WATER POVERTY AND POPULATION IN EGYPT
Challenges and Strategies*

By
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1- 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 (NILE RIVER). Annual water budget from Nile River is 55.5 billion m^3/ year.

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.

The World Summit on Sustainable Development (WSSD) in 2002, 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 ear the top of the political agenda.

Yet of all the social and natural resource crises, we humans face. The first WWDR (World Water Development Report) 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). This report is organized in six main sections: a background, an evaluation of the world's water resources, an examination of the needs for, the uses of and the demands on water (Challenges to Life and Well-Being), a scrutiny of water management (Management Challenges), and seven representative case studies highlighting different water scenarios, and conclusions and annexes. The two 'challenges' sections are based on the seven challenges identified at the 2nd World Water Forum in 2000 plus a further four challenges identified in the production of that report.

Water and food are the basic requirements for survival. Land capacity is virtually unlimited and human power can solve the problem of food

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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.

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.

1-1- Objectives of 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, rice and maize in Egypt.

1-2- The Importance of Study

- To draw plans of water resources and population growth.

- Planning and drawing population and development policies.

- Evaluation of population rates and water resources.

1-3- Methodology

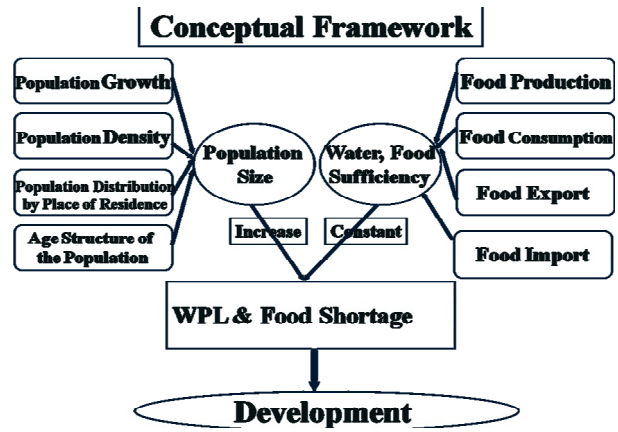
This paper is basically based on a descriptive analysis in order to reveal the interrelation between population growth and water-food consumption. The study depends on tabulation of data on population growth rate, water supplies and consumption

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.

1-4 - Sources of Data

* Ministry of Agriculture and Land Reclamation Bulletin 2000-2006.
* UNESCO Org (Water Report 2003).
* World Bank International Financial Statistics Book 1998.
* Population Bulletin - Vo1. 51 U.N 1997 (Population, Food & Nutrition).
* Food & Agriculture Organization of the UN (FAO) www.fao.org.
* CAPMAS: Demographic Data, 1986, 1996 Censuses, Statistical Yearbook, 2003:2008 and Egypt in Figures, 2006.
* Egypt Population in 20th Century CDC, 2004.
* SIS Year Book 2003.

-The data ranges from 1995 to 2006.



1-5 - 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 (m^3) of water." (UNESCO, WWDR 2003).

Less than 600 cubic meters of water would mean absolute water scarcity. Savenije (2002) 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.

1-6 - Review of Literature

The main actors in Nile basin 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 multinational corporations in order to realize the objecttives 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).

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 m^3, i.e. 20% of rain water (20 thousand billion m^3). Of this amount, however, and despite the 60 or so shared rivers, only 150 billion m^3 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. Mohamed Abd El-Monsef (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).

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. Eckart Ehlers (2000).

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. Marlin Hehvidet (1999).

A report published by FAO (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.

2- EGYPT AND WATER

Egypt is situated at the eastern north of Africa on the eastern south end of the Mediterranean. Egypt is bounded by the Mediterranean Sea to the north, Libya to the west, the Red Sea to the east, Palestine in the eastern north and Sudan to the south. The total area amounts to 1 million square km of which 4% is cultivated land and the remaining 96% are desert and rocky mountains.

