2014

Water Scarcity in Egypt:

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I. Introduction

Egypt has reached a state where the quantity of water available is imposing limits on its national economic development. As indication of **scarcity** in absolute terms, often the threshold value of 1000 m^3/capita/year, is used. Egypt has passed that threshold already in nineties. As a threshold of **absolute scarcity** 500 m^3/ca/yr is used, this will be evident with population predictions for 2025 which will bring Egypt down to 500 m^3/ca/yr.

The total population of Egypt increased from 22 million in 1950 to around 85 million in 2010. The annual rate of population growth has steadily declined from 2.4% during the 1976-1986 decade, via 2.1% for 1986-1996 to 1.9% for the year 1996-2006 periods. This rapid increase in population growth will continue for decades to come and it is likely to increase to between 120-150 million by 2050. This high population growth rates will exaggerate the problems associated with water sector allocation. In terms of water quality, the data available indicate that rapid deterioration is occurring in surface and groundwater quality.

Agriculture consumes the largest amount of the available water in Egypt, with its share exceeding 85% of the total demand for water. In the Egyptian economy, the agricultural sector contributes about 20% to Gross Domestic Product (GDP) and provides about 40% of total employment. In view of the expected increase in demand from other sectors, such as municipal and industrial water supply, the development of Egypt's economy strongly depends on its ability to conserve and manage its water resources.

From the other hand, several studies showed that the Nile River is very sensitive to temperature and precipitation changes mainly because of its low runoff/rainfall ratio (4%). The prolonged 1979-1987 drought forced Egypt to reduce its water use despite the inter-annual storage in Lake Nasser behind the High Aswan Dam, which clearly shows the vulnerability of Egypt to changes in river flows that climate change may produce. A climate change prediction model identified water resources as one of the three most vulnerable sectors to climate change in Egypt; the others being coastal zones and agricultural resources.

Being the most downstream country on the Nile, Egypt is affected by climate change impacts, not only within its borders, but also within the whole basin, which it shares with 9 other countries. Economic developments in upstream countries and measures they might take to adapt to climate change are likely to put more pressure on water resources in Egypt. Therefore, it is of prime importance for Egypt, amongst other Nile countries, to assess the hydrological impacts of climate change on the Nile.

II. Water Resources and utilization in Egypt

2.1 Water Supply

The main (almost exclusive) source of water in Egypt is the Nile River. Egypt is unique among other countries in its dependence on water from one deterministic source. The Nile water agreement with Sudan, allocates 55.5 BCM/year to Egypt. This amount is guaranteed by the multi-year regulatory capacity provided by the High Aswan Dam (HAD).

Rainfall in Egypt occurs only in winter in the form of scattered showers. The average annual amount of effectively utilized rainfall water is estimated to be 1.3 BCM/year. This amount cannot be considered a reliable source of water due to high spatial and temporal variability.

Groundwater exists in Western Desert and Sinai in aquifers that are mostly deep and non-renewable. The total groundwater volume has been estimated at about 40,000 BCM. However, current abstraction is estimated to be 2.0 BCM/year. The main obstacles in utilizing this huge resource are the great depths (up to 1500 m in some areas) of these aquifers and deteriorating water quality at the increasing depths.

Shallow Groundwater in the Nile aquifer cannot be considered a separate source of water. The aquifer is recharged only by seepage losses from the Nile, the irrigation canals and drains and percolation losses from irrigated lands. Hence, its yield must not be added to Egypt's total water resources. Therefore, it is considered as a reservoir in the Nile river system with a huge capacity but with only 7.5 BCM/year rechargeable live storage. The current abstraction from this aquifer is estimated at 6.5 BCM in 2013.

Desalination of seawater in Egypt has been given low priority as a water resource because the cost of treatment is high compared with other sources. Desalination is actually practiced in the Red Sea coastal area to supply tourism villages and resorts with adequate domestic water supply where the economic value of the water is high enough to cover the treatment costs. Other groundwater desalination units are constructed at several locations in Sinai as a water supply for Bedouins. It may be crucial to use such resource in the future if the growth of the demand for water exceeds all other available water resources. However, its use will depend on technological development in this field.

