DRINKING WATER PROBLEMS IN EGYPT AND SUDAN.

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Sarwat Basha

José Fragachán

Advisor John Bergendahl

Date: March 2nd , 2005

Abstract

This project represents an attempt to collect the scattered knowledge about the water problem affecting the world, with a clearer focus on Sudan and Egypt. What Egypt and Sudan faces is not so much a water crisis as a chronic problem escalating to a crisis dimensions because older problems are deepening at the same time as newer ones are becoming evident. Some countries of Africa have already reached or are fast approaching the limits of their water supplies.

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Executive Summary

The water problem in Sudan and Egypt can be approached from either the supply or the demand side of the market. The water crisis suffered in these two countries must be attacked from both sides of the economic equation — demand and supply. As population increases in Egypt, the water demand also increases creating a deficit in this natural resource. Meanwhile, in the case of Sudan, a country that has been struggling to succeed the problems that are arousing from the civil war, the water demand has increased as the population almost remains the same. This is due to the fact that the service is not adequate to fulfill the population requirements. All the money is being used towards the acquisition of newer and more powerful equipment to be used in the war, leaving aside the needs of the population.

Egypt freedom helped solving part of the water problem and increasing the amount of jobs available for the Egyptians; economical activities are in this country performed on daily basis. In Sudan, the war does not permit the population to perform their activities on regular basis; in many cases the scarcity of food is also present among the population.

The government of these two countries has been avoiding the water problem topic for long time. Now is when the Egyptian government decided it was time to confront such topic. In Sudan, due to the war the two political leaders have not taken any actions. As the civil war ends, actions will be taken. In the future the existing population should have the adequate supply of such vital liquid.

Perhaps the most important point in any discussion of increasing water sources is the capacity of new sources of water to serve as agents of progress. By transforming the

water debate between different countries from a zero-sum game into a situation with room for maneuvering, exploitation of non-traditional sources has the potential to smooth the path to a water agreement — and, insofar as water is just one bargaining chip in the final status negotiations, it has the potential to smooth the path to progress and peace as well. Even though from a diplomatic standpoint, a zero-sum game is the most difficult kind of issue to resolve by negotiation.

Introduction

Approximately 70% of the surface of our globe is covered with water, but of that 70% only 3% is considered fresh water available for human consumption. Furthermore, nearly 90% of this fresh water is not really available because it is contained in the ice caps of the Antarctic. "Only 0.26% of the water on this earth is available for humans and other organisms. Only 0.014% of this water can be used for drinking water production, as most of it is stored in clouds or in the ground."[1] The sum of this current situation is that there is a scarcity which is becoming more severe by the day.

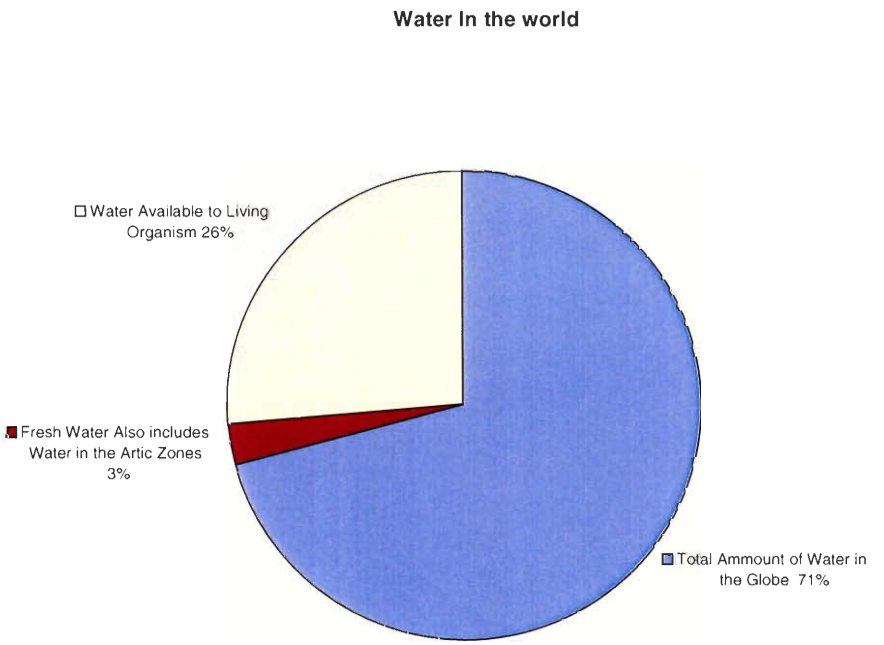

Figure 1.1 Distribution of the world's water

[1] Lenntech. "Water Treatment & Air Purification Holding." 1998-2004. September 23, 2004. <http://www.lenntech.com/water-quantity-FAQ.htm>.

The search is on . . . Every drop of water wasted by contemporary societies becomes priceless for future generations. Every citizen in every country must be concerned about the reality of water scarcity. An awareness of the current situation must be created among these world habitants. There will be a time in the future in which the available amount of fresh water for human consumption will gone, and returning this valuable resource to its original level will be increasing difficult and, in many cases, impossible.

What is the drinking water problem in the world? According to the British Medical Association reports of 2003, almost two and half billion people across the world do not have access to adequate sanitation, and over one billion have no adequate water supply. Nearly all of them (98%) live in the developing world. In Africa, 56% of the population (around 270 million people) have no access to water from protected spring, borehole, standpipe or collected rainwater sources. In Asia only 38% of the population has access to adequate sanitation, and there are may other countries in other parts of the world suffering from the same or similar problems.[2]

Theme and Project Focus

This paper answers the question, Why are there such inadequate numbers of water treatment plants in Egypt and Sudan and how these countries entered such a state. It looks at scenarios that improve with more available water but decline when the situation worsens. Of particular significance in its focus is the following: How the history of

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[2] Vass, Alex. "Water and Sanitation: the target and challenges." Squirrel Mail. April 2003. September 10, 2004. <http://web1.infotrac.galegroup.com/itw/infomark/183/493/57466178w1/purl=rc1_EAIM_0_A99373799&dyn=8!xrn_1_0_A99373799&bkm_9_>

conquests and dominations, especially during the colonial period when the French and especially British ruled Egypt contributed to the current problems.

The problems of various styles of corruption on the part of public officials of the government and private companies might arguably be a modern version—that is, an extension--of the tradition of paying tribute that subjects paid to the pharaohs and kings of Egypt, the result is that the practice undermines public works and projects that could possibly improve the lives of the citizens of both countries. The fact that in order to galvanize the private sector, it must provide the illicit gain, i.e, the graft, necessary to put realize these works. It makes them, already expensive, often prohibitively costly and, thus, impossible to orchestrate.

The truth is that the population is growing, as the very few treatment plants go online. The continual population growth nullifies any gains that come by way of greater access to clean water. The populations' growth needs more fresh water to supply the needs of this new and rising group of consumers. Both in terms of fresh water supplies to home, industries and agriculture—a population of this size needs a lot of food, which in turn, needs a lot of water—there are not the amounts of fresh water, from various sources, to meet the needs of this ever-growing population. And if things in Egypt seem somewhat dire, the situation in Sudan is even more desperate.

In order to improve the infrastructure that is necessary to increase the amount of fresh water available, both countries need to raise the money to buy the necessary technology. That would seem like a prospect not beyond the real of possibilities. The problem is that in both countries tough-to solve, entrenched political problems abound;

the problems, especially the hot political problems--an effective, low-level insurgency in Egypt and a quasi-civil war in Sudan—make international investors too nervous to risk the amounts that either country needs in order to get the necessary equipment and funds it needs to counter this situation. And to make matters worse, fresh water competes with a multitude of other problems, almost as vital, some much more politically expedient, in the national budget and interest.

In many areas of the world, the private sector could just step in and address the problem with varying degrees of success. A certain amount of corruption in both Egypt and Sudan, mentioned earlier, hampers this potential progress, but there is also the tendency of the government and public at-large not to trust the private sector as much as is often the case in the west, for example. After years of socialist leaning governments, the population looks to the state as paternal. Corporate wheeling and dealing are not in the least bit transparent, and the citizenry of both countries might tend to view the private sector with some contempt; these nationals often see giving power to the private sector as the first step toward increasing prices on the poor and overstretched pockets of the vulnerable middle class to reap profits and take control of a precious commodity that many feel is their right to have at not apparent cost.