2-1- Water and Development

Egypt's Minister of Water Resources and Irrigation Mahmoud Abu-Zeid has said recently that the country is facing a major challenge just to provide water for its needs, particularly with the on-going population increase and given the fact that Egypt's water quota has remained unchanged (at 55.5 billion cubic meters) since the signing of the 1959 water sharing treaty. Added to the above is the rise in cost of irrigation projects, currently under implementation, seeking to rationalize water consumption. These include the establishment of a number of new barrages in Upper Egypt with a total investment of approx, LE 4 billion. New breeds of rice are also being tested which could save up to 3 billion cubic meters of water by reducing the crop cultivation cycle from 120 to 90 days; they also could spare for other use 60% of cultivable land, (Adel Abdul – Razik 2005).

Former President of the now defunct Soviet Union Mikhail Gorbachev, who is the current president of Green Cross International, a foundation which seeks to peacefully resolve water crises, took the podium in the 2000 Water Conference held in the Hague, Netherlands, only to note that after a tour in the Middle East, he is now more than ever convinced of the possible outbreak of comprehensive water wars. His reason was that many are now living under water poverty levels (W.P.L) estimated by experts to be 1000 m^3, (Mohammad Abdul-Monsef 2005).

2-2- 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, (Word press. 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.

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).

2-3- Water Supply and Demands

2-3-1- 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.

2-3-2- 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 m^3 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).

2-3-3- 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).

2-4-Population Growth and Water-Agricultural Food Production

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 agricultural 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).

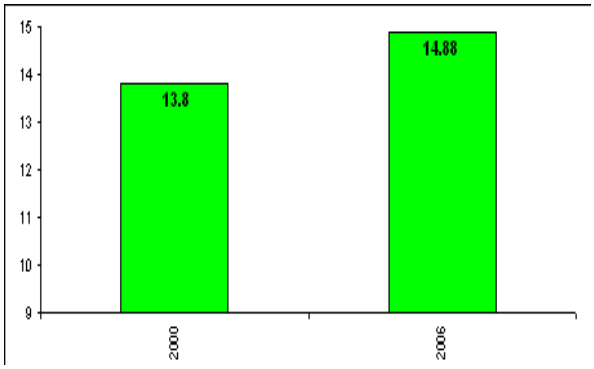


Fig. 1- Cropped Area in (Million Feddans)
Source: The Ministry of Agriculture and Land Reclamation 2006

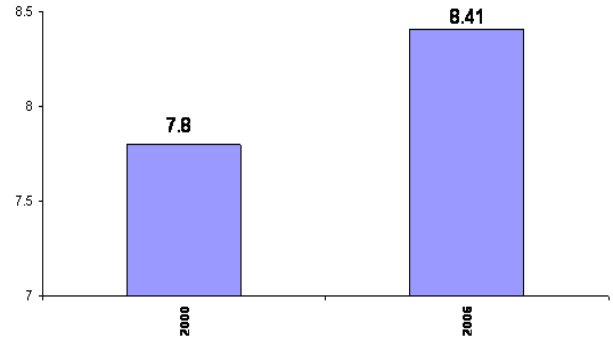


Fig.2- Cultivated Area (Million Feddans)
Source: The Ministry of Agriculture and Land Reclamation 2006.

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 24.71 million tons in 2006 (FAO-UN). The total yield increased gradually from 57.029 million tons in 1990 to 87.9 million tons in 2006.

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		

In 1990 water per-capita was 2.75 m^3 per person and decreased in 2006 to < 2.0 m^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.

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.								

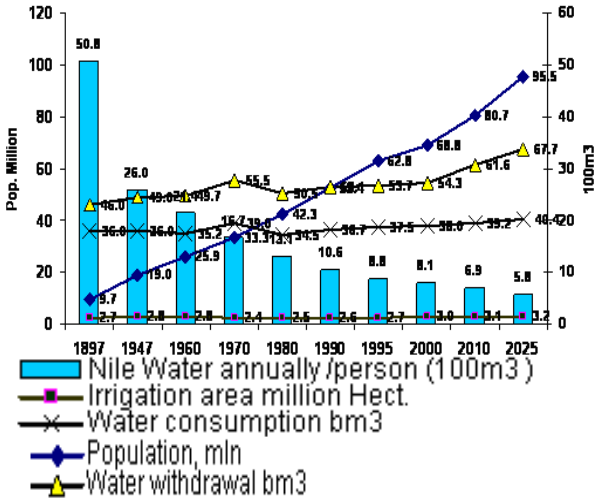


Fig. 3- Dynamics of Population Growth and Percapita Available Water Resources in Egypt.
Source: World Bank Year Book 1998, HAMDAN (1983); CENTRAL AGENCY FOR PUBLIC MOBILIZATION AND STATISTICS (CAPMAS, 1989).