Treated domestic sewage is being reused for irrigation with or without blending with fresh water. The increasing demands for domestic water will increase the total amount of sewage available for reuse. It is estimated that the total quantity of reused treated wastewater in Egypt is about 0.3 BCM in 2013.

Reuse of non-conventional water sources such as **agricultural drainage water and treated sewage water** cannot be added to Egypt's fresh water resources. In fact, using these sources is a recycling process of the previously used Nile fresh water in such a way that improves the overall efficiency of the water distribution system. The amount of water that returns to drains from irrigated lands is relatively high (about 25 to 30%). The total amount of reused water is estimated to be 13 BCM in 2013. The reuse practices increase the overall efficiency of the system as comparable to the efficiency of modern irrigation systems.

2.2. Sectoral Water Demand

Water requirements in Egypt are continuously increasing due to population increase and improving standards of living as well as the governmental policy to encourage industrialization. Demand for water can be categorized in classes representing main items in the demand side of the water balance. Water requirements of the agricultural sector represent the largest component of the total water demand in Egypt.

Agriculture consumes more than 85% of Egypt's share of Nile water annually. Although the country lost part of its fertile land to urbanization, this has been balanced by expansion of agricultural areas. Expansion in agriculture is carried out horizontally and vertically through crop intensification by cultivating the land more than once a year. In 1990 cultivated lands were 6.92 Million Feddans (MF) with cropped area of about 12.43 MF, while in 2005 cultivated areas and cropped lands were 9.2 MF and 17.50 MF respectively, .

Municipal water requirements include water supply for major urban and rural villages. Part of this water comes from the Nile system, either through canals or direct intakes on the river. The other part comes from groundwater resources. Municipal water demand was estimated to be 10 BCM in 2013. Where approximately 97% of urban population and 70% or rural population of Egypt relies on piped water supply. Sanitary facilities are less developed where approximately 50% of urban population and 6% of rural population are connected to a sewerage system. Municipal water production are diverted from two sources, surface water which supplies about 83% of total municipal water demand and groundwater, which supplies about 17% of total demands.

The improvement of the quality and productivity of **the industrial sector** are vital for economic and social progress and increasing rates of growth in Egypt.

MWRI estimated value of the water requirement for the industrial sector during the year 2013 was 2.50 BCM/year. A small portion of that water is consumed through evaporation during industrial processes (only 0.7 BCM) while most of that water returns to the system in a polluted form. These numbers must be reconciled before conducting an accurate assessment of financial aspects of industrial water use and its effects on the economics of water.

In summary, the actual resources currently available for use in Egypt are 55.5 BCM/yr, and 1.3 BCM/yr effective rainfall on the northern strip of the Delta, non-renewable groundwater for western desert and Sinai, while water requirements for different sectors are in the order of 79.5 BCM/yr. The gap between the needs and availability of water is about 20 BCM/yr. This gap is overcome by recycling. The overall efficiency of the Nile system in Egypt is about 75%.