Technology demands money to acquire, including the skills necessary to operate, and this money is not very easy to find. When it is available, as it is in Egypt, considering tourism, financial aid and remittances from countries with advanced economies, other areas of society have great needs. In Sudan, where everybody is

poorer, without the tourism and financial aid, the situation is much worse. The prospects for the future do not look very promising either.

Fast Facts And Figures About The Problem

According to the Europa Research Commission (22 March 2003), these are the facts[3]:

- More than 5 million people die each year from water-borne diseases.
- The United Nations predicts that two out of three people will be living with water shortages.
- 2003 was the International Year of Freshwater
- Twenty percent of all European Union surface water is seriously threatened with pollution.
- The 10 lowest countries on the water poverty index are all in the developing world: Haiti, Nigeria, Ethiopia, Eritrea, Malawi, Djibouti, Chad, Benin, Rwanda and Burundi.
- The top 10 water-richest nations in the world are Finland, Canada, Iceland, Norway, Guyana, Suriname, Austria, Ireland, Sweden and Switzerland.
- About 2 million tons of wastes are dumped every day into rivers, lakes and streams.

Water problems not only occur in developing countries; they occur all around the world as it can be seen from the information above. This is an issue that has concerned the population of developing countries for more than decades; even the most developed countries experience some type of concern for their water resources.

During this study we will concentrate on two countries located in the African continent, specifically Egypt and Sudan. The populations of these countries usually have concerns such as the following:

Why do other regions receive more drinkable water? Is this a political issue? Is the government searching for possible solutions? Are local resources used in an effective

[3] Europa Research. "World Water Day 2003." 23-05-2003. September 23, 2004 <http://europa.eu.int/comm/research/dossier/do220303/index_en.html#top>

way? Is the internal strife affecting the possibilities of developing water storage and resources?

These are some of the questions that are addressed in this report.

In Egypt and Sudan, which share frontiers, the biggest resource of water is the Nile River. There are more international river basins in Africa than on any other continent. But nowhere in Africa are the tensions of drought, inadequate water supply, and water politics felt more acutely than along the Nile River. Whenever engineers turn up along the River Nile, the "tremors" are felt along its reaches, nowhere more so than where the River Nile ends in Egypt.[4] Here all life is the River's gift; the great Greek historian Herodotus said "Egypt is the gift of the Nile". Although Egypt and the Nile River have long been said to be one, actually the Nile River moves through 10 countries and each one of these is highly conscious of its relationship with this magnificent river.

Egypt and Sudan were under the same foreign occupation for a long time. This occupation started on 1811 and ended on 1956 affecting the local populations. In the case of Egypt, the main reason for its occupation was its strategic location. In the case of Sudan, its occupation was focused on the amount of agricultural land, the amount of gold and iron mines present in this country.

The importance of its location and the presence of the natural sources and the River Nile made Egypt the object of many, numerous conquests: the Ptolemys inherited from the conquest of Alexander the Great, the Romans, Greeks, Arabs, Fatimids, Mamluks, Ottomans and Napoleon Bonaparte. The most recent conquest was made by

[4] Ward Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead hardcover edition: August 2002 Published by The Berkley Publishing Group, New York10014. (Ward P 197).

the British from 1881 until the independence in 1954. In 1956, Egypt was involved in war with Israel. This war resulted in Egypt's loss of Gaza strip and Sinai. In October 1973, there was the final war with Israel. This war resulted in Egypt taking back the Sinai. Egypt built a water dam to store water in the Lake Nasser and this way helps prevent the country from the dangers of flooding. So maybe if Sudan built a lake or water reservoirs, some aspects of the water problem might be solved.

Foreign occupations, civil or international wars might not be the only past or present causes to face water scarcity; also the lack of technology is a related issue. We all know that money buys technology, but can technology solve the water problem in these countries? So now, is this a reason why the water supplied amount is different in Egypt than in Sudan?

Geographic Descriptions:

People everywhere read about the fabled history of Greater Egypt, a concept that might include parts of Sudan, especially northern Sudan and, to some degree, northeastern Nubia, which, thought not Egyptian, was associated with the many dynasties of the ancient Egyptians. The concept comes from the domination of the River Nile, for it was the ancient Egyptians who controlled it downstream as well; they spread their culture all along the Great River. It was the route of life whose value could be harnessed.

Map of Egypt[5]

Egypt borders, the Mediterranean Sea, between Libya and the Gaza Strip and the Red Sea located at the north of Sudan, and including the Asian Sinai Peninsula[6]. Egypt has a total area of 386,660 sq. miles[1] with almost the same size of Texas and New Mexico combined. It has a topographic distribution as follows:

It is almost entirely desolate and barren, with hills and mountains in the East region and along Nile. The Nile Valley is the region where most of the people live, and it stretches for 550 miles[7]. Because of this the agricultural activity is not very productive beyond this river basin. Out of the total land area that this country covers, only a "3.5%"

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[5] The World Fact Book (Egypt Map Index) December 16, 2004. December 6, 2004. < http://www.theodora.com/wfb/egypt/egypt_maps.html >

[6] The New York Times. The New York Times Guide To Essential Knowledge (2004). United States of America, NY: St. Martin's Press, October 2004.

[7] The World Almanac Education Group, Inc. The World Almanac and Book of Facts 2005. December 2004

[8] is cultivated and permanently settled. The Nile Valley and Delta are two of the most important regions of this country due to the fact that they support "99%"[3] of the population on the country's only cultivable arable land. Egypt's climate is mostly desert.

Map of Sudan[9]

Sudan is the biggest country on the African Continent, with a total area of 976,495 sq. miles[10]. It is located south of Egypt. The Northwest consists of the Libyan Desert; the mountainous Nubian Desert in the East, with the narrow Nile Valley in between. The center contains large, fertile, rainy areas with fields, pastures, and forests. In the South the soil is rich and there usually is a heavy rain zone[11].

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[8] "Geography of Egypt." World Facts. Library of Congress Country Studies. November 18, 2004. <http://worldfacts.us/Egypt-geography.htm> ; <http://worldfacts.us/>

[9] The World Fact Book (Sudan Map Index) December 16, 2004.

[11] The World Almanac Education Group, Inc. The World Almanac and Book of Facts 2005. December 2004. < http://www.theodora.com/maps/sudan_map.html >

Table 1 Describe the border countries of Sudan

Neighbors: North → Egypt.
West → Libya, Chad, Central African Republic
South→Congo(Formerly Zaire), Uganda, Kenya.
East→ Ethiopia, Eritrea.

Table data from the World Atlas

Even though Sudan is large by any standard, it can also be considered the country with the greatest water scarcity; and one of the least developed areas of the world. It is important to understand that this country is threatened in a constant way by dust storms and periodic persistent droughts that produce great impacts in the existing population and environment.

The Nile River

The Nile River is the main water source for Egypt and Sudan. This river is located within an average height of "350 meters" [12] above sea level. The Nile and its tributaries flow through nine countries before reaching Sudan and later on Egypt making with them a total of eleven countries crossed by this river, from South to North, and it covers a total

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[12] Embassy of the Republic of Sudan in London. "Geography of Sudan." Embassy of the Republic of Sudan in London 2002. December 1, 2004. <http://www.sudan-embassy.co.uk/infobook/geograph.php>.

flow extension of "6,650 kilometers" (4,132 miles). During its path four major dams can be found. These dams are in many cases for hydro-electrical purposes and in others, used for water storage. These dams include the Roseires Dam, the Sennar Dam (Sudan), Aswan High Dam (Egypt), and Owen Falls Dam all located in a variety of African countries through which the River Nile flow.[13]

The System of Water Renewal

Before getting into deep details of the water problems in Egypt and Sudan let us first understand how the water cycle is. Water can be defined as a "vital component on the Earth's ecosystems. It redistributes itself through different natural cycles that contribute to climate control and the hydrologic cycle[14].

