Cairo Demographic Center

Water Poverty and population in Egypt
Challenges and Strategies

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Chapter: I

INTRODUCTION

Egypt as a developing country faces the most serious challenge which is how to make balance between population growth and water resources. The examination of current trends of population growth shows an annual increase of 2%. It means that Egypt has to feed an additional number of more than 1.4 million people every year so the expansion in cultivated land faces strict limits because it mostly depends on one source of water (THE RIVER NILE). Annual water budget from The River Nile is 55.5 billion m^3/ year.

It is well known that Egypt lies in the arid and semiarid zones. Thus, rainfall water is considered a very important asset in the desert lands for being a factor of crop production. While population increases, more cultivated land needs to be in use. This, virtually, necessitates extra water for irrigation, but unfortunately, available water is scarce both quantitatively and qualitatively.

Water and food are the basic requirements for survival. Land capacity is virtually unlimited and human power can solve the problem of food shortage by enlarging the use of land but water resources supply is a great problem in current development projects.

In order for Egypt to achieve equilibrium of population growth and food production, an agricultural expansion strategy of horizontally reclaiming lands and vertically maximizing feddan productivity was adopted. Nevertheless, Egypt still imports food from other countries all over the world to meet population needs.

There is no doubt that the inevitable population growth must decline in parallel with intensive plans to increase water and food production to obtain a satisfactory level of water , food security and self-sufficiency, since the level of water and land resources consumption has powerful impact on the efforts which aim at meeting population needs. Therefore, the desertification of lands in Egypt decreases the cultivated areas.

So, the attention was devoted towards the techniques of dry farming as a means of raising agricultural production. Wheat production is one of the vehicles for remedying the problem of overpopulation, especially under the prevailing conditions of the arid regions concerning salinity and drought.

The rainfall is concentrated in the north coastal areas of Egypt, and vanishes southwards. Gathering rainfall water represents a very important asset for crop production. The rainy season in Egypt extends form autumn to spring with maximum precipitation in winter. Owing to weather instability over north coast and the Red Sea, thunderstorms and heavy showers take place. It is, also, noticed that the annual number of days with precipitation >= 0.1 mm is large over the north coastal areas and decreases inward to the south.

Water storage in the soil profile is critical to the conservation of rainfall water, as well as to crop production. Generally, the limited amount of precipitated water is susceptible to the severe weather conditions prevailing in this area. Actually, soil moisture gets rapidly depleted hence supplemental irrigation is essential for the satisfaction of water requirements of the existing plants. Some people aim at changing soil surface conditions by shallow plowing, so as to break the continuity of capillary tubes existing in the soil profile. This decreases soil moisture loss and contributes to the water budget of the area.

The major source of water for supplemental irrigation is the underground well water. Unfortunately, not many of the citizens in the area have enough pumping facilities of this water at one hand, and the shortage of the under ground water at the other hand. So, supplemental irrigation has to be limited to the least possible number of irrigation times during the plant life span.

In Egypt, where reclamation of new lands and intensive cropping become a necessity, knowledge of water requirements of crops, amounts of irrigation water and water use efficiency are very important.

At the beginning of the twenty-first century, the Earth, with its diverse and abundant life forms, including over six billion humans, is facing a serious water crisis. All the signs suggest that it is getting worse and will continue to do so, unless corrective action is taken. This crisis is one of water governance, essentially caused by the ways in which we mismanage water. The water crisis is the one that lies at the heart of our survival and that of our planet Earth.

But the real tragedy is the effect it has on the everyday lives of poor people, who are blighted by the burden of water-related disease, living in degraded and often dangerous environments, struggling to get an education for their children and to earn a living, and to get enough to eat.

Now Canada, Australia and the USA started to bush wheat and maize crops to produce bio fuel not to help poor countries.

The World Summit on Sustainable Development 2002 (WSSD), UN Secretary General Kofi Annan identified WEHAB (Water and sanitation, Energy, Health, Agriculture, and Biodiversity) as integral to a coherent international approach to sustainable development. Water is essential to success in each of these focus areas. The WSSD also added the 2015 target of reducing by half the proportion of people without sanitation. Thus 2002/2003 is a significant staging post in humankind's progress towards recognizing the vital importance of water to our future; an issue that now sits at or near the top of the political agenda.

The first WWDR (World Water Development Report 2003) is a joint undertaking of twenty-three United Nations (UN) agencies, and is a major initiative of the new World Water Assessment Program (WWAP) established in 2000, with its Secretariat in the Paris headquarters of the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

Although water is the most widely occurring substance on earth, only 2.53 percent is fresh water while the remainder is salt water. Some two-thirds of this freshwater is locked up in glaciers and permanent snow cover.

Better management of water will enable us to deal with the growing per capita scarcity of water in many parts of the developing world. Solving the water crisis in its many aspects is but one of the several challenges facing humankind as we confront life in this third millennium and it has to be seen in that context.

I.1. Objectives and Importance of the Study

The study aims at meeting the following objectives:

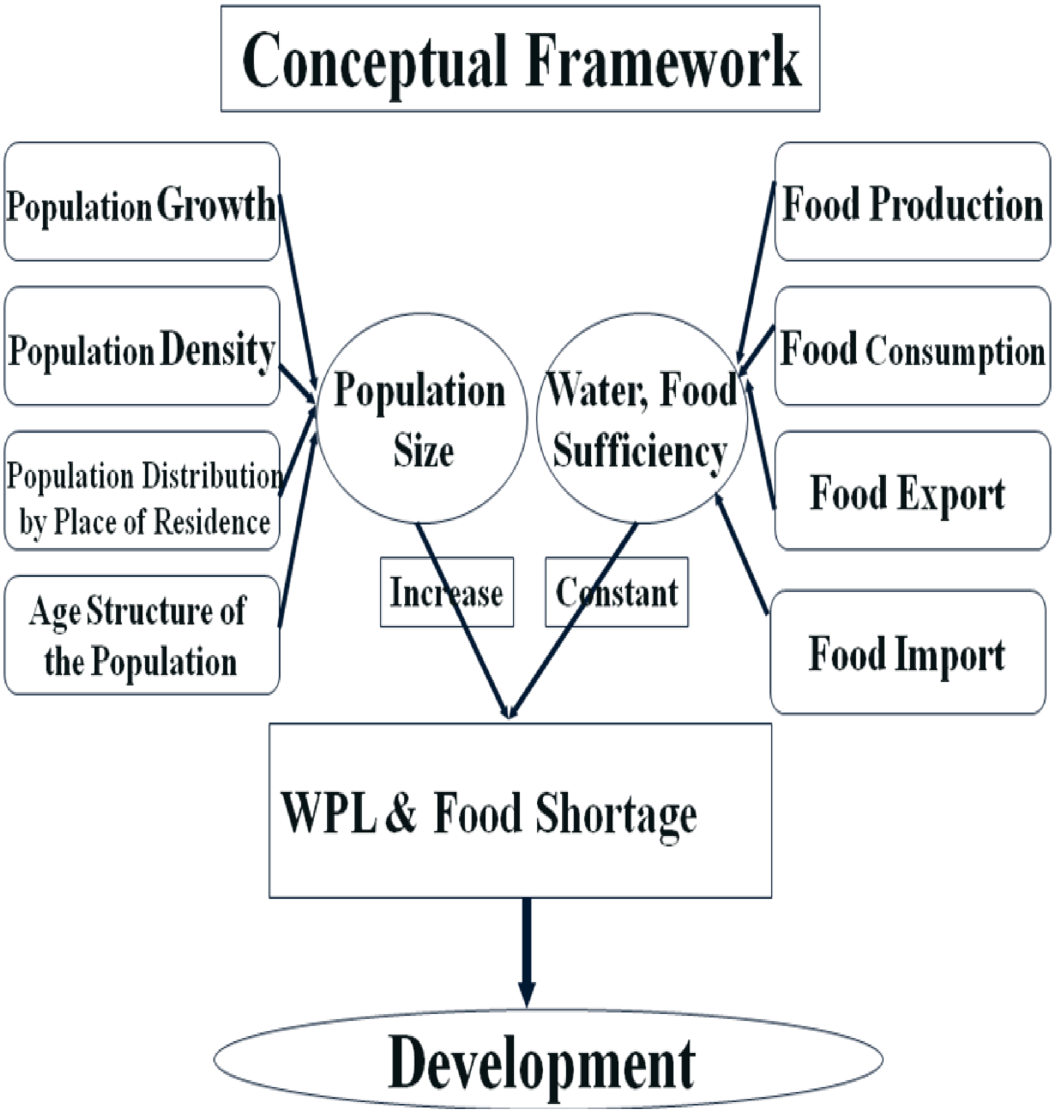
1-To analyze the relation between population growth and water resources supply in Egypt.

2-To highlight the trends of the agricultural food production especially wheat and maize in Egypt.

3-To highlight some solutions for water crisis in Egypt.

So, The importance of the study is as follows:

-Drawing plans of water resources projects and population growth.
-Planning and drawing population and development policies.
-Evaluation of population rates and water resources.



I.2. Methodology

The research is basically based on a descriptive analysis in order to reveal the interrelation between population growth and water-food consumption. The study depends on tabulation of data on population growth rate, water supplies and consumption

The research uses a descriptive analysis approach through cross tabulation bars and graphs using available data. A comparison is also made for different spans of time to analyze the trends of water and food production.

I.3. Sources of Data

* Ministry of Agriculture and Land Reclamation Bulletin.
* UNESCO.Org (Water Report 2003).
* Food & Agriculture Organization of the UN (FAO) www.fao.org.
*CAPMAS: Demographic data, 1986, 1996, 2006 censuses, Statistical yearbook, and Egypt in Figures, 2006.
* Egypt Population in the 20th century CDC, 2004.
* State Information Service (SIS) year book 2003.
* World Bank international financial statistics book.
* International food security research project in Egypt (IFPRI).

I.4. Definitions:

- Water Poverty Line (WPL):

While the absolute minimum water required for survival by a human being is 36 cubic meters per year according to the World Bank, the addition of water required for agriculture, industry and energy production increase this figure to "approximately 1000 cubic meters (m^3) per person per year. In addition, at the local level, agriculture is the mainstay of many rural economies. Providing the 2,800 calories per person per day needed for adequate nourishment requires an average of 1,000 cubic meters (m3) of water."(UNESCO, WWDR 2003)

Less than 600 cubic meters of water would mean absolute water scarcity. Mohamed and Savenije (2000) characterize this level of per capita water availability as the water poverty limit.

So, a major component of the strategy for agricultural development in Egypt is the improvement of the efficiency of use of Nile water, increasing the productivity per unit of water. A saving in the consumption of water on sugar cane of almost 0.5 BCM should be achieved due to the improvement of water use efficiency and land leveling by laser of about 42 000 ha. A further saving is expected to result from improving the use of drainage water and the use of non conventional water resources.

As a rule of thumb, hydrologists use the level of 1000 to 2000 cubic meters (m^3) per person per year to designate danger of water-stress. When the figures drop below 1000 m^3 per person per year country is in water scarcity. (Ohlsson L.2002)

- Food: Is, in general, the amount of quantities obtained by the individual from various food products in a particular time.

- The food problem: Is the insufficiency of domestic production of food for the domestic consumption needs.

- The food consumption: Defined as the use of goods and services to satisfy the needs of humans, also known as the end-use of goods and services in their final shape.

- The food production: Defined as various activities that would have synthesis and coordination between the production elements (inputs) to obtain goods and services (output) with useful value.

- Food gap: Is insufficient local production of food resources to meet the different nutritional needs of the inhabitants. It is the measure of food problem estimated by calculating the difference between local production of food stuffs and total consumption requirements. Food gap leads to the emergence of food problems.

- Self-sufficiency: Is the ratio between the quantity of domestic production of goods and the quantity consumed during a certain period, usually a year. Also it is a measure of the adequacy of the local production to cover the needs of domestic consumption.

- ***Organization of the study***

This study is organized in five chapters. Chapter one includes the introduction with the problem, objectives of the study, methodology, data sources, conceptual framework, definitions of the study, organization of the study and literature review on the water poverty and food gap for the most important food commodities. Chapter two highlights the Population and Water relations and analysis. Chapter three presents Water Policy and Development in Egypt Chapter four shows Population Policy in Egypt. Finally chapter five concludes the study with a summary, main findings and conclusion.

I.4.1. Review of Literature

The structural scarcity of Nile River water, a result of Egypt's insistence on a monopoly, has deterred revering states and peoples from utilizing the water for irrigation and hydroelectric power. The severity and extent of human insecurity and the consequences of environmental degradation are as great in the Horn of Africa as in any other region. Drought, water shortages, and desertification have produced famine and other forms of human insecurity. Famine has been the result of the interplay of growing populations, environmental degradation and drought, as well as conflict and the lack of capacity of states to react. Greater state capacity and local participation are needed to achieve sustainable development and human security. (Burgess 2008)

The main actors are Egypt and Sudan, but Ethiopia and Uganda play a role as well. Conflict could include other nations in the Nile river basin including these 11 countries: Egypt, Sudan, Ethiopia, Eritrea, Uganda, Kenya, Democratic Republic of Congo, Tanzania, Rwanda, Central African Republic, and Burundi.

One very interesting aspect is that the Congo has vast water resources, a relatively small population per land mass and the GDP is an 8th of Egypt. The per capita water available in 1990 was 359,803 cubic meters, compared with Egypt's 1,123.

Disagreements over the allocation of water among countries that share river systems is a common source of international political conflict, especially where populations are outgrowing the flow of the river.(Hans 2007)

Nowhere is this potential conflict more stark than among Egypt, Sudan, and Ethiopia in the Nile River valley. Agriculture in Egypt, where it rarely rains, is wholly dependent on water from the Nile. Egypt now gets the lion's share of the Nile's water, but its current population of 74 million is projected to reach 126 million by 2050, thus greatly expanding the demand for grain and for water. Sudan, whose 36 million people also depend heavily on food produced with Nile water, is expected to have 67 million by 2050. And the number of Ethiopians, in the country that controls 85 percent of the river's headwaters, is projected to expand from 77 million to 170 million.

Since there is already little water left in the Nile when it reaches the Mediterranean, if either Sudan or Ethiopia takes more water, Egypt will get less, making it increasingly difficult to feed an additional 52 million people. Although there is an existing water rights agreement among the three countries, Ethiopia receives only a minuscule share of water. Given its aspirations for a better life, and with the headwaters of the Nile being one of its few natural resources, Ethiopia will undoubtedly want to take more. So, it is hard to argue that Ethiopia should not get more of the Nile water. (Lester 2006)

Water is a catalyst for international cooperation and peace. So, Water scarcity has already become an enormous challenge for African and Asian political actors. Nation states consider water as a military and political tool. Controlling springs may lead towards national and international economical, political and social tension which could escalate into military conflicts. The new challenges for actors like nation-states, NGOs and multi-national corporations in order to realize the objectives of the Agenda 21 and the Millennium Goals of the United Nations that may prevent possible water wars.(Cieslik 2006)

Secure access to freshwater supplies is poised to be an increasingly consequential bone of contention in interstate relations in the future, especially in Egypt and the Middle East, where a host of demographic, political, social and economic factors combine to render it an increasingly water-stressed region. Systematically absent from these studies, though, is any serious consideration of the impact of leaders perceptions on the incidence of cooperation or conflict. (Weiss 2008)

As global demand for water increases but usable freshwater resources decrease, Water scarcity is and will be an important source of armed conflict, but little systematic research has investigated this topic. They argued that increasing water scarcity and water demands make states more likely to begin river claims and to begin militarized conflict over these claims, but that treaties can help to prevent both the emergence and militarization of river claims. (Hensel. 2007)

Climate change is increasingly depicted as a security issue. However, different conceptions of security, ranging from traditional to broad understandings of human security underlies these securitization moves. (Brzoska. 2008)

Egypt has realized the importance which the Nile holds to its very existence. It has reclined for its established natural and historical rights to river waters on the compendium of agreements concluded throughout the 20th Century. Relations between Egypt and Nile-Basin countries, during the Cold War era, were affected by the outbreak of ethnic and power struggles. However, during the past 18 or so years, with President Mubarak at the helm of Egypt's policy-making process, relations have improved with all Nile-basin countries especially Ethiopia. Agreements of cooperation seeking to optimize use of Nile waters have been many. Several agreements have been signed with Ethiopia from which 85 per cent of Egypt's water originates.

Egyptian minister of Water Resources and Irrigation Mahmoud Abu-Zeid confirmed in a press conference on Sunday 27/5/2007 that Egypt's situation concerning water share negotiation with the Nile Basin countries is the strongest. The experts are now discussing the best formula to be agreed on by all the parties concerning the items of the agreement stressing on number of technical, lawful political, economic and social sides which aim at Nile Basin countries' peoples' interests. Abu-Zeid added that the High Dam protects Egypt's water right so, Egypt hasn't any problem to get its right in water according to the currently agreement. Head of Nile water sector confirmed at the press conference that Egypt has proposed together with some Nile Basin countries served conciliating formulas during the present negotiations that reflect Egypt's and other countries' interests. Such formulas are now being studied by experts in each country. "99.5 % of the items of the new water quotas agreement by the ten Nile basin states are over. The agreement included Egypt's keeping of its quota of the River Nile Water which reached 55.56 cubic meters in addition to extra amount to enable it to meet the needs of its agricultural projects, "said Minister of Water Resources and Irrigation Dr. Mahmoud Abu-Zaid. Meantime, the hydraulic and mud institute of water resources center is over with a research containing twenty scenarios for dealing with the new flooding season at the various water levels of Lake Nasser starting with 162 meters level till 183 meters which is the level to pose dangers to the High Dam structure.

The agriculture sector in Egypt is considered a major sector for the Egyptian economy being the sector responsible for providing nutritional security, and the main source that provides entries of other productive and service sectors, in addition to the role of agriculture exports in improving the balance of payments. It absorbs about 34% of the Egyptian labourers. (SIS 2007)

The population in Egypt by 2010 coupled with scarcity of available arable land. The effects are deforestation for pasture land and arable land. Other issues addressed are the increase of cattle herds and overgrazing (Botswana), desertification (Sudan), shortage of fuel wood, water shortages (Jordan), urbanization (11% in 1950 and 46% by 2010), and intervention programs for Population control.(Futures Group 1988)

Over the past 20 years, the population of Egypt has risen from 20 to nearly 70 millions and it has been predicted that this trend will continue, reaching an anticipated 120 millions in the next 20. An estimated 60% live in urban areas - in cities which are growing faster than infrastructure to support them - while the mounting numbers in rural areas provide a ready supply of new migrants to the towns. This increasing urbanization of the population places increased demands on the water supply, further exacerbating the problem for a country which is 95%

desert. The Toshka project - an ambitious project to create a second Nile Valley, redirecting 10% of the country's allotment of water from the Nile via a massive irrigation scheme - arose as part of a plan to increase the inhabitable land from 5% to 25%. One of the Egyptian Government's mega-projects, Toshka and the Southern Egypt Development Project aims to develop and extend agricultural production and create new jobs and population centers away from the narrow confines of the Nile Valley but installing modern irrigation systems on such a scale is costly and takes time. The strategic and social goals have also come in for criticism in some quarters. In addition, the ten countries which share the Nile basin have been involved in a variety of on-going disputes over the water resources for many years - scarcely surprising in the world's most water-scarce region. North Africa and the Middle East is home to more than 6% of the globe's population, yet holds less than 2% of the planet's renewable fresh water, so many of Egypt's neighbors view the project with understandable concern. However, with an annual 1 billion m^3 of rainfall, 7.5 billion m^3 of ground water and 5 billion m^3 of recycled agricultural drainage water, Egypt argues that the scheme can be achieved without increasing the country's 55 billion m^3 quota awarded by the 1959 Nile Treaty. (Water-technology 2007)

Egypt one of the developing countries with continuation of the current high levels of fertility will make it difficult or impossible for them to realize their major economic and social goals. On the other hand, serious attempts to reduce fertility will make many of these goals feasible. As the population dynamics of many countries show, rapid population growth is the result of a country's success in reducing death rates while making little change in birth rates. As a result of high fertility, the populations have a large proportion of young people. Consequently, such countries have a powerful built-in momentum of population growth. Reductions in fertility to a 3-child family average by 2000 would make it possible for many countries to feed themselves or to reduce their import requirements to manageable levels. If a country makes the decision to undertake a program to reduce fertility, it appears to be desirable to combine the population/family planning program with a strong economic and social development effort. (Futures Group 2008)

Emphasis on increased reuse of drainage water for irrigation is essential as Egypt expands its agricultural base to meet the food requirements for rapidly Population growth rate. The Government of Egypt implemented El-Salaam Canal project to reuse drainage water, to create new communities along the Canal and to re-charting Egypt's population map. Diverting considerable amounts of drainage water after blending of the Nile water to newly reclaimed areas for irrigation of 643,560 acres of new lands in the northeastern Delta and northern Sinai peninsula are planned by using El-Salaam Canal water. (Azza 2008)

Water is the vital and most important element for development in Egypt. Nile River with an estimated length of over 6800 km is considered the main source of water in Egypt. To meet the demands of expanding population and economy, and to promote the level of national prosperity, it is essential that water resources be developed and utilized. (Sohair 2006)

Water is one of the major security issues discussed in the Horn of Africa and it has strategic implications for the relations between states such as Ethiopia, Egypt and Sudan. But it also has implications on the individual level for citizens of these countries. So the reasons for these implications are both climatic and political. Egypt is almost totally dependent upon water that originates from the upstream headwaters of the Nile in the humid Ethiopian and East African highlands. Water resources management in the downstream riparian Egypt has involved institutional level reactive adaptations to prolonged periods of low and high Nile flows. Observed responses include the establishment of more robust contingency planning and early warning systems alongside strategic assessment of water use and planning in response to low flows during the 1980s. In the 1990s high flows have enabled Egypt to pursue opportunistic policies to expand irrigation. These policies are embedded in wider socio-political and economic considerations but increase Egypt's exposure and sensitivity to climate driven fluctuations in Nile flows. In many instances the most appropriate entry point for adaptation to climate change will be coping with climate variability and will play out against the certainty of looming national water scarcity in Egypt due to rapid population growth and its possible exacerbation by water demands from upstream riparians. (Arsano 2005)

Egypt confinement governorates suffer a big shortage in water resources. Among the seawater desalination techniques adapted for remote areas is the mechanical vapor compression desalination system (MVC). (Aly 2003)

In the last 30 years, the government in Egypt has reformed the highly centralized economy it inherited from President Gamel Abdel NASSER. The regularity and richness of the annual Nile River flood, coupled with semi-isolation provided by deserts to the east and west, allowed for the development of one of the world's great civilizations. The completion of the Aswan High Dam in 1971 and the resultant Lake Nasser have altered the time-honored place of the Nile River in the agriculture and ecology of Egypt. Maude Barlow2008: Mentioned that Water Is Becoming a Growing Source of Conflict between Countries; the Independent gave several other examples of regions of potential conflict like Ethiopia and Egypt, where population growth is threatening conflict along the Nile.

The water crisis is the status of the world’s water resources relative to human demand as of the 1970s and to the current time. The term "water crisis" has been applied to the worldwide water situation by the United Nations and other world organizations. The major aspects of the water crisis are overall scarcity of usable water and water pollution. The Earth has a finite supply of fresh water, stored in aquifers, surface waters and the atmosphere. Sometimes oceans are mistaken for available water, but the amount of energy needed to convert saline water to potable water is prohibitive today, explaining why only a very small fraction of the world's water supply derives from desalination. Not only are there 1.1 billion without adequate drinking water, but the United Nations acknowledges 2.6 billion people are without adequate water for sanitation (e.g. wastewater disposal). The issues are coupled, since, without water for sewage disposal, cross-contamination of drinking water by untreated sewage is the chief adverse outcome of inadequate safe water supply. Consequently disease and significant deaths arise from people using contaminated water supplies; these effects are particularly pronounced for children in underdeveloped countries, where 3900 children per day die of diarrhea alone. Other conflicts involving North and South Korea, Israel and Palestine, Egypt and Ethiopia, may prove more difficult tests of negotiation. Wind and solar power such as this installation in a village in northwest Madagascar can make a difference in safe water supply. (Wikipedia 2008)

The Nile River is the main source of water for the nine nations which make up the Nile basin. As is, the water provided by the river is barely enough to satisfy the enormous water demands of the region. By the year 2000, it is expected that at least six of the nine nations which share the Nile's water will experience acute water stress. Access to the Nile's waters has already been defined as a vital national priority by countries such as Egypt and Sudan. It is an issue over which the two nations have professed themselves willing to got war over. As more of the nations in the Nile valley develop their economies, the need for water in the region will increase. And while the demand for resources increases, the supply is likely to remain unchanged, drastically increasing the chances for armed conflict over the waters of the Nile River. In addition, development projects that are aimed at increasing the flow of the Nile remain endangered by tension and instability in the region, as well as by environmental and financial concerns. Evaporation also presents a severe problem. Over 2meters depth of water evaporate from the surface of Lake Nasser every year. This is because or its location in the middle of the desert. For this reason many opposed the construction of a dam in that location.

So, the waters, however, do not flow in sufficient quantities to satisfy the future water requirements of all these nations. The nations are barely satisfied by what they now receive and it is foreseen that their needs will increase as populations rise, industrial growth takes place, and more land is irrigated with Nile water for agricultural use in nations besides Egypt. Egypt's cropland is already 100% irrigated, fostering an amazing reliance on the flow of the Nile. It is estimated that Ethiopia and Sudan could achieve high levels of food production if they chose to irrigate as much land as possible.

So, water stress is present when nations find themselves with less than 2000 cubic meters per person of renewable water supplies. By the end of the century at least five nations in the Nile basin expect themselves to be suffering from water stress. This figure does not include the water that would be needed to feed the citizens of the Nile countries. It is unlikely that the flow of water in the Nile could be increased without the completion of the Jonglei Canal, which, given Sudan's internal problems, seems highly unlikely in the near future.

Although war has not yet broken out between the nations involved, some believe growing demands may eventually lead to armed conflict. Signs of this trend are already surfacing. There have been numerous skirmishes between Sudanese and Egyptian troops as well as a number of statements made. The nations of the Nile basin have also classified access to the waters of the Nile River as a vital national interest over which they would be willing to go to war. For now, there has been enough water to satisfy most of the nations' needs, but in the near future those resources which have been left top them will cease to suffice. (ICE 2008)

The Nile River provides nearly all of Egypt's fresh water for agriculture, industry and human consumption. All this water comes from 10 countries up-river from Lake Nassar. Yet, unlike other countries which lie at the base of river systems, Egypt's economic and military might allows it to wield enormous control over how countries up-stream use the Nile's water resources. However, the combination of population growth, economic development and climate change pose to reduce the available water per person in the region and shift the dynamics of power in the basin. However, every change has consequences, some understood, others not intended, and nowhere is this clearer than on the Nile, where history itself has been sacrificed for change. When such a resource is under the guardianship of just one nation state it is easier to control the decision-making process and compensate disaffected parties for the negative consequences of change. The Nile basin, however, is in the trusteeship of 11 cultural and ethnically diverse African nation states, four of which (Egypt, Sudan, Ethiopia, Uganda), have very critical national interests tied up in the river. Not unlike the players in global climate change, these nations vary in population size and growth, culture, GDP, and military might. Although global climate change may alter certain variables over time, it is human population growth, economic development and increases in the standard of living that are the largest contributing factors to the potential for conflict over the natural resources of the Nile. The water which flows down the Nile proper the White Nile, the Blue Nile and the River Atbara. (Hans 2007)

So, what specific impact climate change will have on various areas of the world is uncertain, but any change in the fragile environment of the Nile basin is bound to have an impact. Should rainfall increase the southern Nile, yet decrease in the northern Nile it might result balancing out any change. However, if temperatures do rise as predicted by International Prediction Climate Change (IPCC), it could lead to more water evaporating along the Nile as it flows towards Egypt.

The report on climate change informs us that "by 2020, between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change [in Africa]... Agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020." (IPCC 2007)

"New studies confirm that Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity. Some adaptation to current climate variability is taking place, however, this may be insufficient for future changes in climate."

While climate change and pollution are bound to have some effect on the availability of fresh water in the Nile basin, "the greatest single pressure has been caused by the very rapid growth of population."

In the next 18 years the population of these four countries is expected to grow by nearly 50%. Although the population growth rate is lower than in the other countries, Egypt has a positive immigration rate, presumably because of its stable economic growth and high per capita income. Of these four countries Egypt is also projected to have the lowest per capita water availability in 2025, nearly half of what it had in 1990. The other countries will not fair any better, as they continue to draw from the same limited natural resource. A shift in weather patterns, due to climate change or other atmospheric disturbances, may either have a slowing or accelerating effect on the use and availability of water, but it is unlikely to change the trend's momentum.

