and production systems in the Nile Basin. The former is vulnerable to impacts of climate variability and change and is characterized by subsistence production, and low inputs and yields. The latter, in particular on a commercial scale, has high productivity and improved water-use efficiency, but there are some schemes in the Basin where yields are still low. Intra-basin trade in agricultural products has the potential to promote rural development, enhance regional food security, and foster regional integration. However, trade volumes in primary agricultural commodities between Nile Basin countries are low because none of the riparian countries produces sufficient surplus to sustain high-volume intra-basin trade. The opportunity for enhancement of regional integration through trade, therefore, remains largely unutilized, despite the improving climate for regional trade brought about by the creation of regional trade bodies such as EAC and COMESA [1].
18. Expected shortage of water due to the construction of GERD affects greatly the irrigated agriculture system in Egypt. In general, the construction of Upper Nile

mega projects like GERD will cause a shortage of water at Egypt side leading to total environmental negative impacts. Consequently, the impacts of the water scarcity at Egypt include crop and fish production and farmers income, present and future reclaimed land (other developments), salt water intrusion, soil salinity, supply intakes and intakes for water treatment plants, main canals and rayahs, ecological imbalance, tourism industry, health risks, generation of hydropower, Dam failure impacts, and socioeconomic impacts. The large capacity of GERD reduces the ability of the High Aswan Dam as a long-term storage reservoir as indicated by the increase in water deficit quantity and frequency. The filling of GERD will have very significant negative impacts on the Egyptian water and energy sectors depending on the adopted reservoir filling rule, and GERD dam size and the incoming flow during the flood season.

19. A recent study conducted by Batisha [2] proved that using the Rapid Impact Assessment Matrix (RIAM) technique "indicates that in both Physical and Chemical category and Biological and Ecological category, there are major negative impacts for both upstream and downstream countries. On the other hand, the RIAM indicates that in the Sociological and Cultural category and Economic and Operational category will have a positive impact in upstream countries and negative impacts in downstream countries" [2].
20. On the other hand, the review of the effects of climate change on the Nile Basin revealed that (a) short-term (seasonal or shorter) droughts are expected to intensify in most of Nile basin regions. Longer-term droughts are expected to intensify in large areas of the eastern Nile; (b) annual precipitation and river-flow increases are observed in the west of the delta and the Northwest regions. Very heavy precipitation events have increased nationally and are projected to increase in all regions as a result of Extremes' events. However, the length of dry spells is projected to increase in most areas, especially the eastern portions of the Basin; (c) "climate change is expected to affect water demand, groundwater withdrawals, and aquifer recharge, reducing groundwater availability in some areas" [3] especially at Egypt Nile valley and delta; (d) climate change affects water demand and the ways water is used within and across regions and economic sectors. Egypt and Sudan are particularly vulnerable to changes in water supply and demand due to climate changes and potential development project at the Blue Nile and (e) "changes in precipitation and runoff, combined with changes in consumption and withdrawal, have reduced the surface and groundwater supplies in many areas. These trends are expected to continue, increasing the likelihood of water shortages for many uses" [3]. Recently, Elkolally et al. [4] indicated that the Eastern Nile Basin "received several drought events during the long rainy season (June to September) and the short rainy season (March to May) as well. Annual analysis of SPI time series indicated that the study area received several drought events, and the most severity event was during the year 1984."
21. Climate change could have very serious impacts on growth and development. The costs of stabilizing the climate are significant but manageable; delay would be dangerous and much more costly. Factors like climate change impacts, many

institutional, scientific, economic, and political barriers present challenges to implementing adaptive strategies. Also, non-climate-related stresses that contribute to existing vulnerabilities should be reduced as it can be an effective approach to climate change adaptation.