The Water Cycle is a way of explaining how water travels in different ways. Because it is defined as a cycle there is no beginning or end. Water can change states among liquid, vapor, and ice at various places in the water cycle. The water balance on earth remains fairly constant. Since we said the water cycle has no starting point, we'll begin in the oceans, since that is where most of Earth's water exists. The sun drives the water cycle, heating the water in the oceans, which evaporates into the air. Rising air currents takes the vapor up into the atmosphere, where cooler temperatures cause the vapor to condense into clouds. Air moves clouds around the globe. Clouds particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow (cold weather). Precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. Much of it soaks into

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[14] Karyabwite, Diana Rizzolio. Water Sharing in the Nile River Valley. Geneva, June 2000

the ground as infiltration. Some of this water stays close to the land surface. Over time, though, water keeps moving, some to reenter the ocean where the whole cycle started and ends[15].

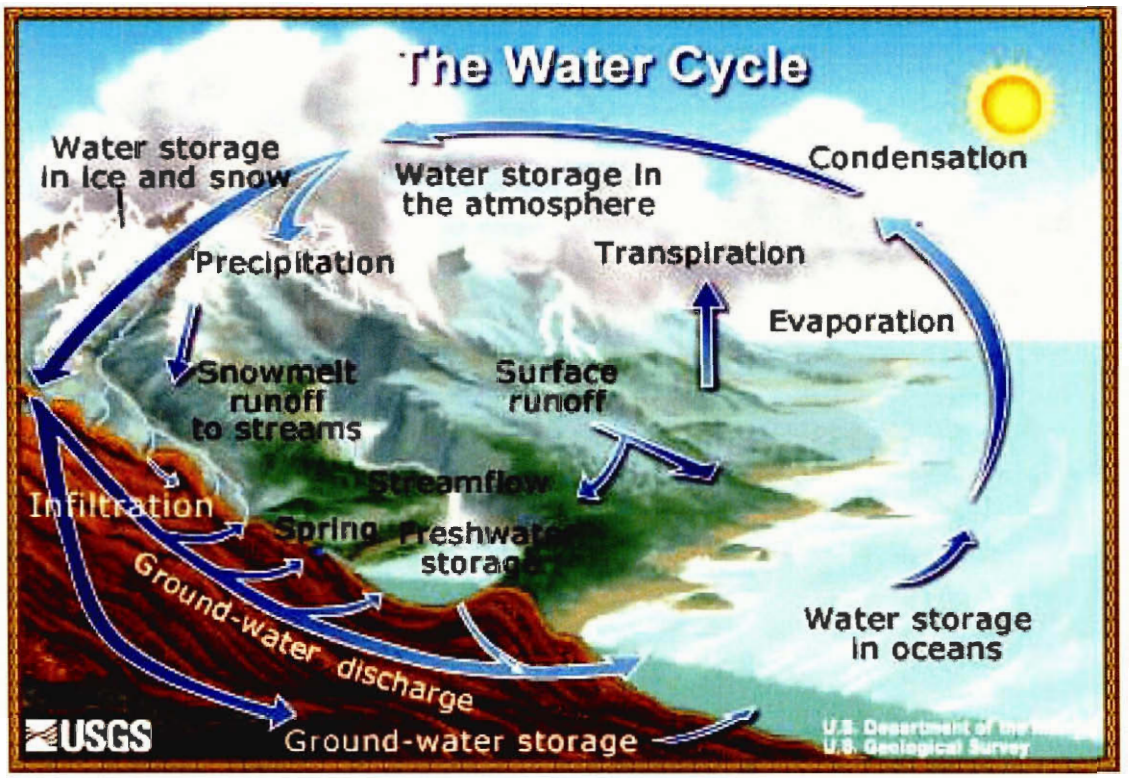

Figure 1 The Water Cycle. Water Cycle is helpful to describe the different ways that the water travels in the ecosystem. Copyright © USGS[16].

Water Pollution

According to the American Dictionary, to pollute is defined as to "make foul or unclean; dirty." Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water. There are two types of water

[15] Evans, John. "The Water Cycle." The Water Cycle. 2005. USGS. 2/28/2005. <http://ga.water.usgs.gov/edu/watercycle.html >
[16] Ibis

pollutants, point source and non-point source pollutants[17].

Point source pollution occurs when harmful materials such as oil spill are dumped or are spilled into a body of water. Non-point sources pollution occurs when pollutants are delivered indirectly through the environmental changes such as fertilizers from fields carried into streams by rain in the form of run-off.[18]

Water can be contaminated in different ways. Many times most of the fresh water available to humans is contaminated due to industrial and agricultural activities. In today's world, regulations have been applied to these industries, many of which try to adhere to them and others just violate regulations. Most of these regulations are more likely to be violated in developing countries. First, there is great poverty and, to some degree, a tradition of corruption that goes largely unchallenged. This happens because in developing countries the people in charge of enforcing the rule get paid low wages and this lead to corruption among the parties, because it is cheaper to bribe an environmental officer than to pay fines or the remediation cost involved.

The Nile River is polluted with industrial and agricultural wastes acquired while running through nine different countries before reaching Sudan and later Egypt. A lack of adequate resources results in 35% of the Egyptian population facing a scarcity in its water supply or sewage systems. Due to this fact the water scarcity must be satisfied in some way, leading them to use the aquifers as source of drinking water. Many times in these aquifers the water looks good and has no smell; however, this water is polluted because of the use of the septic tanks and some of the chemical pollutants.

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[17] Krantz, David and Kifferstein, Brad. "Water Pollution and Society." 1997. 9/23/2004 <http://www.umich.edu/~gs265/society/waterpollution.htm>
[18] Ibid

In the case of Sudan, the main issue is the need for adequate systems to transport the water from the reservoirs to the existing population. Very old rusty pipes exist in which the water is transported. The water scarcity in Sudan is the limiting factor for economical and social development there. The water treatment situation in Sudan is so bad that it has created concern in the whole world. For the Sudanese population to have water access "depends on surface water such as intermittent streams, natural depressions-fulas, rahads, and turas-and hand-dug wells"[19]. With the appearance of technology the population has been able to construct water reservoirs which help with the growth of human and animal populations[20].

As explained in the paragraph above, it is incredible to see a country that has a big delay in technology in absolute terms. Even though the population has enough creativity and enthusiasm to progress every day more but without the resources to obtain the necessary technology, their dreams go largely unrealized. This should be an example for those countries that have better services to work hard and improve every day, even a little improvement in a country such as Sudan can change drastically the life in the population.

Contamination produced affects all the water resources both internally and externally around the world. The population wants cleaner and healthier environments than the ones in which it lives. To approach this issue of contamination and pollution requires that not only the local population but also the whole world to take notice and

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[19] Yaqoub, Abdalla Mohamed. Impact of improved rural water supplies on settlement distribution in western Sudan the case of east Kordofan and el-fasher districts. November 22, 2004. < http://www.unu.edu/unupress/unupbooks/80044e/80044E09.htm >

[20] The New York Times. The New York Times Guide To Essential Knowledge (2004). United States of America, NY: St. Martin's Press, October 2004.

help these countries to approach healthier environments, and in this way our whole ecosystem will be healthier and last longer for future generations.

Causes Of Water Pollution In Egypt

There are many causes of the water pollution in Egypt. These causes will be discussed in order according to the quantity of the wastes released into the environment:

- Industrial wastes
- Agricultural wastes
- Human wastes and household wastes
- Septic wastes and sewerage system

In Egypt the industrial waste water is considered one of the main sources of water pollution, because of their toxic chemicals and organic loading that are dropped into the rivers daily. About 80% of the whole country's annual industrial effluents are discharged untreated into the Nile, canals, wells, and municipal sewerage systems and into the Mediterranean Sea[21]. Cairo is one of the main industrial centers in Egypt: 50% to 64% of industrial activity is mainly located in the capital. The public sector industries (75%) consist of chemical, textile, metal (iron and steel), food, engineering and cement production. For proper operations these industries use 162 million m^3 of fresh water per

[21] Joensuu, Finland. " Cairo - A Mega-City and Its Water Resources" 19-22 June 1995 December 7, 2004. < http://www.hf.uib.no/institutter/smi/paj/Myllyla.html#35>

year $\left(\frac{162000000m^3}{yr}\right)$ and discharge 129 million m^3 per year $\left(\frac{129000000m^3}{yr}\right)$, each day they discharge 0.75 tons of heavy metals.[22]

According to the report of the Egyptian Environmental Ministry, the private contaminating "industries include tanneries, gasoline stations, and marble and tile factories". Most of the private industrial wastes are discharged into the sewerage collection system." Industries in Cairo also discharge wastes annually to collection systems, in many cases without pretreatment; only half of the industries have some type of effluent treatment before the waste is being discharged into the collection system.

