NILE BASIN INITIATIVE
Initiative du Bassin du Nil

Assessment of the level of implementation of Integrated Water Resources Management In Egypt

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EXECUTIVE SUMMARY

The report addresses an important issue in water resources, which is the level of implementation Integrated Water Resources Management (IWRM) for one of the Nile Basin countries, which is Egypt, as part of a regional assessment to come up with comprehensive understanding of the current status and recommendations for improvement. This collective effort is orchestrated through the Applied Training Program – Nile Basin Initiative. The report is organized to discuss the problem from a global perspective and tie it to the particular importance for the Nile Basin countries, state the status of water resources management in the country including policy, legal, institutional frameworks, the concept of IWRM as understood in Egypt, and the implementation status. The report then describes three case studies as examples of initiatives at the national level. Such case studies were chosen carefully to represent three of the major water management issues in Egypt, i.e. salinity in the newly reclaimed areas, integrated management in the Lake Nasser area, and the effective operation of irrigation schemes at the district level. The report is concluded by summarizing the efforts made for successful implementation of the IWRM and the recommendations to improve such implementation.

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LIST OF ABBREVIATIONS

PJTC	Permanent Joint Technical Commission
TECCONILE	Technical Cooperation Committee Nile Basin
NBI	Nile Basin Initiative
NRS	Natural Resources System
SES	Socio-Economic System
AIS	Administrative and Institutional System
IWRM	Integrated Water Resources Management
EPADP	Egyptian Public Authority for Drainage Projects
NWRP	National water Research Plan
NWRC	National Water Research Centre
IWMD	Integrated Water Management Districts
IIIMP	Integrated Irrigation Improvement and Management Project
WUA	Water Boards and Water User Associations
IWRM	Integrated Water Resources Management
WRM	Water Resources Management
MWRI	Ministry of Water Resources and Irrigation
NWC	National Water Council
MGD	Millennium Development Goal
IPCC	International Panel on Climate Change
GWP	Global Water Partnership
UNEP	United Nations Environmental Program
UNDP	United Nations Development Program
CSD	Commission on Sustainable Development
FtC	Facing the Challenge
IIP	Irrigation Improvement Project
O&M	Operation and Maintenance
MPWWR	Ministry of Public Works and Water Resources
EEAA	Egyptian Environmental Affairs Agency
NWC	National Water Council
IRU	Institutional Reform Unit

1 INTEGRATED WATER RESOURCE MANAGEMENT AND THE NILE BASIN INITIATIVE

1.1 Global Development of Integrated Water Resources Management

Introduction

The goods and services provided by water play a central role in achieving the Millennium Development Goals (MDGs) adopted at the Millennium Summit in New York in 2000. Good water governance – in an integrated water resources management (IWRM) framework – is a critically important contribution to the achievement of the MDGs. IWRM improves cross-sectoral efficiency and cooperation at all levels on sustainable water resources development and management[4], including specific sector interventions. The importance of water management has been further highlighted by the recent reports of the Intergovernmental Panel on Climate Change (IPCC) and others that have warned that climate change will have extensive impacts on water resources.

The IWRM approach facilitates mainstreaming water issues in the political economy of a country, and as such in all societal sectors. It focuses on better allocation of water to different water user groups and in so doing stresses the importance of involving all stakeholders in the decision-making process. It also calls for gender mainstreaming in land and water management decision making. And it supports the integration of water supply and use with the management of waste, sewage and groundwater protection, while recognizing that the protection and quality improvements of water are preconditions for sustaining both human livelihoods and natural ecosystems. This approach is also recognized as a framework for the adaptation of water management to climate change and the management of floods and droughts.

Improved development and management of water resources, based on a true and inclusive stakeholder involvement, provides a direct link to the MDGs addressing poverty, hunger, gender equality, health, education and environmental degradation. In recognition of this link, an important short term target was agreed upon at the World Summit for Sustainable Development in Johannesburg in 2002 and included in the Johannesburg Plan of Implementation: "To develop integrated water resources management and water efficiency plans by 2005, with support to developing countries", or in short the "IWRM Target". This target was intended to highlight the vital role of improving water management through IWRM as a means towards the achievement of the Millennium Development Goals. Since 2002, many countries have progressed towards this target, as reported by the Global Water Partnership (GWP), UNEP, UNDP and the Japan Water Forum in survey reports presented at the 4th World Water Forum in 2006. By the end of 2005, 25% of the 90 countries surveyed had made "good progress", while 50% had made "some progress" and 25% had made limited or no progress towards the