Boutros Boutros-Ghali once commented: "The next war in our region will be over water of the Nile, not politics. His statement goes to underscore how important Egypt considers the water of the Nile; naturally it does, but Egypt also considers the access and supply of the Nile's water its undisputed right. Whether Egypt would attempt to destroy dams in other countries through the use of it's military is uncertain, however, Egypt does have much closer ties with powerful Western countries who would with high likelihood support Egypt in a water dispute. (Hans 2007)

Agriculture in Egypt provides nearly 36 percent of national employment, and it is crucial to the livelihoods of many of the two-thirds of the poor who live in rural areas. Egypt's agricultural sector is almost completely dependent on the Nile and the irrigation water that it provides. However, a low level of investment in drainage was unable to keep pace with more intensive and extensive irrigation, and agricultural productivity was severely affected by problems of water-logging and salinity. Major investments in drainage were needed in order to support sustainable agricultural development, reduce rural poverty, and ensure the well-being of the population. (Worldbank 2006)

The sources for water in Egypt are limited to the Nile River and underground water. The underground water in lots of wells is salted and not suitable for agriculture or drinking and needs to be processed which is capital intensive, a tool that Egypt lacks. The Nile River flows from Ethiopia to Egypt across multiple African countries. Each country has its own needs and growing agriculture projects to fulfill the needs of its people. An agreement was reached between these countries to divide the available water between them; this agreement is threatened to fail, as the need for water increases.This dilemma raises the question: how long can Egypt sustain expanding its agriculture land? There are other countries in the same situation and trying to find a solution**.** (SDCA 2008)

Red and white banners along Nile bridges and Cairo streets this month were Egypt's latest effort to curb an increasingly pressing problem: a population growing faster than the economy can support.

With about one fifth of the population living on less than 50 pence a day and food and fuel prices lifting inflation to a 19-year high, discontent is mounting. But beyond domestic concerns, Egypt could become a poster-child for a global trend.

According to the United Nations, the poor are set to be more and more numerous by 2050 and many will be living in towns as the world population climbs to a total of 9.2 billion. Essentially all the growth will be in less developed countries.

Around 38 % of Egyptians are younger than 15, and according to the World Bank, women make up only around 22 % of the labour force, so the incentive for birth control is weak.

Population growth has remained stubbornly high at around 2 % for the last decade and the fertility rate, at about 3.1 children per woman -- compared with 2.1 in the United States -- has also been stable. While lamenting the strain on the country's limited resources -- especially of water and fertile land in a country where rainfall is almost zero -- the government has avoided using incentives or punitive policies to modify behavior. (Will 2008)

Fresh water sources in Egypt are less than 13% of the world average per capita. To meet growing water and electricity demands, projections were made up to the year 2025 considering population growth, rise in standard of living, and development plans. A medium-sized nuclear desalination reactor was found to be a viable choice. Considering the effect of extreme climatic and geomorphological conditions on the plant and the effect of the plant on the area, it was found that the coastal strips from El-Arish to Rafah and from El-Dabaa to Saloum are the most suitable areas for construction of a nuclear power plant. **(**Aly 2001)

Sustainable development of the earth's limited water and land resources is of paramount importance because of rising world population and existing conflicting demands for these resources. Enormous capital investment has been made in developing these resources, but now there is irrefutable evidence that such developments have led to major resource degradation. This includes problems of salinisation and damages to ecosystems. The countries predominantly affected by human induced salinisation are located in arid and semi-arid regions of the world and include Australia, China, Egypt, India, Pakistan, USSR, and USA. (Ghassemi 1991)

It is argued that water resource vulnerability is determined by economic and political conditions, water availability, and the extent of shared water supplies. Countries are at risk if water withdrawals due to limited water supplies or high water demands exceed 33% of their total renewable supply. 21 such countries are at risk, of which nine countries import fresh water and are located in the Middle East, where political tensions are already strained. Most of the water limited countries are located in Africa or Asia. The minimum annual per capita water availability is estimated to be 1000 cu. m per person. 33 countries were in 1990 and are expected in 2025 to fall below this minimum standard. 31 nations rely on a water supply that originates outside national borders. Egypt is an example on one such country, which relies on water from the Nile River. About 45 countries are vulnerable due to more than 50% reliance on hydroelectricity. International law and international institutions rarely address the issue of conflicts over access to resources or the threat of environmental harm as a weapon of war. The limited UN conventions of 1977 and 1982 lack enforcement power. More progress has been made in the development of some general principles and concepts about water resources. The UN in 1966 and 1991 developed a set of principles dealing with equitable use of water resources, the obligation not to harm other states, the obligation to regularly exchange water data and information, and the cooperative management of international rivers. Equitable use is one of the most difficult problems. Water treaties governing use of river basins offer a better alternative that broad principles. Other issues discussed pertain to international security which is affected by resource and environmental problems, the geopolitics of shared water resources, water resources as a military goal or instrument, resource inequalities and water development, and future expectations. **(**Gleick 1993)

Perhaps the most vivid example of the interaction of population growth and water scarcity is the vast basin of the Nile River in northeastern Africa. The 10 countries with territory in the Nile basin contain 40 percent of Africa's population (not all actually within the basin) and make up 10 percent of its land mass. More than 85 percent of the Nile's water comes from the Blue Nile, which originates in Ethiopia. The vast majority of the river's flow, however, is used by Egypt, the last nation on the Nile's path to the Mediterranean Sea.

For centuries the cultural symbol of Egypt, the Nile provides almost all the fresh water used by more than 60 million Egyptians living along its banks. When few people lived upstream—and modern economic development was a distant dream for the entire basin—Egypt saw no reason to worry about its dependence on the Nile's waters. Its complacency is now ending, however, as the upstream nations begin to harness the Nile's waters to provide economic prosperity for their own growing numbers.

Ethiopia, for example, recently emerged from a long period of civil war and famine into a period of accelerated growth and economic development. The government has overseen the construction of more than 200 small dams that will use nearly 500 million cubic meters of the Nile's flow annually. Additional dams are planned to increase the country's irrigation and hydropower capacity. Though Ethiopia's current development plans will require only a small portion of the Nile's water, its potential demands could significantly reduce the river's flow into Egypt. Ethiopia has an estimated 3.7 million hectares of land—an area larger than Belgium—that could be irrigated. With a population nearly the size of Egypt's and a faster annual rate of population growth—3.2 percent annually for Ethiopia versus two percent for Egypt—Ethiopia will need to develop a large portion of this land for agricultural use. Irrigating only half this land area with water from the Nile could reduce the river's flow to Egypt by 15 percent.

Egypt itself is raising the stakes with ambitious plans for its New Valley land reclamation project. Pressed by population growth within its own borders, the Egyptian government has begun a massive irrigation project in the country's western desert in an attempt to persuade seven million Egyptians to move there from the crowded Nile Valley. When completed, a pipeline will carry up to five billion cubic meters of Nile water from the Lake Nasser reservoir to the New Valley site to facilitate the construction of new cities and provide irrigation to more than 200,000 hectares of desert—an area more than twice the size of New York City. Hydrologists doubt the basin produces enough renewable fresh water to satisfy the irrigation plans of both Ethiopia and Egypt. (Tandra 2005)

African water ministers (meeting in Cairo in 2003) cited water as the continent’s most pressing problem. Half of Africa’s populations are deprived of clean freshwater; a third of them are deprived of sanitary drainage services. Since most of it depends on rain, for its irrigation, agricultural land productivity is poor. Only 7 % of the land is regularly irrigated. The fact given that agriculture constitutes the backbone of development in Africa, with its being the sole breadwinner of 80 % of the population, it is considered essential to maximize the benefits of the activity by raising the productivity of arable land to 15 % by the year 2015. Experts have also urged that water projects should top the list of the financial policy priorities of the African governments. Regional cooperation is also called for with the purpose of implementing irrigation mega-projects, whose cost is estimated at US$240 billion, of which 70 million would go to maintenance and operation. The absence of institutional bodies capable of managing any such project together with the insufficient number of experts in that field has put Africa’s figure representing water storage projects at only 2% compared to that of the world. Generally speaking, therefore, Africa stands internationally with the most inferior water investment record.

The amount of surface –flowing and subterranean water is estimated at 4 thousand billion m3, i.e. 20 % of rain water (20 thousand billion m3). Of this amount, however, and despite the 60 or so shared rivers, only 150 billion m3 are used all over the continent. Also, a very limited and ineffective number of technical authorities are actually in existence. This study deals with the most prominent such authorities, while seeking to explore the efforts exerted with the purpose of developing water resource. It further proposes to identify the most significant problems facing them. (Abd El-Monsef. M 2005)

Points out that food accounts for 80% of all Egypt's agricultural imports; by contrast the share of food products in the total agricultural exports doubled from 30% percent to 65% during 1980-2000. (FAO 2005)

It has been possible to achieve a lasting and effective increase in the productivity of land by technical and scientific methods, so Egypt employs multitude efforts to achieve improvements in both the yield and quality of agricultural production. (Abd Elaziz. M 2005)

The crisis is experienced also by the natural environment, which is groaning under the mountain of wastes dumped onto it daily, and from overuse and misuse, with seemingly little care for the future consequences and future generations. In truth it is attitude and behavior problems that lie at the heart of the crisis. We know most (but not all) of what the problems are and a good deal about where they are. We have knowledge and expertise to begin to tackle them. We have developed excellent concepts, such as equity and sustainability. Yet inertia at leadership level, and a world population not fully aware of the scale of the problem (and in many cases not sufficiently empowered to do much about it) means we fail to take the needed timely corrective actions and put the concepts to work. For humanity, the poverty of a large percentage of the world's population is both a symptom and a cause of the water crisis. Giving the poor better access to better managed water can make a big contribution to poverty eradication, changing unsustainable patterns of production and consumption and protecting and managing the natural resource base of economic and social development are overarching objectives of, and essential requirements for, sustainable development. We have to fit the water crisis into an overall scenario of problem-solving and conflict resolution. A key component of the World Water Assessment Program (WWAP) is the development of a set of indicators for the water sector. These indicators must present the complex phenomena of the water sector in a meaningful and understandable way, to decision-makers as well as to the public. They must establish benchmarks to help analyze changes in the sector in space and time in such a way as to help decision-makers to understand the importance of water issues, and involve them in promoting effective water governance. Good indicators help water sector professionals to step 'outside the water box', in order to take account of the broad social, political and economic issues affecting and affected by water. Furthermore, targets are essential to monitor progress towards achieving the Millennium Development Goals related to water Indicator development is a complex and slow process, requiring widespread consultation. New indicators have to be tested and modified in the light of experience. (The World Water Development Report (WWDR 2003)

Egypt is facing increasing water needs demanded by the rapidly growing population and agricultural development; so it has to design plans to make the optimum use of available water. Egypt's goal to achieve self- sufficiency in crop production is checked by limited resources. The study has examined the relationship between population growth and food supply. The study indicates that agricultural production has seen extraordinary growth over the last two decades which allowed per capita food supply to increase despite population growth, but there are warning signs that Egypt may reach the limit of agricultural expansion.

So, knowledge is accepted as one of the keys to development, improved livelihoods, environmental participation and stronger democracies. Generating and disseminating knowledge – to expand education, facilitate research, build capacity and bridge the gap between the rich and the poor – needs political will, investment and international cooperation.

The knowledge base for the water industry is exceptionally broad, embracing health, agriculture/aquaculture, industry, energy and ecosystem issues. It covers the following sectors: education, medical, legal, economic, scientific, technological and management disciplines, as well as a wide range of business issues. It includes grassroots communities, industrial and business leaders, health specialists, educators, lawyers, economists, scientists and engineers of all types, and government.

So, there is a huge body of information and knowledge on water, but language problems, limited access to Information and Communication Technologies (ICT) facilities and limited finances deny many people especially in lower-income countries access to such information. Much of the knowledge relates to advanced country problems and there is a marked lack of indigenous knowledge and expertise relevant to local problems, and an equal lack of appropriate research on lower-income country problems. Science education at post-secondary level is facing a severe crisis in many developing countries, and there is a growing perception that science is failing to tackle acute problems associated with water supply, sanitation, food security and the environment. Research on effective institutional structures and management techniques for lower-income countries is badly needed. Privatization is focusing research more on industrial requirements than basic holistic research. (Marlin 2002)

Chapter: II

Population and Water

Population growth affects negatively the agricultural development and will create a new challenge in the 21^{st} century because Egypt may face water scarcity due to the increasing water consumption. State Information Service (SIS) year book 2003 indicates that Egypt withdraws 60 billion m^3 annually from the River Nile, 49.7 bm^3 for agriculture, and 3.3 bm^3 for population daily, 2.5 bm^3 for industries and 4 bm^3 for electricity.

The water supply is governed by an international agreement. Presently 48 percent of the world's population lives in towns and cities; by 2030 this will rise to about 60 percent. The logic of urbanization is clear – those countries that urbanized most in the past forty years are generally those with the largest economic growth. Urban areas, generally, provide the economic resources to install water supply and sanitation, but they also concentrate wastes. Where good waste management is lacking, urban areas are among the world's most life-threatening environments.

Agriculture in Egypt provides nearly 36 % of national employment, and it is crucial to the livelihoods of many of the two-thirds of the poor who live in rural areas. Egypt's agricultural sector is almost completely dependent on the Nile and the irrigation water that it provides. However, a low level of investment in drainage was unable to keep pace with more intensive and extensive irrigation, and agricultural productivity was severely affected by problems of water-logging and salinity. Major investments in drainage were needed in order to support sustainable agricultural development, reduce rural poverty, and ensure the well-being of the population.

However, irrigation requires water and this is an essential commodity in increasingly short supply. There is now growing realization that an increasing number of countries are approaching full utilization of their conventional surface water resources and that the quantity of good quality water supplies available to agriculture is diminishing. What is left is water of marginal quality such as saline groundwater and drainage waters. The question that needs to be answered is: "can agriculture make use of marginal quality water such as saline water in a way that is technically sound, economically viable and environmentally non-degrading; in other words, is it a viable proposition to use saline water for agricultural production?"

Egypt's agricultural sector is unique in that over 95% of its agricultural production is derived from irrigated land and its irrigation waters originate outside of its borders. On the macro level, the last two centuries of modern Egypt have witnessed considerable development starting by the construction of the Delta Barrage (1898) to assure summer cotton irrigation in the Nile Delta, and the establishment of an intensive canal networks for irrigation, and ending by the construction of the Aswan High Dam in the sixties of the nineteenth century.

The concentration on the macro level was on the hardware part of the irrigation system, while the present and the future will concentrate on the software of the system. Such activities include improvements in operation and maintenance, demand management, water re-cycling, capacity building, and user's participation.

The High Dam is one of the biggest dams in Africa. The region includes more than 1,200 dams, more than 60 per cent of which are located in South Africa (539) and Zimbabwe (213). More than 50% of them were constructed to facilitate irrigation and only 6 % for electricity generation. Outside of West Africa, only the richest 20 percent of households have electricity. Large dams have had several negative impacts, including displacement of people, increasing erosion and flooding, loss of land and loss of income from downstream fisheries, etc. The development of micro-hydropower facilities is now seen as a more sustainable means of managing water resources.(www.unesco.org/wwap.2003).

The High Aswan Dam was constructed to assure the long term availability of water for both Egypt and Sudan. However, the average annual flow during the last decade has been slightly decreased than the long-term average.

A new level of thinking is required - an “intelligent” water system could provide a support. By first understanding the entire scope and nature of the Nile’s depletion, the leaders of those neighboring states can ensure that the right problem has been identified.

Present agricultural water use accounts for about 84% of the total water use while industrial, municipal and navigational use accounts for 8%, 5%, 3% respectively. Percentages of water use by agriculture and municipal sectors are expected to remain by the year 2000 almost similar to the above-mentioned values while for industry it is expected to increase by about 50% and navigational use will decline very substantially.(CIA 2005).

While climate change and pollution are bound to have some effect on the availability of fresh water in the Nile basin, "the greatest single pressure has been caused by the very rapid growth of population.' In the next 18 years the population of these four countries (Egypt, Sudan, Ethiopia, Uganda), is expected to grow by nearly 50%. Although the population growth rate is lower than in the other countries, Egypt has a positive immigration rate, presumably because of its stable economic growth and high per capita income. Of these four countries Egypt is also projected to have the lowest per capita water availability in 2025 nearly half of what it had in 1990. The other countries will not fair any better, as they continue to draw from the same limited natural resource. A shift in weather patterns, due to climate change or other atmospheric disturbances, may either have a slowing or accelerating effect on the use and availability of water, but it is unlikely to change the trend's momentum. (Hans 2007).

Yet how can desert expansion be sustained when Egypt's very limited water supply is consumed virtually for free? Developers continue to set up five-star resorts in the Sinai that rely on water pumped in from the Nile. There are other activities that are taking place in the desert lands - tourism, location of new industries, schools, new urban communities, golf courses - which have water uses. All of which is using Nile water, largely free. The water is not priced in ways that one would have to think of if you have to pay the true cost of the golf course. There is a kind of private sector development that is pushing into and taking advantage of what is available in water, acting as if the water is here forever, and plenty of it, no problem.

Whether the government will move toward a realistic pricing of water remains to be seen. In the meantime, it is pressing forward with reclamation plans. Over the next 10 years, it wants to reclaim 1.4 million hectares of desert. Critics, however, say this is unrealistic and estimate the figure to be half of that, water permitting. One highly visible example of desert reclamation exists on the desert highway connecting Cairo and Alexandria.

President Hosni Mubarak inaugurated the world's largest water-pumping station in Egypt's Western Desert as part of a massive reclamation project. The station pumps more than 14 million cubic meters per day of water from Lake Nasser, behind the Aswan High Dam, to irrigate over 200,000 hectares of desert land. The ultimate plan is to resettle some six million Egyptians from the Nile Valley to southern Egypt and the western oases. (VOA 2006).

II.1. Dependent on Nile Water

From a political perspective, conditions have obviously changed since the first signing of the agreement. This looks like a good opportunity for a political and scientific community project to create intelligent and innovative solutions to meet the needs of the Niles' "clients" and the communities that it services. What's most important here is to have the right representatives around the table with a true, clear picture of the severity of the drinking water problem along the Nile. From a technology perspective, there are plenty of MNEs that provide services such as feasibility studies, best practice audits, and strategic master plans (for example). Naturally, one needs to address the water cycle in order to improve overall water quality. Also, efficient water desalination techniques do exist which would allow for consumption of salt water, not only from the Nile, but also from the Red and Mediterranean seas. (Wordpress.2008).

Egypt already uses more than its quota of Nile water, 55.5 billion cubic meters a year, and might have to cut back on consumption if Sudan uses more or if other Nile Basin countries, such as Ethiopia and Uganda, divert more water for themselves. In a 1959 treaty, Egypt and Sudan agreed to take almost all the Nile's flow for themselves, leaving out other Nile basin states, who have not agreed to respect it. Some experts question whether a $70 billion government plan to reclaim 3.4 million acres of desert over the next 10 years -- which Egypt continues to push ahead with -- is feasible given constraints on water. While lamenting the strain on the country's limited resources -- especially of water and fertile land in a country where rainfall is almost zero -- the government has avoided using incentives or punitive policies to modify behavior.

The primary objective of the series of drainage projects has been to increase agricultural productivity of irrigated land by improving drainage efficiency and controlling water-logging and salinity, thereby increasing crop yields and rural incomes. Associated with this, the projects have aimed to build the institutional capacity of the Egyptian Public Authority for Drainage and Projects (EPADP) in order to increase its effectiveness and efficiency in implementing the drainage program.

Continued support should be given for institutional reform and integrating irrigation and drainage operations. The Ministry of Water Resources and Irrigation is increasingly facing a shortfall of funds and will need to streamline its multiple units to cut costs, increase coordination, and enhance productivity. There are strong Egyptian champions for change, and development partners should continue to work with them in order to consolidate the many achievements made thus far. (World Bank.2006)

II.1.1. Water Supply and Demands

II.1.1.1 Water Supply

Surface water resources are limited to Egypt's share of the flow of the River Nile. This Nile Water discharge constitutes more than 95 % of Egyptian total water supplies. Egypt has no effective rainfall except in a narrow bond along the northern coastal area where the average rainfall is 200 mm.

The Nile system below Aswan can be considered a closed system with a single input from the High Aswan Dam and five outlets, which are: Evapotranspiration, non-recoverable municipal and industrial consumptions, evaporation, agricultural drainage water to the sea, and non recoverable inland navigation water released to the sea. Using this concept, the valley and Delta groundwater extractions and drainage re-use would be considered as internal mechanisms to increase the system overall efficiency and not as added resources.

II.1.1.2 Water Demands

Agriculture is the largest water user in Egypt. It is essentially dependent upon irrigation, and consumes the bulk of the available water (about 84%). Excess Irrigation water applications contribute to the groundwater shallow aquifers and to water logging problems. Water pumped from such aquifers or re-used through re-cycling of agricultural drainage water brings up the overall water use efficiency to a reasonable value. The Ministry of Public Works and Water Resources (MPWWR) does not give any irrigation permits for new lands, within the program of land reclamation, unless evidence is given that modern irrigation systems will be used.

Present-annual municipal, industrial and navigational water demands amounts to 3.1, 4.6, and 1.8 billion m3 respectively. In the year 1995-1996 the MPWWR has succeeded to bring navigational water use to 0.3 billion m3 following the construction of New Esna Barrages and through changing the operating rules of winter closure period. Future requirements in such demands depend very much on population growth. The population of Egypt now is about 73 million and is expected to increase to 95 million by the years 2025.

Preparation of Water Policies for Egypt dates back to 1933 when a policy was set up to make use of additional capacity due to the second heightening of the old Aswan Dam. The most recent update for the year 2000 that took place was in June 1994. The Ministry of Public Works and Water Resources is currently reviewing its water policy considering these new factors, Meanwhile the year 2000 is becoming too close for planning purposes and the year 2027 is the new target for planning. (Eoearth.org 2008).

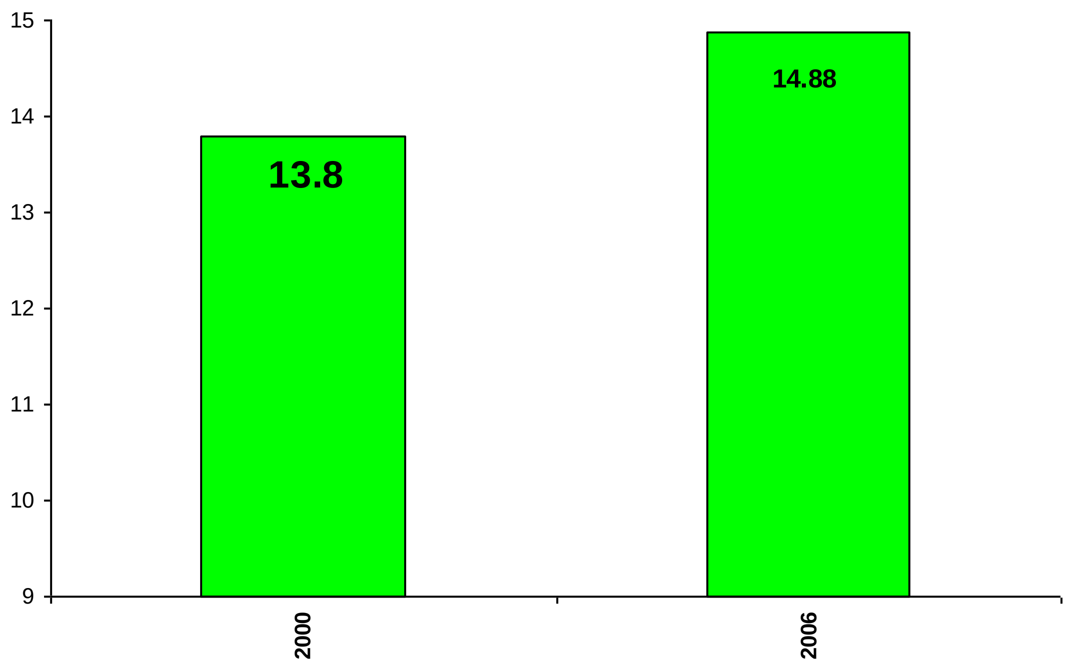
II.1.2. Irrigation Needs and Sanitary Measures

The expansion of irrigation is projected to be the strongest in North Africa, as well as in the Near East. By 2030, Egypt and North Africa will have reached critical thresholds of water availability for agriculture. In sub-Saharan Africa, no additional land resources are available to exploit, and the proportion of renewable water resources allocated to irrigation is likely to remain far below the critical threshold. Africa's dependence on cereal imports is expected to continue to grow, with a widening net trade deficit (www.unesco.org/wwap.2003).

II.1.3. Population Growth and Water-Agricultural Food Production

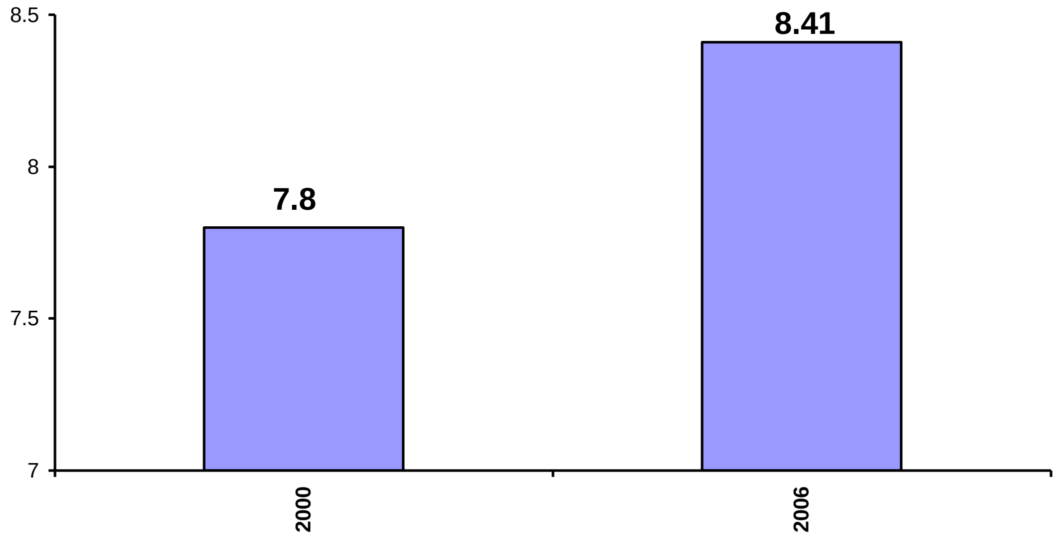
Egypt's agricultural land is on average highly productive and ideally suited to intensive agriculture with good climate conditions, including maximum sunlight and perennial source of irrigation water (The Nile).The agricultural land of Egypt totals about 8.41 million feddans: about three million within the Nile basin and Delta, 5.4 million feddans are old and 3 are new reclaimed land. According to FAO report the continuing rapid growth of population caused the decrease of agricultura1 land per capita from 0.19 feddan in"2000 to 0.12 in 2006, but the total agricultural food production increased due to the vertical and horizontal expansion in agriculture and also due to land reclamation .Fig (1), Fig (2)

Figure (1)
Cropped Area in (million feddans)



Source: The Ministry of Agriculture and Land Reclamation 2006.

Figure (2)
Cultivated Area (million feddans)



Source: The Ministry of Agriculture and Land Reclamation 2006.

Table (1) shows clearly that the total production and yield of the main food crops (wheat- rice- maize) increased from 13.02 million tons in 1990 to 20.11 million tons in 2000 (FAO-UN). The total yield increased gradually from 57.029 million tons in 1990 to 72.799 million tons in 2000.

Table (1)
Egypt Statistics on Total Crops (Cereals) Production (Million Tons)

Years	**Production (MT)**	**Yield (1000 Tons)**
1990	13.02	570
1991	13.86	561
1992	14.61	589
1993	14.96	599
1994	15.01	586
1995	16.10	590
1996	16.54	650
1997	18.07	661
1998	17.96	680
1999	19.40	717
2000	20.11	728
2001	20.22	740
2006	24.71	879

Source: FAO –UN 2006.

Table (2)
POPULATION, LAND AND WATER PER CAPITA

Year	Population Millions	Land per capita ha	Water per capita m^3
1800	2.0	0.42	n.a.
1850	4.6	0.36	n.a.
1897	9.7	0.21	5 084
1947	19.0	0.13	2 604

SOURCE: HAMDAN (1983); CENTRAL AGENCY FOR PUBLIC MOBILIZATION AND STATISTICS (CAPMAS, 1989).