- **Agricultural waste**. Most of the residents of Upper Egypt depend on irrigated agriculture for their livelihood and most of these residents do not have the awareness not to pollute the water, so they get rid of the agricultural wastes through the River Nile. These wastes include commercial livestock and poultry farming waste. The agricultural wastes are the sources of many organic and inorganic pollutants.
- **Human and household wastes** from washing, cleaning and cooking wastes are considered as one of the most important causes to the water pollution in Egypt because they include organic materials and chemical materials as well as fecal matter which pollute the water.
- **Sewerage and septic systems works.** There are often operational problems in sewer networks, especially when they are buried deep underground. Most of the wastewater collected by sewerage is not treated or does not have an effective treatment. Also, many wastewater treatment plants operate unsatisfactorily. Even though 75% of the population is connected to the public sewerage system, still only 15% of the wastewater collected is fully treated and maintained there. About 25% is partially treated and 60% is carried by open canals and finally to the Mediterranean Sea. There is about 25% of the Egyptian population non-sewerage, which leads to the use of the septic tanks. Mud and bricks, mostly used in building septic tanks mean they may leak the included materials, which leads to pollution of the water in the aquifers.[23]

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[22] Joensuu, Finland. " Cairo - A Mega-City and Its Water Resources" 19-22 June 1995 December 7, 2004. < http://www.hf.uib.no/institutter/smi/paj/Myllyla.html#35>

[23] Joensuu, Finland. " Cairo - A Mega-City and Its Water Resources" 19-22 June 1995 December 7, 2004. < http://www.hf.uib.no/institutter/smi/paj/Myllyla.html#35>

Egypt and Sudan have problems with transparency of their governmental bureaucratic operations. Compounded with a lack of awareness regarding the seriousness of the contamination, these countries remain sensitive—perhaps in part due to their history of outside occupation—to any criticism leveled at them from the international community regarding the problem of pollution and contamination of their natural resources. All of this is exacerbated by the fact that the press in both countries is muzzled by the government to a great degree in the name of national security; therefore, there is little internal inquiry with regard to the sources of the problems.

It was after the war with Israel in 1973 that the government started to think about the water problem. This problem became so big that the government had no way to ignore it any more. A similar case is what Sudan is suffering in the actual moments, disagreements between different regions of the country leads to sabotage and disturbs that mess up the whole country economy producing a shortage in available resources to invest towards technological changes. Many plants have to be built in Sudan. For example the Merowe Dam is the biggest water resources project in Africa. This project was awarded on 2003 and is supposed to be finished by the year 2008 in Sudan.

Now after acquiring the appropriate background of these two countries, let's base the problem in the fact that money buys technology, will technology provide better water treatment to these countries? Was foreign occupation a limiting factor for developing better technological resources?

Challenges That Egypt And Sudan Face In Solving The Water Problem

Before solving the water problem Egypt and Sudan must face the following challenges:

1. Economic and Financing Problems
2. Technological
3. Natural Geography
4. The political instability/ the poverty on the region
5. The Need of Conscience on the part of their citizens
6. The need of multilateral finance mainly for Sudan and in a lesser scale to Egypt

In our research we will discuss these challenges in more detail. The first two categories are linked together. By having the technology to solve these water problems, these two countries would not suffer from a water problem of this seriousness.

Right now we will discuss the Economic problem for each country.

The Main Income Sources In Egypt Are:

1. Natural resources, including petroleum, natural gas, iron ore, phosphates, manganese, limestone, gypsum, talc, asbestos, lead, and zinc
2. Agricultural products, including cotton, rice, corn, wheat, beans, fruits, vegetables, cattle, water buffalo, sheep, and goats
3. Industrial products, including textiles, food processing, chemicals, hydrocarbon production, construction, cement, and metals
4. From tourism
5. Suez Canal proceeds

Some the proceeds of these sources are used to cover local demands and some the government exports to foreign countries. According to the Central Bank of Egypt, the country's exports were totaled at about $8.21 billion for the fiscal year 2003. Egypt's imports were $14.78 billion; from this report we can understand that Egypt's imports are more than the exports, which means Egypt has to provide about $7.00 billion to cover the local use.[24]

Table 2 Shows Monetary Power. It includes changes from current Egyptian currency (Data from World Fact Book[25])

Finance Monetary Unit: Pound (Egypt)
Sept 2004: 6.23= $1U.S
GDP (2003 Est): $ 294.3 bil.
Per Capita GDP: $ 3900 GDP growth 2.8%

The Gross Domestic Product (GDP) *is the market value of all final goods and services produced within a country during a given time period, usually a year*[26].

Egypt's economy is increasing very slowly due to the increase of the population and the increase of living standards. This could cause Egypt's economy to decline in the long run. From all of these sources, Egypt's low level of technology is linked to the economy. If the country is able to solve the economic problems, this will lead to a solution of the technology problem. This leads us to ask what Egypt could do to improve its economy.

[24] The World Fact Book (Economy) December 16, 2004.
December 6, 2004. < http://www.cia.gov/cia/publications/factbook/geos/eg.html#Econ.>
[25] Ibis.
[26] Parkin, Michael. Macroeconomics. University of Western Ontario.

Some Of The Many Solutions To Improve Egypt's Economy Are:

1. Find new sources of energy. The government is hopeful that natural gas exports, which began in 2003, will become a more stable source of hard currency, especially because Egypt has two-thirds of the total world products of natural gas.
2. Encourage more foreign investments in Egypt. The government tries to attract foreign investors by providing several advantages, including incentive programs, duty-free zones, mega-projects to reclaim desert land and a growing domestic market of 76 million people, among whom the literacy rate is increasing. Among these, Egypt is helped by its strategic location relative to Europe and other nations of the Middle East.
3. Encourage the private sectors to share with the government in building and developing of water treatment plants. The private sectors will make a profit from these projects through distribution of potable water. This will ensure the water will be available to each person in the country.
4. Encourage the foreign tourism. Tourism is Egypt's most important industry. In 2000 about 5.5 million people visited Egypt, generating revenue of $4.3 billion. However after the September 11th attacks the number of visitors fell to 4.6 million in 2001 (bringing revenue of $3.8billion). In spite of the war in Iraq, during 2000 the numbers of visitors rose to 6.04 million and revenue of $5 billion.[27]

For Sudan The Main Income Sources Are:

[27] Executive briefing: Egypt. 08 Jul 2004
December 5,2004 .<http://www.eb.eiu.com/index.asp?layout=oneclick&country_id=1640000164#23>

1. Natural resources, including modest reserves of oil, natural gas, gold iron ore, copper, and other industrial materials.
2. Agricultural products, including cotton, peanuts, sorghum, sesame seeds, Arabic gum, sugarcane and livestock.
3. Industrial types, including motor vehicle assemblies, cement, cotton, edible oils and sugar refining.

Trade In Sudan For The Year 2004:

Exports were about $2.0 billion from the aforementioned resources. *Major markets* include Egypt, Persian Gulf States, Saudi Arabia, Malaysia, China and South Korea.

Imports--$2.6 billion including oil and petroleum products, oil pipeline, pumping and refining equipment, chemical products and equipment, wheat and wheat flour, transport equipment, foodstuffs, tea, agricultural inputs and machinery, industrial inputs and manufactured goods. Major suppliers are the European Union, China, Malaysia, Canada, U.K., Italy, Germany, Saudi Arabia, Egypt, the Gulf Arab states. Fiscal year 2003: January 1-December 31[28].

[28] *Bureau of African Affairs. December 2004.* "Background Note: Sudan" Jan.2, 2004. <. http://www.state.gov/r/pa/ei/bgn/5424.htm >

Table 3 Shows Monetary Power. It includes changes from current Sudanese currency to US dollar (Data from World Fact Book[29])

Finance Monetary Unit: Dinar (Sudan)
Sept 2004: 259.54= $1U.S
GDP (2003 Est.): $ 70.8 bil.
Per Capita GDP: $ 1,900 GDP growth 6.1%

Table 4 Sudan's Total Land Area (Data from World Fact Book[30]).