IWRM Target. Although the surveys recognized that considerable progress had been made, it was clear that many countries still had a long way to go in achieving the target, and most countries still faced considerable challenges in implementation. Experience to date suggests that the problems encountered by developing countries in both planning and implementation of IWRM approaches include the lack of political will to seriously engage in water policy change, financing and national resource allocation for water related development , awareness of water issues, weaknesses related to human and institutional capacity, and discontinued support programs. At the Thirteenth Session of the Commission on Sustainable Development (CSD) in 2005, all countries were called upon to accelerate the preparation of nationally-owned IWRM and water-efficiency plans. In the Commission's decision, UN-Water was requested to give equal consideration to the CSD-13 thematic issues of sanitation and water and to promote system-wide interagency cooperation and coordination among relevant UN agencies, funds and programs on these issues. The UN Secretary General was requested to include in his report to the CSD the activities of UN Water as they relate to these thematic areas. In addition, in 2006 all countries were requested by the UN Secretary General to "report on progress on IWRM and Water Efficiency Plans" at the CSD16 in 2008, in keeping with a recommendation of the UN Secretary General's Advisory Board on Water and Sanitation.

Steps for planning and implementation of IWRM

In order that policy changes can be put into place to support the achievement of the national goals, it is helpful to consider the stages involved in improving water management through an IWRM approach. Figure 1 illustrates some of the stages involved in both planning (right side), where many countries have made much progress, and implementation (left side), where more attention is needed. IWRM needs to be more than just a planning mechanism. Increased attention needs to be given to the mainstreaming of water issues in national political economies, in order to ensure broader political, economic and social sustainability.

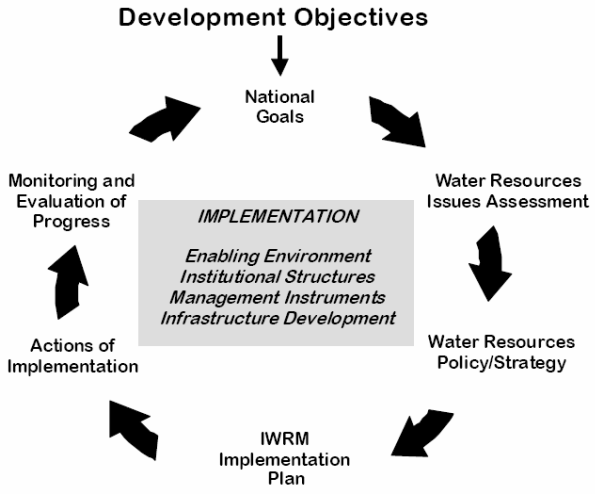


Figure 1. *Stages in IWRM planning and implementation*

Nationally-owned roadmaps for improving water management through IWRM could include a set of milestones to help countries translate their IWRM plans into specific actions and interventions on the ground, as well as to monitor the impact of actions taken or interventions made. Such roadmaps could be developed around outcomes to be achieved through implementing IWRM policy changes aimed at the achievement of the MDGs and the adaptation to climate change. Countries are at different stages of their water development and management, and institutional and policy changes to be effective for some countries will need substantial capacity building and time. The timeline of individual national processes will, therefore, vary widely according to existing plans and points of departure.

Regional and global evaluation

Regular reporting and discussion at regional and global levels can play an important role to encourage and support such in-country processes and address the barriers to progress. Towards this end, in 2008, country reports to the Commission on Sustainable Development will focus on country progress in establishing plans to implement IWRM and to address their identified MDG related water resource management priorities. Beyond 2008, it would be useful for countries to monitor on a continuing basis and in an integrated (process and outcome) way, on all three key inter-related processes outlined above. To facilitate meaningful discussion and comparison, it is recommended that such monitoring may be carried out within a structured framework under which, every three years, a specific set of indicators or theme is chosen. Suggested themes:

a. 2009: Focus principally on reviewing the extent to which key enabling conditions for the implementation of national IWRM priorities have been addressed. Note progress on specific IWRM change processes and the realization of the water-related MDGs
b. 2012: Focus principally on reviewing the progress of specific IWRM change processes. Note progress on enabling conditions and the realization of the water-related MDGs
c. 2015: Focus principally on assessing the extent to which improving water management through IWRM has successfully contributed to the implementation of the MDGs. Note progress on enabling conditions and on specific IWRM change processes

An evaluation mechanism along these lines would encourage all countries to report their progress in an integrated process and outcome way, while enabling global and regional discussion every three years on a specific theme as well as the inter-connections among them. Such a system would also enable the global community to get a more realistic picture of how the IWRM approach is being developed in different contexts and to identify needs, while at the same time encouraging and learning from those who are most ahead of the game -- clearly adding value to advancing IWRM at country level, rather than being yet another useless reporting burden. The contents of each of the proposed set of indicators are illustrated by way of examples below.