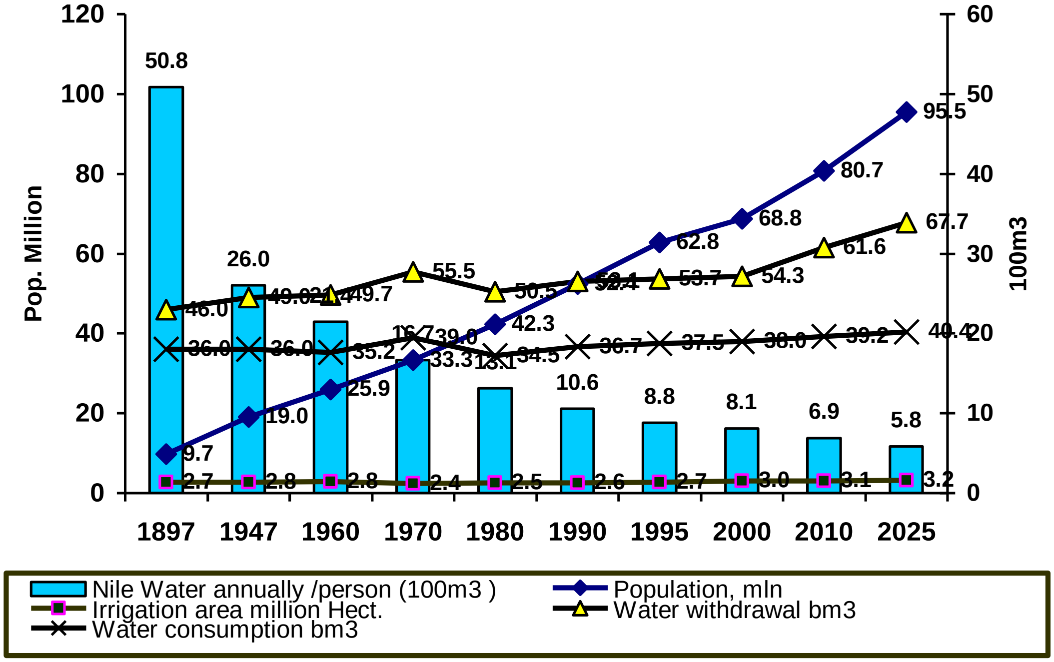
Table (2.1)
Dynamics of Water Use in Egypt

Years	1960	1970	1980	1990	1995	2000	2010	2025
Population, million.	25.9	33.3	42.3	52.4	62.8	68.8	80.7	95.5
Irrigation area, million hectares.	2843	2445	2507	2578	2650	3000	3100	3200
Water withdrawal bm^3	49.7	55.5	50.5	53.1	53.7	54.3	61.6	67.7
Nile Water annually /person (m^3)	2142.9	1666.7	1312.1	1059.2	883.8	806.7	687.7	581.2

Source: World Bank Year Book 1998, water annually calculated by researcher.

In 1990 water per-capita was 2.75 m^3 per person and decreased in 2006 to < 2.0m^3 daily because of the population increase. Tables (2),(2.1) and figure (3) show the trends and projections of population growth and water consumption from 1897 to 2025; we can conclude that there is a strong relation between the two variables: The more the population increases, the more consumption of water, and the more we need water for irrigation. So agriculture' is closely linked to the Nile water.

Fig. (3) Dynamics of population growth and percapita available water resources in Egypt.



Source: World Bank Year Book 1998

II.1.4. Physical Variables

II.1.4.1. Water Resources

More than 96 percent of Egypt' all fresh water resources is supplied by the river Nile (UN CCA, 2001) which originates from outside of the country boundaries and supplies nine countries among which Egypt, Sudan and Ethiopia are the main users. Fresh water sources from Nile are limited for Egypt by an international agreement between Sudan and Egypt from 1959. The agreement entitled Egypt to 55.5 billion cubic meters (BCM) of Nile water per year and assigned 18.5 BCM for Sudan. (Abu-Zeid, 1991)

A current water demand of Egypt is estimated at 67.47 BCM per year, from which the river Nile provides 55.5 BCM and therefore becomes an almost exclusive source of fresh water for country. The rest of the water requirements are met by a renewable groundwater with 4.8 BCM /year and a drainage water reuse, which is estimated as 4.5 BCM. Treated municipal and industrial wastewater water returns to the closed water system 0.7 and 6.5 BCM respectively. (UN CCA, 2001) From the 55.5 BCM about 3 billion BCM is lost to surface evaporation from the irrigation system (MWRI, 2002a).

For year 2017 water demand is expected to rise up to 87.9 BCM. The rapid growth of demand is planned to be partly supplied with additional water resources that can be obtained from non-renewable groundwater aquifers in the Sinai and the Eastern and Western deserts. (UN CCA, 2001)

Table (3) Present and projected water resources in BCM based on CCA materials

Source	2001	2017
The River Nile	52.5*	55.5**
Renewable ground water	4.8	7.5
Agricultural drainage water	4.5	8.4
Treated domestic waste water	0.7	2.5
Treated industrial waste water	6.7	6.7
Desert aquifers	0.57	3.77
Rainfall and flush harvesting	-	1.5
Saving from management	-	1.5
Total	69.77	87.37

(UN CCA, 2001)* 3 billion cubic meters of surface evaporation is subtracted

** Including the 2 BCM possibly yield from Jonglei project. Jonglei project in Sudan intended to increase availability from Nile water reducing the evaporation from Sudan's Sudd swamps. Project has not been completed due to conflict in region.

Table (4) Water allocation among the water users

Water Users	Worldwide (In percent)	Egypt (In percent)		
	1999	1990	2001	FAO 2001
Agriculture	65	84	83	78
Industry	25	7.8	10	14
Domestic use	10	5.2	6	8
Total water use in BCM	-	59.2	67.47	68.67

Source: (Abu-Zeid, 1991 and UN CCA, 2001 and Figures given by FAO Aquastate).

The Plans promise to add 3.4 million feddans of desert land to the cultivated land area (UN CCA, 2001). The land expansion projects indent to reclaim almost 44 percent of present cultivated land area by transferring the water to the desert lands. This means that at the present water use practices land expansion would place an enormous strain on water supply.

The main concern in irrigation water planning is to achieve higher agricultural production and reduce water consumption. The latest water policy of Egypt is a ten -year plan which started in 1990 in response to several events, i.e. the drought in 1988 when the Nile flowed less water than expected and reduced the reservoir to a critical level, cessation in construction works on the Jonglei

Canal because of the civil war in southern Sudan and requiring one mil1ion m^3 of additional water for the land reclamation program. It is estimated that the flow to Lake Nasser could be increased by 18 billion m^3 per year to be shared by Egypt and Sudan by implementing Jonglei Canal project.

II.1.5. Agricultural Expansion to Meet Population Needs:

Egypt launched in 1997 mega national projects to provide new charts for the agricultural production, the most important. of which is developing the Southern valley where 540.000 feddans are to be reclaimed within the project of Toshka and Shekh Zayed canal to be irrigated from the Nile, besides about 200.000 feddans which will be cultivated by subterranean water in Owinat and 150.000 feddans in Kharga, Dakhala and Frafra Oases, in addition to the project of reclaiming 220,000 feddans on the west side of the Suez Canal.

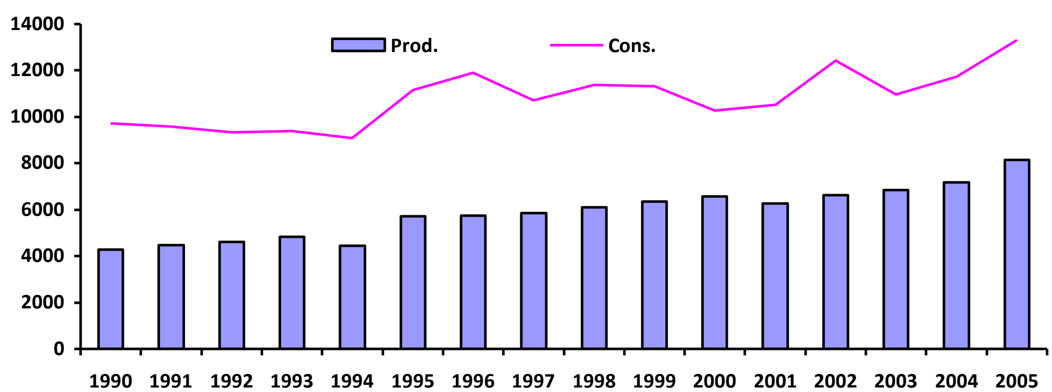
II.1.5.1. Wheat Production and Consumption

Figure (4) presents the trend of production and consumption for wheat in Egypt during the period (1990-2005). From the trend of the wheat production, it ranged from 4268 thousand tons in 1990 and 8141 thousand tons in 2005. By examining the trend of the wheat consumption, it ranged from 9074 thousand tons in 1994 and 13310 thousand tons in 2005. Also the figure illustrates that there is a gap and it is fluctuated between high and low during the whole period and this might be due to the increase in both production and consumption.

Figure (4)

Wheat Production and Consumption Trends in Egypt

During the Period (1990-2005)



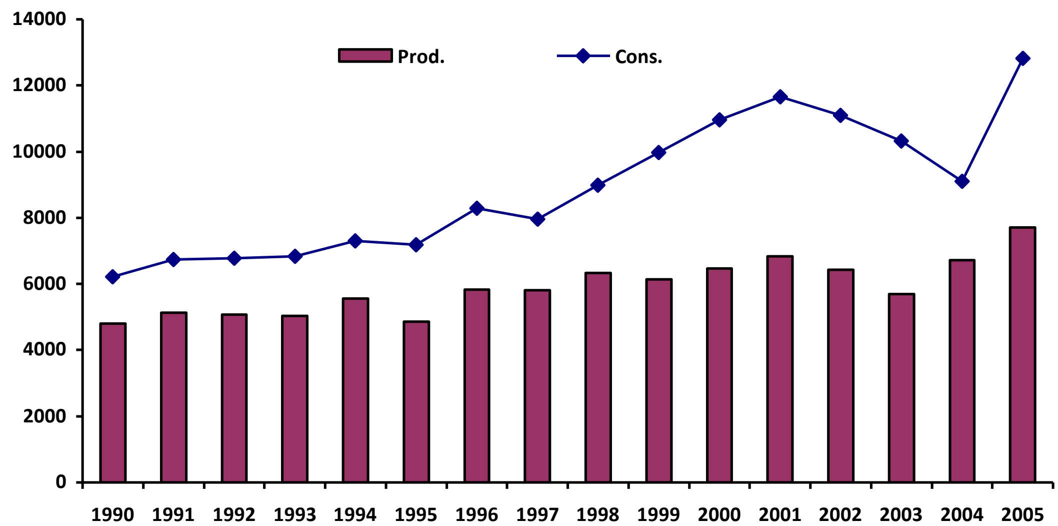
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Agricultural Economics Bulletin". Vols. (1990-2005).

II.1.5.2. Maize Production and Consumption

Figure (5) presents the trend of production and consumption for maize in Egypt during the period (1990-2005). From the trend of the maize production, it ranged from 4799 thousand tons in 1990 and 7698 thousand tons in 2005. By examining the trend of the maize consumption, it ranged from 6219 thousand tons in 1990 and 12818 thousand tons in 2005.

Also the figure illustrates that there is a gap and it is increased during the whole period and this might be due to the efforts to increase the production.

Figure (5)
Maize Production and Consumption Trends in Egypt
During the Period (1990-2005)



Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Agricultural Economics Bulletin". Vols. (1990-2005).

II.2. Wheat Gap and Self Sufficiency

Figures of wheat gap in Egypt during the period (1990-2005) from table (5), it shows that the average gap reached about 4924 thousand tons. The total gap of wheat ranged from a minimum of 3703 thousand tons in 2000 to a ceiling of about 6174 thousand tons in 1996.

From the trend of the wheat self sufficiency in Egypt during the period (1990-2005) from table (5) it shows that the average self sufficiency reached about

54 %. Also it shows that the lowest percentage of self sufficiency reached about 44% in 1990 and the highest was about 64% in 2000. Statistical analysis of the trend of the wheat self sufficiency evolution in the same period, the time series for the wheat self sufficiency showed that self sufficiency had increased annually by about 1.1% which represented about 2% from the average wheat self sufficiency. The result reflects that the percentage of change of wheat self sufficiency is mainly due to the strong association with the time factor and the correlation coefficient is statistically significant.

Data of the wheat production in Egypt during the period (1990-2005) from table (11), it shows that the average production reached about 5875 thousand tons. The total wheat production ranged from a minimum of 4268 thousand tons in 1990 and a ceiling was about 8141 thousand tons in 2005.

Table (5)

Wheat Gap, Self Sufficiency, Wheat Production and Wheat Retail Price in Egypt During the Period (1990-2005)

Year	**Wheat Model**			
	(1) Wheat Gap (1000 tons)	(2) Self Sufficiency %	(3) Production (1000 tons)	(4) Wheat Retail Price (K.g/ L.E.)
1990	5456	44.00	4268	0.642
1991	5086	47.00	4483	0.747
1992	4712	49.49	4618	0.775
1993	4544	51.54	4833	0.750
1994	4637	49.00	4437	0.753
1995	5421	51.35	5722	0.834
1996	6174	48.15	5735	0.935
1997	4875	54.54	5849	0.976
1998	5295	53.50	6093	0.999
1999	4977	56.00	6347	0.992
2000	3703	64.00	6564	1.019
2001	4253	59.52	6255	1.038
2002	5797	53.33	6625	1.061
2003	4113	62.46	6845	1.127
2004	4570	61.09	7178	1.494
2005	5169	61.16	8141	1.413
Average	4924	54	5875	0.972

Source: Columns (1),(2),(3) from Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Agricultural Economics Bulletin". Vols.(1990-2005),Column(4)from (CAPMAS), "Materials, Food Products and Services Price Bulletin" Average Selling Prices to the Consumer for the Main Food Commodities.

Simple analysis for the trend for the evolution of wheat production in the same period, the time series for the wheat production showed that the production had increased annually by about 224.7 thousand tons which represented about 3.8% from the average wheat production. The result reflects that the percentage of change of wheat production is mainly due to the strong association with the time factor which is statistically significant.

Data of the wheat retail price in Egypt during the period (1990-2005) from table (5), it shows that the average retail price reached about 0.972 k.g. /L.E. The total retail price of wheat ranged from a minimum of 0.642 k.g. / L.E. in 1990 to a ceiling of about 1.494 k.g. / L.E. in 2004.

Simple trend analysis of the wheat retail price in the same period, the time series for the wheat retail price showed that the retail price had increased annually by about 0.045 (k.g./L.E.) which represented about 4.6% from the average of wheat retail price. The result reflects that the percentage of change of wheat retail price is due mainly to the high association with the time factor which is statistically significant.

II.3. Maize Gap and Self Sufficiency

Data of the maize gap in Egypt during the period (1990-2005) from table (6), it shows that the average gap reached about 2987 thousand tons. The total gap of maize ranged from a minimum of 1420 thousand tons in 1990 to a ceiling of about 5120 thousand tons in 2005.

Statistical analysis of the trend for the maize gap evolution in the same period, the time series for the maize gap showed that the gap had increased annually by about 236 thousand tons which represented about 7.9% from the average maize gap. The result reflects that the percentage of change of maize gap is mainly due to the strong association with the time factor and the correlation coefficient which is statistically significant.

Data of the maize self sufficiency in Egypt during the period (1990-2005) from table (6) it shows that the average self sufficiency reached about 68%. Also it shows that the lowest percentage of self sufficiency reached about 55% in 2003 and the highest was about 77.2% in 1990.

Statistical analysis of the trend for the maize self sufficiency evolution in the same period, the time series for the maize self sufficiency showed that self sufficiency had decreased annually by about 1.2% which represented about 1.8% from the average maize self sufficiency. The result reflects that the percentage of change of maize self sufficiency is mainly due to the strong association with the time factor and the correlation coefficient is statistically significant.

Table (6)
Maize Gap, Self Sufficiency and Maize Retail Price in Egypt During the Period (1990-2005)

Year	Maize Model		
	(1) Maize Gap (1000 tons)	(2) Self Sufficiency %	(3) Maize Retail Price (K.g/ L.E.)
1990	1420	77.17	0.610
1991	1607	76.12	0.677
1992	1708	74.80	0.687
1993	1792	73.77	0.667
1994	1749	76.04	0.690
1995	2322	67.68	0.728
1996	2454	70.36	0.837
1997	2159	72.89	0.898
1998	2642	70.58	0.914
1999	3835	61.57	0.859
2000	4481	59.10	0.935
2001	4808	58.73	0.937
2002	4672	57.92	0.969
2003	4644	55.04	1.047
2004	2377	73.89	1.256
2005	5120	60.06	1.327
Average	2987	68	0.877

Source: Columns (1), (2) from CAPMAS, "Study the Evolution of the Production, Foreign Trade and Available for Consumption of Agricultural Commodities", Different Years. Column (3) from (CAPMAS), "Materials, Food Products and Services Price Bulletin" Average Selling Prices to the Consumer for the Main Food Commodities.

Data of the maize retail price in Egypt during the period (1990-2005) from table (6), it shows that the average retail price reached about 0.877 (K.g/ L.E.). The total maize retail price ranged from a minimum of 0.610 (K.g/ L.E.) in 1990 to a ceiling of about 1.327 (K.g/ L.E.) in 2005.

From simple trend analysis of the maize retail price evolution in the same period, the time series for the maize retail price showed that the retail price had increased annually by about 0.041 (K.g/ L.E.) which represented about 4.7% from the average maize retail price. The result reflects that the percentage of change of maize retail price is strongly associated with the time factor which is statistically significant.

Chapter: III

Water Policy and Development

The total area of agricultural land in Egypt amounts to around 3.5 million ha, accounting for almost 3.3 % of the total area. At present only 5.4 % of the land resources in Egypt is qualified as excellent, while about 40 % is of either poor or of low quality, due mainly to salinity, water logging and sodicity (alkalinity) problems.

The total area cropped annually increased from 4.7 million ha in 1982 to 6.5 million ha in 2003 due to increased cropping intensity, which reached about 180 %. This was made possible by the introduction of earlier maturing varieties of various crops, which permit up to three harvests per year. That crops are cultivated on relatively large areas, reducing waste in the use of land resources, minimizing and organizing pest control, improving the use of water for irrigation and mechanization practices.

III.1. Land Management and Soil Resources

Egypt has an area of about one million square kilometers or 238 million feddans (one feddan = 0.42 ha). The total agricultural land in Egypt amounts to nearly 8.4 million feddans (3.5 million ha) and accounts for around 3.5 % of the total area. One million ha in the irrigated areas suffer from salinization problems, water logging and sodicity. The majority of salt-affected soils are located in the northern-central part of the Nile Delta and on its eastern and western sides. Increased attention is being given to the improvement of salt-affected soils, since they are potentially productive and require less investment, effort, and time for restoring their productivity, than the reclamation of new land.

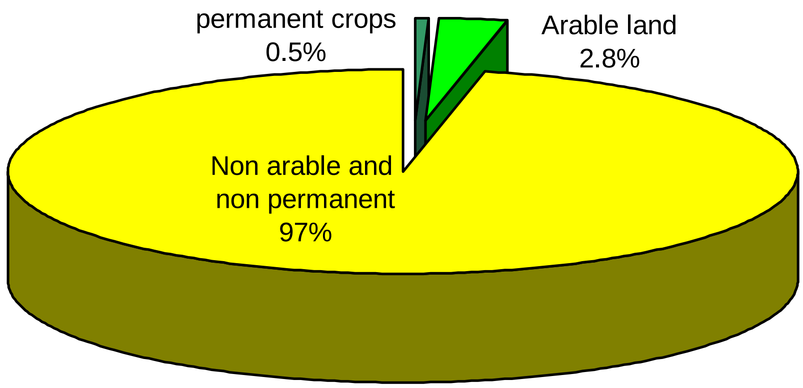
III.1.1. Agro-Ecological Zones and Farming Systems

Soils in the Nile River and Delta are silt-clay mixtures of good quality, deposited during thousands of years of Nile flooding. The total cropped area is estimated at approximately 5.8 million ha with a cropping intensity of 180 %. Most of the newly reclaimed desert areas use modem irrigation practices such as drip and sprinkler systems. An estimated 3.5 million farmers cultivate holdings of about two feddans (one feddan = 0.42 ha). Production is intensive and yields are relatively high compared with world standards in countries with similar agro climatic conditions.

III.1.2. Land Use and Farming Systems

Figure 6 shows that around 3.3 percent of the land is used for agriculture. The most significant change in land use is increasing intensification, resulting from the progress of mechanization and the application of fertilizers and agrochemicals. The aim of land use planning in Egypt is to change the pattern of land use in such a way that crops are cultivated on relatively large areas, reducing waste in the use of land resources, minimizing and organizing pest control, improving the use of water for irrigation and mechanization practices.

FIGURE (6)
Land use in Egypt :Total land area 100 million ha



Source: Ministry of Agriculture and Land Reclamation (MALR), 2002.

III.1.3. Agricultural Development

Three main factors limiting the growth of the agriculture sector are:

1. Water (resources) quantity and quality
2. Land resources
3. Human resources

1. Water resources:

Limited water resources
Inefficient utilization of water
Rapidly deteriorating quality of water due to pollution and salinization

2. Land resources:

Population pressure
Urban encroachment
Implementation of legal and regulatory systems
Land degradation

3. Human resources:

Coordination

Information transfer
Lack of adequate credit

III.1.4. Water Supply

There is no effective rainfall in Egypt except on the narrow band along the north coast and Egypt's agriculture is almost totally dependent on irrigation. The total water resources currently available in Egypt are estimated at 73.8 billion cubic meters (BCM) per annum including the natural and non-traditional resources. At present approximately 62.6 BCM of water are used annually. The agricultural sector consumes about 81 percent of the total water available. The total torrent water is estimated at 1.5 BCM annually. The Nile is the major source of water in Egypt and agricultural development is closely linked to the Nile River and its management.

TABLE 7

Availability and current use of water

Source	Availability BCM/annum	Percent	Current use BCM/annum	Percent
Nile	55.5	75.2	51.7	82.6
Underground	11.3	15.3	5.2	8.3
Agriculture*	5.0	6.8	3.7	5.9
Waste water	1.5	2.03	1.5	2.4
Rainfall	0.5	0.67	0.5	0.8
Total	73.8	100	62.6	100

*Re-use of drainage water
Source: FAO, 2003.

TABLE 8

Distribution of water use by sector

Sector	**Consumption BCM/annum**	**Percent**
Agriculture	50.8	81.1
Industrial and municipal	8.8	14.1
Electricity	2.0	3.2
Navigation & winter closure	1.0	1.6
Total	62.6	100

Source: FAO, 2003.

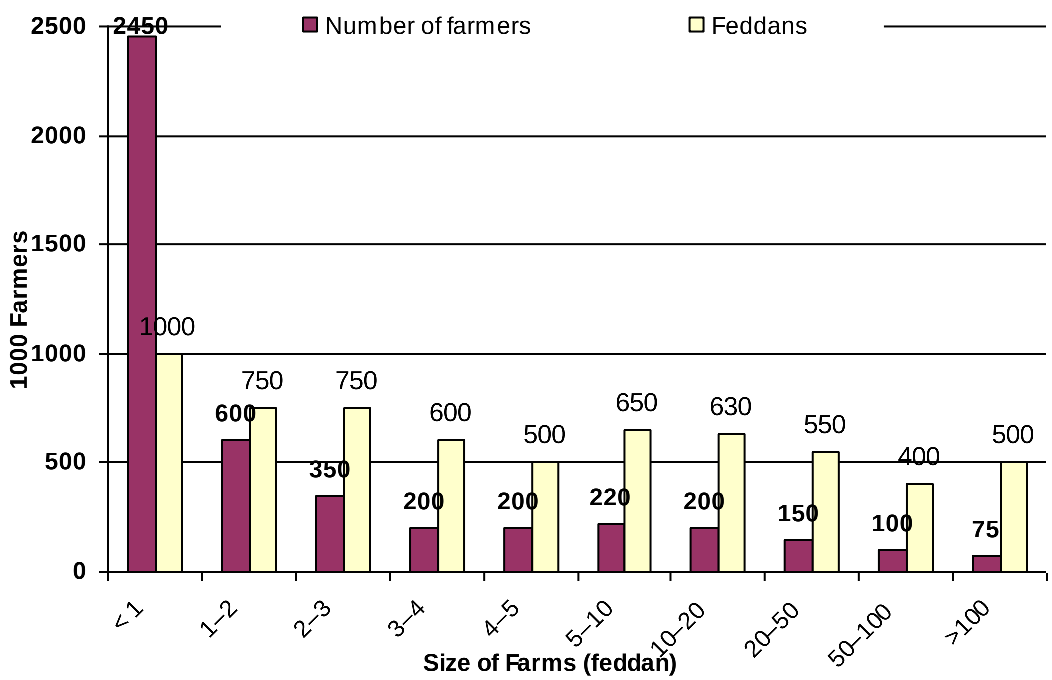
A major component of the strategy for agricultural development is improvement of the efficiency of use of Nile water, increasing the productivity per unit of water.

Total water consumption in the year 1995 was approximately 49 BCM. Water consumption for the proposed cropping pattern for year 2017 should amount to around 67 BCM for the cultivation of about 9.2 million ha. The additional water is expected to result from reducing the area under rice to 420 000 ha and the cultivation of new varieties with a shorter growth duration and lower water consumption. This should reduce the consumption of irrigation water for rice cultivation by four BCM. A saving in the consumption of water on sugar cane of almost 0.5 BCM should be achieved due to the improvement of water use efficiency and land leveling by laser of about 42 000 ha. A further saving is expected to result from improving the use of drainage water and the use of non conventional water resources.

III.1.5. Land tenure

The Agrarian Reform laws limit the maximum farm size to 50 feddans for an individual or 100 feddans for a family. However, farms of this size are not common in Egypt. The large estates, with thousands of feddans, were expropriated in various ways in the 1952 and 1961 land reforms. About 81 percent of farms do not exceed three feddans while 9 percent have between 3 and 5 feddans. The average farm size is about 1.5 feddans. Figure (7) shows the distribution of agricultural landownership in the year 2000.

FIGURE (7)
Ownership of agricultural land



Source: Ministry of Agriculture and Land Reclamation (MALR), 2003.

There is a slight trend towards concentration of landownership, especially in the new lands, but it is less significant than the concentration of ownership of agricultural machinery or the ability of the larger farmers to take advantage of new market opportunities. Any trend towards concentration of landownership is still inhibited by the agrarian reform rules that limit the size of holdings. There are many "landless" people in the rural areas. Though some work as labourers, not all are involved in the agrarian sector: many have other occupations - civil servants, merchants, commuting factory workers.

III.2. Agricultural *Production Systems Crop Production Systems*

The successful implementation of two agricultural strategies in the 1980s and the 1990s had a positive economic impact at both macro and sector levels. Farmers are very responsive to technology transfer, extension activities and price incentives.

The total cropped (cultivated) area increased from 4.7 million ha in 1982 to 6.5 million ha in 2003 due to an increase in cropping intensity to 180 percent. This was made possible by the cultivation of earlier maturing varieties of various crops, permitting the possibility of harvesting three crops a year. The aim is to reach a cropping intensity of 220 % within the next 20 years. This target requires new varieties that combine earliness with higher yields.

In Egypt, the major field crops are cotton, rice and maize in the summer rotation and wheat, berseem clover, and faba bean in the winter rotation. Plant production contributes about 65.8 percent of the total value of agricultural GDP.

- *Cereal crops* represent about 50 percent of the value of field crops, occupying about 2.72 million ha out of the total 6.5 million ha of cropped area. Wheat occupies approximately 1.05, maize 0.88, rice 0.59, sorghum 0.15 and barley 0.1.9 million ha (Table 9).

TABLE 9
Field crops: areas, yields and returns, 2002/03

Crop	Area ('000 ha)	Yield (kg/ha)	Cost (LE/ha)	Net return (LE/ha)	Revenue (LE/ha)
Cotton	297	462	1 221	866	355
Wheat	1 053	1 147	1 147	720	427
Rice	650	1 659	1 152	739	413
Maize	770	1 373	968	622	346

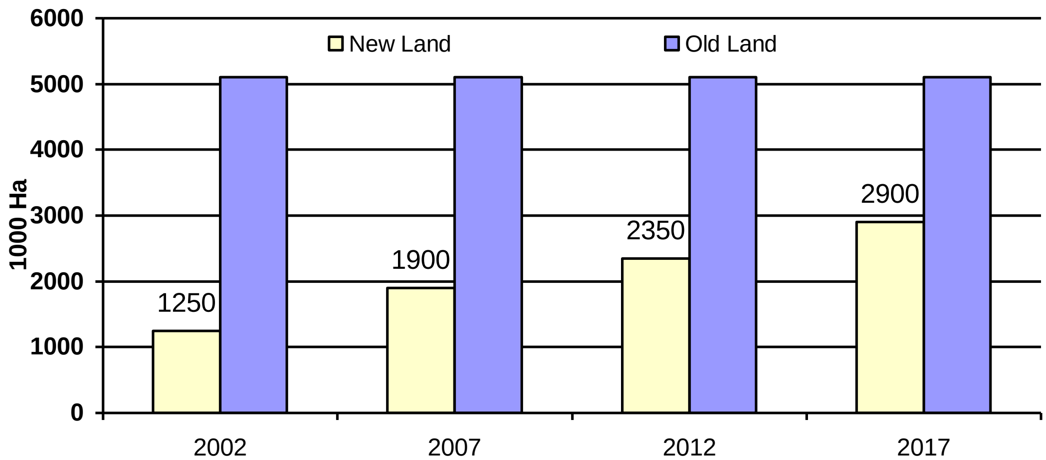
Source: National Agricultural Income, 2002; Agricultural Statistics, 2003.

In 1982, the total area occupied by cereal crops was estimated at about 2.03 million ha, producing 8.5 million tonnes. Total cereal production amounted to 20.1 million tonnes in 2000. Rice production increased from 2.4 million tones in 1982 to 6.1 million tonnes in 2002 because of the cultivation of short duration, high yielding varieties, which are almost 60 percent of the area grown to rice, in the context of the National Campaign for Rice Improvement. The increase in cereal production has had a significant impact on cereal imports and exports.