Total	2,505,810 Km^2
Land	2.376 Million Km^2.
Water	129,810 Km^2

Almost the size of continental U.S., Sudan has natural recourses such as the arable land, oil, gold, iron, and many water sources such as Nile River, White and the Blue Rivers. All these sources would make Sudan one of the biggest economies in the world. But due to the civil war, which has made the country unable to make investment using natural sources Sudan's economy has declined, and Sudan has become the world's largest debtor nation to the World Bank and International Monetary Fund by 1993. Its relationship with the international financial institutions soured in the mid-1990s and has yet to be fully rehabilitated. The government fell out of compliance with an IMF standby

[29] The World fact Book. November 30, 2004.
December 6,2004.<http://www.cia.gov/cia/publications/factbook/geos/su.html#Econ>
[30] Ibis

program and accumulated substantial arrearages on repurchased obligations. A 4-year economic reform plan was announced in 1988 but was not pursued. An economic reform plan was announced in 1989 and implementation began on a 3-year economic restructuring program designed to reduce the public sector deficit, end subsidies, privatize state enterprises, and encourage new foreign and domestic investment. In 1993, the IMF suspended Sudan's voting rights and the World Bank suspended Sudan's right to make withdrawals under effective and fully disbursed loans and credits. Some Funds and European Union (EU) agricultural credits, totaling more than 1 billion Euros were also suspended[31].

This leads us to ask what Sudan could do to improve its economics. The main solution to improve Sudan's economy is to find a solution to stop the civil war. Since 1993, the leaders of Eritrea, Ethiopia, Uganda, and Kenya have tried to persuade the Sudanese Government and the Sudan People's Liberation Army (SPLA) to sit on a negotiation table under the auspices of the Intergovernmental Authority on Development (IGAD), but results have been mixed. Despite that record, the IGAD initiative promulgated the 1994 Declaration of Principles (DOP) that aimed to identify the essential elements necessary to settle comprehensive peace and to determine the relationship between religion and the state, power sharing and wealth sharing, and the right of self-determination for the south of Sudan. The Sudanese Government did not sign the DOP until 1997 after major battlefield losses to the Sudan People Liberation Army (SPLA). Since this time, Sudan's government signed a series of peace agreements with the SPLA. But none of these agreements have led to a peaceful solution of the problems. On

[31] *Bureau of African Affairs. December 2004.* "Background Note: Sudan" Jan.2, 2004. <. http://www.state.gov/r/pa/ei/bgn/5424.htm >

November 19, 2004, the Government of Sudan and the Sudan People's Liberation Movement/Army signed a declaration committing them selves to concluding a final comprehensive peace agreement by December 31, 2004, in the context of a special session of the United Nations Security Council in Nairobi, Kenya. The Sudanese Government and the SPLA signed the agreement, so it is hoped in the next few years peace will occur, and the government and the SPLA will be able to use all the economic sources to help in solving the water problem among others[32].

We know that we live in a world that depends on economic factors. Through the years almost the whole world can suffer drastic changes in the economy. The more economic stable a country is, the wealthier the people who live there are. In the USA a country with a GDP of "$10,847 billion"[33] we can find the following:

- Fair wages are paid to employees -the minimum salary is $ 6.75 **per hour**- while in Egypt or Sudan is half of that amount **per day**.
- Technological Advance.
- Good public services are offered to the population.

Based on the economy of each country we can see that the GDP of Egypt is more than four times greater than Sudan's GDP. Egypt having more money than Sudan in terms of GDP and GDP Per Capita has better resources available to treat the water issue. It can be seen that in Egypt water plants and dams exist. The most important of these dams is the Aswan High Dam. This Dam is important because the amount of water that

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[32] *Bureau of African Affairs. December 2004.* "Background Note: Sudan" Jan.2, 2004. <. http://www.state.gov/r/pa/ei/bgn/5424.htm >

[33] U.S. Department of Commerce, Bureau of Economic Analysis. From Parkin, Michael. Macroeconomics. University of Western Ontario.

is stored ("5.97 trillion cubic feet"[34]) and also because it is a hydroelectric plant that provides about a half of Egypt's power supply. We can also see the Mansoura water treatment plant as one of the other most important constructions regarding water issues in the Egyptian region. This Treatment Plant has a capacity to serve about "770,000"[35] people and accommodate the growing population of Mansoura. As we can see from the graph that Egypt water supply is increasing every year due to the increasing of building water treatment plant. When we compared Egypt's economy with the rest of African countries; we found out that Egypt's economy is better than the rest of Africa countries.

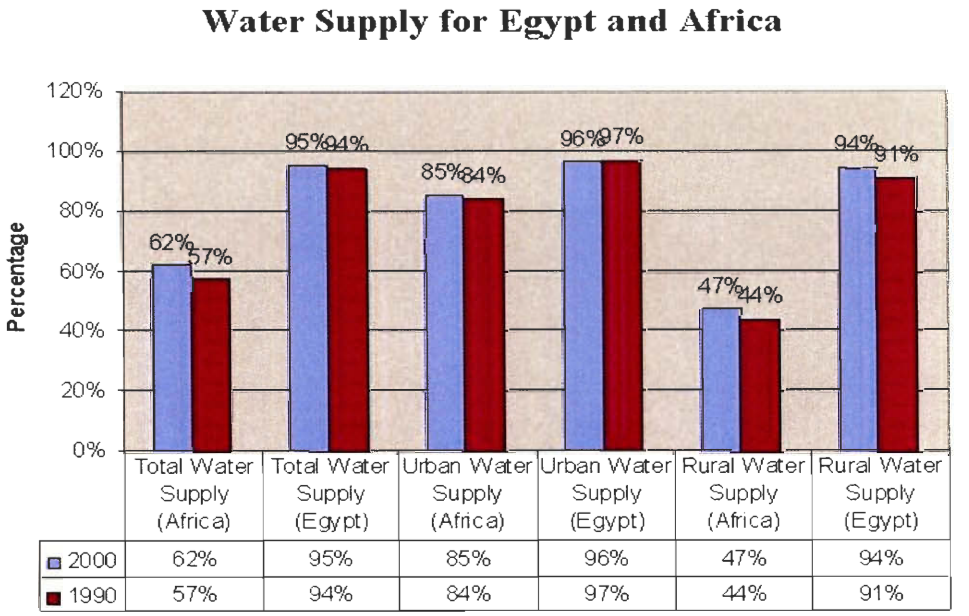

Figure 2 Shows the water supply of Egypt in comparison to the rest of Africa.[36]

Technologically speaking, the first world countries have more advanced treatment plants than Egypt or Sudan. Here is when the statement "money buys technology" comes

[34] "Aswan High Dam." Wonders of the World Databank. 2001-2002. WGBH Educational Foundation. December 5, 2004. <http://www.pbs.org/wgbh/buildingbig/wonder/structure/aswan_high.html>
[35] Water-technology.net.Copyright 2004 SPG Media Limited a subsidiary of SPG Media Group PLC Jan.30th, 2004 <http://www.water-technology.net/projects/mansoura/>
[36] Water-technology.net.Copyright 2004 SPG Media Limited a subsidiary of SPG Media Group PLC Jan.30th, 2004.<http://www.water-technology.net/projects/mansoura/mansoura3.html>

into play. In the world exist 40,000 dams that are fifty feet tall or higher, out of this amount in China can be found "19,000" and "5,500 in United States. Also in United States, there are "96,000" smaller dams as well. This is an example of how technology and water issues are linked in a direct way with money. China and United States are countries in which money resources are not such an issue; they have been able to sustain the needs of the population and help to solve the water problems that exists in them. Meanwhile Egypt and Sudan were under foreign occupation that benefited from their lands and available natural resources by destroying them. The money these countries got from these lands was not used towards the benefit of these countries that has been exploded by these foreign governments.

Blaming on foreign occupation as a cause that blocked this two countries becoming technologically advanced does not make sense: Egypt and Sudan have been free of foreign occupation for more than 50 years!