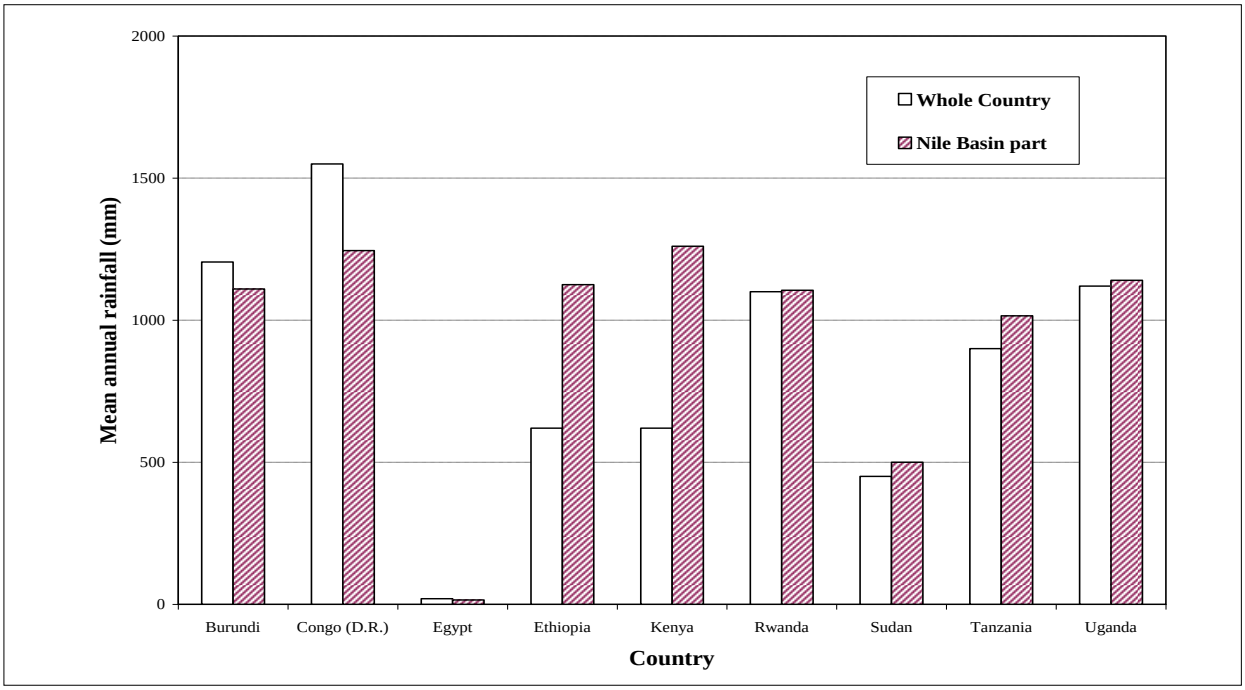
By the year 2020, water requirements will most likely increase by 20% (15 BCM/yr). Water quantity and water quality are inseparable. Since all water uses require that water quality falls within a range specific to that use. Thus the present rate of deterioration of quality will certainly increase the severity of the water scarcity problem or add to the cost (i.e., treatment requirements) of using water at the levels expected in 2020.

On the other hand Egypt is self-sufficient in almost all agricultural commodities with the exception of cereals, oils and sugar; however, these exceptions make Egypt one of the world's largest food importers. The agricultural imports bill in the country has rapidly increased putting a substantial burden on the country's foreign exchange resources. It was more than twofold that of imports in the early seventies, but the balance became negative and the gap continuously widened since the mid-seventies.

The total imports bill reached 6000 million US$ in 2013 against 2905 million US$ in 2004 and only US$ 1 110 million for exports. Cereals contributed the largest share of the import bill, with 49%, and wheat alone accounted for approximately 32.6% of the total. On the other hand, in 2004 the main export crops were 183 736 tonnes of cotton, 836 940 tonnes of rice, 176 000 tonnes of potatoes and 37 000 tonnes of citrus.

2.3. Comparison of rainfall patterns for the Nile Countries

The general pattern of rainfall over the Nile basin shows high rainfall in the mountainous areas in the south and east: typically about 2000 mm per year, and even more in certain location. In the plateau areas of the southern lakes region, it is generally in the range 1000-1500 mm. As one moves northwards through southern Sudan, rainfall gradually declines, reaching about 200 mm per year at the junction of the Blue and White Niles in Khartoum. North from there, desert conditions prevail, and rainfall drops to practically zero in northern Sudan and most of Egypt. This marks a progression from humid climates that can support rainforest, through a range of less humid and semi-arid climates where the vegetation is a variety of types of savannah and grassland, to arid climates in the north, supporting practically no vegetation.



Average annual rainfall on the Nile Countries
(Source FAO, 1995)