22. The Nile Basin is also prone to severe inter- and intra-annual variability of rainfall. The basin's population is expected to double every 25 years. High population growth and increased variability of rainfall are forcing many of the countries, which depend on rain-fed agriculture, into irrigated farming system, thus increasing overall consumptive water demand on the system.
23. The analysis of legal and international laws shows that the principle of fair and just use of the international waterways is the most appropriate legal principle internationally. It is also the best that is suitable for the nature of the international rivers because it considers the differences among the onshore states as far as their water needs, their population, the degree of their economic and social progress are concerned. Also, the absence or presence of river fresh waters alternatives should be considered. However, the debate remained in many cases among the onshore states located on the banks of the same international river although they recognize the principle of fair and just use.
24. The conducted analysis on the Nile, an international river is based on (a) the agreement of 1978 regarding the international succession of the treaties, (b) Vienna Convention regarding the laws governing the agreements (1969), and (c) the basics of the African actions adopted since the establishments of the Organization of African Unity in relation to the recognition of the inherited borders – including the disadvantages – in order to maintain the stability of the international relations, security, and peace in the continent. Therefore, the analysis proved the accuracy of the Egyptian/Sudanese position legally. Egypt and Sudan adhered to the desire that the agreement should include a provision that would ensure the historical and acquired rights, guaranteed by the law which is already present in the existing agreements. They agreed that expressing those rights should be under the term "current uses." They also adhered to the principle of prior notification about the projects which upstream states plan to execute, a stable and fixed principle according to the actions, jurisprudence, and laws.
25. Depending on reading the scenarios of the hydropolitical relations in the Nile Basin, the analysis clarifies that the conflicting interactions would be increased in the area due to one or more of the following variables: (a) the insistence of the upstream states on the Entebbe Framework Agreement as a legal framework, (b) the execution of dams and projects in the Nile upstream states without prior consultation, and (c) the refusal of the Republic of South Sudan to the Agreement signed by Egypt and Sudan in 1959 and the increased external interventions that stimulated conflict.
26. On the other hand, it is anticipated that the cooperative tendency regarding interactions among the Nile Basin states will increase due to one or more of the following variables: (a) the establishment of collective developmental projects, (b) the resurrection and activation of the Nile Basin Initiative, and (c) the

activation of water diplomacy between Egypt and the Nile Basin states and the activation of the people's diplomacy.

27. To conclude, the weighting scenario remains subject to the will of the people and the states of the Nile Basin. Also it depends on the rational choice and the trade-offs between the alternatives: managing the conflicts or managing the cooperation on water in a promising area.

3 Recommendations

The following recommendations are stated to help Egypt taking utmost care of its water supply to ensure

1. A significant amount of water could be harvested and added to the net Nile water discharge via efficient and well-managed cooperation between Nile Basin countries. This might minimize or prevent any conflicts between the Upper and Lower Nile stream countries and meets the demand of the high population growth in all Nile basin countries. By the year 2050, the population might reach more than 850 million capita and will certainly cause much pressure on the Nile water quantity and quality.
2. It is highly recommended to conduct a hydrodynamic study to investigate the change in the sedimentation patterns of the AHDR due to different scenarios of sediment concentrations of the incoming flow after the complete construction and operation of GERD.
3. A spatial change in water quality and trophic status is noticed due to the spatial, morphological, and hydrological characteristics of the AHDR. Therefore, it is recommended that the different zones of the AHDR should be assigned to different water uses based on comprehensive water quality studies.
4. It is highly recommended to use the satellite remote sensing and GIS approach to monitor or change detection and estimate the amount of accumulated sediment in the lakes based on building an accurate 3-D model for the lakes.
5. Updating the rating curves for the dams' reservoirs is highly recommended whenever new reliable observations are available. Moreover, "Egypt has to be prepared to significantly improve management of Lake Nasser, it's only major water storage infrastructure" [5]. At the same time "Water-use efficiency in domestic, industrial, and agricultural sectors can be very significantly improved with existing knowledge, technology, and management practices" [5].
6. A future morphodynamic investigation to the first and second reaches of the Nile River (from Aswan to Esna Barrages and from Esna Barrages and from Naga Hammadi Barrages) to understand the mechanism of the increase in the islands surface areas and to understand the mechanism of the sedimentation process through the river banks. Also, it is highly recommended to conduct the same study on other reaches along the Nile River as pre-investigations for future studies on the improvement and sustaining of the navigation paths/requirements through the Nile.