Demand side initiatives play an important role in increasing the water efficiency of industrial processes, and lowering the pollutant load of effluents discharged by industry.

Training and education in demand-side management, combined with technology transfer, can provide both environmental benefits and the improved economic performance of enterprises Within industry, water, often in large quantities, is most commonly used in the manufacturing process -- for washing, cooking, cooling, etc.-- and then returned to local water systems. Water discharged by industries may be of poor quality and, unless adequately treated, threatens the surface and groundwater resources into which it is discharged. Industry may pose a chronic threat to resources by the continuous discharge of effluents, or an acute threat when a catastrophic failure generates an intense pollution event over a short period.

Damage to water resources by industry activity is not restricted to 'local' freshwater resources. The increasing concentration of population and industry in coastal zones is resulting in the impoverishment of coastal habitats and the people that depend on them.

In addition, air emissions of, for example, persistent organic pollutants, may pollute waters far removed from industrial centers.

Further action is required at the global level to develop and refine appropriate and robust indicators of water consumption and quality, and to support the continuing collection of reliable data. Assistance is needed to build these indicators into regional and local water management and to integrate this with industrial, economic and investment planning.

The promotion of demand-side initiatives at enterprise level is needed to provide positive incentives for industry engagement in efforts to meet targets set at the 2nd World Water Forum and the Millennium Development Goals.

3- The Egypt's Water Crisis

The specific challenges related to the production of water indicators include the slow progress of the water sector in adapting existing earth systems modeling data into water resource assessments (e.g. greenhouse warming impacts on regional water resources) and a relatively poor understanding of how complex drainage systems function in relation to anthropogenic challenges in comparison to a good understanding of hydrology at the local scale.

Further, the decline of measuring stations and systems for hydrology (a widespread international problem) limits good data acquisition. However, this decline can be offset by the great monitoring opportunities offered by contemporary remote sensing capabilities and computerized data analysis capacity. There remains however an urgent need for a broad set of socio-economic variables to help quantify the use of water. The conjunction of these latter variables with the hydrographic variables can create two fundamental quantities -- the rate of water withdrawal/consumption and the available

water supply. Together these produce a valuable indicator of relative water use and the ability of water resource systems to provide the services we need.

The precipitation is taken up by plants and soils, evaporates into the atmosphere via evapo transpiration, and runs off to the sea via rivers, and to lakes and wetlands. The water of evapo transpiration supports forests; rain fed cultivated and grazing lands, and ecosystems. We withdraw 8 percent of the total annual renewable fresh water, and appropriate 26 percent of annual evapo transpiration and 54 percent of accessible runoff. Humankind's control of runoff is now global and we are significant players in the hydrological cycle. Per capita use is increasing (with better lifestyles) and population is growing. Thus the percentage of appropriated water is increasing. Together with spatial and temporal variations in available water, the consequence is that water for all our uses is becoming scarce and leading to a water crisis. As ever, the poor are the worst affected, with 50 percent of the population of developing countries exposed to polluted water sources.

The precise impact of climate change on water resources is uncertain. Precipitation will probably increase from latitudes 30^{o} N and 30^{o} S, but many tropical and sub-tropical regions will probably get lower and more erratic rainfall. With a discernable trend towards more frequent extreme weather conditions, it is likely that floods, droughts, mudslides, typhoons and cyclones will increase. Stream flows at low-flow periods may well decrease and water quality will undoubtedly worsen, because of increased pollution loads and concentrations and higher water temperatures.

Recent estimates suggest that climate change will account for about 20 percent of the increase in global water scarcity. We have made good progress in understanding the nature of water in its interaction with the biotic and a biotic environment. We have better estimates of climate change impacts on water resources.