- ***Fiber crops*** occupy 315 000 ha (cotton 298 200 and flax 15 750 ha). In 1993, lint cotton achieved the highest ever average yield of 19.4 kentars per ha (871 kg/ha). The production of seed cotton from 352 800 ha was similar to that produced from 0.84 million ha in the 1950s. The cotton acreage in 2003 amounted to 296 692 ha and seed cotton production was estimated at 4.9 million kentars (220000 tonnes). The decrease in the cotton acreage, which is accompanied by an increase in the yield, has permitted an increase in the wheat acreage from 0.63 million ha in 1951 to 1.01 million ha at present.

FIGURE **8**

Cropped area, 2002 to 2017, new and old land



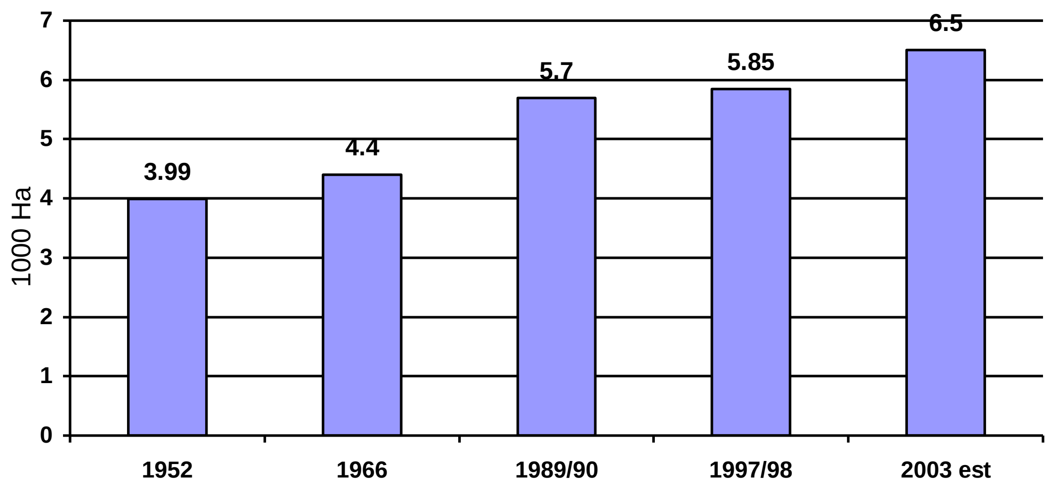
Source: Ministry of Agriculture and Land Reclamation (MALR), 2003.

In the agricultural year 2002/03, the crop areas in the old and new lands amounted to 5.1 and 1.4 million ha respectively. According to the "indicative cropping pattern", the area allocated to various crops and the recommended rates of nitrogen and phosphate fertilizers, it is estimated that the country needs 1.1 million tonnes of N_2 and 364 thousand tones of P_2O_5. The status of potash and the micronutrients in most Egyptian soils is different from that of N and P. In consequence, it has been decided to determine requirements for these nutrients by taking the consumption of the previous year and increasing it by about 10 percent. Most farmers have a poor knowledge of potash and micronutrient requirements and it is hoped that, with the help of the extension staff, farmers will recognize their importance. Figure 8 shows the estimates of the areas and fertilizer requirements of "new" and "old" land respectively up to 2017.

III.2.1. Fertilizer Use by Crops

In Egypt, mineral fertilizers, especially nitrogen, phosphate and potash are being applied to an increasing extent. The consumption of nitrogen and phosphate fertilizers has tripled during the last 30 years. This increase in consumption is due to various factors including: The additional cropped area (Figure 9).

FIGURE 9
Cropped Area



Source: Ministry of Agriculture and Land Reclamation (MALR), 2003.

III.3. Water Scarcity:

"We are currently on the threshold of a serious water shortage" (Martinez, 1994)

"Fresh water available for human consumption, for social, economic and cultural needs and for environmental requirements is rapidly becoming scarcer." (Abu-Zeid, 1998)

"There are finite amounts of water that must be shared in common between various sectors, regions, and their users". (Johansson 2002)

"Water shortages and needs are increasing, and the competition for water among urban, industrial, and agricultural sectors, as well as other resources users, is growing more intensive". (Hamdy 2003)

In Egypt before building high Aswan dam (Which provides irrigation water year round)" river basin irrigation only allowed for one crop per year in large areas. Now perennial irrigation allows on average 2 harvests all over the Nile valley and Delta" (Holmen 1991)

When per capita water use falls below 1000 cubic meters, countries undergo a chronic water scarcity with a".. .significant and often severe restriction on material welfare at individual level and on development prospects at national level" (Myers 1998).

"Experience leads us to the fact that to feed 2 billion people water supplies used in agriculture will have to be augmented by an additional 15-20% over the next 25 years, even under favorable assumptions regarding improvements in irrigation efficiency and agronomic potential to meet food requirements. This will amount to an additional 0.6- 0.7% of water supply per year"(Hamdy 2003).

The irrigation agriculture, which helped to increase food production rates, to stabilize and make the yields less vulnerable to the natural conditions might meet great constraints imposed by water shortages, especially for countries with high population growth rates. (Kijne 2001; Hamdy 2003)

Currently 18 percent of total arable land of our planet, which is under irrigation, produces 33 percent of the global food (Johansson, et al., 2002). Ongoing trends of water transfers from agriculture sector can further endanger the food production levels on irrigated lands pushing countries to increasing the food imports in order to meet the local food demands. (Kijne, 2001; Hamdy, 2003)

A competition from other sectors reduces the availability of water for irrigation purposes. Agriculture is losing its existing supplies to domestic use and industry. Already observed trend of transferring the water resources to the domestic and industry sectors will remain the same as the agriculture accounts for the low added value user and becomes difficult to compete with other high value added users such as for example industry or service sectors. (Abu Zeid, 1998; Johansson, 2002; Hamdy, 2003)

The irrigation agriculture as the major user of water is recognized to be the main source for additional water. System efficiency improvements might meet one half of water demands by year 2025 (Johansson, 2002). It would increase the water productivity, as the crop production per volume of water will rise. (Kijne, 2001)

III.3.1. Conservation Measures

Limited supplies of fresh water create an urgent need for rationalizing the water use, but the ways aiming at the optimal use of water differ and are complex. Before reviewing different water saving measures let us take a look at the concept of water conservation itself. Defined by Bauman water conservation is any socially beneficial reduction in water use or water loss. (Tate, 1994).The main objectives of water conservation pointed out by Bau (1994) are as follow: "reducing the demand for water by fostering water conservation habits, stopping wasteful uses, decreasing peak consumption and charging for water at the appropriate rates. It also means taking advantage of technological developments and improved management techniques; coordinating water resource planning and management with land-use planning and economic and social planning; and establishing new or updated standards and regulations. In short, water conservation means optimal water use.

It should be stressed that except in drought or other exceptional conditions, a water conservation policy is not intended to enforce arbitrary cuts in water consumption levels at the expense of the quality of life of the population. Its main purpose is different: the efficient use of a limited resource, which is essential to life". Water conservation can be implemented through effective water resources management, which involves both supply and demand side management measures.

Supply side conservation measures would include the efficiency improvements in water extraction, transmission and conveyance, its reuse, whereas the demand side conservation measures seek for demand regulations through public education and effective water use practices. (Bau, 1994; Postel, 1997)

The other measures, which would enhance demand side conservation, are economic instruments such as taxes, quotas, Water Pricing.

III.3.2. Water Pricing

Water pricing has many constraints. First of all it is the cultural perception, believes sanctioned by religion and tradition, which perceive water not as commodity but one of the basic human needs. Thus the perception of water as a non-commodity resource persists to the increasing or introduction of charge for irrigation services (Abu Zeid, 1998; Perry, 2001; Rogers, 2002)

The objectives of water pricing simply can be shown with the following causal relationship:

Pricing ------→ Efficient Allocation ----→ Meet Increasing Water Demand .

Water pricing is considered important strategy for water conservation purposes as it will be allocated for most valuable uses and avoided the waste of resources.

The main objective of the water pricing policy is maximizing efficient allocation of water resources, promote conservation but at the same time it should not compromise the social objectives such as affordability of water resources. (Rogers, 2002)

According to Rogers, the full price of water consists of operation & maintenance cost together with capital charges, adding economic and environmental externalities. However, nowhere is paid more than operation and maintenance cost. Different methods have been used for pricing, which can be placed in four major categories: volumetric pricing, non-volumetric pricing (based on land size or crop cultivated on land), quotas and water markets.(Johansson, 2002).

III.3.3. Water Reuse

The efficiency increase implies not only improvements in technical performance of the system but irrigation water reuse as well.

The drainage water reuse is given great importance in Egypt which is reflected in plans to increment the recycling levels from present 4.5 BCM to 8.4 BCM in 2017 (UN CCA, 2001).

1.5 million feddans are currently irrigated with drainage water (MWRI, 2002a) and reuse rate is about 2.5 . However, as the final report of Drainage Research Institute concludes "increased salinity level will limit full utilization of this amount" (DWIP, 1997). The main reason behind this is adverse effects on soil and farmer's welfare.

III.3.4 .Environmental Impacts:

There are negative environmental effects, which might emerge with efficiency increase due to drainage water reuse. These negative effects include the extensive accumulation of salt in the soil and the degradation of underground water quality. The environmental implication of drainage water reuse will be discussed on the example of Fayoum governorate. Here were collected region-specific materials and conducted interviews with farmers. The study intends to introduce briefly the environmental aspects of soil salinity before the discussion of region-specific constraints.

Soil salinisation is the process that "results from the accumulation of free salts to such an extent that leads to the degradation of soils and vegetation"(Hillel, 2000). The problem of soil salinisation in arid conditions emerges with irrigation and agricultural practices. Soils naturally containing sizeable amounts of salt are enriched with salt from other sources such as the irrigation water and fertilizers. (Hillel, 2000; Umali, 1993)

There are other factors that influence the salinity of soil as for example seawater intrusion, but we will focus only on salinity elements that can be linked to irrigation. The irrigation water with its content of salt added to the soil can cause the increase in soil salinity levels if there is no sufficient leaching.

At the root zone of plant salt concentration raises imposing unfavorable conditions to grow. As the osmotic pressure surrounding the root zone is high, extraction of water becomes more troublesome for plant and requires more metabolic energy. To prevent plants from damage, the soil must be sufficiently leached. Moreover, in saline soils soil flocculation can occur as a result of increased salt concentration. The clay particles clumped together and forming flocks hinders plants' root to access the oxygen. (Hillel, 2000) The negative relation between saline soils and plant survival is reflected in declined crop yields. As the DWIP (1997) shows there is a strong negative correlation between the Electrical Conductivity (EC)1 of soil and crop yield of rice and maize, moderate for cotton and low for wheat.

In Egypt the irrigation water shows large uptake of salt. For example the salinity of irrigation water at the Aswan dam accounts 0.4 dS/m while already in Cairo it raises up to 0.55 dS/m (Keller, 1992). The increment of water salinity partly is determined by salt contributions from domestic and industrial discharges but it is considerably low in comparison to the salt leached from drainage or groundwater. Reuse of water again and again mountains the concentration of salts in water. So in Fayoum fresh water salinity averages 0.5-0.7 dS/M (Mission report 30, 1996), while in drainage catchments the salinity of water varies between 1.56-3.12 dS/m. In the Delta, near the coast, the concentrations of drainage water increases significantly to the values up to 7.8-9.36 dS/m (high salinity partly is determined by presence of saline groundwater in the north (MADWQ, 2000) (see for comparison table 10).

Table 10: Classification of water quality according to the total salt concentrations

Water	Electrical Conductivity in dS/m	Category
Fresh water	< 0.6	Drinking, irrigation
Slightly brackish	0.6-1.5	Irrigation
Brackish	1.5-3	Irrigation with caution
Moderately	saline 3--8	Primary drainage
Saline	8--15	Secondary drainage, saline groundwater
Highly saline	14-45	Very saline groundwater
Sea Water	>45	Sea water

(Source: Hillel, 2000)

There is a clear tendency of declining yield as quality of irrigation water is deteriorated. Table (11) presents the average crop yields in the Delta for different types of irrigation water. The effects on crop production levels are sizable. The rice yields are subjected to 40 percent decline in comparison to the production rates from the land irrigated with fresh water. For wheat this figure is 29 and for cotton 23 percent.

Table 11: Average crop yield (tone per feddan)

Crop	Yield irrigated with Fresh Water	Yield irrigated with Mixed Water	Yield Irrigated with Drainage Water
	(ECiw – 0.72 dS/m, ECe – 2.27 dS/m)	(ECiw – 1.47 dS/m, ECe – 3.01 dS/m)	(ECiw – 2.61 dS/m, ECe –3.93 dS/m)
Cotton	0.84	0.76	0.65
Wheat	2.75	2.42	2.0
Maize	2.03	1.92	1.75
Rice	3.5	3.0	2.1
Berseem	6.34	5.84	4.14

(Source: DWIP, 1997)

III.3.5. Social impacts:

The drainage water reuse has negative impact on farmers' income. Low quality drainage water causes the salinisation of land, therefore decrease in yields and increase of inputs lower down the net returns. This reduces farmer's ability to invest. Farm inputs are declining negatively affecting the crop production rates.

As DWIP report (1997) states the average net return per feddan for crop mixes on lands irrigated with drainage water is 80 percent of the net returns from the fields irrigated with fresh water. The drainage water reuse has some positive effect on reduction of fertilizer requirements for crops (as it contains the fertilizers residues from previous use) but in this case the careful and precise land management of land is needed to avoid salinity. In the concluding remarks of the final report is stated " farmers using the drainage water will be more at risk that those using mixed water and therefore with require more technical assistance and other support mechanism". It goes further by suggesting the establishment of compensation fund financed by fresh water users
(DWIP, 1997).

So the small farmers, which constitute the majority of farmers in Egypt, are vulnerable to the impacts from irrigation water quality. In regard to soil salinity much the same applies to the under irrigation and water shortage conditions. The applications of lower water quantity results in poor leaching of salts and further salinisation of soil with all its negative outcomes for farmer.

III.4. Health:

Another factor, which makes reuse cautious, is the concentrations of pathogens in drainage water. As the bacteriological and parasitological examinations of fresh, mixed irrigation water and drainage water show the concentration of fecal coli form bacteria and parasitic eggs usually exceed standards set by World Health Organization (WHO) for unrestricted use of irrigation water.According to the study only 15 percent of drainage irrigation water comply WHO guidelines for unrestricted use with regard to fecal coliform bacteria and parasite eggs concentration in water 1.) WHO standard is 100 MNP/100 ml (MADWQ, 2000)

Table 12: Percentage of suitable irrigation water in The Nile Delta according to WHO standards

Type of irrigation water	**Nile Delta**	
	Fecal coliform	**Parasites**
Fresh water (in percent)	42.1	84.21
Mixed water (in percent)	23.07	90.9
Drainage water (in percent)	15.38	76.92

(source: DWIP, 1997)

Other concerns in respect of water reuse but from non-irrigation sources are evoked by wastewater reuse with its high concentrations of nutrients, heavy metals, toxic materials that can enter food chains. Wastewater contain also salt and thus pose the danger of soil salinisation as well. (Umali, 1993)

Table (13) Impacts of irrigation water use on different variables (+ is used to indicate increase; -points to the decrease, double plus and minus indicate greater change)

Type of irrigation water	**Soil salinity**	**Efficiency**	**Yield**	**Farm Inputs**	**Farmer's vulnerability**
Fresh water	0	0	0	0	0
Mixed water	0	+/-	-	0	+
Drainage water	+	+/-	--	+	++

Source: Ministry of Agriculture and Land Reclamation (MALR), 2003.

The constraints for technical efficiency improvement are the same - increase of soil salinity problems. As the on farm irrigation efficiency increases the applied water on field drops down which makes leaching non sufficient enough and can lead to the soil salinisation (Perry, 1999; Hillel, 2000; Bazza & Ahmad, 2003). Some respondents of interviews used this point for justification of over-irrigation and low farm efficiency. However, the precise application of water to the crops and careful management of land could probably ease a problem.

III.5. Water Resources and Use:

The Egyptian territory comprises the following river basins:
The Northern Interior Basin, covering 520 881 kIm^2 or 52 percent of the total area of the country in the east and southeast of the country. A sub-basin of the Northern Interior Basin is the Qattara Depression. The Nile Basin, covering 326 751 kIm^2 (33 percent) in the central part of the country in the form of a broad north-south strip. The Mediterranean Coast Basin, covering 65 568 kIm^2(6 percent). The Northeast Coast Basin, a narrow strip of 88 250 kIm^2 along the coast of the Red Sea (8 percent). The River Nile is the main source of water for Egypt, with an annual allocated flow of 55.5 $kIn^{\mathbf{3}}$/yr under the Nile Waters Agreement of 1959. Internal surface water resources are estimated at 0.5 kIm^3 /yr. This brings total actual surface water resources to 56 kIm^3 / year. The Nubian Sandstone aquifer located under the Western Desert is considered an important groundwater source. The volume of groundwater entering the country from the Libyan Arab Jamahiriya is estimated at 1 kIm^3 /yr. Internal renewable groundwater resources are estimated at 1.3 kIm^3 /yr, bringing total renewable groundwater resources to 2.3 kIm^3 /yr. The main source of internal recharge is percolation from irrigation water in the Valley and the Delta. The total actual renewable water resources of the country is thus 58.3 kIm^3 /yr .All drainage water in Upper Egypt, south of Cairo, flows back into the Nile and the irrigation canals; this amount is estimated at 4 kIn3/yr. Drainage water in the Nile Delta is estimated at 14 kIm^3 /yr. Treated domestic wastewater in 2001/02 was estimated at 2.97 kIm^3 /yr. There are several desalination plants on the coasts of the Red Sea and the Mediterranean to provide water for seaside resorts and hotels; total production in 2002 was estimated at 100 million $m^{\mathbf{3}}$. Estimates of the potential of non-renewable groundwater in the eastern and western deserts, mainly from the Nubian Sandstone aquifer, vary from 3.8 kIm^3 /yr to 0.6 kIm^3 /yr; the latter estimate is defined as an indicator of exploitability over a period of time, where the time is not given.

Table 14
Water: sources and use

Renewable water resources			
Average precipitation		51	mm/yr
		51.07	10^9 m^3/yr
Internal renewable water resources		1.8	10^9 m^3/yr
Total actual renewable water resources		58.3	10^9 m^3/yr
Dependency ratio		97	%
Total actual renewable water resources per inhabitant	2004	794.4	m^3/yr
Total dam capacity	2002	169 000	10^6 m^3/yr
Water withdrawal			
Total water withdrawal	2000	68 300	10^6 m^3/yr
- irrigation + livestock	2000	59 000	10^6 m^3/yr
- domestic	2000	5 300	10^6 m^3/yr
- industry	2000	4 000	10^6 m^3/yr
• per inhabitant	2000	1 008	m^3/yr
• as % of total actual renewable water resources	2000	117	%
Water use for navigation and hydropower	2000	4 000	10^6 m^3/yr
Non-conventional sources of water			
Produced wastewater	2001	3 760	10^6 m^3/yr
Treated wastewater	2001	2 971	10^6 m^3/yr
Reused treated wastewater	2000	2 971	10^6 m^3/yr
Desalinated water produced	2002	100	10^6 m^3/yr
Reused agricultural drainage water (including seepage to gw)	2001	10 967	10^6 m^3/yr
Use of fossil water	2000	825	10^6 m^3/yr

Source: Irrigation in Africa infigures -AQUASTAT Survey 2005

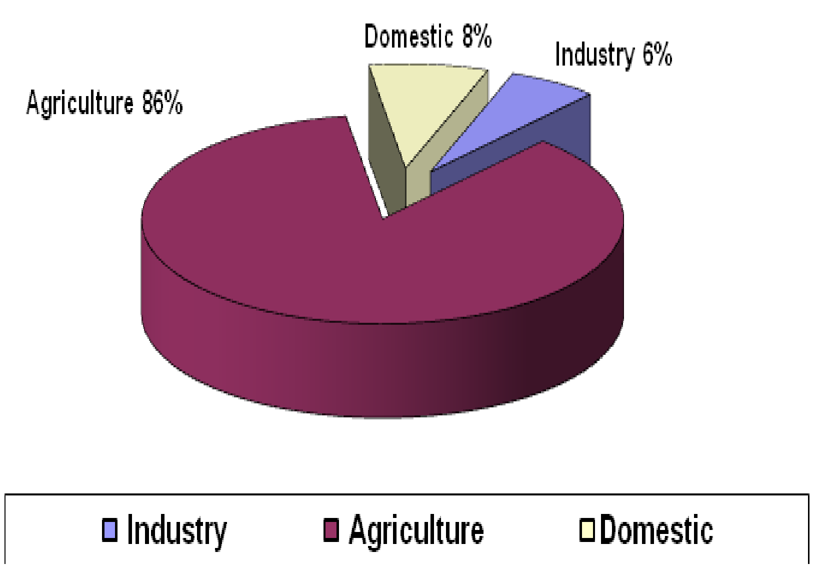
If conditions permit the completion of the development projects on the Upper Nile, Egypt's share in the Nile water will increase by 9 kIm^3. This amount includes 1.9 $kIm^3$and 1.6 kIm^3respectively from the first and second phases of the Jonglei canal project in southern Sudan. Two other projects in the upstream swamps are expected to provide 5.5 kIm^3. The vast Nubian Sandstone aquifer is shared with the Libyan Arab Jamahiriya, Sudan and Chad.

TABLE 15
Water availability and water use in Egypt (2000)

Water input	billion m3/yr	Water use	million m3/yr
Renewable surface water resources	56 000	Agriculture	59 000
Renewable groundwater resources	2 300	Domestic	5 300
Reuse of agricultural drainage water (return flow to rivers)*	4 840	Industry	4 000
Reuse of groundwater (seepage from agriculture)*	6 127		
Reused treated wastewater	2 971		
Desalinated water	100		
Use of fossil groundwater (non-renewable water)	825		
Total	73 163	Total	68 300
Navigation and hydropower			4 000

Source: Irrigation in Africa in figures -AQUASTAT Survey 2005 Note *: Total water returning from agriculture was about 18 kIm^3, of which about 12 kIm^3 was return flow to rivers and 6 kIm^3 seepage to groundwater

Figure (10)
Water withdrawal (total: 68300 kIm^3 in 2000)



Source: Irrigation in Africa infigures -AQUASTAT Survey 2005

III.5.1. Water Use:

Total water withdrawal in 2000 was estimated at 68.3 kIm^3. This included 59 $kIm^3$for agriculture (86 percent), 5.3 $kIm^3$for domestic use (8 percent) and 4.0 $kIm^3$for industry (6 percent) (Table 15 and Figure 10). Apart from that, 4.0 kIm^3were used for navigation and hydropower (Table 15). Groundwater extraction in 2000 was 7.043 kIm^3comprising: 6.127 $kIm^3$from the Nile Basin (seepage waters). 0.825 $kIm^3$from the eastern and western deserts, i.e. mainly the Nubian Sandstone aquifer 0.091 $kIm^3$from shallow wells in Sinai and on the northwestern coast

Reuse of agricultural drainage water, returned to the rivers, in irrigation amounted to 4.84 kIn3/yr in 2001/02. Of the 2.97 kIm^3/yr of treated wastewater, 1.5 kIm^3/yr is reused for irrigation, while the rest is pumped into main drains where it mixes with drainage water and is then used for irrigation. Treated wastewater is usually used for landscape irrigation of trees in urban areas and along roads.

III.5.2. International Water Issues

Under the 1959 Nile Waters Agreement between Egypt and Sudan, Egypt's share of the Nile flow is 55.5 kIm^3/yr. The agreement was based on the average flow of the Nile during the 1900-1959 period, which was 84 kIm^3/yr at Aswan. Average annual evaporation and other losses from the Aswan High Dam and reservoir (Lake Nasser) were estimated at 10 kIm^3/yr, leaving a net usable flow of 74 kIm^3/yr, of which 18.5 kIm^3/ yr was allocated to Sudan and 55.5 kIm^3/yr to Egypt.

In 1998, recognizing that cooperative development was the best way to bring mutual benefits to the region, all riparian countries (except Eritrea which had observer status only) joined in a dialogue to create a regional partnership to facilitate the common pursuit of sustainable development and management of Nile waters. The transitional mechanism, the Nile Basin Initiative (NBI), was officially launched in February 1999 in Dar es Salaam, the United Republic of Tanzania, by the Council of Ministers of Water Affairs of the Nile Basin States.

The shared vision of the NBI is "to achieve sustainable socio-economic development through the equitable utilization of and benefit from the common Nile Basin water resources".

III.5.3. Irrigation and Drainage Development

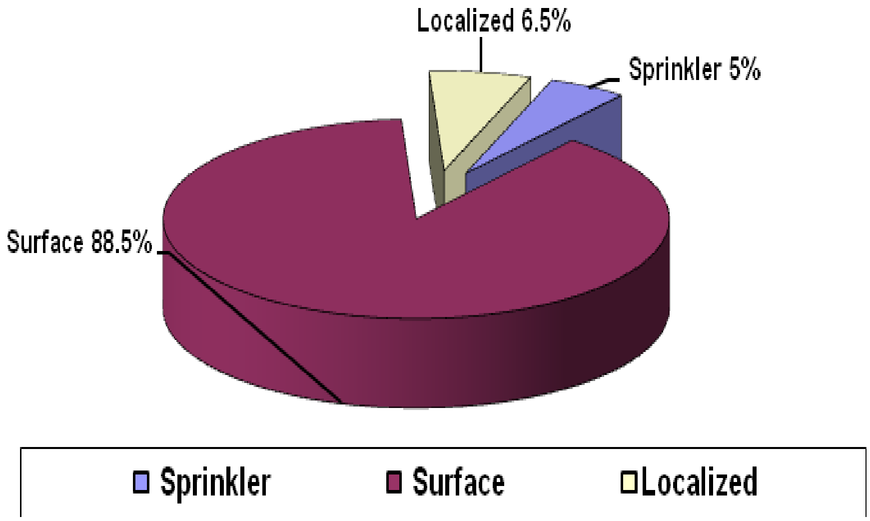
III.5.3.1. Evolution of irrigation development

Irrigation potential is estimated at 4 420 000 ha. The total area equipped for irrigation was 3 422 178 ha in 2002; 85 percent of this area is in the Nile Valley and Delta. Rainwater harvesting is practised in about 133 500 ha in Matruh and North Sinai. All irrigation is full or partial control irrigation. Surface irrigation was practiced on 3 028 853 ha in 2000, while 171 910 ha were under sprinkler irrigation and 221415 ha under localized irrigation (Figure 11). Surface water was the source for 83 percent of the irrigated area in 2000, while 11 percent (361 176 ha) of the area was irrigated with groundwater in the provinces of Matruh, Sinai and New Valley. The remaining 6 percent (217 527 ha) was irrigated with mixed sources (Figure 12). The power irrigated area in 2000 was estimated at 2 937 939 ha. The irrigation system in the old land of the Nile Valley is a combined gravity and water lifting system.

Surface irrigation is banned by law in the new reclaimed areas, which are located at the end of the systems, and are more at risk of water shortage. Farmers have to use sprinkler or drip irrigation, which are more suitable for the mostly sandy soil of those areas. If used efficiently, sprinkler and drip irrigation need less water than surface irrigation.

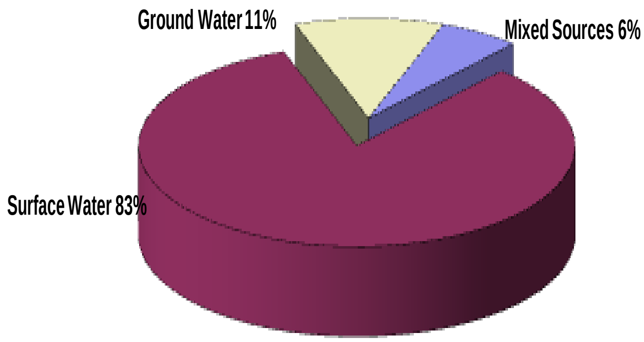
In addition to the older developments in the oasis of the New Valley, which pump water from the Nubian Sandstone aquifer, new large irrigation schemes are under development in the southwestern part of the country at Al Oweinat; in 2003 about 4200 ha were under cultivation and there are plans to extend the project to several times that area. Water harvesting (Matruh and Northern Sinai) is possible thanks to the construction of cisterns and diversion dikes. The average rainfall in the areas is between 220 and 250 mm.