7. When modeling the bed morphology of the Nile River, a stochastic model like Monte Carlo simulation is needed to run to assess the uncertainty of the results of the 2-D modeling.
8. The distribution of the natural radioactivity in the sediments of the Nile River from El-Minia to the Mediterranean Sea needs to be investigated to complete the picture of the spatial distribution of the natural radioactivity along the Nile.
9. The results of investigating the water and sediment quality from the downstream of Aswan high dam to Assiut indicate that the study should be extended to all sites along the Nile up to the northern coast.
10. Continuous monitoring of the cross sections along the Nile River is needed to measure water levels and velocity pattern and observing the morphological changes in the reach (if any) and consequently updating the hydrodynamic simulation for the different reaches once a new updated data set is available or a change in the morphology is observed.
11. Future research work should move forward towards investigating the use of ecological and environmentally friendly protection methods to sustain the dynamic stability of Rosetta and Damietta promontories. Also, ecological-environmentally-friendly shore protection methods should be adopted whenever possible along the northern coast of Egypt for sustainability of the shoreline in the future.
12. Regular and continuous monitoring scheme for developing ecosystems of the Nile River system is needed. Environmental law should be modified and enforced to prohibit the discharge of wastewater such as agricultural, domestic, industrial, or other sources to the Nile River system. At the same, treatment plants should be constructed (whenever possible) and well operated with high performance at all point source pollution. Also, cooperation in scientific and environmental monitoring of water quality and sources of pollution in African countries should be implemented since any contamination in any upstream country of the Nile basin will affect some or all of the downstream countries. The possible risks of fish cages on the water quality of Nile River and its branches should be assessed, and then the regulations and law should be implemented if any violation exists.
13. Studying the fish and fisheries along the Nile Basin identified a list of constraints that hamper the development of the fish industry. Those constraints should be addressed by Nile Basin States, both individually and cooperatively if aquaculture is to be developed sustainably. The international organizations and fund providers associated with aquaculture development (such as FAO, EU) should also provide more assistance to overcome the listed constraints and to promote aquaculture development in the region. Among the needed actions to sustain the fish industry the following are important: (a) set up and enforce appropriate laws; (b) regulations and policies to sustainably manage the fisheries resources and their habitats in the Nile Basin; (c) develop efficient and effective institutions and institutional processes and governance which involve stakeholders in planning and implementation; (d) develop sustainable funding mechanisms for implementing fisheries programs; and (e) provide adequate

financial resources and human capacity to implement fisheries management program.