Over the years, our understanding of hydrological processes has enabled us to harvest water resources for our needs, reducing the risk of extreme situations. But pressures on the inland water system are increasing with population growth and economic development. Critical challenges lie ahead in coping with progressive water shortages and water pollution. By the middle of this century, at worst 7 billion people in sixty countries will be water-scarce, at best 2 billion people in forty-eight countries. Water is an essential part of any ecosystem; both in quantitative and qualitative terms, and reduced water quantity and quality both have serious negative impacts on ecosystems. We have come to accept two important concepts in the past decade: firstly, that ecosystems not only have their own intrinsic value, but also provide humankind with essential services; secondly, that the sustainability of water resources requires participatory, ecosystem-based management.

- Measures of ecosystem health include:

Water quality indicators (physic-chemical and biological), hydrological information and biological assessment, including the degree of biodiversity.

Although there are various problems in acquiring the relevant data, it is clear that inland aquatic ecosystems have problems.

3-1- The Nile Basin and Initiatives

The great problem there is land reclamation's costs and rains losing. Nile runs through 10 African countries. Although it is bountiful with its benefits it has been used poorly. Out of the total amount of rain feeding its sources, only 1661 billion m^3 are exploited. The remaining amount is lost to vaporization, swamps and / or subterranean wells.

Cooperation between Nile basin countries began as early as 1959 with the signing between Egypt and Sudan of water-sharing treaty. A project, hydrometer, has been implemented later for use by Kenya, Tanzania and Uganda. In December 1998, the Nile basin initiative (NBI) was launched with the purpose of implementing projects likely to develop the entire waterway.

The significance of the Nile Basin Initiative, signed on 3 August, 2000 derives from the fact that it is a contractual formula binding to all countries riparian on the river. It has an economic framework applicable to all NBI parties and is also a sign of the notable progress in their quest to avert the failures of previous cooperation attempts. NBI proposes to build confidence between member states by implementing projects of shared benefits,

including dams, electricity grids, flood management, desertification control, and watershed management.

While previous cooperation attempts were spurred by the moment or were the product of individual efforts, particularly those of Egypt, NBI has been born out of a collective will to create a body to regulate and develop water resources, (Sally Hani 2005).

3-2-Egypt's Nile Water Agenda and Considerations

It is based on the following:

* Water occupies a top priority in the country's policy-making.
* Egyptian concerns do not relate to the present but rather to the future.
* The country's water needs are increasing as time goes by.

The position adopted by Egypt as regards the 1959 and the 1929 agreements is that the application of international river agreements cannot be subject to alteration by regime changes in countries either at the source or at the mouth of a river. Nor are they liable to abrogation due to change in a country's colonized or independent status. Nile water has been used frequently by Ethiopia and sometimes by Sudan to trigger a political conflict with Egypt. According to studies, Egypt's needs up to 2050 will be secured by insuring agreement of its water resources, (Sally Hani 2005).

4- Water and Economy

The Nile-basin countries constitute a vast market for Egypt's products. However, while the country possesses a major infrastructure of advanced agricultural expertise, it has limited financial and land resources plus an overgrowing population that is eroding all efforts at achieving food sufficiency despite the ultra-high productivity of agricultural land.

In addition to the geography of water supply, issues of technological capacity to provide water service, population growth, levels of environmental protection and health services, and investments in water infrastructure must be included in future analyses. At this point, we have made a start on the long-term project to develop a comprehensive set of user-friendly water indicators, which will build on the experience and ongoing monitoring activities of Member States and the UN agencies involved.

4-1- Egypt's Role in NBI

Ever since the 1960s, Egypt has had a major role to play in promoting regional cooperation. It has continuously urged Nile basin countries to commit themselves to such attempts; however, they were either afraid or hesitant to do so. Meanwhile, cooperation has now reached such a stage that all Nile-basin countries have joined NBI. NBI has been proposed by Egypt to include all Nile-basin countries, Kenya and Ethiopia not excluded, in a single mechanism. NBI also seeks to implement a number of projects whose benefits would be shared by all riparians.

Egypt's role is two-sided. It uses diplomacy as a negotiating tool, as in the recently held Blue-Nile Basin Conference, and in the first parliamentary forum for Nile basin countries. The other is the economic and developmental side seen in the power trade project, the water calculation matrix and the west Delta project, (Sally Hani 2005).