FIGURE 11
Irrigation techniques Total: 3 422 178 ha in 2000



Irrigation in Africa in figures -AQUASTAT Survey 2005

FIGURE 12
Origin of irrigation water Total: 3 422178 ha in 2000



Irrigation in Africa in figures -AQUASTAT Survey 2005

TABLE 16
Irrigation and drainage

Table 16, 16 a:

Irrigation potential		4 420 000	ha
Water management			
1. Full or partial control irrigation: equipped area	2002	3 422 178	ha
- surface irrigation	2000	3 028 853	ha
- sprinkler irrigation	2000	171 910	ha
- localized irrigation	2000	221 415	ha
• % of area irrigated from groundwater	2000	11	%
• % of area irrigated from surface water	2000	83	%
• % of area irrigated from mixed sources	2000	6	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)		-	ha
3. Spate irrigation		-	ha
Total area equipped for irrigation (1+2+3)	2002	3 422 178	ha
• as % of cultivated area	2002	100	%
• average increase per year over last 9 years	1993-2002	0.6	%
• power irrigated area as % of total area equipped	2002	86	%
• % of total area equipped actually irrigated	2002	100	%
4. Non-equipped cultivated wetlands and inland valley bottoms		-	ha
5. Non-equipped flood recession cropping area		-	ha
Total water-managed area (1+2+3+4+5)	2002	3 422 178	ha
• as % of cultivated area	2002	100	%
Full or partial control irrigation schemes	Criteria		
Small-scale schemes	< ha		ha
Medium-scale schemes			ha
Large-scale schemes	> ha		ha
Total number of households in irrigation			
Irrigated crops in full or partial control irrigation schemes			
Total irrigated grain production	2003	19 230 797	tonnes
• as % of total grain production	2003	100	%
Total harvested irrigated cropped area	2002	6 027 115	ha
• Annual crops: total	2002	3 773 462	ha
- wheat	2002	1 029 180	ha
- rice	2002	650 026	ha

Table 16 a:

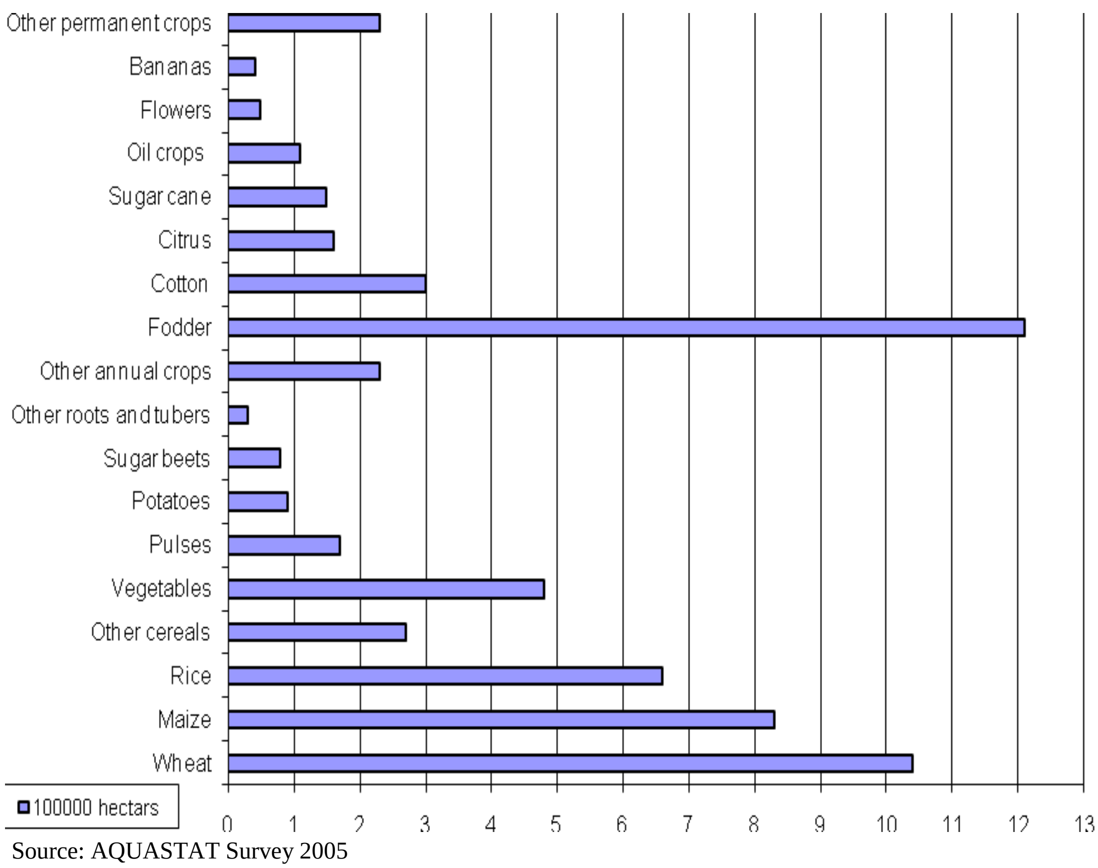
- barley	2002	96 201	ha
- maize	2002	827 949	ha
- sorghum	2002	156 155	ha
- potatoes	2002	82 588	ha
- sweet potatoes	2002	8 388	ha
- other roots and tubers (taro, yams, etc.)	2002	3 001	ha
- sugar beets	2002	64 596	ha
- pulses	2002	164 013	ha
- vegetables	2002	472 062	ha
- other annual crops	2002	219 303	ha
• Permanent crops: total	2002	2 253 653	ha
- sugar cane	2002	135 815	ha
- bananas	2002	24 165	ha
- citrus	2002	145 421	ha
- cotton	2002	296 693	ha
- fodder	2002	1 195 903	ha
- soya beans	2002	5 914	ha
- groundnuts	2002	59 241	ha
- sunflower	2002	15 493	ha
- sesame	2002	30 284	ha
- flowers	2002	26 055	ha
- Other permanent crops	2002	318 669	ha
Irrigated cropping intensity	2002	176	%
Drainage - Environment			
Total drained area	2003	3 024 000	ha
- part of the area equipped for irrigation drained	2003	3 024 000	ha
- other drained area (non-irrigated)		--	ha
• drained area as % of cultivated area	2002	88	%
Flood-protected areas		-	ha
Area salinized by irrigation	2005	250 000	ha
Population affected by water-related diseases		-	inhabitants

Source: AQUASTAT Survey 2005

III.5.3.2. Status and evolution of drainage systems:

An extensive National Drainage Programme has been carried out over the last four decades to control water logging and salinity. The drainage system consists of open drains, sub- surface drains and pumping stations. In 2003, slightly over 3 million ha of the total irrigated area were drained, of which about 2.2 million ha with sub-surface drainage. The sub-surface drained area represents more than 65 percent of the total cultivated area. There are 99 pump stations devoted to the pumping of drainage effluent. The power-drained area was estimated at about 1.65 million ha in 2000. Drainage water from agricultural areas on both sides of the Nile Valley is returned to the River Nile or main irrigation canals in Upper Egypt and in the southern Delta. Drainage water in the Delta is either pumped back into irrigation canals for reuse or pumped into the northern lakes or the Mediterranean Sea.

FIGURE 13:
Irrigated crops (cropping intensity 176%) Total: 6 027 115 ha in 2002



Source: AQUASTAT Survey 2005

III.6. Water Management, Policies And Legislation Related To Water Use In Agriculture

The Ministry of Water Resources and Irrigation (MWRI) is in charge of water resources research, development and distribution, and undertakes the construction, operation and maintenance of the irrigation and drainage networks. Specifications and permits for groundwater well drilling are also the responsibility of MWRI. Within MWRI, the following sectors and departments are of importance:

The Planning Sector is responsible at central level for data collection, processing and analysis for planning and monitoring investment projects.

The Sector of Public Works and Water Resources coordinates water resources development works.

The Nile Water Sector is in charge of cooperation with Sudan and other nilotic countries.

The Irrigation Department provides technical guidance and monitoring of irrigation development, including dams.

The Mechanical and Electrical Department is in charge of the construction and maintenance of pumping stations for irrigation and drainage.

Further to the above institutions, other public authorities are directly related to MWRI: The High Dam Authority is responsible for dam operation.

The Drainage Authority is responsible for the construction and maintenance of tile and open drains.

The National Water Research Center comprises 12 institutes and is the scientific body of MWRI for all aspects related to water resources management.

MWRI also represents Egypt in the meetings of the Nile basin countries on Nile water issues. There are several joint projects between those countries for the development of Nile water. These projects, if completed, would increase the water shares of member countries significantly. Egypt would gain an additional 9 kIn3 of Nile water.

The Ministry of Agriculture and Land Reclamation (MALR) is in charge of agricultural research and extension, land reclamation and agricultural, fisheries and animal wealth development.

The agricultural Research Center comprises 16 institutes and 11 central laboratories and is the scientific body of MALR for all aspects related to agricultural development. The Land Development Authority is in charge of contracting and monitoring land development projects and manages land allocation to investors and individuals. The Agricultural Development and Credit Bank provides credit to farmers to finance various production requirements.

III.6.1. Water management

The Government has indicated its intent to shift emphasis from its role as the central (or sole) actor in developing and managing water supply systems, towards promoting participatory approaches in which water users will play an active role in the management of irrigation systems and cost sharing. Important institutional and legislative measures have been taken recently to promote the establishment of sustainable participatory irrigation management (PIM) associations. However, despite these measures, the development of water users' associations (WUAs) as effective partners in irrigation management remains at an early stage. In the new lands, the concept of PIM is not yet effectively operational for a variety of economic, financial and institutional reasons.

While most settlers recognize the importance of WUAs in the equitable distribution of available water, uneven water availability, either due to design shortcomings or to lax enforcement of rules against excess abstraction by front-end water users, has acted as a disincentive to the successful operation of WUAs in many instances.

III.6.2. Finances

The government invests considerable resources in the land-reclamation programme. Investment is primarily in irrigation and drainage infrastructure, settlement construction, and provision of potable water, electricity and roads. Very little is invested in social services (education and health), and no investment is made in the provision of agricultural services (technology, water management and rural finance). Consequently, poor settlers face difficulties in settling and farming, and a considerable percentage move back to the old lands and abandon their new land farms.

Both MWRI and MALR activities are considered public services and their water and land development projects are budgeted in the national economic and social development plan.

III.6.3. Policies and legislation

The main water and irrigation strategy is concerned with the development and conservation of water resources. This is done through adopting water rotation for irrigation canals, limiting the rice growing area, lining irrigation canals in sandy areas and prohibiting surface irrigation in the new developed areas outside the Nile basin.

Recent water resources policies include different structural and several nonstructural measures. Structural measures include: irrigation structures rehabilitation; improvement of the irrigation system; installation of water level monitoring devices linked to the telemetry system; and expansion of the tile drainage system. Nonstructural measures include: expansion of water user associations (WUAs) for irrigation ditches; establishment of water boards on branch canals; promotion of public awareness programmes; and involvement of stakeholders.

The legal basis for irrigation and drainage is set in Law No. 12/1984 and its supplementary Law No. 213/1994 which define the use and management of public and private sector irrigation and drainage systems including main canals, feeders and drains. The laws also provide legal directions for the operation and maintenance of public and private waterways and specify arrangements for cost recovery in irrigation and drainage networks. The most recent water policy was drafted in 1993. It included several strategies to ensure satisfying the demands of all water users and expanding the existing agricultural area at that time of 7.8 million feddan (about 3.12 million ha) by an additional 1.4 million feddan (about 560 000 ha).

III.6.4. Environment and Health

Salinity and waterlogging are now under control in about 80 percent of the affected areas following the installation of drainage systems. This has led to a reduction in saline areas from about 1.2 million ha in 1972 to 250 000 ha at present. Seawater intrusion is a problem in the northern part of the Delta, where groundwater becomes brackish to saline. About half of the Delta contains brackish to saline groundwater, and no water is pumped in the northern Delta. Average salinity of groundwater in the Delta was between 680 and 1 170 mg/liter in 2000/01.

It is said that the rice belt is a major defense factor to keep salinity under control in the northern areas of the Nile Delta, as well as to stop the invasion of sea water further inland in the Delta aquifer. The salinity of agricultural drainage water is higher in winter, especially downstream because less water is used for irrigation. In the new Al Salam Canal, drainage water is mixed with Nile water at a ratio of 1:1, and the salinity of the mixed water is within safe levels.

The main challenge for the sustainability of water resources is the control of water pollution. The Ministry of the Environment is observing the enforcement of the new legislation regarding the treatment of industrial and domestic wastewater. MALR is also advocating organic farming and limiting the use of chemical fertilizers and pesticides to reduce crop, soil and water pollution. In addition, present policy is to minimize the use of herbicides and to depend mainly on the mechanized control of submerged weeds and water hyacinths.

Bilharzia, or Schistosomiasis, is still a common disease in rural areas in Egypt but its occurrence has greatly decreased with the provision of improved drinking water to most rural areas, periodic examination of schqol children, free medical treatment and extension programmes to educate people on ways of protecting against the disease. The Ministry of Health and Population announced that Bilharzia cases in the examined samples of rural population in 2001 were only about 4 percent. Malaria is rare in Egypt.

III.6.5. Perspectives for Agricultural Water Management

In 1984 it was estimated that there were another 0.5 million ha with development potential, in addition to the approximately 2.5 million ha already equipped for

irrigation. The Al Salam irrigation canal has recently been inaugurated, delivering mixed water from the Nile and two main drains to the northeastern delta and northern Sinai.

The area to be irrigated with canal water is about 268 800 ha. In the present five-year development plan ending in 2007, 463 000 ha are to be developed, all outside the Nile Basin. This area includes:

150 000 ha east of the Delta and in Sinai, as part of the Al Salam project.

228000 ha in Upper Egypt and New Valley at Toshky and Al Oweinat, to be inaugurated in the next few years.

64 000 ha on the northwestern coast. 11 000 ha in the western Delta. 10 000 ha in middle Egypt.

All new development areas have to use sprinkler or localized irrigation. Surface irrigation is not permitted outside the Nile Basin. The Al Salam project and the project at Toshky have been financed locally and with aid from Arab countries and international agencies. The long-term plan in Sinai is to develop 630 000 ha; the present five-year plan includes 107 520 ha in the region.

III.7. Sharing Water

The overriding basic principle of Integrated Water Resources Management (IWRM) is the holistic approach to combining water resources management with ecosystem needs, using the river basin as the base unit (Andah, 1987).

The question to be posed is to define what type of river basin, the physical observable one whose boundaries are geographically delineated or an inseparable form process interactive unit. The river drainage network therefore offers a unique complex system of information, which can be derived from its inseparable attributes of form and process necessary for the management of water resources in harmony with the environment.

In all scientific works connected with the application of ideas of systems analysis in the sphere of morphology, physical geography and hydrology, the river network system comes out as the closest to the principle of structural development from an elementary system continuously developing into a complex system of a large river defined by the network branches of numerous streams. It is therefore clear that river basins know no boundaries, be they ethnic, regional, national or international. It is within this concept that trans boundary river basins must be considered and analyzed from all its various aspects within an integrated framework (Andah, 2002).

III.7.1. Trans boundary water basins in Africa

Most of the fresh surface water resources of Africa are found in a number of major trans boundary river/lake basins -some shared by as many as ten African countries. The continent has over 80 major trans boundary river/lake basins, some of which are among the largest in the world. About 55 of the world's 200 major international rivers are in Africa -a number greater than in any other continent. Some of these basins are shared by as many as ten or more African countries and ten major river basins are shared by more than four African countries.

The political boundaries of fourteen African countries almost entirely fall within the catchment areas of one or more trans boundary river systems. Twelve African countries are co-Riparian to four or more river basins. Some of these shared water basins hold tremendous potential for various natural resources, including cross- boundary hydropower generation, large-scale multi-country irrigation schemes, inter- and intra-country navigation, joint inland fisheries development, joint water supply sources utilization, environmental protection, wildlife conservation, recreation and eco-tourism development.

The Congo River Basin alone holds almost 30% of Africa's total fresh surface water reserves and the world's largest hydropower potential in anyone single river basin. Integrated development of these trans boundary natural resources will not only contribute significantly to the socio-economic development of the Riparian countries sharing these rivers and lakes, they will also promote and enhance sub regional and regional cooperation for economic integration in Africa.

However, integrated development of these resources on the basis of win-win principles needs enhanced and concerted cooperation among the Riparian countries sharing these resources.

III.7.2 .Water Resources Management and Water Conflict Resolution

Water resources management refers to a range of activities: monitoring, modeling, exploration, assessment, design of measures and strategies, implementation of policy, operation and maintenance, and evaluation. Water resources management includes local, national, and international activities, directed at either short- or long- term goals (Savenije H. and Hoekstra A. 2002). As such, water resources management is rather a diffuse field. It includes the whole set of scientific, technical, institutional, managerial, legal, and operational activities required to plan, develop, operate, and manage water resources.

III.7.3 .Management of Transnational Basins

The main thrust of the management of shared river basins is to find ways of turning potential conflicts into constructive cooperation, and to turn what is often perceived as a zero-sum predicament -in which one party's gain is another's loss - into a win-win proposition. The foundation for the sharing of international rivers is the recognition that the management of water resources should be done in a fully integrated fashion. Upon this foundation, three pillars support the "roof" of the temple: the sharing of international waters. The central pillar is that of technical cooperation, which may also be called the operational pillar. The two side pillars are:

.The political pillar, responsible for an enabling environment, and

.The institutional pillar, responsible for laws and institutions.

All three pillars are necessary in order to arrive at a balanced and equitable sharing of international waters, based on a concerted strategy towards the integrated management of shared river basins incorporating elements of demand-and-supply management, public participation, and regional integration.

The basis of an integrated strategy towards the sharing of international waters is the recognition of the principle of "unity in diversity". Because of differences among Riparian countries the task is to look for complementarily between countries, and to foster cooperation to their mutual benefit. The sharing of international waters may be a consequence of this cooperation, but also a crucial factor in further strengthening it.

III.7.4. General Principles and Critical Issues

At a national scale, governments appear to base their policy for resource management on a number of "emerging" principles that have general validity. Such principles are often also underlying international policies. In international law, more specific principles are used with regard to international river basins

(Savenije H. 2002). A number of critical issues emerge with respect to the sharing of international watercourse systems, which include (Savenije H. 2002):

- River basins do not respect village, district, provincial, or national boundaries. Too often, we have attempted to fit the water into these administrative and institutional boundaries, rather than to design institutions that fit the physical and spatial characteristics of the resource. As a consequence, there is often an administrative/institutional void when dealing with the management of water resources. This is especially true at the transnational level.

- Management of water resources has generally concentrated on surface water, while insufficient attention has been given to groundwater, soil moisture ("green water") and related aspects.

Perhaps the biggest problem in sharing an international water resources system is its sheer scale and the opaqueness of system interactions over large distances (upstream and downstream). For example, it is difficult to see, let alone quantify, the consequences of upstream land use changes on downstream flood levels. This opaqueness may result in unforeseen negative consequences of human interventions, which are difficult to correct and may give rise to tensions between Riparian countries sharing the basin.

III.7.5. The Sovereignty Dilemma:

To what extent may individual countries develop and use resources found within their territories, and to what extent do they have to consider interests of Riparian countries, and the "common interest" of the river basin as a whole? The legal institutional aspects with the increasing demands on water due to population growth and the general awareness of the diminishing availability of water in time and space due to either natural factors or human's negative impact on water bodies through pollution, there is a need for regulatory actions, which, in their totality, is considered as the basis for water management. Such actions could include (Andah, 2002):

- Regulation of the water system which refers to measures which make it possible for increases in the available supplies;
- Regulation of the boundaries between the water system and user system, covers the phases of planning, construction and operation of hydraulic infrastructures necessary to ensure that the natural supply is adequate to meet the demand programmes of the whole user systems, which should now include the impacts of water consumption on the water system such as groundwater use, erosion and pollution controls;

- Regulation at the boundaries of inter-related users, especially useful in water stress regions, interrelated users can be subjected to a prioritization scheme in the form of differential pricing and allocation for different uses, as well as conflict resolution. Such a regulation is normally better effected if the physical water basin is taken as the basis for water management; and

- Regulation of international costs and boundaries refers to all activities that ensure the adequate quantity and quality supply for various trans boundary water uses through international agreements on water allocation and pollution control.

The most recommended forms of regulation are utilization concessions, waste discharge permits and tariffs which must be established prior to the use of the resource. Tariff systems must not only take into account the recovery of capital and operating costs but also promote the efficient and beneficial use of water. The principle that the polluter must meet the cost of de-pollution should be the economic basis for pollution control. Three important systems of water rights include (Savenije. H 2002):

- Riparian rights link ownership of or reasonable use of water to ownership of the adjacent or overlying lands, and are derived from Common Law as developed in England. As a consequence, this principle is mainly found in countries that were under the influence of the British Empire.

-Public allocation involves administered distribution of water, and seems to occur mainly in "civil law" countries, i.e., that derive their legal system from the Napoleonic Code, such as France, Italy, Spain, Portugal, the Netherlands and their former spheres of influence.

-Prior rights are based on the appropriation doctrine, under which the water right is acquired by actual use over time. This system developed in the western part of the USA, a typical (semiarid) frontier zone. Institutionally, the essential functions of international basin organizations include (Savenije. H 2002):

.Reconciling and hannonizing the interests of Riparian countries;

.Technical cooperation;

.Standardization of data collection;

.Exchange of hydrologic and other information;

.Monitoring water quantity and quality;

.Submission for examination and approval of proposed activities, schemes or plans which could modify the quantity and quality of the waters;

.Development of concerted action programs;

.Enforcing agreements; and .Dispute resolution.

III.8. Technical and Operational Issues:

III.8.1. The Case of Flood Management.

The construction of large dams has been a major feature of water management in Africa over the second half of the twentieth century. The resulting reduction in flooding downstream was seen as a benefit, and thus, constructing a dam capable of making flood releases was never contemplated. More recently the great value of natural floods to fisheries; recession agriculture and groundwater recharge has been realized. So much so that many authorities are now examining the possibility of creating artificial floods (Savenije H 2002).

The example of the Cahora Bassa Dam is a case in point. Whereas the shrimp fisheries in the mouth of the Zambezi were never contemplated when the Dam was designed, the income in foreign currency from shrimp fisheries has been far more important for Mozambique than the export of power. However, the way the Cahora Bassa Dam is operated affects the shrimp stock negatively. The shrimp stock "depends on a natural seasonal variation in the runoff, both a marked dry and wet season. This seasonal runoff regime has been completely destroyed by river regulation." By changing operation procedures of the Cahora Bassa Dam, substantial increases in shrimp catches may be achieved without additional investments or labor (Savenije H 2002).

Dam operations may impact a large number of different users and stakeholders. Stakeholders should participate in formulating alternative scenarios. Here we refer to the River Senegal, where the Government adopted an artificial flood scenario after 10 years of lobbying by flood-recession fanners. Government finally recognized the legitimacy of the fanners concerns and took these seriously in the weighing of alternative flood scenarios. This should not be interpreted as "benevolence" on the part of the Senegalese Government.

It is plain economic common sense: if no appropriate flood scenario were developed, grain production from flood recession agriculture would have been severely affected. By letting local stakeholders have a voice in decision-making in river management, they may revise their opinion from opposition to active cooperation as experienced in Senegal and in the South African part of the Phongolo- Maputo River Basin. The construction of the Pongola Port Dam in the 1950s severely disrupted traditional agriculture further downstream.

The authorities did not properly inform the people in the plain in advance about water releases from the Dam. However, in the mid-1980s the department responsible for the rivers management changed its approach, after research had shown the adverse effects of the way the dam was operated.

Committees were instituted in each of the wards, with elected representatives of five different user groups: farmers, fishermen, livestock owners, women and health workers. These "Combined Water Committees" send representatives to the Liaison Committee in which the water authorities are also represented. The Liaison Committee finally decides about flood size, duration, flooding date and related issues.

An elaborate procedure was accepted in order to let all Committees have input into how much (and when) an artificial flood is required. This enables effective information flows on the extent and timing of the flood between the water authorities and communities.

Much emphasis is given to hydrologic monitoring, and post-flood feedback meetings are held in order for all involved to better understand how the river reacts to human manipulation. The major issue that remains to be solved in the Phongolo- Maputo River Basin is the active participation in flood operation by Mozambique (Savenije H. 2002).

III.8.2. Water Scarcity

As a rule of thumb, hydrologists use the level of 1000 to 2000 cubic meters (m3) per person per year to designate danger of water-stress. When the figures drop below 1000 m3 per person per year, nations are considered water scarce, which means that the lack of water becomes a severe constraint on food production, economic development, and protection of natural systems. Today, 26 countries with 232 million people belong to this group. The key word here is the sharing of a common water resource. The problem lies at the nexus between what essentially is a zero-sum game, and the peculiarities of the upstream- downstream dilemma: when the sum of the Riparian states water withdrawals from a shared river approaches the finite flow of the river, any further withdrawals from an upstream state will mean less water for the downstream states.

Conflicts between countries over such shared water resources occur in all parts of the world. Most often they are about dividing the quantity of water in a river between Riparian States, but they may also be about water quality (pollution means a scarcity of usable water for downstream recipients), and about groundwater withdrawals (aquifers know no borders). It is important to understand the limitations of the zero sum game by attempts to increase supply (Ohlsson L. 2002).

III.8.3. Confidence- Building

There are many ways to increase the supply (flow) of a river. The clue lies in minimizing the large evaporation losses that follow whenever water is spread out over a large area in a hot and arid climate. Such spreading-out may occur naturally (a prime example is the Sudd Marshes on the Nile in southern Sudan), or more commonly, through the building of dams in flat areas (such as the Aswan Dam).

The Aswan Dam is actually situated in a singularly bad position from the point of view of evaporation losses. Residing on Egyptian territory close to the border of Sudan, it covers an enormous area in order to capture an amount of water sufficient enough to maintain the flow of the Nile through Egypt even during several dry years in a row. The same amount of stored water, and the same regulatory function, could, in principle, be obtained from building a dam on the Blue Nile, in the Ethiopian mountain gorges, but with a much lower cost of evaporation losses, since a dam of similar volume there would have much less surface area (Ohlsson L. 2002).

A joint Egyptian-Sudanese-Ethiopian project in Ethiopia thus would result in more water to be shared among the Riparian States. The problem, of course, is that to the Egyptians, such a solution is unacceptable on two grounds:

As things stand at present, they could never leave the fate of their agricultural production capability to the goodwill of Ethiopia.

Secondly, they could never trust Ethiopia not to use the Dam for irrigation projects of their own, thus diverting potentially larger amounts of water from the upper Nile than now (Ohlsson L. 2002).

The same, unfortunately, applies to the now-aborted project to dry up the Sudd Marshes by building the Jonglei Canal. Any attempt by the Sudanese to use the canal to divert water for irrigation would be a threat to downstream Egypt, since it could potentially mean larger water withdrawals than present evaporation losses.

Two lessons could perhaps be derived from these examples. The extra amount of water to be obtained from attempts to increase the supply in rivers may not be that large (particularly compared to the magnitude of steadily rising demands), and realizing what potential there is crucially depends on creating enough confidence between the Riparian States (Ohlsson L. 2002).

The present institutional framework of the Nile Basin Initiative is expected to move in this direction. In fact, the pressures on Riparian States to cooperate in managing shared water-resources are so strong, that in many cases, pragmatism tends to overcome a less-than-perfect international legal framework.

Evidence comes from the Trans boundary Freshwater Dispute Database developed by Aaron Wolf, which now includes the full text of 140 water-related treaties, negotiating notes from 14 Basins, and files on water-related conflicts.

III.8.4. Policy Tools for Adopting To Water Scarcity Within Countries

The analysis has so far pointed to three great challenges for water policy-makers: manage conflicts, get more use out of the same amount of water, and get better use out of the available water. The policy goals for dealing with water scarcity within countries accordingly could be formulated as (Ohlsson L. 2002):

(a) Managing the competing water demands from different societal sectors and population groups in order to achieve a distribution of the scarce resource that is perceived as equitable;

(b) Facilitating technological changes to achieve greater end-use efficiency; and

(c) Facilitating socio-economic changes to achieve greater allocative efficiency.

There is an increasing awareness that natural resource scarcity of renewable resources, in particular, constitutes a risk for conflicts within countries, rather than between them. The causal link, however, is indeterminate and the causal chains are hard to track. By the stage that conflicts break into open, the causal links may be buried under several layers of intermediate links and links to other causes of conflict. " It is nevertheless regarded as an urgent policy-related research task to understand the mechanisms behind the pervasive conflicts now threatening the stability and welfare of populations in an increasing number of developing countries.

Key factors in these mechanisms are population increase, frustrated development expectations, and a lack of adaptive capacity to manage shrinking per capita allotments both of income and renewable resources, water ranking high among them. Dealing with water scarcity under such conditions entails strengthening the capacity for institutional change in order to create the new societal tools needed to manage water scarcity (Ohlsson L. 2002).

The debate on whether these tools should be founded on an economic incentive approach or a traditional administrative approach is gradually converging into the understanding that suitable market conditions cannot be created without substantial inputs of both administrative regulation and governmental intervention. The challenge to undertake these large-scale societal processes of change, without, at the same time, creating new sources for conflict that may threaten the very adaptive capacity needed, has only begun to be understood.

The following is a number of technical issues that lend themselves to cross-border cooperation. The order in which these issues are presented indicates an increasing level of cooperation (Savenije H. 2002):

Information. Exchange hydrological and other relevant data on water use between the Departments of Water, Hydropower, Agriculture. Update data series, calibrate data collection systems and agree on data formats. Establish joint databases and develop rules for swift information exchange in case of (impending) crises such as floods, droughts, and pollution. Finally, exchange of relevant national water policy plans and basin action plans, and information on revisions made to relevant laws and regulations. Crises procedures. Establish procedures to manage crises, including monitoring, warning and evacuation plans in case of natural or man-provoked disasters, such as floods, tropical cyclones, droughts, accidental pollution.