First set of indicators (focus for 2009): Enabling conditions in place
Here, the focus would be on ensuring that enabling conditions are in place, and that change processes have been initiated in accordance, with a politically supported and approved legal framework and with allocation of appropriate financing sources for management functions. To illustrate the way in which countries might monitor progress in these areas, here are some possible examples of process indicators that could be used:

a. Changes in enabling environment:
i. Revision and amendment of policies and laws;
ii. Water is mainstreamed into national development policies, strategies, plans
iii. Allocation of appropriate and sustainable funding in national budgets.

b. Changes in institutional framework:
i. Establishment of cross-sectoral coordination frameworks;
ii. Change of ministerial and departmental mandates;
iii. Formal involvement of stakeholder groups;
iv. Launching of awareness and mobilization campaigns;
v. Decentralization and delegation of decision making at the river basin, provincial/local and community levels;
vi. Capacity development of government staff and stakeholder groups.

c. Changes in management instruments:
i. Improvements in information management;
ii. Water resources issue assessment;
iii. IWRM strategy and plan development
iv. Countries produce coherent water resources development and management plans that support the achievement of the MDGs;
v. Demand management of user behavior and water use efficiency ;
vi. Social change instruments for public awareness, mobilization and conflict mediation;
vii. Regulatory instruments and associated enforcement frameworks;
viii. Economic instruments for behavioral change.

Second set of indicators (focus for 2012): IWRM change process taking effect
Here, the focus would be on ensuring that actual implementation of change processes takes place and that changes begin to take effect in the way "water managers" at all levels deal with water. To illustrate the way in which countries might monitor progress in these areas, here are some possible examples of performance indicators that could be used:

a. Enabling environment:
i. New legislation and standards, institutional capacity building is taking effect;
ii. Water resources agencies are starting to administrate according to new IWRM principles

a. Institutional framework:

i. Sector ministries are actively promoting and implementing the IWRM approach;
ii. Water use organizations and the private sector is increasingly coordinating water use in cooperation with government authorities;
iii. Awareness and management capacity is growing measurably in government and user groups.

b. Management instruments:

i. Monitoring and research programs are documenting the impacts and causes of major water issues;
ii. Transparent, coherent and consensus-based planning and strategy making is taking effect in all sectors;
iii. Social, economic and regulatory instruments are changing inappropriate water allocations and uses;
iv. Water conflicts across the sectors are mediated through participation of appropriate stakeholder groups.

Third set of indicators (focus for 2015): Mitigating key water constraints related to achievement of MDGs

Here, the focus would be on reviewing the extent to which required water infrastructure has been developed and water resources management issues addressed, in accordance with the strategic goals and targets in water resources development and management plans -- and thus in support of the achievement of the MDGs. To illustrate the way in which countries might monitor progress in these areas, here are some possible examples of process and outcome indicators that could be used:

a. MDG 1: Poverty and Hunger:

i. Infrastructure to store surface water, and further develop groundwater resources, is put in place
ii. The health and productivity of aquatic ecosystems – in particular related to fish productivity – is optimized and protected;
iii. Rural poor populations are protected against flood risks.

b. MDG 4-6: Health:

i. Discharges of human waste waters are treated for bacterial contamination to prevent diarrhea outbreaks;
ii. Toxic emissions from industrial enterprises are controlled within international health standards;
iii. Pesticide release to groundwater, wetlands and surface water is controlled.

c. MDG 7: Environmental sustainability:

i. Appropriate environmental flows are ensured to maintain wetlands goods and services
ii. Safe water supply and sanitation expansion has reached or exceeded target 10
iii. Urban slum dwellers are protected against flooding.

iv. Social, economic and regulatory instruments are changing in-appropriate water allocations and uses
v. Water conflicts across the sectors are mediated through participation of appropriate stakeholder groups

1.2 The Nile Basin Initiative process

The Nile River is an international river and is shared by ten countries: Burundi, Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. From its major source, Lake Victoria, the White Nile flows north into Sudan. At Khartoum it meets the Blue Nile, which rises in the Ethiopian highlands. From the confluence of the White and Blue Nile, the river continues North, enters Egypt through Lake Nasser and terminates in the Mediterranean Sea.