4-2- Egypt's Nile Basin Water Strategy

The joining by Ethiopia as an active member of the Nile basin initiative (NBI), launched in 1998 is a positive turn in that country's attitude towards the other Nile riparians. NBI seeks to implement major projects designed to exploit the huge amount of water wasted as the Nile flows from source to mouth.

The Addis Ababa position has witnessed a landmark change of late. Ministers, experts and technicians from both Egypt and Sudan have been allowed to tour the riparian basins on the Ethiopian plateau. They have been updated on the country's water agenda and have also been involved in studying the likely effects of Ethiopia's water plans on the countries at the river's mouth. The about-change in favor of cooperation is the fruit of Egypt's persuasive diplomacy; the fact being that in the very recent past Ethiopia categorically rejected any exchange of information over its water projects.

More understanding of the need for pro-active cooperation has been the result of the creation lately of the Council of Ministers (COM) and the Panel of Experts (POE) which includes Egypt, Sudan and Ethiopia. Moreover, Addis Ababa has

also abandoned its long-standing position of seeking to abrogate previously signed treaties and urging the redistribution of water quotas.

To protect its national interests and to avoid threats, Egypt has over the years, concluded a number of agreements and endorsed several protocols with the other Nile-basin countries, independent or not at the time of the signing. The purpose of this has been:

- To preserve Egypt's Nile quota un-touched and intact; and
- To create new projects to reduce water waste and double the Nile's yield.

On the question of transferring Nile water to Israel, along a bone of contention with the other riparians of the river, Cairo has repeatedly asserted its rejection of the very idea given that signed treaties disallow the use by a third party of any amount of water un-less all river-basin countries agree. For a long time now, Egypt has adopted an even-handed policy with all the Nile Basin countries seeking to achieve:

- Good neighborly relations with all of them.

- Cooperation with the purpose of developing the river's water resources away from politics.

- Tapping the huge amount of the river's potentials still to be exploited, which could be a great benefit both to Egypt and to the other Nile Basin countries.

- Optimizing the use of the great amount of water wasted in the Upper Nile and the swamps regions; and put-ting to full use the river's power generation, navigation and fishing potentials in the Ethiopian plateau and Uganda.

- Maintaining Egypt's historical water quota as established in the 1959 treaty, and preserving its natural right to a greater amount of the river's yield to meet the needs of future joint projects in Egypt, Sudan and Ethiopia.

- Protecting the rights of all riparians to fairly shared benefits and preventing any infringements there (Adel Abdul – Razik 2005).

5- EGYPT'S POPULATION GROWTH RATE

Egypt is the largest Arab country with a population of (72.8 million in January 2006). 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 (3) 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 2006 it declined to 2.05.

Table 3- Population Size and its Rate of Growth in The years (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
*** Conducted by Sample Survey**			
Source: Egypt Population in 20th Century CDC and CAPMAS, Statistical Year Book, 2004, Egypt in Figures, 2006			

The natural population growth increased steeply until 1989, then both the birth and death rates stabilized by the year 1996 at 21.1per thousand. Egypt's population still grows each year by approximately l.4 million and it is expected to continue its growth because:

1-The fertility rate is still high, i.e. 2.9 per woman.

2- A large proportion of women are of reproductive age (according to census 1996 they are 25.7% of the total population), so the population size is expected to double for the third time in 2007, in spite of the national family planning program Egypt has adopted since the 1980s. This program succeeded in decreasing the fertility rate in Egypt from 5.3 in 1980 to 3.3 in 2003.

3- The gap between birth rate and death rate is still large because of the improvements in health and living conditions as we can see in table (4).

Table 4-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						

The death rate remained at its high level from the beginning of the last century until 1949; it was around 26%o during that period. It began to show a gradual drop from 1950 to 1995 when it reached the low level of 6.3%o by the end of the century. So the Egyptian population has been passing through the third stage of the demographic transition since 1970 because both birth rate and death rate declined. Egypt's population is expected to double for the third time in 2007 to become 73 million.