Human resources development. Let staff of one country follow relevant courses in a neighboring country, and let experts give guest lectures at educational institutions. In so doing, strive for balancing the capacities to manage water resources among Riparians. If a university in one Riparian country has a renowned expertise in, for example, hydrology, whereas another Riparian is strong on water quality, exchange staff to take (short) postgraduate courses. Thus regional differences become an impetus for cooperation and exchange, not only between government departments but also between educational institutions.

Joint research. Once educational linkages exist, a logical step would be to strengthen and stimulate regional research on a variety of topics related to river basin management. This and the previous activity could be suitably embedded in a network of institutions consisting of universities, NGOs and relevant government departments.

Joint plans. Prepare joint river basin plans, including compatible strategies for water conservation. Jointly developed plans have more credibility, and hence are more effective, than plans developed by individual states. Jointly prepare operational rules for large dams that impact on more than one Riparian country. Jointly revise the legal systems so as to harmonize them. Prepare action plans for demand management, water pricing, joint water use, and for inter-basin transfer.

Joint ventures. When two or more countries develop joint ventures (such as the Lesotho Highlands project and the Kariba Dam), a large step has been made towards the "community of interest" of individual countries in a shared resource. However, joint ventures by a few Riparians should not jeopardize the other Riparians of a basin. Such joint ventures should thus fall within the scope of a truly basin-wide organization.

III.8.5. River Basin Organizations (RHOs)

African leaders recognized such needs for inter-country cooperation as early as the 1960s and 1970s, soon after most African countries obtained their independence. As a result, a number of inter-country cooperation mechanisms in the form of trans boundary river/lake basin organizations (RBOs) were set up in the 1960s and 1970s. In some major river/lake basins such as the Nile, the Zambezi, the Congo, Lake Victoria and others, where such mechanisms do not exist, efforts are presently underway among their Riparian countries to set up such mechanisms for cooperation. Yet, the number of such existing and/or emerging mechanisms is still low given the number (over 80) of major trans boundary river/lake basins in Africa. For example, there are fewer than ten trans boundary RBOs in Africa and serious efforts are underway only in two or three others.

Most of the existing RBOs set up in the 1960s and 1970s initially had significant political support from their member countries and substantial technical and financial support from the international communities and donor agencies. Some of these RBOs prepared ambitious development plans and strategies and some, such as the Senegal River Basin Organization, the Mano River Union, the Niger Basin Authority, were initially successful in mobilizing resources and implementing a number of such development programmes and projects quite successfully.

However, over the years, some of these RBOs faced multiple problems, including a lack of political and financial support from their member countries and reduced in technical and financial support from the donor agencies. Some of these RBOs even faced temporary relocation of their headquarters because of political instability in their host countries. These problems severely affected their performance, especially in the implementation of development projects in their respective sub regions.

Chapter: IV

Population Policy

Egypt lies in the northeastern corner of the African continent and has a total area of about 1 million square kilometers (km^2). It is bordered in the north by the Mediterranean Sea, in the east by the Palestine and the Red Sea, in the south by Sudan and in the west by the Libyan Arab Jamahiriya. Its north-south extent is about 1,080 kilometers (km), and its maximum east-west extent about 1,100 km. The Egyptian terrain consists of a vast desert plateau interrupted by the Nile Valley and Delta which occupy about 4% of the total country area. The land surface rises on both sides of the valley reaching about 1,000 meters (m) above sea level in the east and about 800 m above sea level in the west. The highest point of the country, at Mount Catherine in Sinai, is 2,629 m above sea level and the lowest point, at the Qattara Depression in the northwest, is 133 m below mean sea level. Egypt is one of the oldest societies in the world. Egypt is an African Country, however, a part of its land, Sinai Peninsula ,is located at Asia Continent, and It passes across its land Suez Canal which separates its Asian part from the African part. (AQUASTAT Survey 2005)

The majority of the country area is desert land. Most of the cultivated land is located close to the banks of the Nile River, its main branches and canals, and in the Nile Delta. Rangeland is restricted to a narrow strip, only a few kilometers wide, along the Mediterranean coast and its bearing capacity is quite low. There is no forest land. The total cultivated area (arable land plus permanent crops) is 3.4 million hectares (ha) (2002), or about 3% of the total area of the country. Arable land is about 2.9 million ha, or 85% of the total cultivated area, and permanent crops occupy the remaining 0.5 million ha.

Hot dry summers and mild winters characterize Egypt’s climate. Rainfall is very low, irregular and unpredictable. Annual rainfall ranges between a maximum of about 200 mm in the northern coastal region to a minimum of nearly zero in the south, with an annual average of 51 mm. Summer temperatures are extremely high, reaching 38°C to 43°C with extremes of 49°C in the southern and western deserts. The northern areas on the Mediterranean coast are much cooler, with 32°C as a maximum.

Since President Hosni Mubarak took office in 1981, the population has nearly doubled. But most of the country's 72.6 million people are squashed in urban areas near the Nile, in an area roughly the size of Switzerland, which is home to just 7.5 million. "Before we add another baby, make sure his needs are secured," ran the slogan, adding to a string of campaigns over 30 years to encourage family planning. Mubarak told a government-sponsored population conference that cutting population growth was urgent.

With about one fifth of the population living on less than 50 pence a day and food and fuel prices lifting inflation to a 19-year high, discontent is mounting. But beyond domestic concerns, Egypt could become a poster-child for a global trend. According to the United Nations, the poor are set to be more and more numerous by 2050 and many will be living in towns as the world population climbs to a total of 9.2 billion. Essentially all the growth will be in less developed countries.

Egypt -- where the divide between rich and poor is stark and resistance to targeted birth control common -- shows how that could happen. Around 38 % of Egyptians are younger than 15, and according to the World Bank, women make up only around 22 % of the labour force, so the incentive for birth control is weak. Population growth has remained stubbornly high at around 2 % for the last decade and the fertility rate, at about 3.1 children per woman -- compared with 2.1 in the United States -- has also been stable. Lacking the oil reserves of their Gulf Arab neighbors to fund investment, Egypt's recent economic growth at around 7 % has not been steady enough to build a significant middle class. The population explosion is a crisis the government doesn't know how to handle. (AQUASTAT Survey 2005)

IV .1. Egypt geographical area is divided into four main geographical regions:

- The Nile Valley and Delta: its area is 33 thousand Km^2 approximately.
- The Western Desert: occupies approximately 68% of area of Egypt with an area of approximately 680 thousand Km^2.
- The Eastern Desert: around 225 thousand Km^2.
- Sinai Peninsula, its area in around 61 thousand Km^2.

IV.*2. Population:*

Egypt is the most populous Arab Country with Population about 76.7 million (inside, outside the country) according to final result 2006 census with an average annual growth rate of 1.8%. Ranks with Turkey and Iran as one of the largest Countries in the region. The rural population is 58% of the total population. Overall population density is 73 inhabitants/km^2; however, with about 97% of all people living in the Nile Valley and Delta, population density reaches more than 1,165 inhabitants/km^2 in these areas, while in the desert it drops to only 1.2 inhabitants/km^2. (CAPMAS 2008)

Agriculture contributes nearly 20 % of the gross domestic product (GDP) and about 20 % of the total exports and foreign exchange earnings. The population of Egypt is estimated at 73 million people occupying only about 4 % of the national territory. The population density varies among the governorates. Approximately 17 % of the Egyptian population lives in Upper Egypt. The rest is distributed between Lower and Middle Egypt. Egypt is an arid to semi-arid region and can be divided into 5 main physiographic units, the Western Desert, Nile Valley, Nile Delta, Eastern Desert and the Sinai Peninsula. (CAPMAS 2008)

The present distribution of land use in Egypt is principally the result of long- ten historical processes, resulting from the interaction between socio-economic, political and environmental factors. These factors have influenced land ownership and tenure, population growth and urban-industrial development.

The historic trend shows that Egypt's population doubled for the first time in fifty years and the largest part of the increase took place in the second half of the last century. The change in population size during this period was attributed mainly to the natural increase. It can be noted from the data in table (1) that the intercensal growth rate began to increase rapidly (2.30 from 1947 to 1960) then it declined to be (2.12 from 1960 to 1976) because of wars and then increased in 1986 to 2.86 and according to the last census in 1996 it declined to 2.06.(Egypt in Figures, 2006).

The historical data of population censuses shows that Egypt's population number was doubled during the fifty years from 1897 to 1947 as their number increased from 9.7 Million to be more than 19 Million during the intercensual period and it was doubled for the second time during the thirty years from 1947 to 1976.

The population has multiplied for the third time during the last thirty years as the population increased from about 36.6 million according to the final results of census 1976 to about (72.8) Million (inside Egypt) according to final results of the population census 2006.

In 1997 it was estimated that 26.5% of the Egyptian population was living in poverty. The percentage was higher in rural than in urban areas and the incidence of poverty and "ultra poverty" was highest in Upper Egypt, while a larger absolute number of poor households was found in Lower Egypt because of the concentration of population there. In rural areas, about 29% of the population was living in poverty, compared to 23% of the urban inhabitants. Inadequate social services, landlessness, small farm size and inadequate off-farm income opportunities are the main causes of rural poverty.

About 96% of the rural population and 99% of the urban population had access to improved drinking water sources, with an average of 97% of the total population. Almost 100% of the urban population and 96% of the rural population had access to improved sanitation, with an average of 98% of the total population. A rapidly growing population (the largest in the Arab world), limited arable land, and dependence on the Nile all continue to overtax resources and stress society. The government has struggled to meet the demands of Egypt's growing population through economic reform and massive investment in communications and physical infrastructure.

Egypt was among the earliest countries of the world that undertook censuses, and conducted the first census in 1882. Since that time, thirteen censuses were successfully conducted in Egypt. The Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS) conducted the 13th census in this series of censuses of population, housing and establishment in 2006. Egypt has the longest densely settled population among the Arab Countries. The majority of Egyptians population lives in the Nile Delta Located in the north of the Country or in the narrow Nile Valley south the Capital of Egypt Cairo.

IV.3. *Administrative Description:*

Administratively, Egypt is divided into 26 governorates and Luxor city; four are urban governorates (Cairo, Alexandria, Port Said, and Suez) without rural population. Each of the other 22 governorates and Luxor city are subdivided into urban and rural areas, nine of these governorates are located in Nile Delta (Damietta, Dakehlia, Sharkia, Kalyubia, Kafer El-Sheikh, Gharbia, Menoufia, Behera, Ismailia). [(Lower Egypt), eight governorates and Luxor city are located in the Nile volley (Upper Egypt), and the other are Giza.].

- Frontier Governorates located on the eastern and western boundaries of Egypt (New Valley, Matrouh, North Sinai, South Sinai, and Red Sea).

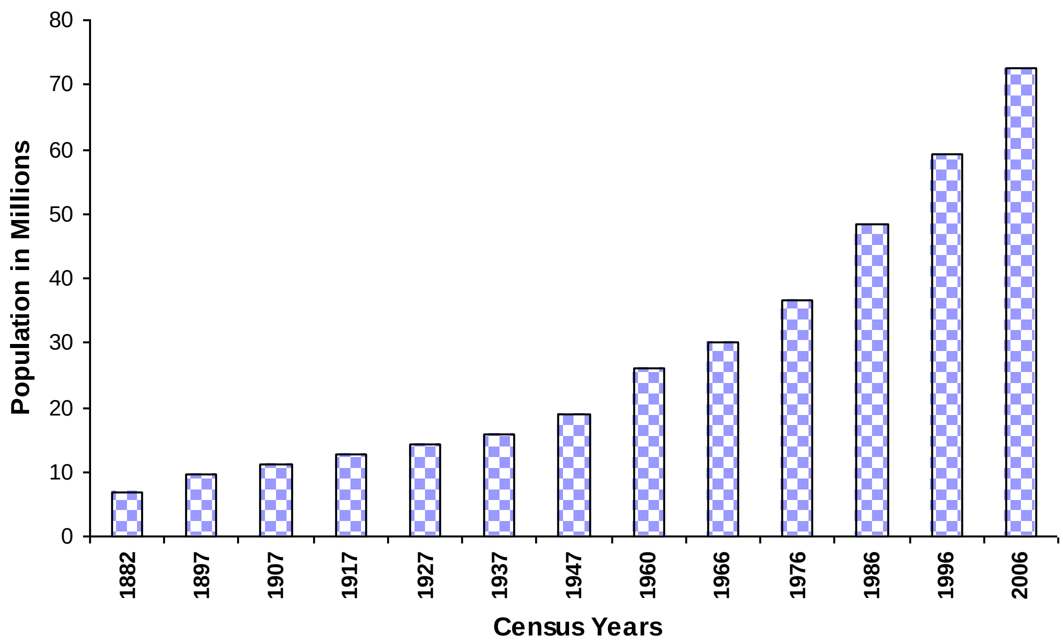
- According to presidential decree Number:114 of year 2008, modified by decree124 of year 2008 concerning the division and modification of some governorate`s administrative borders and the establishment of two governorates (Helwan and 6th of October) as two urban governorate, In 2008. Administratively according to the latest pervious legislation, Egypt is divided into 28 governorates and Luxor city.

Table (17)
Size of Population and Annual Growth Rate by Census Year
(1882 – 2006)

No of Census	Date of Census	No. of Population in Millions	Annual growth Rote %
1	1882	6.8	-
2	May 1897	9.669	-
3	June 1907	11.19	1.46
4	March 1919	12.718	1.28
5	February 1927	14.178	1.09
6	March 1937	15.921	1.16
7	March 1947	18.967	1.75
8	September 1960	25.984	2.34
*9	September1966	30.100	2.52
10	November 1976	36.620	1.92
11	November 1986	48.254	2.75
12	November 1996	59.313	2.08
13	November 2006	72.699	2.05

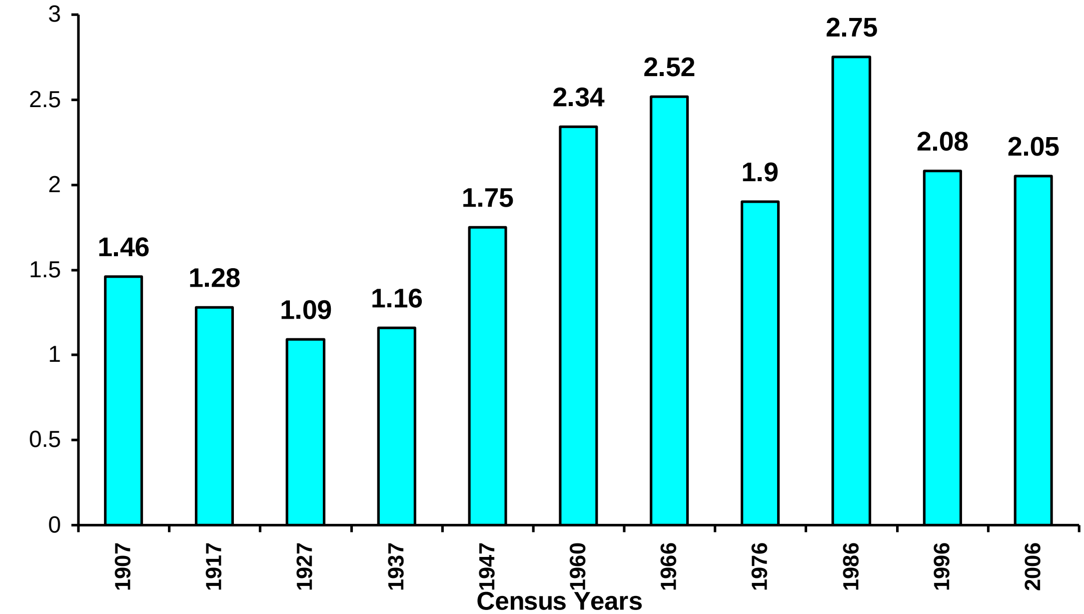
Source: Population of Egypt in the 20th century CDC. *Conducted by sample survey.

Figure (14)
Population Size of Egypt in Census Years 1882 – 2006



Source: Population of Egypt in the 20th century CDC

Figure (15)
Intercansel Annual Growth Rate (1907 – 2006)



Source: Population of Egypt in the 20th century CDC

Table (17) and figures (14),(15) show the trends in Egypt's population based on successive population censuses conducted during the twentieth century and year 2006, the annual intercensal growth rate for this period of time.

Table (18)
Index Numbers of Egyptian Populations Growth Between1 (Population in (1897 = 100)

Date	Population in Millions	Index number
1897	9.669	100
1907	11.19	115.7
1917	12.718	131.5
1927	14.178	146.6
1937	15.921	164.7
1947	18.967	196.2
1960	25.984	268.7
1966	30.100	311.3
1976	36.620	378.8
1986	48.254	499.1
1996	59.313	613.4
2006	72.699	751.9

Source: Population of Egypt in the 20th century CDC

- Table (18) shows the index numbers of change in population during the last century and the last census 2006 based on the census data (1897 census = 100).
- It can be noted from all previous data that Egypt's population doubled for the first time in fifty years, and the largest part of the increase took place in the second half of the twentieth century the change in population size during that period was attributed mainly to a corresponding change in the natural increase since migration played no effective role in population growth in Egypt at that time.

IV.4. Population Growth Rate

a) Tables (17) and figure (15) show that the average annual growth rates during the different intercensal periods have been unstable. On average, the population grows at first fifty years from last century between 1907-1947 by (1.45 /1.75 %). However, the intercensal growth rate in the period 1947-1960 was (2.34) percent, increased to 2.52 percent in the period (1960-1966) and then decreased to 1.92 percent in the period (1966-1976) due to the (1967-1973) wars.

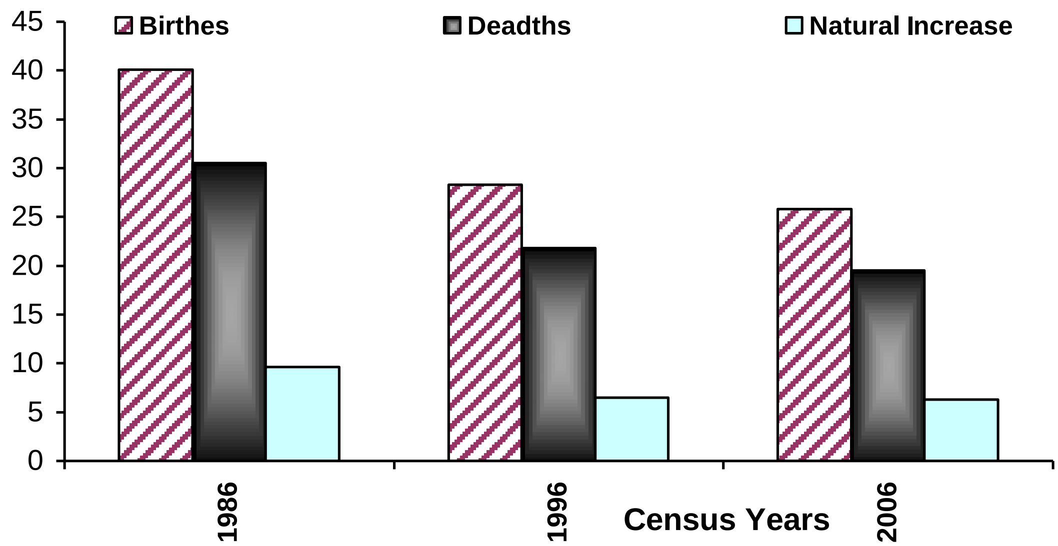
b) The growth rate had also increased in period (1976-1986) to be 2.75% due to baby boom after the 1973 war. After war, also, the growth rate decreased to (2.08%) in 1996 but the growth rate in 2006 still decreased to (2.05%) due to changes in reproductive behavior, economic and social changes. The government adapted a successful family planning between: 1986 to 2006.

Table (19)
The Trend of the Crude Birth Rate, Crude Death Rate and Rate of Natural Increase between Intercensal Periods 1986-1996-2006

Years	Crude birth rate		Crude death rate		Natural Increase	
	No. (000)	Rate %	No. (000)	Rate%	No. (000)	Rate%
1986	1908	40.1	456	9.6	1452	30.5
1996	1662	28.3	380	6.5	1282	21.81
2006	1858	25.8	452	6.3	1406	19.5

Source: (CAPMAS Statistical year Book Dec.2007), Population of Egypt in the 20th century CDC

Figure (16)
Trend Of Birth, Death, And Natural Increase Rates Between Intercensal Period 1986 – 1996 – 2006



Source :(CAPMAS Statistical year Book Dec.2007)

c) T**able (19) and figure (16) Show that:**

The trend of crude birth rate (CBR) during the two intercensal periods have changed, but on average the (CBR) in 1986 was (40.1) per one thousand population. And after that decreased to (28.3) per one thousand population in 1996, in 2006 it still decreased further to (25.8) per one thousand population.

The trend of crude death rate (CDR) during the two intercensal periods (1986/1996/2006) have been changed and still decreased in 1986 from 9.6 per thousand to 6.5 per thousand in 1996 to 6.3 per thousand in 2006.

Due to the decrease in CBR/CDR during the intercensal period (1986/1996/2006) the Natural increase rate (NIR) was decreased between intercensal periods (1986/1996/2006) from (30.5) per thousand in 1986 to 21.8 per thousand in 1996 and still decreased to 19.5 per thousand in 2006.

IV.5. Population Dynamics in Egypt

Population dynamics have many definitions but the simple definitions are construed on studying of change and reasons of change in the population size.

IV.5.1- Fertility

a) It is means the actual reproductive performance of women or it is the actual child bearing of women, or it is refers to realization the potential fertility. The study of fertility is one of the demographical variables that contribute to determining the rate of population growth.
b) Sources of Fertility Data
   1) Vital statistics.
   2) Census
   1) Sample surveys.

IV.5.2 - Crude Birth Rate

It is the total member of births in a given year divided by the total midyear population in that year. Total number of births is calculated from vital statistics.

Midyear population estimation; it is calculated from vital registration (births –deaths) and previous results of population census.

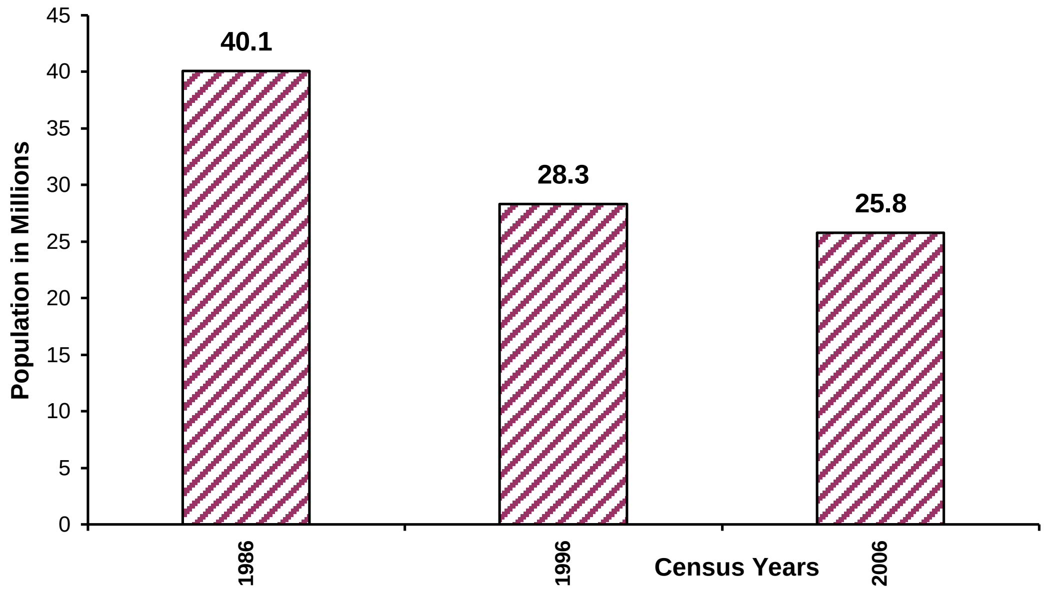
Table (20)
The Trend of Crude Birth Rate between Intercensal Period 1986, 1996, 2006

Data	Crude Birth Rate		
Year	Mid-year pop(000)	No. of births (000)	Rate By thousand (000)
1986	47582	1908	40.1
1996	58728	1662	28.3
2006	72016	1858	25.8

Source: (CAPMAS Statistical year Book Dec.2007), Population of Egypt in the 20^{th} century CDC.

The crude birth rate for years 1986, 1996, 2006 in table (20) and figure (17) shows that it fluctuated substantially during that period, it witnessed a period of decline from 40.1 per thousand in 1986 to 28.3 per thousand in 1996 and still decline to 25.8 in 2006, that decline happen due to economic, social variable and the changes in reproductive behavior in Egypt.

Figure (17)
The Trend of Crude Birth Rate between Intersensal Periods 1986, 1996, 2006.

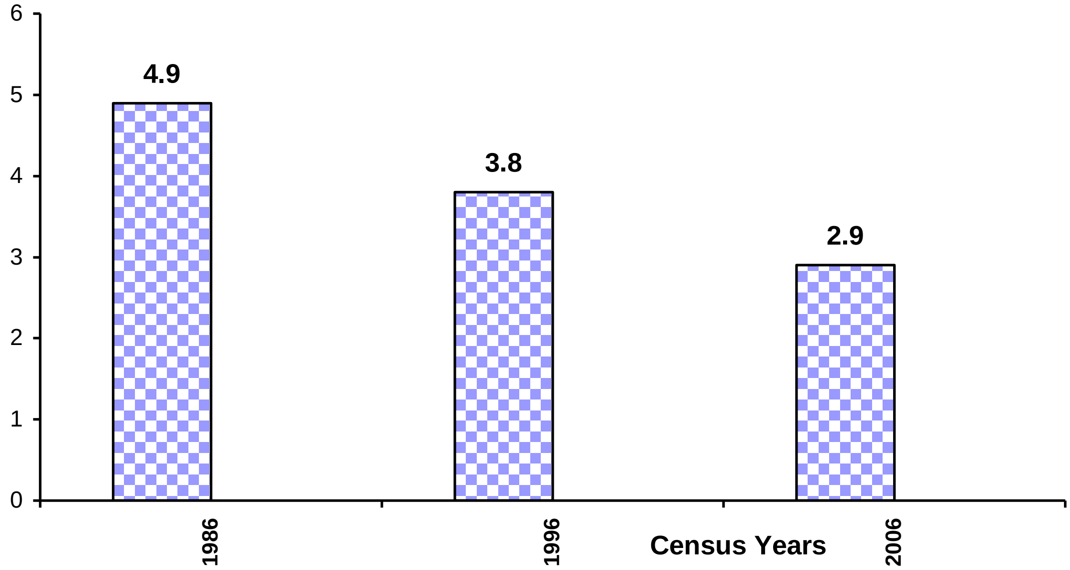


Source: (CAPMAS Statistical Year Book Dec.2007), Population of Egypt in the 20th century CDC

The trend of total fertility rate in figure (18) shows that it decline from 4.9 in 1986 to 3.8 in year 1996 thin to 2.9 in year 2006. It witnessed a numbers of decline was (1.1%) between 1986 and 1996 and still less decline to (0.9 %) between (1996, 2006) due to get in changes in reproductive behavior and economic and social changes in Egypt.

This section aims at exploring levels and trends of the population size, the intercensal growth rate, and the age composition of the population of Egypt. It also examines the components of change, particularly fertility and mortality that sustained the rapid population growth in Egypt. Learning about the indicators of population growth helps in analyzing variables related to this growth, clarifying their dimensions and trends and illustrating population status at different times and periods.

Figure (18)
Trend of Total Fertility Rate between Intercensal Periods (1986/1996/2006)



Source: (CAPMAS Statistical Year Book Dec.2007), Population of Egypt in the 20th century CDC

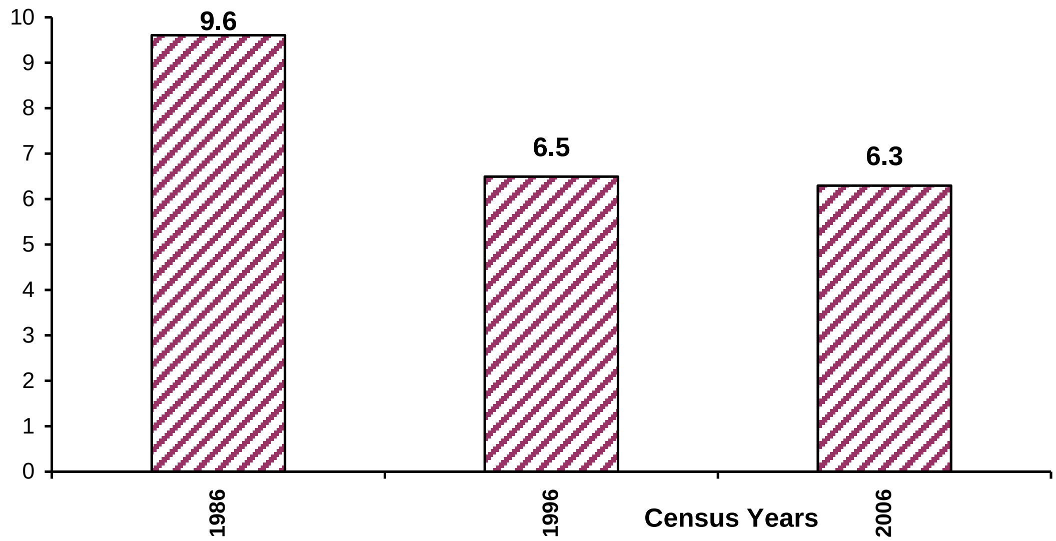
IV.5.3- Mortality

a) Sources of Mortality Data: (Vital statistics, Census, sample survey)
b) Measuring Mortality

To measuring mortality we are attempting to estimate the force of mortality the extent to which people are unable to live to their biological maximum. The ability to measure accurately varies according to the amount of information available and as a consequence, the measures of mortality differ considerably, in their level of sophistication. The least sophistication and most often quoted measure of morality is the crude death rate.