The river is approximately 6,700 km long and the basin covers an area of approximately 3 million km^2. Egypt, being the most downstream country in the basin, has been cooperating with the other countries for many years through agreements. These agreements aim to secure Egypt's share in the Nile Water. The first agreement between Nile Basin countries was signed in 1891.

Main agreements between Nile Basin Countries

1929: Egypt and Great Britain (repr. Sudan, Kenya, Tanzania and Uganda)

i. No works to be undertaken on the Nile, tributaries and lakes which would reduce the volume of the Nile waters reaching Egypt.
ii. Egypt has the right of inspecting the implementation of projects
iii. All agree on Egypt's ancient rights of the Nile water
iv. Egypt has the rights of investigating along the whole length of the Nile, to the remote sources of Nile tributaries in these territories

1959: Egypt and Sudan

i. Interrelated with the agreement of 1929
ii. Earlier acquired rights: 48 BCM/yr for Egypt and 4 BCM/yr for Sudan
iii. Utilization of Nile waters after construction of the High Aswan Dam to be shared by Egypt (7.5 BCM/yr) and Sudan (14.5 BCM/yr).
iv. Construction of Roseiras reservoir in Sudan
v. Projects to minimize losses in Gabal and Zaraf lakes, Ghazal lake and its branches, Sobat river and its branches, and the White Nile Basin
vi. Technical cooperation between both countries and with other Nile Basin Countries
vii. Establishment of the Permanent Joint Technical Commission (PJTC) of the Nile waters

1993: Egypt and Ethiopia

i. Both countries should not embark on any works on the Nile that could harm and affect other countries

ii. Importance of safekeeping and protecting the Nile water
iii. Compliance with international laws
iv. Consultation and cooperation between both countries for utilization of the Nile water to increase water flows and to reduce losses.

An important step for the cooperation has been and still is the technical cooperation. This started in 1967 in the form of a joint project of Egypt, Sudan, Uganda, Kenya and Tanzania on hydrological and meteorological studies in the basin. The project was joined by other countries at a later stage. In 1992 the ministerial council of the Nile Basin countries initiated the technical committee TECCONILE (Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin) to investigate and study all technical aspects related to the Nile Basin. TECCONILE continued until 1999 when it was replaced by Nile Basin Initiative (NBI) as a wider framework with different operating organs aiming at paving the way for a final installation of legal and institutional arrangement. Egypt has been a strong supporter of the work of the Nile Basin Initiative and will continue to do so.

Objectives of the study

The main objective of the present study is to examine the concept of IWRM and its current implementation status in the real world, critically and objectively for the countries of the Nile Basin where water is often an essential requirement for fostering regional development and poverty alleviation, and where water management and development have a long history. The IWRM issues and challenges need to be analyzed in their totality with an open mind, without any preconditions or biases. The study is to examine the implementation status and potential of IWRM in each of the Nile Basin Countries and draw lessons and recommendations for policy and decision makers as ways forward.

The major objective of the current study will thus be to identify linkages between IRWM and poverty alleviation and regional development so that IRWM could be an efficient instrument to improve water resources planning, management and development, and to improve the standard of living and quality of life of the people of the Nile Basin countries.

Besides examining the level of IWRM implementation there will be case studies which should be neither academic nor theoretical, but rather would be based on what has happened, or not happened, in terms of implementing the concept of IWRM in the Nile Basin countries. The study will objectively analyze the current status of application of IWRM in the region, and what have been its overall impacts on the people, regional development and the environment. To what extent has IWRM improved the water management practices in the region? This comprehensive analysis will be carried out primarily through a selected series of case studies from the region. These case studies will then be discussed in depth at a specially convened workshop which is expected to identify the successes and failures of IWRM implementation in the region, the reasons thereof, and come up with recommendations for more efficiency at national and regional levels.

A few case studies from outside the region will also be considered to see the results and status of impacts of implementations of the concept, which may be of specific interest to the Nile Basin countries.