5-1- Irrigation Needs and Sanitary Measures

60% of food production is from non-irrigated agriculture. A sizeable part of irrigation potential is already used in North Africa and the Near East (where water is the limiting factor), but a large part also remains unused in sub-Saharan Africa. Water for irrigation is a high priority for economic development and stability. However, few countries can afford the financial investment in efficient irrigation systems, and water losses through leaking pipes and evaporation are as high as 50% in South Africa alone.

The expansion of irrigation is projected to be the strongest in North Africa, as well as in the Near East. By 2030, 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).

Sanitary Measures are an indicator of access to adequate food supplies, use of health services, availability of improved water sources, and sanitation facilities, which are prime determinants of maternal nutritional status (UNICEF, 1990). The data showed that women from low sanitary measures were the most affected by malnutrition. Obesity was more common among women, who had better sanitation, as indicated by good water sources, tile floors, and latrine facilities in their homes.

5-2- High Dam Impact

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).

6 - RELATION BETWEEN POPULATION GROWTH AND WATER-AGRICULTURAL FOOD PRODUCTION

The Ministry of Agriculture in its publications in the year 2000 reported that the self- sufficiency ratios of food crops increased; there was self-sufficiency of rice, and the self-sufficiency ratio of wheat increased from 25% in 1982 to 60.9% in 2000 in spite of the increase in population consumption.

The Egyptian economy has traditionally relied heavily on the agricultural sector for economic growth both in terms of contribution to the GDP as well as a source of employment for a significant part of the labor force. The agricultural sector constitutes about 17% of the GDP and absorbs about 39% of the total labor force.

Egypt tries to face the potential scarcity of water in the near future through minimizing the fresh water released to the sea, supporting saving water systems, increasing the use of subterranean water in irrigation and also by reusing the drainage water after having processed it.

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.

Another problem affects the soil: there are many factories that get rid of their chemical wastes in the River Nile causing pollution to its water, which in turn affects the agricultural crops and the soil.

The over-irrigation by farmers who generally apply more water than crops need because there is no control on water supply prompted the Egyptian government to design a strategy for irrigation development to improve control and distribution of irrigation water.

Good city water management is complex. It requires the integrated management of water supplies for domestic and industrial needs, the control of pollution and the treatment of wastewater, the management of rainfall runoff (including storm water) and prevention of flooding, and the sustainable use of water resources. To the above must be added cooperation with other administrations that share the river basin or groundwater source.

Cities often take water from outside their administrative boundaries and discharge their waste downstream, there by affecting other users.

For monitoring purposes, the World Health Organization/United Nations Children's Fund (WHO/UNICEF) Global Water Supply and Sanitation Assessment 2000 Report specifies reasonable access to water as at least 20 litters per person per day, from an improved source within 1 km of a user's dwelling. This does not, however, represent a definition of adequacy of access, but rather a benchmark for monitoring purposes. For example, in a densely populated squatter community with 100,000 inhabitants, it certainly is not reasonable. The reliability and regularity of many urban water supplies in lower-income countries is a big problem, with poor quality water and the high price of water when bought from street water vendors. On the sanitation front, shared toilets and pit latrines are not really adequate in urban areas. They are often badly maintained and not cleaned. Children find them hard to use and the cost of use for a poor family may be prohibitive. So, many urban dwellers resort to open defecation or defecation in a bag or wrapping, which is then dumped.

Accurate data is limited on the quality and availability of water supply and sanitation provision in cities in many lower-income countries. It appears that official national data provided for various studies may overstate the provision of improved water supplies and improved sanitation, and the actual situation may be worse than present figures indicate. What is clear is that the health gains from the provision of improved water supply and sanitation are like quantum leaps, with the biggest gains in the transition from no service at all to basic services, and then service extended to individual households.

To provide better water supplies, sanitation and flood management for cities, a range of actions is needed. Competent water utilities are foremost among these, whether public ones that have been corporatized or private ones, both of which must be subject to good regulation. The application of sound city planning and zoning regulations to control industrial and housing developments, together with the control of water abstractions and polluting effluents, is also essential. Good watershed management, to minimize ecological disturbance and make better use of water resources, is vital. Creating an enabling environment for communities and NGOs to make their own water supply and sanitation provision, with the proviso that these do not cause problems elsewhere in the system, will make a big contribution in pre-urban areas. However, problems of weak local government and the low incomes of many urban dwellers will complicate the achievement of these objectives.