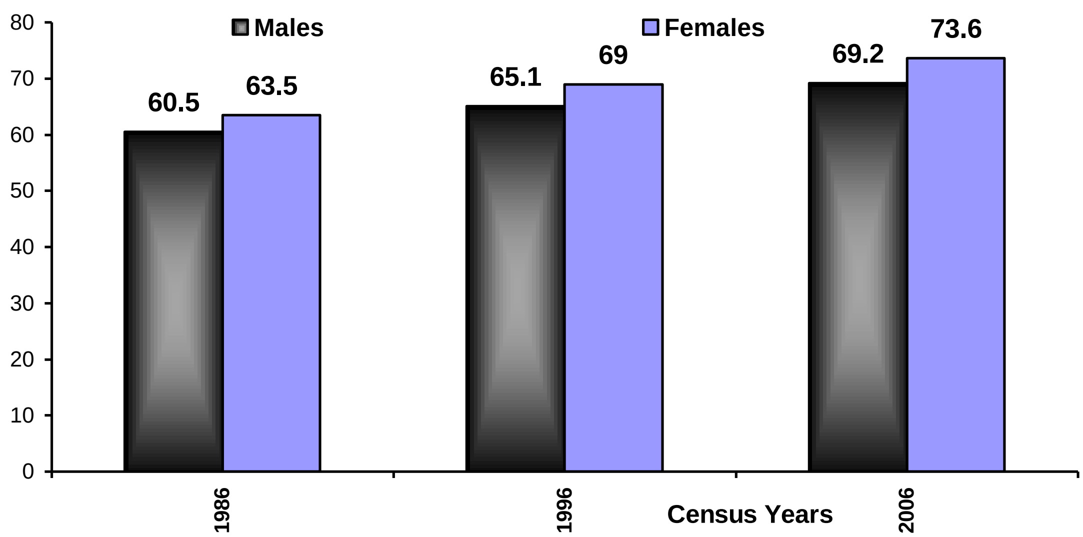
- From figure (19) to examine the rate and the trend of crude death rate between intercensal period 1986, 1996, 2006 it witnessed a period of decline from 9.6 per thousand in 1986 to 6.5 per thousand 1996 with difference around 3.1 per thousand due to many changes in health care sector and other changes in social and economic sector, and then decline very little to 6.3 in 2006 with difference 0.2 per thousand due to the highly interesting of government in health care sector.

Figure (19)
The Trend of Crude Death Rate between Intercensal Period 1986:2006



Source: (CAPMAS Statistical Year Book Dec.2007), Population of Egypt in the 20th century CDC

Figure (20)
The Trend of Life Expectancy by Sex between Intersensal Period 1986:2006



Source: (CAPMAS Statistical Year Books), Population of Egypt in the 20th century CDC

The figure (20) explains the trend of life expectancy at birth by sex between intercensal period 1986, 1996, 2006 it witnessed a period of increase of life expectancy for males in 1986 from 60.5 year to 65.1 year in 1996 to 69.2 year in 2006 with difference 4.6 between 1986 and 1996 and with difference 4.1 between 1996 and 2006 in same time the life expectancy for females were increased from 63.5 in 1986 to 69.0 in 1996 to 73.6 in 2006 and still increased with difference 4.6 between 1996 and 2006.

The period between 1986 and 2006 witnessed a marked decline in mortality a sharp decline in the crude death rate during the period 1986-2006. This coincided with increasing governmental and public interest in services, improving the environment, providing public health services to protect against infections and parasitic diseases and minimizing the risk of exposure to chronic diseases related to accidents and violence. That stage witnessed great concern over public health services, especially for the aged and preventive health programs in relation to smoking and poor nutrition.

IV.5.4 -Urbanization

The data explain the percentage, extent, of urbanizations in Egypt on the basis of relative value of urban population in the successive censuses from 1986 up to 2006 it means the ratio of urban population to the total population in all Egypt.

Table (21)
Population Distribution by Urban and Rural Residences

Census	No. of Population					
	Urban		Rural		Total	
	No (000)	%	No (000)	%	No (000)	%
1986	21.216	44.0%	27.038	56.0%	48.254	100%
1996	25.286	43.0%	34.027	57.0%	59.313	100%
2006	31.371	43.1%	41.427	56.9%	72.798	100%

Source: CAPMAS; Statistical Year Book 2008

Table (21) shows a substantial increase of population in urban areas as a whole in the three census, The total number of urban population in 1986 was (21.216) Million residence which represents 44% from the whole population, and this number increased to (25.286) Million residence which represents 43% from whole population in 1996, After that in 2006 census the total number of urban population was (31.371) Million residence, around 43.1% from whole population.

The percentage of urban population was around 44%, 43%, 43.1% in the last three successive censuses, this means that the percentage of urbanization become relatively stable for the country as a whole.

Since Cairo, Alexandria, port Said and Suez are urban governorates, the percentage of urbanization in them equals 100%.

However this percentage varies in lower and Upper Egypt governorates, in addition to the difference in each governorate from one census to other.

It is noted that the percentage of urbanization at the national level does not reflect accurately and clearly the level of urbanism frequently associated with this type of human settlement.

Most of the Cities and towns and facilities to meet the pre-requisite criteria specified by functional definition of the term.

There is still a wide gap in the stage of development between rural and urban areas, as demonstrated by the heavy exodus of the population from the former to the latter, leading to devastating effects on cities and towns .

So, The rapid urban growth that took place in the country during the last century was attributed primarily to the pushing forces in rural areas rather than to the pulling ones in urban areas. This situation perhaps explains the reason behind the stability of the percentage of urbanization in Egypt during the last decades.

Egypt population is growing fast, by a newborn every 27 second. The fast growing population is outgrowing the water and food supply. To help solve the food shortage problem the Egyptian government is expanding the amount of land available for agriculture by reclaiming more desert land, this expansion in agriculture land needs sustainable amount of water which is becoming problematic as the population increases and their demand for water increases. Urbanization and the movement of population from rural areas to cities have serious impact on the agricultural production because the expansions in cities and building new houses and infrastructural facilities which are established in these cities have led to loss in the agricultural land. Degradation of the top soil layer to make bricks for building also destroys the land fertility and exposes it to desertification.

The percentage of urbanization in 1986 was 44% and became 57% in 1996 according to CAPMAS. The movement of farm workers to cities to look for easy work and better income causes loss of agricultural land and skillful farmers. The agricultural labor force decreased from 41 per thousand in 1990 to 33 in 2000. Egypt loses about 6 % of the cropped land annually because of urbanization. Other parts of land were being lost due to desertification caused by inadequate drainage and soil salinization, sand movement, intensive cultivation, removal of top soil for brick making, and declining use of organic fertilizers. Agriculture in Egypt is almost entirely dependent on irrigation except in a narrow land along the northern coastal areas. So consumption of the River Nile water is taken into consideration when we design any agricultural development projects because of the limitation of water availability. The water supply is governed by an international agreement.

Urbanization and the movement of population from rural areas to cities have serious impact on the agricultural production because the expansions in cities and building new houses and infrastructural facilities which are established in these cities have led to loss in the agricultural land. Degradation of the top soil layer to make bricks for building also destroys the land fertility and exposes it to desertification.

The firm measures such as restricting maternity benefits for those with large families, which helped Iran sharply slow its population growth during the 1990s, would be politically dangerous in Egypt, where there have already been protests over food shortages. Egypt is not about to legalize abortion, which has helped Tunisia bring down its fertility levels, and vasectomy, commonly practiced in Iran, is barely heard of in Egypt.

Egyptians, especially in the countryside, view large families as a source of economic strength. Many will continue bearing children until they have a boy. The population will continue to grow and the government can only make an appeal.

The outlook for both Egypt and the region will be grave if the most populous Arab country continues to grow at current rates, Egyptian and U.N. officials say.

"The consequences are a real deterioration in the quality of life and in agricultural land per person," said Magued Osman, chairman of the cabinet's Information and Decision Support Center. "We are depending heavily on imported food items and this will increase."

If levels of growth don't slow, Mubarak says Egypt's population could double to 160 million by 2050. But Egypt's government hopes it can be stabilized at 100 million, Osman said: "More than that will be difficult."

IV.*5.5 -Migrants Seek Jobs Abroad*

Ziad Rifai, Egypt representative for the United Nations Population Fund, said continuing high population growth in Egypt could affect neighboring countries. If the general welfare of the people goes below a certain threshold, it affects stability in the region and it affects migration. The worse the conditions get, the easier it is for extremism to flourish. Tens of thousands of Egyptians a year try to reach Europe, Libya or the Gulf countries in search of jobs at wages that they cannot find at home. Many die at sea on the way to Europe. Mubarak tends to avoid mentioning a specific number of children but the government says it prefers a family with two.

IV.6. The Challenge

The challenges of poverty and hunger in Egypt remain as great and compelling as ever. The number of the world's under-nourished is still on the increase, despite the remarkable progress made in agricultural development in developing regions in recent years. Increasing food production to meet the needs of the increasing world population on a sustainable basis remains the primary goal of all nations. (Nino M. 2003)

Egypt needs to use the desert to take care of the tremendous increase in population. Egypt also needs to use the desert to produce food, which we are now importing most of it. Egypt is in a mess, in order for the desert development to be successful; Egypt has to have two things. One, enough water, and two, proper plans to get people convinced they can live there more comfortably and have a good life for themselves and their children. This dilemma raises the question: how long can Egypt sustain expanding its agriculture land? There are other countries in the same situation and trying to find a solution.

IV.*6 .1. Land expansion*

Expected considerable increment in demand occurs in agricultural and industry sectors (Abu- Zeid, 1991) due to further development of manufacturing sector and land reclamation projects. Annual 2.1 percent population growth rate obliges agriculture sector to provide food for larger number of people and this under condition of continuously declining per capita crop area and per capita crop production (MWRI, 2002a). The difficulties in relation to limited land resources are not restricted to the problem of food security but it is linked to the employment issue as well. The rural area is accommodating 57 percent of the population, 50 percent of which is involved in the agricultural sector (HDR, 2003).

Agricultural sector occupies an important place in the Egyptian economy between the various production sectors, where agricultural production is responsible for providing food for all the population of Egypt. For the importance of identifying the volume of agricultural production and the size of local consumption this chapter deals with the trend of the production and consumption for the selected commodities: wheat, flour's wheat, maize, broad bean, sugar and edible oil. The right to food is one of the most urgent needs for human beings. The problem of securing food has remained the foremost concern of all societies throughout the ages, increasing in intensity and sometimes abating, other times depending on changing circumstances. The problem of food gap is not nascent today but extends to many years ago. The food problem in Egypt showed mixed signs in the late sixties and early seventies, increased severity of the problem specifically in 1974 and has been increasing in intensity over the years to become one of the most serious problems facing Egyptian society and threaten the security at the economic, social or political dimensions. Population size in Egypt during the period (1990-2005) from table (22), it shows that the increase in population size reached about 36%. The total population size was about 51.91 million at the start of the study period in 1990 and reached about 70.67 million in 2005.

Table (22)
Population, GNP, Estimated Per Capita GNP (L.E.)
in Egypt During the period (1990-2005)

Year	**(1) Population Size (million)**	**(2) Gross National Product GNP (million L.E.)**	**(3) Estimated Per Capita GNP (L.E.)**
1990	51.91	91535	1763
1991	52.99	110011	2076
1992	54.08	131057	2423
1993	55.20	146160	2648
1994	56.34	162967	2893
1995	57.51	191010	3321
1996	58.76	214185	3645
1997	60.08	247028	4112
1998	61.34	266757.7	4349
1999	62.64	282578	4511
2000	63.98	315667	4934
2001	65.29	332543.8	5093
2002	66.63	354563.8	5321
2003	67.97	390619.4	5747
2004	69.30	456322.4	6585
2005	70.67	506511	7167

Source: Column (1) from Central Agency for Public Mobilization and Statistics (CAPMAS) "Statistical Year Book" 2005. Column (2) from the Ministry of Economic Development, Unpublished Data. Column (3) calculated from dividing column (2) by column (1).

From simple trend analysis of the population size in the same period, the time series for the population size showed that the size had increased annually by about 1.26 million. The result reflects that the percentage of change of population size is highly associated with the time factor, the correlation between them is highly statistically significant.

The estimated per capita GNP in Egypt during the period (1990-2005) from table (22), it shows that the increase in per capita GNP reached about 307% during that period. The total per capita GNP ranged from a minimum of 1763 L.E. in 1990 to a ceiling of about 7167 L.E. in 2005.

From simple analysis of the trend for the estimated per capita GNP in the same period, the time series for the estimated per capita GNP showed that the per capita GNP had increased annually by about 333.2 L.E. The result reflects that the percentage of change of estimated per capita G.N.P. is associated with the time factor and the correlation between them is strongly statistically significant.

The Egyptian economy has traditionally relied heavily on the agricultural sector for food, fiber and other products. The agricultural sector provides the livelihood for about 55 % of the inhabitants and accounts for almost 34 % of the total employment and labour force.

Efforts are being focused on measures that lead to a significant increase in crop production. Among the many factors involved in achieving this aim are the balanced fertilization of different crops and the adoption of suitable fertilizer use practices. Hamdan (1983); Central Agency for Public Mobilization and Statistic.(CAPMAS, 1989).

The demand for food and other agricultural commodities is increasing in Egypt due to the increase in the population and improvements in living standards. Efforts continue to improve crop productivity and quality. The breeding of new high yielding varieties and the development of better agricultural practices are some of the measures aimed at increasing agricultural production to meet the increase in demand.

Areas at risk do include some regions of developed countries as well. (Martinez, 1994; Abu-Zeid, 1998; Halridy, et al., 2003) Just 50 years ago absolute majority of a population had abundant fresh water resources per capita, except a few of the less fortunate countries. The situation since then has been changed dramatically and the list of countries suffering from water shortages expanded to 26 in total with population of 300 millions. (Abu-Zeid, 1998)

IV.*6.2. Water Scarcity in Egypt*

Per capita fresh water availability in Egypt dropped from 1893 cubic meters per person in 1959 to 900-950 cubic meters in 2000 and tends to decline further to the values of 670 cubic meter by 2017 and 536 by 2025 (UN CCA 2001; MWRI, 2002a; Abd-EI- Hai, 2002).

The main reason behind this rapid fall is the fixed water resources and the raising pressure from population growth. However, there are other factors more important in escalating the water issues in Egypt.

Here are presented the main driving forces of water scarcity. Some of the factors do not show direct linkages to the problem but have great contribution in establishing water stress conditions. So the driving forces are categorized in four different subgroups: social, economical, political forces and physical variables. First are presented social forces, next are physical variables, followed by economic and political forces.

Water scarcity cannot longer be considered as a problem, which can emerge at a certain point over time and spread over the country just at once. Unequal distribution of water along the canal do not always provide users sufficient water even within the same village already now even though average per capita figures based on existing supplies, do not indicate water stress conditions. The same applies to the water allocation among the different water users. Increasing competition between different consumers, the water contamination from industry and poorly treated sewage further reduces the available water for irrigation uses.

IV.*6.3. Why do we need to save water?*

The water saving at this stage might seem a measure just for sake of conservation itself, since the supply and demand are still in balance. Listed below a short summary of arguments, collected from literatures, support the importance of addressing the issue of irrigation water conservation. Water becomes scarce, increasing the need for efficient management of a valuable resource and the water conservation is an instrument, which allows:

- To avert acute water deficits, where the water needs outrun the supply;

- To respond to the loss of existing water supplies for agriculture due to population growth, urbanization and completion from high value users;

- To ensure enough water supply for agriculture (including the expanded lands) which can be a guarantee for the food supply and secure level of food self-sufficiency (The last can be regarded as a strategic plan, which makes country less vulnerable to the unfavorable price fluctuations on global market. As it has been suggested, the cut back of subsidies in developing countries can shift prices on food upwards (Carruthers, et al. 1997).

- To slow down the depletion of non-renewable water reserves;

- To lessen the pressure on groundwater extraction as the last is very fragile system and needs careful management to avoid the overuse;

- To provide water equally between regions and the farms;

- To reduce the water quality deterioration;
- To avoid rural-urban migration since there is already enormous pressure on overpopulated cities;

- To achieve these objectives the water conservation measures must be applied. However, the issue of implementation of water saving instruments is not as easy task as it seems in the beginning.

IV.*6.4. Benefits from the Aswan High Dam*

The Aswan High Dam (AHD), completed in 1971, has allowed Egypt to shield itself from natural variations in the Nile's flow. It has also had negative effects, such as the loss of soil fertility through reduced siltation and coastal erosion in the Nile Delta, but, even taking those into account, recent studies suggest that it has had a major positive impact. Economic models estimate that the dam has generated annual benefits, net of the negative impacts, equivalent to at least 2 percent of Egypt's 1997
GDP.

These benefits consist of increased agricultural production (including reclaiming approximately 22 percent of Egypt's total irrigated land); energy generation; and improved navigation, which, in turn helped develop Nile-based tourism. The social benefits of the AHD are harder to measure, but studies estimate that stored water from the dam has saved Egypt from the costs of poor harvests in 1972 to 1973 and 1979 to 1987, and protected the Nile valley from major floods in 1964, 1975, and 1988.

Furthermore, by reduing uncertainty about water supplies, the dam has acted as insurance for farmers and other consumers. Applying different measures of risk aversion, estimates of this risk premium range from 1.12-4.25 billion Egyptian pounds (US$330-1,250 million [1997 average exchange rate]), or 0.4 to 1.7 percent of 1997 GDP. (Strzepek et al. 2004).

At the central government level, Egypt demonstrated how a flexible government organization can help deliver real improvements to the population and help achieve the full benefits of a public investment because the government was able to adapt to environmental problems that arose after constructing the Aswan High Dam (AHD). The AHD changed the hydrology of the basin. Traditional Egyptian agriculture, practiced over five millennia, grew one crop per year, which was sustainable because it did not degrade land quality. After construction, the AHD made water available for perennial irrigation and increased crop intensity to 200 percent.

This increased application of water led to land salinization and waterlogging that could have undermined Egypt's productivity gains. Addressing these problems required installation of drainage infrastructure, which was not popular with farmers, because these traditional open field drains used up 10 percent of the land area. The government managed to innovate and develop subsurface drains, which it installed on more than 2 million hectares, at a total cost of US$1 billion. Although in general,

Egypt has a large centralized bureaucracy, unresponsive to clients and with a history of low cost recovery in the water sector. The Delegating Authority has required the concessionaire to extend the water network to low-income government was able to make a series of organizational, technical, and financial innovations. Institutionally, it created the Egyptian Public Authority for Drainage Projects within the Ministry of Water Resources and Irrigation. This organization was able to act flexibly and rapidly to address the drainage problems. Financially, it implemented a policy of full cost recovery for field level drainage investments. Technically, it adapted the leading international experience to develop tile drains that would perform efficiently without taking up valuable agricultural land. A recent international review concluded that Egypt is "one of the few countries worldwide that has developed institutions with capacities to address drainage needs" (Friesen and Scheumann 2001).

This example illustrates the importance of actions to address the second level of scarcity if countries are to benefit from investments that tackle the first level of scarcity. Egypt has improved water supply services in the public sector by strengthening accountability mechanisms. The government separated service provision from regulation by creating a Holding Company for Water and Wastewater in 2004 to manage water services in 14 cities. It then held the Holding Company accountable for achieving progress against a series of performance indicators monitored monthly. The indicators include quality of drinking water, response to public complaints, and improvements in revenue collection. The company has set up performance incentives for staff responsible for bill collection. It has also helped improve consumer trust in the accuracy of the water bills by overhauling domestic water meters. Most of the affiliated companies are now recovering 90 percent of operations and maintenance costs, with 150 percent cost recovery in Alexandria (The World Bank, 2007).

Table (23): Basic statistics and Population

Physical areas			
Area of the country	2002	100 145 000	ha
Cultivated area (arable land and area under permanent crops)	2002	3 422 178	ha
• as % of the total area of the country	2002	3	%
• arable land (annual crops + temp. fallow + temp. meadows)	2002	2 778 872	ha
• area under permanent crops	2002	643 306	ha
Population			
Total population	2004	73 390 000	inhabitants
• of which rural	2004	58	%
Population density	2004	73	inhabitants/km2
Economically active population	2004	27 902 000	inhabitants
• as % of total population	2004	38	%
• female	2004	33	%
• male	2004	67	%
Population economically active in agriculture	2004	8 594 000	inhabitants
• as % of total economically active population	2004	31	%
• female	2004	49	%
• male	2004	51	%
Economy and development			
Gross Domestic Product (GDP)	2003	82 400	million US$/yr
• value added in agriculture (% of GDP)	2003	16.1	%
• GDP per capita	2003	1 146	US$/yr
Human Development Index (highest = 1)	2002	0.653	
Access to improved drinking water sources			
Total population	2002	98	%
Urban population	2002	100	%
Rural population	2002	97	%

Source: Irrigation in Africa infigures -AQUASTAT Survey 2005

In 2000, about 96 percent of the rural population and 99 percent of the urban population had access to improved drinking water sources, with an average of 97 percent of the total population. Almost 100 percent of the urban population and 96 percent of the rural population had access to improved sanitation, with an average of 98 percent of the total population (Table 23).

IV.6.*5. Economy, Agriculture and Food Security*

In 2003, Egypt's GDP was estimated at US$82.4 billion with an annual growth rate of 3.2 percent. The agricultural sector accounted for 16.81 percent of GDP and employed about 31 percent of the labour force, of which 49 percent were female (Table 23).

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. Agricultural imports in 2001 included 4.4 million tonnes of wheat and wheat flour, 4.7 million tonnes of yellow maize, 0.6 million tonnes of vegetable oils and 0.4 million tonnes of sugar. On the other hand, the main export crops were, amongst others, 53 000 tonnes of cotton, 444 000 tonnes of rice, 176000 tonnes of potatoes and 37 000 tonnes of citrus.

In Egypt, 99.8 percent of cropland was irrigated in 1997. Even the small, more humid area along the Mediterranean coast requires supplementary irrigation to produce reasonable yields. Smallholdings characterize Egyptian agriculture; about 50 percent of holdings have an area less than 0.4 ha (1 feddan). Farmland urbanization represents a serious threat to agriculture in Egypt. It is prohibited by law to construct any buildings on farmland without a licence from the Ministry of Agriculture and Land Reclamation, and violators are prosecuted and face serious penalties.

IV.6.*6. Water Scarcity -Risk of Conflict*

Africa suffers from the most unstable rainfall regime and freshwater distribution. For example, more than 30% of the total surface water resources in Africa are in one river basin, namely the Congo River Basin, although this Basin is home to only 10% of the total population of the continent. Seventy- five per cent of the total continental water resources are concentrated in eight major river basins: the Congo, the Niger, the Ogadugne (Gabon), the Zambezi, the Nile, the Sanga, the Chari-Lagone and the Volta. Only 4% of Africa's available surface water resources are presently exploited, although the continent suffers from chronic drought and desertification.

Africa's water resources, especially trans boundary, are less developed than those in other parts of the world. The continent also suffers from chronic seasonal water supply fluctuations. For example, most sub-Saharan rivers have high flows during rainy seasons and much-reduced flows during dry seasons. Therefore, dams and large storage reservoirs are required for regulating their annual flow variations as well as for irrigation and power generation. Most of these large projects have trans boundary implications because most are shared by two or more countries.

The task of managing the process of adaptation to water scarcity essentially entails learning how to deal with:

(a) The conflicts encountered as a result of the natural resource scarcity itself (both international and internal conflicts on the distribution of the resource); and
(b) The conflicts encountered as a result of the social resources applied to overcome the natural resource scarcity (internal conflicts, often directed at the state, and therefore a dangerous impetus for external conflict).

Countering the widely held opinion that water scarcity entails prime risks of international conflicts over shared water resources, it is argued that the risk of conflicts within countries is in fact larger, and that the risk of international conflict is derived from the necessity to avoid conflicts within countries, caused not by water scarcity itself, but by the institutional change required to adapt to water scarcity. The potential risks of conflict are thus better analyzed as caused by a social resource scarcity, rather than by a natural resource scarcity of water (Ohlsson L. 2002).

Scarcity by definition entails increased competition for a resource with increased economic value, and implies diminishing resources and/or pressure on the supply of available resources from an increasing demand. Attempts to overcome scarcities can be sought through two distinct mechanisms:

supply side regulation and demand-side regulation in order to avoid competition, which is a source for potential conflict. Two levels of conflict are easily identified:

national and international. Following this simple analytic framework, (Ohlsson L. 2002):

.Attempts to increase supply are the driving force for water conflicts between countries;

.Attempts to manage demand will, by definition, alleviate this pressure;

.The driving force for conflicts within countries at present are attempts to increase supply, resulting in competition between different sectors of society and different groups of population; but

.Attempts to increase supply by necessity will be superseded by demand regulation.

In order to develop appropriate policy responses, there is a need for an understanding of how water scarcity will develop over the medium-term ahead (up to around 2025).

IV.6.*7. Availability of Water Resources*

There is general awareness that water is a scarce resource. At the same time there is also a common perception that an abundance of water could be mobilized if socio-economic and technological constraints could be overcome. Both scientific and policy interests would gain from a greater clarity of perception on how much of the annual flow of water over the continents really is appropriated and how much is left for future increases of demand.

From a conflict-analysis point of view, however, evapotranspiration as such (through rainfed agriculture) is not a cause of conflict. Conflicts are about getting more water for societal use, particularly for irrigated agriculture. Of more immediate policy interest therefore is the calculation of available runoff, that is, the renewable flow replenishing all rivers, lakes, and groundwater reservoirs, from which is taken all water for irrigated agriculture, societal and industrial needs.

Three categories of water use can be identified (Ohlsson L. 2002). Withdrawals or abstractions, that is, water taken from rivers, lakes, and aquifers for human activities (also known as water demand or water use). .Consumption; water that is withdrawn in such a way that it cannot later be reused (mainly by agriculture but also as a result of, for example, pollution).

Human needs; for what is known as "in-stream purposes" (mainly to maintain wetlands and aquatic eco-systems, watercourses as transportation routes, or for aesthetic and recreational purposes).

IV.*6 .8. Environmental Scarcity and Social Conflicts:*

A growing mass of empirical evidence and theoretical work points to a link between environmental degradation or scarcity of natural resources and social conflicts. The concept of "environmental. scarcity," has proved to be an extremely powerful tool with which to analyze the challenges ahead, and is used here to get a conceptual grip on the risk for conflicts within countries induced by water scarcity.

Environmental scarcity is defined as the sum (or product) of a particular environmental impact, population increase, and societal inequality. Simply put, the environmental impact (over pumping of aquifers) will make the resource pie smaller, population increase will make the slices (per capita allotments of finite water resources) smaller, and societal inequality will make an inordinate number of slices end up in the hands of the wealthy, while the less powerful will get fewer slices of the already shrinking pie than they are entitled to (Ohlsson L. 2002).

A typical example would be increasing water scarcity in a farming community from over-pumping groundwater boreholes or farming on steep mountainsides. The driving forces would be the environmental impact per se (lowering of water tables or less infiltration of rain into the ground). At the same time, demand-induced scarcity will probably be in operation, stemming from population increase, and possibly also from increased affluence and economic activity (more people demand more and better food, placing still greater demands on water resources) (Ohlsson L. 2002).

In a situation of growing scarcity, the more powerful sectors within a local society would tend to monopolize access to diminishing water resources (resource capture), leading to marginalization of poorer segments. Structurally induced scarcity may be reproduced on a larger societal level, through the competition over water from more powerful sectors (cities and industries), thus further marginalizing the agricultural sector in general, and poorer farmers in particular.

Marginalized people in turn will tend to sustain themselves in ways that by necessity rather than choice are unsustainable, that is, result in increased environmental impacts. Conflict would not be a predetermined outcome of such a vicious circle (Ohlsson L. 2002).

Contrary to common wisdom, there is no clear-cut connection between poverty and conflict. For conflict to occur, several conditions must be fulfilled, among them that impoverishment is pervasive to the degree that the legitimacy of the state is threatened. The existence of ethnic or religious cleavages within a society, acting as a channel for organizing resentment, is a common exacerbating factor. Finding the appropriate policy tools for dealing with water scarcity and the risk for these complex causes of conflict within countries is a task that has only recently begun to take form.