14. The hydrological modeling of Nile Basin watersheds needs ground measurements to calibrate the available remote sensed data which has long temporal coverage and can be used for hydrologic modeling purpose. It should be emphasized that a comprehensive study should be conducted to identify the trend and the pattern of the global data and the extent of agreement with the local data to set a suitable adjustment mechanism to the global data sets to suitably integrate them with the local data sets.
15. Concerning the agricultural productivity across the Nile Basin countries, "it is recommended that the Nile countries should implement a coordinated set of measures targeting the multiple constraints affecting the agricultural production sector" [1], which include: (a) Floods and failing rains; (b) Vigorous weeds; (c) High disease and pest prevalence; (d) High cost of farm inputs such as fertilizer and pesticides; (e) High post-harvest losses; (f) Weak extension services; (g) Lack of credit; and (h) Inadequate information on market opportunities.
16. From a water management perspective, the critical interventions in the Nile Basin should include: (a) Increasing investment in irrigation development such that in the downstream countries, focus should be on improving water-use efficiency, while in the upstream countries it should concentrate on improving efficiency of existing irrigation systems and expand the land under irrigation [1]; (b) Improving scheme management and agricultural productivity within the smallholder irrigation schemes in the downstream countries so as to double or triple the agricultural production without additional water demands; (c) Increasing investment in rainwater harvesting and in small-scale irrigation in upstream countries to increase the resilience of rainfed agriculture to climate-related shocks; (d) "Increasing investment in watershed management in upstream countries to reduce soil erosion and to increase water availability, especially in mixed highland smallholder subsistence farming systems; and (e) As production rises and agricultural commodity trade within the region continues to benefit from progressive reduction in tariffs, the struggle to increase trade should shift to deal with the many non-tariff barriers between countries" [1].
17. The entire system of the Nile River Basin should be studied to examine whether the proposed agricultural and hydropower projects can be established together. Also, the needs for development in the entire basin and water scarcity conditions highlighted the need to harvest the vast amount of water losses occurring in the wet (swampy) areas of the Nile River basin to reduce the food gap and promote development in all Nile Basin countries.
18. The study of the effects of the upper Nile mega projects on Egypt justified the apprehension that Egypt has adverse impacts of unilateral development in upstream countries. Therefore, the general international rules of win-win, no harm, and no regret are the only way for regional development for the interest of all Nile Basin countries.

19. Proactively preparing for climate change can reduce impacts while also facilitating a more rapid and efficient response to changes as they happen. Such efforts are beginning at different nations in Nile basin to build adaptive capacity and resilience to climate change impacts.
20. Increasing resilience and enhancing adaptive capacity in most of the Nile Basin are needed. Water resources managers and planners should seek new innovative strategies to be ready to manage the new risks, vulnerabilities, and opportunities that might not be adequately managed within existing practices.
21. Review and analysis of climate change impacts across the Nile Basin indicate that proper mitigation and adaptation actions are required across all Nile basin countries, and it needs not cap the aspirations for growth of rich or poor countries. Therefore, climate change demands an international response, based on a shared understanding of long-term goals and an agreement on frameworks for action. "Three well-respected global circulation models indicate flow increases of 12 and 18% and catastrophic decline of 77%. Under such uncertainties, Egypt needs to increase all types of water storage, improve water use efficiencies significantly in all sectors, and monitor river flow changes over the years very carefully" [5].
22. Evidence indicates that cooperative development of the basin's water resources would lead to more efficient and sustainable development of the basin's water sources. Therefore, a regional system to apply an integrated water resources management in Nile Basin countries' water policies is highly needed.
23. It is highly required to have a shared knowledge base, analytical capacity, and supporting stakeholder interaction to ensure cooperative planning and management decision making for the Nile River Basin sustainable management of its natural resources to be included into national, economic, and sustainable development policies.
24. The achievement of the sustainable development of any Nile Basin state should be encouraged as long as it causes no harm to the Nile onshore states. Therefore, consultation and prior notification must be adopted by the upstream states if they seek to implement any development project (such as construction of dams) to avoid any harm that may affect the quantity and quality of the current water share to the downstream countries.
25. The efforts of the upstream countries should be employed to secure the benefits of the Nile Basin communities via mutual projects that can help achieving the requirements of the principle of equitable and reasonable use without causing any harm to the downstream countries instead of focusing on attempts to change the legal amounts of the downstream countries.
26. It is highly recommended that the Nile Basin countries should go to manage the cooperation instead of going to manage the conflicts for the benefits of all of them. Other external countries (non-Nile Basin) should enforce any real cooperation trend and respect the real willingness of the Nile Basin countries regardless of their strategic issues in the region.
27. The increasing demand of water by Egypt due to the increase in the population necessitates that Egypt should give considerable attention to the water supply

issue during the next few coming decades. “Ensuring water security in Egypt in the coming decades means that the country will have to run ever faster and faster simply to remain in the same place” [5].

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