2 STATUS OF WATER RESOURCES MANAGEMENT IN EGYPT

2.1 Country background information

The holistic approach of Integrated Water Resources Management requires water managers to look beyond the physical aspects of the water system and to take into account also the users and uses of the water and the institutions involved. In fact, they have to consider these users and institutions as part of their Water Resources System. The Water Resources System can be defined as consisting of three components:

a. The *Natural Resources System* (NRS), being the system of rivers, lakes, groundwater aquifers and its related infrastructure; it includes both quantity and quality aspects of the water;
b. The S*ocio-Economic System* (SES), the water using and water related human activities;
c. The *Administrative and Institutional System* (AIS), the system of administration, legislation and regulation including the authorities responsible for the management of the WRS and the implementation of laws and regulations.

The Natural Resources System (NRS) stands for the supply side of the system (resource base). The demand side of the system is made up of the Socio-Economic System (SES). The Administrative and Institutional System (AIS) controls the supply as well as the demand of the resources.

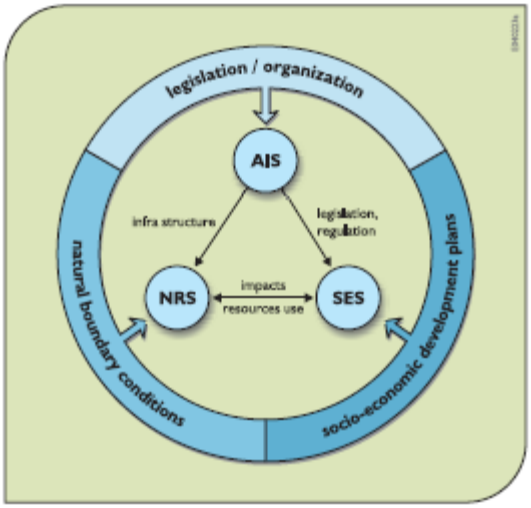


Figure 2-1 The Water Resources System in its environment

2.2 The water resources of the Egypt

Governments all over the world pay more and more attention to fresh water resources because these either become increasingly scarce or they are a threat due to flooding. At the same time there is a growing awareness that the quality of water resources should be protected. Water of good quality and without risks for public health is nowadays considered to be a major asset. In this field Egypt has its own particular position. It covers a very arid region situated between the Sahara and Arabian deserts. Egypt is extremely dependent on the River Nile, being the most downstream country in the Nile basin. This makes co-operation with other Nile basin countries indispensable. The country hardly has any other fresh water resources. Rainfall is very rare, except for a very small strip along the coast of the Mediterranean. Fossil groundwater is available in parts of the Western and Eastern Deserts and the Sinai.

The Nile source of Egypt's water

The Nile supplies nearly all water in Egypt. Being one of the largest rivers in the world, it is approximately 6,700 km long. Its basin covers an area of approximately 3 million km^2 and is shared by ten countries as illustrated in Figure 2-3. Its two main tributaries are the White Nile which originates from the Lake Victoria basin, and the Blue Nile which has its sources on the Ethiopian Plateau. The two rivers join at Khartoum, the capital of Sudan. The Nile river basin includes a wide range of climatological conditions and land-use, from tropical rainforest in the Lake Victoria area, the wetlands in southern Sudan, pastoral plains and rough mountains in Ethiopia till the extreme aridity of northern Sudan and Egypt. The rainfall distribution in the Nile Basin is illustrated in Figure 2-2.

Major water related infrastructure in Egypt

a. Dams and barrages

Major control structures on the Nile in Egypt include the High and Old Aswan Dams, and a number of downstream barrages. The Old Aswan Dam was completed in 1902 with a storage volume of about 1 BCM. By increasing the height of the dam the storage capacity was increased to 5 BCM in 1934. The High Aswan Dam (HAD), upstream of the (Old) Aswan Dam, was completed in 1964; the Lake Nasser reservoir created by this dam drastically improved the regulation of Nile water. The reservoir has a large annual carry-over capacity and is partitioned into different storage zones as shown in Table 2-2.

Downstream of Aswan, the water levels and water distribution are controlled by a number of barrages (Figure 2-4). These barrages have locks to allow the passage of boats. The first barrage was the Delta Barrage at El Kanater, built as early as 1861.