IV.7. Policies of Family Planning:

Population policies adopted by the state to face these conditions for social and economic development and the Purpose is to raise the standard of living in Egypt during the twentieth century :

-Asserting that population growth depends in part on the social and economic development and that any increase in demand for family planning services depends on the rate and nature of social change - an economic downturn. And identified nine key factors influential in accelerating the reduction of population growth:

(1) Increasing the level of social and economic family
(2) Education
(3) The employment of women
(4) Agricultural mechanization
(5) Rural industrialization
(6) Reducing child mortality
(7) Social Security
(8) Information and education
(9) And provision of quality services including family planning services.

In 1975 - after amending the name of the Supreme Council for Family Planning to the Supreme Council for Family Planning and Population in the previous year - was to amend the population policy to include recognition of three dimensions of the problem of population in Egypt (rapid growth, and the unbalanced distribution, and characteristics of the low population).

In 1980, was developed the national population strategy, human resources and family planning, and identified the necessary programs in four programs:

(1) Program aimed at optimizing the size of the population by reducing the rate of population growth,
(2) program aimed at redrawing the map of Egypt's population, through the creation of new communities,
(3) program designed to rebuild the Egyptian village,
(4) program focuses on the level of productivity of the workforce.

In 1985 established the National Population Council to replace the Supreme Council for Family Planning and Population and issued a new national policy for the population in 1986 to replace the earlier documents - presented to the National Council on Population, headed by President Mubarak and approved by, followed by a headline of quantitative goals - 1986. Included a national population policy document like the 1975 - three general objectives is to reduce the rate of population growth and achieve better geographical distribution of the population and improve population characteristics. It also contained a number of methods and interventions through which to achieve the goals set; the current study was classified in three groups, each including one of the stated objectives.

Group A: Methods and interventions related to population growth, including a package of interventions aimed at reducing fertility, including family planning programs and other programs - not family planning - the nature of development that would reduce fertility indirectly, such as support and protection of the family - Improving the Status of Women, Literacy and population education, information / education / communication ... Etc.

It also included - with regard to mortality - a package of interventions aimed at reducing maternal mortality, and infant and early childhood programs through safe motherhood, child survival ... Etc.

It is noticeable with regard to international migration - as one of the components of growth - a document that the national population policy has been included to encourage temporary migration, and have been quantitative targets.

Group B: methods and interventions related to the distribution of the population included a number of strategies that would impact on rural migration trends - urban areas where access, and build method to create a regional development centers to attract new industry and settlement programs away from major urban centers ... Etc.. The strategies also could affect the migration streams at the source through the integrated rural development.

Group C: Includes methods and interventions related to upgrading population characteristics, has made implicit in the package of interventions aimed at reducing fertility, mortality and rural-urban migration... Etc.

In a later stage - followed by the National Policy on Population and dissemination, was - as the study showed - the development and a population strategies, which included nine the number of strategies covering the period 1992 - 2007 in three five-year periods.

The numbers under each strategy of "quantitative targets" for the years 1997, 2002, 2007, these strategies are:

(1) family planning strategy
(2) strategy of maternal and child care
(3) Women and Development Strategy
(4) the public information / education / communication
(5) Labor and Employment Strategy
(6) youth strategy
(7) Environment Strategy
(8) strategy of education and literacy
(9), land-use strategy.

It has been the national policy of population in 1986, and established its strategic plan for the period 1992 - 2007 is the official policy adopted only until the end of the twentieth century, despite the structural changes in the institutional framework of the population work in Egypt. In an effort to assess the effectiveness of the Strategic Plan of Action on population in 2000 - study pointed out that some of the targets contained in the interim strategic plan had been reached, and some have a boat, it was achieved with solutions in 2002 - the target date for achieving the goal of the plan - and others Unexpectedly reached at the end of the five-year period 1997 - 2002 and require greater effort in the coming period - after 2000. The study encountered some difficulties in trying to assess the effectiveness of the plan referred to by the fact that targets set had been built on expectations, which assumes the continuation of conditions prevailing in 1991 and any deviation from them will affect the goal.

On the other hand, that the targets - as indicators were not sufficiently clear, in terms of definition and calculation methods and sources of data and patrol, resulting in difficulty in judging the extent achieved or not.

In general, the study concluded - in the District - is expected to be targeted to the relevant population increase, fertility, mortality and practice can achieve the same current efforts with the end of the current five-year plan; any by 2002. The targets related to safe motherhood and child survival has been achieved on target date for the most part, while the targets related to women's development, labor and employment, youth, education, literacy, environment, population distribution can be achieved in 2002 after more efforts are being made . It is noticeable in the process of evaluating the effectiveness of the strategic plan on 2000, a number of benchmarks contained not be calculated only at a later date, with the release of preliminary results of Census 2006 - God willing.

In any case, since the period of a national population policy and other relevant documents, is called periods and critical stance has been to determine whether the objectives are still dominated by faith, and strategies that have been adopted to achieve the objectives are still valid, and under each interventions selected Are still appropriate. And also monitor what the government database containing the population objectives to be achieved in a specified time.

As well as the harmony with the orientations of all regional and international conferences related in particular the International Conference on Population and Development held in Cairo in 1994, and contains objectives to be attained.

In this regard has already been the National Council for Population and demographic status in 2000, to prepare a study on the extent of agreement and disagreement between hubs / strategies / interventions, which contained documents related to national policies and strategies of population and Program of Action of International Conference on Population and Development - 1994, and concluded that First noted in this regard to what the national hubs and strategies to achieve the objectives of Egypt's population does not differ much from guaranteed work program of the International Conference on Population and Development - 1994, but in the classification or labels.

At the level of under each interventions focus / strategy, it was noted that there are different only in degree of detail in a document of the International Conference on Population and Development - 1994; while a national documents it had used the words to describe the broad interventions; can in one way or another to absorb the details in the program.

The Program of Action focused on specific areas in selected aspects of the coverage included the accessibility of reproductive health services including family planning and sexual health, reduce infant mortality, childhood and motherhood, include access to primary education and to narrow the gap between girls and boys ... and so on. In general, can benefit from the level of detail, which came in the interventions, which were received under each axis / strategy in any process for the modernization of the national population policy.

In this process should be - whenever possible - goals adopted by the Program of Action recommended by the International Conference on Population and Development - 1994.

The other hand, there is - as already pointed out - some of the objectives of population declared in a statement the government (in the final meeting of the National Conference for Social Development - September 2000) and the most important achievement of a population growth rate of 1% By 2020, the total fertility rate replacement level by the same year. These goals should also be adopted in the process of modernization of the national population policy recommended.

The link between these indicators and what is said in a statement the government in September 2000 previously noted, lead to the conclusion that adoption of the national population policy scenario based on the imposition low in the future population projections made by demographic Center in Cairo - September 2000, and subsequently adopted a community assessment results Target Program's national family planning which is based on the use of this scenario in this estimate came in the form of both the rate of practice to be reached on who in 2020, or years of protection target and estimates the necessary means and types of ... Etc..

In general, in the light of the outcome of the current study, with regard to current levels and trends of the rates of population growth, fertility, mortality and international migration, and also in the light of the results of the analysis with regard to the characteristics of the population and their geographical distribution pattern, as well as to assess the effectiveness of the light of the strategic plan on population in 2000, And review the appropriateness of objectives, strategies and interventions, which contained texts of national and the consistency of these documents with the trends reflected in the work program of the International Conference on Population and Development - 1994. In the light of all this can be confirmed the following:

First: The objectives of the national population policy of 1986 and reduced the rate of annual growth of the population (up to 1% by 2020), and to achieve better geographical distribution of the population increase of manned space increased significantly, enhancing characteristics of population in the framework of the national project to modernize Egypt - are still targets And justified remain for the next two decades from 21.

Second: The principles underlying the national population policy is still appropriate during the next 20 yrs, with a re-look at some of these principles to keep pace with developments and problems of the highest priority in Egypt.

Add to that some of the principles contained in the Program of Action of International Conference on Population and Development - 1994, such as those relating to the assertion of human rights, family, equality, equity and empowerment of women, and the integration of population concerns in the policies, strategies and plans for sustainable development.

Third: The strategies and interventions that have been adopted to achieve the objectives of the national population policy is still valid in most, and can introduce some amendments to the classification of such strategies, and content of interventions of high priority. And the recommended strategies is the re-classification strategies: family planning and reproductive health - child health and the preservation of life - education and literacy - Improving the Status of Women - adolescents and young people - to support and protect the family - Information and Education (Education) and communication - environmental protection - the population distribution - to reduce disparities - Support information and research.

Fourth: the need to develop lists of Bmsthdvat amount under each of these strategies, derived from modern sources available such as:

1 - The government statement in September 2000, which includes annual growth rate of 1% by 2020, the total fertility rate in the replacement level of the year.

2 - projections of future population center - demographic, Egypt - September 2000, imposing low, with respect to: the size of the population - the crude birth rate - Crude death rate - the rate of natural increase - the rate of population growth - the development of quantitative goals for the program's national family planning, expressed in rates Practice - years of protection ... Etc..

3 - Lists of quantitative targets of the Program of Action of the International Conference on Population and Development in Cairo in 1994 (1994 ICPD-POA) and after five years (ICPD + 5) in infant mortality - and under-five mortality - maternal mortality - the gap between the desire to use and actual use Of the means of family planning - easy access to community service for each target - unmet needs - the relative size of the sites provide the service, which provides more than 3 services of reproductive health services - care during pregnancy - care situation - immunization against neonatal tetanus - the proportion of people 15 - 24 who Subjected to the media on HIV / AIDS - the rate of infection with human immunodeficiency age (15 - 24) - the illiteracy rate among women - the total enrollment of females - the gap between girls and boys in the enrollment ratio in primary education - easy access to higher education and secondary school And vocational and technical training for girls and women - reduce the illiteracy rate - net enrollment ratio in primary education for both types ... Etc..

4 - Lists of targets related programs under each strategy, which was not included in the three preceding paragraphs, contained in document design programs, tools for the achievement of the objectives of the national population policy.

Fifth: the need to focus in the coming stage, which shows some aspects of the process of evaluating the effectiveness of the strategic plan of the population in 2000 on the previous reference to it - to set quantitative targets have not been achieved, especially those relating to domestic manufacturing of the means of family planning and literacy, women's development, employment, youth , The environment and population distribution; and research on methods and interventions to activate the programs on these aspects.

Sixth: to study the possibility of the enactment of the population identifies institutional frameworks for working population in Egypt, and the respective roles and responsibilities of institutions and ministries and bodies concerned with the management and implementation of the program of the population can carry out two control and evaluation and a course correction on a continuous basis.

Seventh: the establishment of an observatory to study the possibility of a separate Census aimed at scientific monitoring of population change and economic and social repercussions at all levels, be able to issue an annual report on "the situation of the population in Egypt" to put the facts before the population regularly in order to assist policy makers in a The outlook in a realistic and scientific.

Eighth: consider the possibility of holding regular conference of the population every five years, for example, to examine successes and failures in achieving population objectives to correct the tracks of the population program and discuss any new developments have occurred in the population situation and assess the effectiveness of the strategic plan in place and review the future vision of a five-year period to come.

Ninth: to study the possibility of the enactment of the population defines the roles and responsibilities of ministries and bodies involved in the implementation of population policy, including possible distribution of those responsibilities, precise and binding and follow up the implementation.

Tenth: study the possibility of the establishment of a Commission of the People's Assembly of the population adopts the preparation of the draft law proposed for the population under the provisions of the constitution and existing legislation, after studying the impact of such legislation on various aspects of population in order to try to avoid any negative repercussions of such legislation on the population problem, and the functions of the committee also propose mechanisms And follow up the implementation of the new law of the population to ensure the achievement of the objectives hoped. (Population of Egypt in the 20^{th} century CDC 2004)

Chapter: V

Summary and Recommendations

In 1998 a national survey of Egyptian farmers was carried out, aiming at identifying the farmer's awareness, attitudes and practices concerning the water resource management. The study shows that about 61 percent of male and 29 percent of female farmers know that available water resources in the country are fixed.

The water provision for agriculture sector has to catch up with increased needs for food as well, which place additional pressure on the water supply. Due to the above mentioned population boost, available fresh water resources per capita was subjected to drastic changes during the last 50 years. It was reduced by half and the opportunities for future supply are not sufficient enough to support rapid population growth. The population growth is escalating the water scarcity in Egypt but is not the single reason. It is a far more complicated issue involving many other aspects of social life and personal behavior.

A major component of the strategy for agricultural development is improvement of the efficiency of use of Nile water, increasing the productivity per unit of water. When per capita water use falls below 1000 cubic meters, countries undergo a chronic water scarcity with a".. .significant and often severe restriction on material welfare at individual level and on development prospects at national level" .

Less than 600 cubic meters of water would mean absolute water scarcity. Mohamed and Savenije (2000) characterize this level of per capita water availability as the water poverty limit. For 2025 about 3 billion people are expected to have less than 1700 m3 of water per capita.

The main users of water resources are agriculture, industry, and households. A major consumer of all fresh water withdrawals is agriculture sector; especially this is the case if the agriculture is irrigation-based. Therefore, serious disturbances in provision of adequate water supplies for food production puts at risk the basic needs of human livelihood. The food production takes up to 70 percent of all fresh water withdrawals per year.

The right of water and food is one of the most urgent needs for human beings. The population of Egypt is estimated at 73 million people occupying only about 4 % of the national territory. The dilemma of the choice between present welfare and future generation rights is part of this complicated issue. Egypt has been managing its agricultural lands using irrigation methods since 5000 years.

A slight look at statistics provokes even more concerns. The figures point to the water stress < 1000 cubic meters available water per capita. Statistics place Egypt among the countries where the water stress in the near future tend to drop under water scarcity thresholds decreasing to values of 670 cubic meter for 2017 .

The problem of securing water and food has remained the foremost concern of all societies throughout the ages, increasing in intensity and sometimes abating, other times depending on changing circumstances. The problem of water and food shortage is not nascent today but extends to many years ago.

Egypt is known with its absolute dependence on irrigation water, heavily subsidized water provisions and considerable strain from population growth. Problems came up in context of water pricing such as drainage water reuse and irrigation efficiency issues that have a direct connection to the water pricing measures.

Food problem in Egypt showed mixed signs in the late sixties and early seventies, increased severity of the problem specifically in 1974 and has been increasing in intensity over the years to become one of the most serious problems facing Egyptian society and threaten the security at the economic, social or political dimensions.

The population density varies among the governorates. Approximately 17 % of the Egyptian population lives in Upper Egypt. The rest is distributed between Lower and Middle Egypt. Egypt is an arid to semi-arid region and can be divided into 5 main physiographic units, the Western Desert, Nile Valley, Nile Delta, Eastern Desert and the Sinai Peninsula.

The Egyptian economy has traditionally relied heavily on the agricultural sector for food, fiber and other products. The agricultural sector provides the livelihood for about 55 % of the inhabitants and accounts for almost 34 % of the total employment and labour force. Agriculture contributes nearly 20 % of the gross domestic product (GDP) and about 20 % of the total exports and foreign exchange earnings.

The agricultural sector is considered as critical for tackling poverty in developing countries. Egypt is not an exception as the large population is engaged in agricultural activities. In future irrigation water, which is the absolutely crucial part of Egypt's agriculture, has to satisfy demands of even larger population and increasing living standards. Till now, the main means the water shortages were tackled with, were increased extractions of resources and development of new supply options for irrigation system. However, most of supply options are already exhausted and cannot be subjected significant enlargements. Some improvements can be achieved through efficiency increase. The demand side management entails some potential for water saving which might be possible though water-pricing as one of the financial' instruments for water conservation.

The main objection provoked by efficiency and water-pricing measures are negative social effects and environmental implications. The problem discussed in context of sustainability, which usually implies the concerns for future generation's welfare, seems to introduce social and environmental pressure on the present generations. Without building favorable preconditions for water pricing policy, introduction of user charge at this stage might face inevitable problems. Preconditions imply community involvement in canal management, well-defined rights, responsibilities for quota violations in case of drainage water reuse and rice cultivation.

Whatever conservation measure will be applied the main problem for environment will remain the same. Soil salinization due to drainage water reuse or reduced water applications on fields will be the threat. Balanced approach in pricing and adequate knowledge of the soil salinity itself can ease the task. This would mean intensive awareness campaigns enriching farmer's information about family planning, salinity management, spreading the information about new water saving and salinity resistant crops.

Population and water scarcity is not easy to deal but still there are hopes that the negative effects of it can be minimized. In order to do it we must have as inclusive picture of problem as possible with all factors involved. In current study was taken attempt to view just only some parts of whole, but for further understanding of issue other factors needed to be added, which might be the subject for future study.

Water as a Vehicle for Cooperation: The Nile Basin Initiative A positive example of cooperation in the management of international river basins is evolving in the Nile River Basin. The Nile, at almost 7,000 km, is the world's longest river.

The Nile basin covers 3 million km2, and is shared by 10 countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, and Uganda. Tensions, some ancient, arise because all riparians rely to some extent on the waters of the Nile for their basic needs and economic growth. For some, the waters of the Nile are perceived as central to their very survival.

The countries of the basin are characterized by extreme poverty, widespread conflict. This instability compounds the challenges of economic growth in the region, as does a growing scarcity of water relative to the basin's burgeoning population. About 150 million people live in the basin today, with growing water demand per capita. Over 300 million people are projected to be living there in 25 years.

The pressures on water resources will be great. The countries of the Nile have made a conscious decision to use the river as a force to unify and integrate rather than divide and fragment the region; they have committed themselves to cooperation.

Together they have launched the Nile Basin Initiative (NBI). The NBI is led by a Council of Ministers of Water Affairs of the Nile Basin, with the support of a Technical Advisory Committee, and a Secretariat located in Entebbe, Uganda. The initiative is a regional partnership within which the countries of the Nile Basin have united in common pursuit of the sustainable development and management of Nile waters.

The NBI's Strategic Action Program is guided by a shared vision "to achieve sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources" .

The program includes both basin wide projects designed to lay the foundation for joint action, and two sub basin programs of cooperative investments that will promote poverty reduction, growth, and improved environmental management. The Nile waters embody both potential for conflict and potential for mutual gain. Unilateral water development strategies in the basin could lead to serious degradation of the river system and result in greatly increased tensions among riparians. Conversely, cooperative development and management of Nile waters in sustainable ways could increase total river flows and economic benefits, generating opportunities for "win-win" gains that can be shared among the riparians.

Cooperative water resources management might also serve as a catalyst for greater regional integration beyond the river, with benefits far exceeding those that could potentially be derived from the river itself.

- Irrigated Farming Systems

Water is not used efficiently and there have been significant economic and environmental impacts from an excessive drawdown of non-recharged aquifers, excessive irrigation that has led to rising groundwater tables and resulted in soil salinization and sodication.

In many cases, irrigated cropping is combined with animal husbandry. It is possible to distinguish between full and partial water control. Intense local competition for limited water resources between livestock owners and farmers is becoming increasingly evident. Crop failure is generally not a problem but livelihoods are vulnerable to water shortages, scheme breakdowns and deteriorating input/output price ratios.

There are many "landless" people in the rural areas. Though some work as labourers, not all are involved in the agrarian sector, many have other occupations - civil servants, merchants, commuting factory workers.

- Fertility:

The age specific fertility rate fluctuated unstable between intercensal periods. It witnessed a period of decline in each age group due to changes in reproductive behavior, economic and social changes in Egypt between 1986, 1996, 2006.

It is possible to state that ,the principles of national population policy of population are still suitable for the next two decades although some of them may have to be reviewed ; specially the geographical population distribution and density .

- Food and Water:

The increase in food consumption in Egypt arises mainly from the increase in both population and standard of living. The problem of food in Egypt has more than one side, on the one hand the deficit of domestic production to grow at the rates facing high rates of growth rate of food demand, and on the other hand the problem of the low quality of food received by the individual.

Water-food problem will remain the biggest challenge facing the Egyptian society because it depends to a large extent on a big part of national resources; on the other hand there is a risk when Egypt depends on a large extent on food imports and this affects its economic and political issues.

Food production situation of Egypt is affected by many factors; some of these factors are crop area, crop yield and crop price levels. The food consumption levels are also affected by some factors such as population size, per capita GNP, volume of crop imports, crop imports value, crop production and crop retail price. So, when the population size increases, it leads to the increase of population density and this is because the land is almost stable and the increase in the new land reclamation doesn't meet the increase in population size. Also the crop yield is affected by many factors which reflect on production or consumable commodities.

In general:

1- Production and consumption are increasing yearly. Trend of both of them is similar to population and per capita income increases to a great extent.
2- Water- food shortage based on two independent components, production and consumption, which makes it rather difficult to draw inferences or reach specific conclusion from the size or changes in the food gap.

The population increase has its effect on increasing consumption, imports and the balance of trade.

- *Recommendations*

Population issues should be integrated into national strategies for sustained development and population goals should be linked to basic needs and social services (eg, education, clean water, sanitation, child care, primary health care,…etc). Successful implementation has to be based on political commitment and people's support.

A clear recognition of the fact that problems in the field of human development emerge from inadequate government's policies is needed, because ignoring the source of problem makes the prospects of solution quite remote.

More cooperation and coordination among governmental institutions is important.

Public expenditure on education should assign the highest priority to the targets of illiteracy eradication and universal primary education, given their importance in controlling the growth of population.

A more favorable business climate is needed to encourage private sectors' expansion and creation of new jobs; the main elements of such a favorable climate are competition, market flexibility, adequate social and economic infrastructures. l. Support family planning programs to reduce fertility and population growth rate.

. Support efforts to increase agricultural capacity via the following:

- Improvement of the irrigation system and depending on technical programs.
- Agricultural intensification program in the old and new land, support of local fertilizers, insecticide industries, maintain restrictions on excessive use of pesticides and chemical fertilizers to increase exports to provide hard currency necessary for agricultural development projects and keep proceeding in the new land reclamation programs.
- Place more emphasis on legislations to protect the agricultural land from degradation and desertification.

.On the Fields of Egypt's Water Strategy until 2017:

- Mega projects in irrigation and nuclear reactors.
- Upper Nile projects and support Nile basin and High Dam lake projects.
- Operational water resources management and optimal use of available resources.
- Sea water desalinization using energy from nuclear reactors, subterranean water and non-conventional water resources.
- Drainage network project, water quality improvement and water pollution projects and water policies, water studies and research.

. Launch mass media campaigns to rationalize the population's consumption of food specially wheat, where bread is used as fodder to animals, and poultry and also the consumption of water and clarify how it will be scarce.

. Slow down rural to urban migration by developing rural areas.

Unsatisfactory management of the land is the main limiting factor to agricultural productivity. The following land and water management practices are necessary in order to extract the optimum benefits from crop production using fertilizers:

- Control of salinity, water logging and deterioration of soil structure.
- Prevention and control of soil degradation.
- Proper use of reclaimable land, based on land capability.
- Concentration of intensification efforts on the best land.
- Recycling of organic matter for use as fertilizer.
- Identification of areas where soil regeneration should be given high priority.
- The construction of open drainage systems and the installation of shallow tile drains.
- Promotion of land leveling to increase water use efficiency in transition and fresh water zones.
- Development of land use plans for reclaimable areas.
- Use of reclaimable land in sweet water areas to grow ecologically appropriate crops.

- Promotion of the most efficient crop husbandry practices.
- Integrated crop and livestock systems.

Agro-ecological zones and farming systems

The following policy options are proposed to improve the efficiency of water use in agriculture:

- Improvement of farm water management through laser land leveling programs and improved irrigation practices.
- Water saving policies according to the different water management zones.
- Restriction of the areas of rice and sugar cane.
- Move towards demand driven water management and an entailed volumetric system, by the middle of the twenty-first century.
- Balancing engineering solutions in the Nile basin with cooperative social approaches at the mesqa (private canal) and distribution level.
- Move toward decentralization of water management responsibilities to effective water user associations.
- Mechanisms for cost sharing to meet the full costs of operation and maintenance.

Water Pricing

Water pricing has many constraints. First of all it is the cultural perception, believes sanctioned by religion and tradition, which perceive water not as commodity but one of the basic human needs. Thus the perception of water as a non-commodity resource persists to the increasing or introduction of charge for irrigation services.

Water Conservation

The causal relationship between pricing and water conservation (Pricing of irrigation service should encourage the investments in efficiency increase on farm. which would lead to rationale water use. At the same time the cost recovery would add capital to the funds and ensure the investments for improving the operation and maintenance. The last would increase the irrigation system efficiency in whole. This would result in achieving the main objective - water conservation)

The legal institutional aspects with the increasing demands on water due to population growth and the general awareness of the diminishing availability of water in time and space due to either natural factors or human's negative impact on water bodies through pollution, there is a need for regulatory actions, which, in their totality, is considered as the basis for water management. Such actions could include:

.Regulation of the water system which refers to measures which make it possible for increases in the available supplies;

.Regulation of the boundaries between the water system and user system, covers the phases of planning, construction and operation of hydraulic infrastructures necessary to ensure that the natural supply is adequate to meet the demand programmes of the whole user systems, which should now include the impacts of water consumption on the water system such as groundwater use, erosion and pollution controls;

-Regulation at the boundaries of inter-related users, especially useful in water stress regions, interrelated users can be subjected to a prioritization scheme in the form of differential pricing and allocation for different uses, as well as conflict resolution. Such a regulation is normally better effected if the physical water basin is taken as the basis for water management; and

-Regulation of international costs and boundaries refers to all activities that ensure the adequate quantity and quality supply for various trans boundary water uses through international agreements on water allocation and pollution control.

The most recommended forms of regulation are utilization concessions, waste discharge permits and tariffs which must be established prior to the use of the resource. Tariff systems must not only take into account the recovery of capital and operating costs but also promote the efficient and beneficial use of water. The principle that the polluter must meet the cost of de-pollution should be the economic basis for pollution control. Three important systems of water rights include:

- Riparian rights link ownership of or reasonable use of water to ownership of the adjacent or overlying lands, and are derived from Common Law as developed in England. As a consequence, this principle is mainly found in countries that were under the influence of the British Empire.

-Public allocation involves administered distribution of water, and seems to occur mainly in "civil law" countries, i.e., that derive their legal system from the Napoleonic Code, such as France, Italy, Spain, Portugal, the Netherlands and their former spheres of influence.

-Prior rights are based on the appropriation doctrine, under which the water right is acquired by actual use over time. Institutionally, the essential functions of international basin organizations include:

.Reconciling the interests of Riparian countries;

.Technical cooperation;

.Standardization of data collection;

.Exchange of hydrologic and other information;

.Monitoring water quantity and quality;

.Submission for examination and approval of proposed activities, schemes or plans which could modify the quantity and quality of the waters;

.Development of concerted action programs;

.Enforcing agreements; and .Dispute resolution.

Scarcity by definition entails increased competition for a resource with increased economic value, and implies diminishing resources and/or pressure on the supply of available resources from an increasing demand. Attempts to overcome scarcities can be sought through two distinct mechanisms:

supply side regulation and demand-side regulation in order to avoid competition, which is a source for potential conflict. Two levels of conflict are easily identified:

national and international. Following this simple analytic framework, it is the argument of this chapter that :

.Attempts to increase supply are the driving force for water conflicts between countries;

.Attempts to manage demand will, by definition, alleviate this pressure;

.The driving force for conflicts within countries at present are attempts to increase supply, resulting in competition between different sectors of society and different groups of population; but

.Attempts to increase supply by necessity will be superseded by demand regulation.

In order to develop appropriate policy responses, there is a need for an understanding of how water scarcity will develop over the medium-term ahead (up to around 2025).

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Abbreviations And Symbols :

ARC	**Agriculture Research Center**
BCM	**Billion Cubic Meters**
CAPMAS	**Central Agency For Public Mobilization And Statistics**
CLD	**Causal Loop Diagram**
DRI	**Drainage Research Institute**
DWIP	**Drainage Water Irrigation Project**
FAO	**Food And Agriculture Organization Of The United Nations**
FEDA	**Friend of Environment and Development Association**
Feddan	**0.42 Ha**
FFS	**Farmers' Field Schools**
GDP	**Gross Domestic Product**
GOGCWS	**General Organization for Greater Cairo Water Supply**
HA	**Hectare**
HDR	**Human Development Report**
IIP	**Irrigation Improvement Plan**
IPM	**Integrated Pest Management**
ISNM	**Integrated Soil And Nutrition Management**
IWRI	**International Water Resources Institute**
LE	**Egyptian Pound**
MALR	**Ministry Of Agriculture And Land Reclamation**
MWRI	**Ministry of Water Resources and Irrigation of Egypt**
NWPSWD	**National Organization for Potable Water and Salinity Drainage**
O&M	**Operation and Maintenance**
ORDEV	**Organization for Reconstruction and Development of Egyptian Village**
PBDAC	**Principal Bank For Development And Agricultural Credit.**
UNCCA	**United Nation Common Country Assessment**
UNEP	**United Nations Environmental Program**
WPL	**Water Poverty Line.**
WUA	**Water User Association.**