6 -1- Agricultural Expansion to Meet Population Needs

The Egyptian government through the last two decades adopted reform programs for the agricultural sector. The Ministry of Agriculture implemented these programs in order to .provide the population with their needs from basic food. So many key measures have been taken to accomplish this objective:

* Crop areas allotment with delivery quotas at fixed procurement prices have been removed for all major crops.
* Liberalization of agricultural producer prices for all products.
* Encourage the private sector in. processing and marketing agricultural products.
* Support the local fertilizers and insecticides industries.

* Enhance reclamation efforts and encourage new graduates and investors to work in this sector (low prices for land-loans...etc).
* Credit facilities available to the agricultural sector increased from L.E 1.2 billion in 1982 to L.E 11 billion in 2000.
* The government 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.

6-2- Trends of Main Crops Production

The new agricultural policies that were implemented through the last two decades achieved significant positive impacts on food production and the rate of growth.

6-2-1- 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.

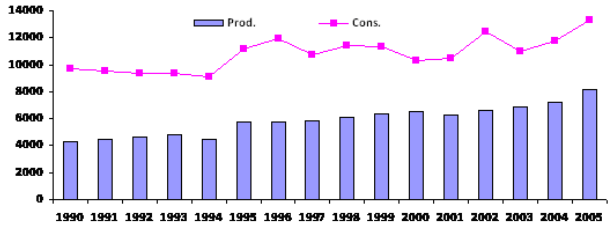


Fig. 4- Wheat Production and Consumption Trends in Egypt (1990 - 2005)
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Agricultural Economics Bulletin". Vols. (1990-2005)

6-2-2- 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.

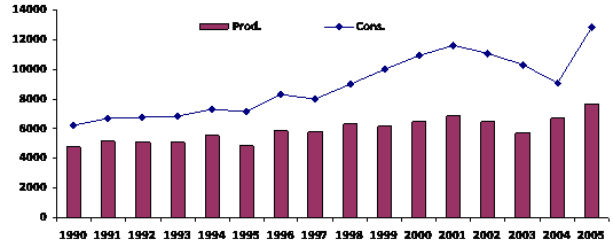


Fig. 5 –Maize Production and Consumption Trends in Egypt (1990-2005)
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, "Agricultural Economics Bulletin". Vols. (1990-2005).

Egypt has to provide hard currency for imports as it imports 34% of its food and produces 66% as figure (6) shows.

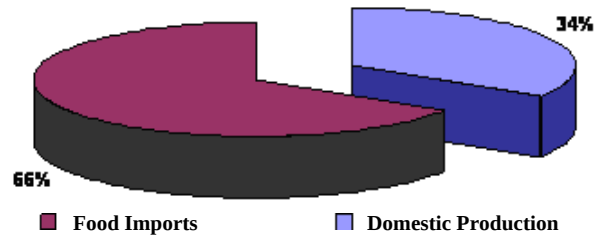


Fig. 6- Net imports and food production Egypt
Source: Irrigation in Africa in figures -AQUASTAT Survey 2005

7- SUMMARY AND RECOMMENDATIONS

7-1- Summary

This research attempts to show the trends of the Egyptian population growth and the main agricultural food products with water income and the impact of population growth on food sufficiency and also to shed light on the relation between the production and the population consumption of food and the effect of population increase on the per capita of these main crops. The research also reveals the improvements and reforms of agricultural policies that aim to increase the total production and exports and reduce the imports to narrow the food gap.

The research has found that the trends of population growth declined but they are still of high concern to Egypt because TFR is still high. The trends of main food products increased due to the agricultural expansion.

The population growth reflects negatively on the arable land area and the water supply because of urbanization.

The development in the past two decades indicated that the extension of the agricultural area and the intensification of land use were manifest in the increase of the cropped area and the productivity and exports. Egypt is a Malthusian model; there is no balance between population growth and food production. It is the most basic challenge Egypt wil1 face in the near future.

7-2- Recommendations

1- Support family planning programs to reduce fertility and population growth rate.

2. 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.

3- 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.

4- 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.

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

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