In 1881, when Egypt was under the British occupation, the British Consul-General hired William Willcocks, an inspector of irrigation to construct and retool Egypt's irrigation system to provide more cotton to the mills of Manchester, England. Willcocks was determined to find a way to protect Egypt from both floods and famines. He would dam the Nile. No one had ever dared try to dam a river of such width or ferocity.

In 1890 Willcocks was looking for a suitable site for a dam that would hold back an immense reservoir. After the three years of researching and investigating Willcocks became convinced that there was only one place for such a reservoir: at the caravan town of Aswan. He then began to design a dam unlike any other, a gravity dam, which would

resist the weight and lift of water by virtue of its own bulk, but curved to fit the half moon of solid rock underlying Aswan's riverbed. At 6,400 feet, it would be the longest dam ever built, its masonry facade penetrated by 180 sluice gates-140 along the bottom of dam and 40 on the top- through which the Nile in full flood could flow.

Work on the dam was begun in December of 1898 by a British firm using Willcocks's design.[37]

In 1902, the dam at Aswan was completed, and Egypt became no longer subject to the uncertainty of seasonal flow but could draw upon stored water all year round. The amount of Egyptian land under irrigation increased by half a million acres. The economy boomed. But soon it would not be enough when the population grew and more water was needed; Willcocks's visionary design allowed the Aswan Dam to be raised twice, first in 1911, then again in 1934, adding a total of fifty feet and enough storage to irrigate another million acres.[38]

After the British occupation three governments have been elected in Egypt: the first, led by Gamal Abd el Nasser, tried to solve the water problem affecting the existing population, and did the best possible under the circumstances. Either it was not as good as it is in the developed countries, this governor lowered the mortality rate produced by water related diseases. After Egypt had received independence, it was led by Gamal Abdel Nasser. The government was desperate to find a way to produce more food, and

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[37] Ward Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead hardcover edition: August 2002 Published by The Berkley Publishing Group, New York10014. (Ward P 61).

[38] Ward Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead hardcover edition: August 2002 Published by The Berkley Publishing Group, New York10014. (Ward P 62).

envisaged a new dam and reservoir on the Nile as symbol of a new Egypt. This monumental will be a highly visible, technologically advanced.[39]

After Western governments backed away from Egypt, the Soviets agreed to finance the high dam at Aswan. The high dam was completed in 1971, at a cost of nearly $1.5 billion. At 364 feet The Dam is an unremarkable monument structure. This dam backs up one of the largest man-made lakes in the world. The lake was named after President Nasser, who died a year before his monument was completed. Lake Nasser loses as much as fifteen percent of the Nile flow due to evaporation in a year, and more to seepage around its ends.[40] The over flow and the seepage from Lake Nasser resulted in some recent discoveries of the existence of four lakes in the "southern Egypt in an area that was previously desert"[41]. These lakes are fed by unusually high levels of rainfall and water that overflows from Aswan High Dam on the Nile River. The first lake appeared in 1998, and because this lake had overflow many times it helped produced the other three. The existence of the Aswan High Dam located in the caravan town of Aswan results one of the most important "monument" for the city. Not only because its magnitude is due to the amount of water that is reserved in this Dam, but it also results in help for the growth of the population.

Egypt tried to cooperate with the Sudanese government to build the Jonglei Canal to limit the lost of the River Nile water. Because there is about half of the flow of the White Nile is lost due to the evaporation in the Sudd swamps. The canal would bring an

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[39]Ward, Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead. New York, The Berkley Publishing Group, August 2002. (Ward P 68).
[40] Ward, Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead. New York, The Berkley Publishing Group, August 2002. (Ward P 68).
[41] NASA GSFC. New Lakes in the Egyptian Desert. November 21, 2004. <http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=4437>

extra 20 million cubic meters of water to Aswan every day. But the Muslim north of the Sudan engaged in a civil war with the southern tribes. In 1976, when a French consortium began digging the canal, there were riots in Juba in Southern Sudan., and the Sudan people's liberation army attacked the canal. In 1984, with 166 kilometers dug and 60 to go, the digging process was stopped entirely when one engineer was killed on an attack at the base camp causing the others to run.[42]

After Nasser died, the newly elected president, Anwar el Sadat, did not continue this plan. During his presidency, Egypt was involved in a war with Israel, so all the economic sources were used towards military purposes. Instead of doing the same, he brought Egypt back to be what it was or maybe worst than before. We know that this is hard to understand, but going back and forth creates a certain amount of instability, something not good for the economy.

The third challenge The natural geography of the area. In Egypt 96% of the area desert and only 4% of the total area, is used for living and farming. Most of the Egyptian population lives in different places around the River Nile, or desert or between agricultural lands. Living in different places is making the building of a water treatment plants and installation of a pipelines and sewerage system very expensive. It is very difficult to dig in the desert to install pipeline to the oasis inhabitants. As we Civil Engineers know, the cost of digging in the desert could cost three times the cost of digging in a clay soil.

The fourth challenge The political instability/ the poverty of the region. The on-going civil war in Sudan has displaced more than 4 million southerners. Some fled

[42]Ward, Diane Raines. Water war: drought, flood, folly, and the politics of the thirst. First Riverhead. New York, The Berkley Publishing Group, August 2002. (Ward P 199).

into southern cities, such as Juba; others trekked as far north as Khartoum and even into the border countries such as Ethiopia, Kenya, Uganda, Egypt, and other neighboring countries. These people have been unable to grow food or earn money to feed them selves, and malnutrition and starvation have become widespread. This reason is making the building of a water treatment plants and installation of a pipelines system to distribute the water to these people very expensive.

The fifth challenge, The Need of Conscience on the part of their citizens, especially because there are a large numbers of uneducated people in both countries. This is especially true in the countryside where most of the people are working on the farms, and they are not aware of the way that pollution negatively affects their health. In Egypt there is about 57.7% of the total population which is literate[43]. In Sudan the number of literacy is about 61.1% of the total population[44].

The sixth challenge, the need of multilateral finance mainly for Sudan and in a lesser scale to Egypt, When we come to the financing problems, for Egypt today this is not a big issue because there is stable government. So Egypt will be able to borrow money from the World Bank or any other financing organizations. But for Sudan, financing is a big problem. Because the country is involved in a civil war, and the newly signed declaration is too new to led to a stable government, there are not any financing organizations which will lend Sudan the funds.

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[43] The World Fact Book December 16, 2004. December 6, 2004. <http://www.cia.gov/cia/publications/factbook/geos/eg.html#People>

[44] The World fact Book. November 30, 2004. December 6, 2004. <http://www.cia.gov/cia/publications/factbook/geos/su.html#People.>

Water In Today's World: Political And Economical

In today's world many of the original flow channels of the rivers have been manipulated by human beings. Many times these changes are not always beneficial for the surrounding populations. According to Jeffrey Rothfeder study water dams are not always beneficial, there are positive and negative consequences but mostly are negative. As he said in his book Every Drop for Sale one of the consequences of dams is that they destabilized hydrological cycles and as a consequence freshwater shortages occur. By agreeing with Rothfeder we can say that the water issue is becoming more of a monopoly or power-possession/power-type issue of the owners of such treatment plants and dams. With the current trend, there will probably come a time when those who own the water plants will control all of the water resources in a country if the population doesn't pay the required price for their right of water then the daily requirements will not be met.

All these possessive powers have not started now; they started with earlier generations. As an example, we can see that the King Parakrama Bahu from Sri Lanka owned dams that he used as monuments to his power. We feel in complete disagreement with all these companies that have in mind that their power will lead them to incredible profits of this valuable resource. The business that these companies have made out of this resource must be finished at some point by the government of each country; the plants in each country should be owned by the country and must be used to serve the whole population charging fair prices. These prices will vary since distribution costs are real cost. It's not the same to serve a population 10kms. from a dam than one located at 1,000kms: pumping stations, pipe lines, are real cost that need to be paid.

In instance after instance, floods occur when dams and their abatement systems are unable to withstand the increasing pressure from swelling reservoirs and rivers in the hunt for their natural course in rainy season. After the first barrier is taken away the domino effect occurs, this means that the subsequent barriers will also be taken away. Many of these floods cause numerous deaths in the population, and also shorten the available fresh water to the population. After the flood is gone, the water is highly contaminated and before is supplied to the population, it should be treated. In poor countries such as the case in Sudan, the possibilities of the water being treated are low. Meanwhile in the case of Egypt at least water plants exists, which are used to clean the water after a flood occur. Water from a flood is polluted from oil spills by cars, animal excrements, all the sediments that are in the floor are disturbed, and the amount of pesticide that can be carried in a flood is enough to harm the existing population. The southern part of the African continent is usually affected by floods, but the floods have become so common that they are not shown in the news any more.

We can say that floods are a limiting factor in areas such as Egypt and Sudan. In the past before the Aswan High Dam was built the floods were more common in Egypt, but now they are less common, thanks to the dam. But as it was said before: Dams are taken down when pressure exceeds what the dam can withstand. If this dam ever begins to fail, what will happen to Egypt? This is a hard question to answer. Egypt might get the same amount of floods that it used to get before, or who knows maybe more than before, and this will lead to a delayed in its goal to improve. A tragedy like this produces irreversible damages to the surroundings. Many times villages, houses, rocks are moved from side to side like feathers. So now again the governors will have to help the affected

population and the money that was supposed to be used in financing public services will be used towards other interests. This will reduce the chances of updating the machinery in the treatments plants, which are valued in million dollars. For countries whose currency is not as powerful as the US dollar or the Euro, to reach the required amount to upgrade their plants can be hard and in some cases impossible.

Due to being hard to reach the amount of money to pay for their projects, poor countries get financial help from foreign countries. But this help is received under certain conditions. Usually the lender will ask for participation in the control of the plant for certain amount of years, or in some cases it will be asked for complete control. This is wrong in developing countries, because of the fact that the lender controls the facility in a monopolistic manner, without competence and the prices are not regulated by the government. These prices can only be paid by certain members of the population, while the others face scarcity for the offered service. Then after time passes, the need for water increases among the population, and due to the demand being higher the price will rise again, producing reduction in the amount of members subscribing the service. This way the equipment installed in the water treatments plants are not working on a 100% capacity, leading to a more operative life period of the equipment and facility.

We can see it is not an issue of how the water is supplied to the community, but it is more an issue of "playing" with the community by raising prices and lowering the demand, and this way the equipment suffers less than at full operation cycles. Then it is not a monopoly factor, it is playing with those who are wiser, the community or the owners of such plants. Benefiting from something like this is not right, water is a right not just a need, and all the population should be able to receive equal amount of water.

The monopoly or business activity that has been affecting this valuable resource is incredible. As an example we can see these two French firms, Vivendi SA and Suez Lyonnaise des Eaux, own or control water companies in 120 countries out of the 193 the form the total world countries. These two firms distribute water to almost "100 million"[45] people.

The problem is being treated as kind of a social injustice issue. Only wealthy people pay for the service, so who cares about the poor people; they can suffer scarcity, and find their path around it. No! This is not the right way to treat such problems, water must be equality distributed, and if such treatments plants were operated by the government the case would not be that bad. The government knows which zones are not economically stable, so the water supply will be less effective than in wealthier regions, but there will exist a water supply.

In today's society water is becoming a need instead of a right that all human being should deserve.

Possible Solutions To The Problem:

Learning that water has been shaping the face of the Earth, not only as a geologic agent, since the dawn of time is obvious but it is also a major factor in the rise and fall of great civilizations and as a source of conflict and tension between nations, both historically and today. Talking about solutions for these aforementioned problems is not as simple as expected. Possible solutions can always be suggested to help prevent

[45] Rothfeder, Jeffrey. Every drop for sale: our desperate battle over water in a world about to run out. New York, NY, 2004

scarcity of water in the world. As we know the global demand for water is increasing and the destruction of water-dependent ecosystems has been accelerated.

In developing countries rapid population growth is contributing to critical environmental degradation, and this degradation, along with inadequate water supply and sanitation services, are imposing large health problems and burdensome economic costs on the poor in developing nations. Water supply sources are being stretched to their limits, and many parts of the world are facing water scarcity. As sanitation facilities are being overloaded, or in some cases lacking, producing a rapid increase in surface- and groundwater pollution is essential.

There are organizations and facilities that have been concerned with the water problem that surrounds our environment. For example, the "**Global Environment Facility** (GEF) can be seen; this facility, with over $2 billion, is open to universal participation and builds upon the partnership between the UNDP (United Nations Development Programme), UNEP (United Nations Environment Programme), and the World Bank, which are its implementing agencies"[46]. Many times these types of agencies and organizations receive their funds from donations companies make in order to improve in machinery used for research, which can lead to possible solutions of the water problem.

So how can we solve the drinking water problem? Egypt and Sudan needs what is called a Blue Revolution, an immediate and structured change in the handling of pure and fresh water to maintain its cleanliness; to conserve and manage the fresh water

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[46]El-Ashry, Mohamed. Finding solutions to water disputes. Washington, DC: The American University UP, 1998.

supplies in the face of growing demands from the population growth; to irrigate agriculture and to grow industries and cities. Solving the water problem will require a coordinated response to the problem from local, national and international levels.

There are several ways to solve the problem, using different technologies on a cumulative basis. There are definite considerations that governments and agencies can make to solve the problems. The easiest way to define them is by enumerating these possible solutions in phases:

Phase 1: Building Dams And Drinking Water Treatment Plants:

Building bigger treatment plants in different places in each city and installing a new piping system at the same time will help to improve water quality, due to the presence of old, rusty pipeline network, which needs to be replaced. This solution will cost millions or either billions of dollars. For a developing country, reaching this amount of money and the proper people or technicians to help in such an investment is difficult and, in many cases, impossible to find. This is one of the most important solutions.

As we know that the costs of a treated cubic meter of water is very variable from country to country and even from city to city in the same country. The reason for the variation in the costs of treated cubic meter of water depends on the density of population (inhabitants per area), amount of raw water supply, amount of the wastes in the water and the available technology. We can see from figure 1.3 that countries, such as the USA, Canada, Spain, and Australia, pay less money for treating a cubic meter of water. The other countries such as Germany, Denmark, Belgium, and Netherlands with similar technological level but higher levels of population and less extension (high population density) have to pay higher prices for water service.

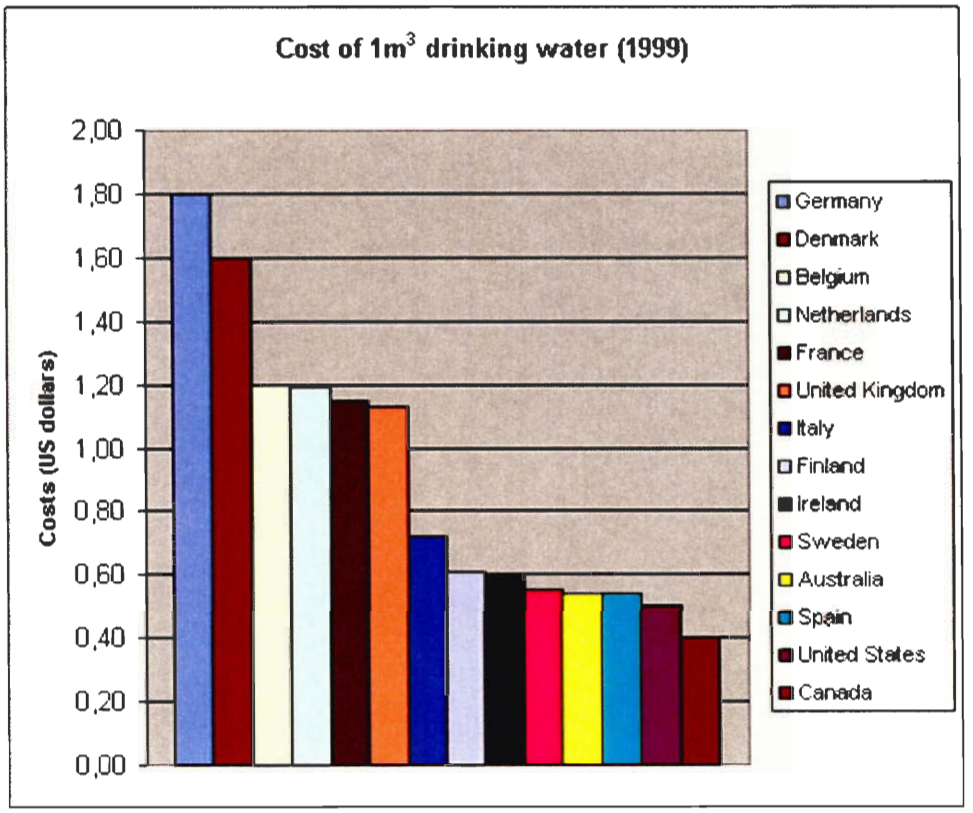

Figure 3 Shows the costs of cubic meter of water in 14 different countries[47].

Phase 2: Increasing Public Awareness:

To create public awareness of the water problem, it is necessary to use television and radio programs to inculcate the need for water conservation and treatment. Here is where the lack of technology plays an important role. In developing countries such as Egypt and Sudan the radio service is not used as effectively as it is in any developed country. In the case of Sudan in which only one radio station exists, it is hard to transmit programs of this indulge.

Phase 3: The Creation And Enforcement Of New Environmental Law:

This law will require all citizens and corporations to clean up their polluting

[47] Lenntech. "Water Treatment & Air Purification Holding." 1998-2004. September 23, 2004.<http://www.lenntech.com/water-quantity-FAQ.htm>.

discharges. If this law is strictly enforced, industrial wastewater will be properly treated before returning to environment. If the law is violated, the offenders will have to pay fines or even serve prison terms. If the plants do not meet the required standards before discharging the used or treated water, a central governmental agency should be prompted to act.

Phase 4: Desalting and treating the agricultural drainage water (ADW). Agricultural drainage water is considered one of the potential water resources. The present total quantity is estimated to be 14.34 billion m^3 /yr, of which about 7 billion m^3 /yr are currently used, after mixing with fresh canal water, for irrigation purposes. Egypt uses this technique, but it is a very expensive solution[48].

Phase 5: Encouraging Private Sectors To Invest In Facilities:

Encouraging the private sector invest, develop and build of new facilities to treat the contaminated water surrounding each country are measures to begin the process with; later it can be demonstrated how these investments pay off and further develop the base for national water treatment. The private sectors will make a profit from the project through distribution of potable water.

Phase 6: Creation Of New Plants To Turn Wastes From The Industry And Agriculture To Marketable Products And The Creation Of New Sewage Systems. In many cases, the wastes products can be turned into other kinds of materials to be used either in, perhaps, the construction industry or in agriculture. This proposal is to build a new sewage system as well as build a bigger treatment plant to accommodate the large amounts of sewage from the surrounding areas, which do not currently have access to

[48] A.G. Abulnour, M.H. Sorour, H.A.Talaat, April 25, 2002. (Desalination 152(2002) 353-357). December 5, 2004. <www.elsevier.com/locate/desal.>

sewage system. This will help in protecting aquifer water from the pollution.

Phase 7: The Creation Of Desalinization Plants: Egypt uses this technique in the Red Sea and Sinai. These cities over the Red Sea, such as Hurghada and Sinai, are the most important tourism sites in Egypt. The cost of desalination technology in the Red Sea was up to \$5.0 per m^3. Here comes the question: Will the ordinary citizens be able to pay their water bills? As we mentioned before, the salary in Egypt is very small, it is impossible that the regular people will be able to pay for this technology[49].

As we can imagine desalinization machinery and respective maintenance is extremely expensive, so very few will benefit from this technology in the short term.

In the case of Sudan where financial resources are scarcer than in Egypt, thinking of such high technological method is impossible before taking a prior step to solve the water problem. For Sudan, it is necessary first to fulfill the earlier phases before thinking in desalination. Even though Sudan has an outlet to the Red Sea, its money and effort would be better spent raising public awareness of water problems and doing grass-roots efforts to ensure that the water that is available is used efficient.

In order for Egypt and Sudan to confront and deal effectively with their water treatment issues as well as a host of others, it probably needs to reorganize the political system in the country whereby the people have a greater hand in making the elected officials more responsive to their needs. The successive governments since independence from Britain have not had the resources and, in some cases, the verve to attack some of the problems whose solutions could help people out of poverty. The tendency is that when the people really have a stake in the affairs of the government, especially when they

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[49] khalil Essam. (Desalination 136(2001) 57-62).August18, 2000. December 5, 2004. <www.elsevier.com/locate/desal.>

can vote candidates into and out of office, things tend to get done albeit not ever overnight. A very good beginning would be an adoption of a competitive two-party system in the country.

Very recently President Hosni Mubarak has done more than hinted that he would like Egypt to open up and have a more competitive electoral process. With this newer, more adaptive system, the problems as perceived by the people can take center stage and earnest efforts can be made to solve problems after an open public debate. It is high time that the Egyptian people actually had a hand in running the country.

The other aspect of society that needs to be allowed more freedom is a responsible press which the public officials do not have the right to muzzle and quiet. With a new style of electoral government , it can only be hoped that the next step would be a freer press which would be allowed to investigate and publish the results of such an public examination. These two steps, if implemented, would set the foundation to helping these two countries confront their problems and begin to free the economies to remove some of the socialist limitations that have been placed to prevent the public from freeing itself of some of its problems.

In summary, it should be remembered that two-thirds of African populations are threatened by water scarcity and famine. Solving the drinking water problem needs all efforts (technology and resources) from the private sectors, governmental and international support, because there are many causes to the water problem in Egypt and Sudan such as industrial wastes, agricultural wastes, human and household wastes. In the actuality, Egypt and Sudan are facing many challenges to solve these problem involving the economy, nature, and transportation from local reservoirs to each city. The simplest

human right is to drink clean pure water. If we keep polluting our fresh water supply as well as the aquifers, in decades to come there will be no drinking water for anyone to drink.

Conclusion

Egypt water resource planning is given the task of satisfying the ever-increasing water demands which are dictated by rapidly growing population, increased urbanization, higher standard of living, and an agricultural policy which emphasizes expanded production in order to feed the growing population. Meanwhile, in the case of Sudan the water problem is not due to rapid growth of the population, it is due to the fact that the country is struggling in a civil war, which has been affecting the economy leading to higher levels of scarcity, of this natural resource. The role of research should be to ensure that economically efficient, ecologically sustainable, and politically acceptable alternatives are developed and put forward forcefully enough to lead to both the necessary internal adjustments and the equally necessary international negotiations.

Fresh water distribution is uneven around the globe and political borders have been created with little regard for the boundary of water basins. There are countries that have tremendous fresh water resources, but in the case of Egypt and Sudan tremendous scarcity is the problem. Typical solutions to solve the water scarcity work better on wealthy, energy rich countries, not the case of these two countries of the African Continent. The demand for fresh water, when coupled with population growth, has created a "water gap" in many areas of the third world.

The lack of economic resources is in our opinion the key element in helping Sudan and Egypt to solve their problem of drinking water scarcity. We had seen in the previous pages that the problem in Egypt is been treated in a very technical way: River dams, drinking water treatment plants and distribution lines are being built to solve the

problem and this country is on its way to find a progressive solution to the water supply of its people.

In Sudan the problem is really a huge problem: The war has destroyed the economy and credit record of this country. All resources are (or were) being drained by that war, while the population is lacking for the basic for subsistence. Water for this country is so necessitated that a non profit organization has recently incorporated in USA to help Sudan with its problem – see http://www.waterforsudan.org/. This type of initiative will help but not solve the problem of Sudan; the required resources will not be financed through charities.

The economic problem has to be solved in order to Sudan can dream with water in reasonable quantities for its population. Sudan has to put its economy back on track, reestablish its credit lines with multilateral financial entities (like the I.M.F. or World Bank) and prioritize its needs, but in order to reach that goal; Sudan needs to reach its peace.

The technology to build dams, drinking water and sewage water plants is known and is available, but the works are massive and costly works, so financial resources are the key elements in solving these two countries water scarcity problems. Several technological alternatives were addressed in the previous work, but without the economical resources, all the courage, initiatives, inventiveness and willingness of these two countries will crash against the reality that resources are required to make dreams come true.

Water is essential to all life. However our and future generations has yet to learn that a world, seemingly so plentiful in one resource, is likely to face a water crisis in their

life times. Fresh water is now a strategic resource and there is a strong likelihood that fresh water scarcity will provoke conflicts all around the world.