Figure 2-3 Nile and Nile basin

Figure 2-3 Nile and Nile Basin

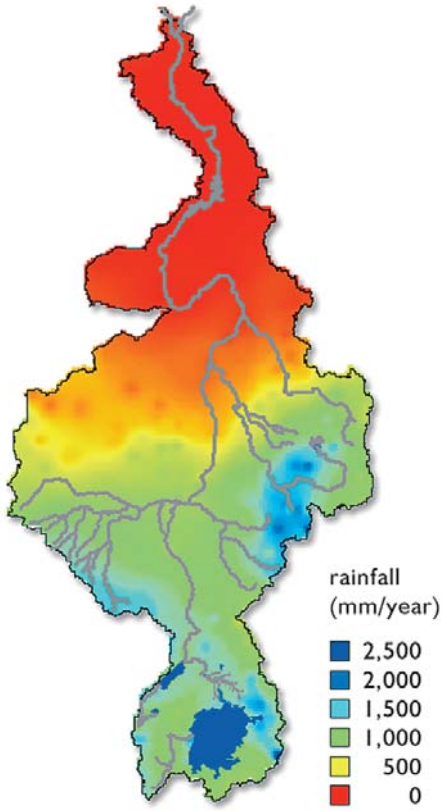


Figure 2-2 Rainfall in the Nile Basin

Storage zone	Level (above MSL)	Volume (BCM)	Cum. volume (BCM)
Dead storage	< 147	31.6	31.6
Active storage	147 – 175	89.7	121.3
Flood control storage	175 – 178	16.2	137.5
Maximum surcharge storage	178 – 183	31.4	168.9

Table 2-2 Storage zones of Lake Nasser

b. Canal system

The major canals that divert just upstream of the barrages and the Irrigation Directorates that are served by these canals are given in Table 2-3. These canals have regulators or weirs at intervals depending on their slopes and the locations of the lower order canals. The canal system in Egypt is very extensive, in particular in the Delta area. Figure 2-5 shows the main features of the irrigation canal system in the Delta.

Branch canals that take off from the main or lateral canals deliver the water to smaller distributary canals, which in turn deliver water to the mesqas. Because the water level in the system is below field level in most of the area, the water has to be raised through diesel pumps or the traditional water wheels. In some areas the farm intakes are directly from the distributaries.

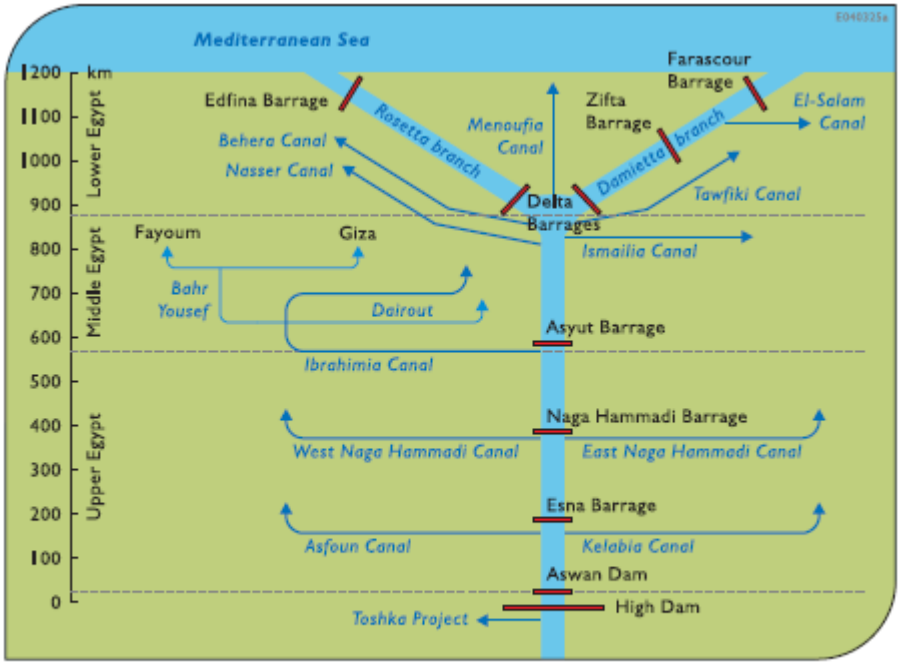


Figure 2-4 Schematic diagram of major control structures on the Nile in Egypt

Barrage	Main canal	Directorates served
Esna	Asfoun Kelabia	Qena
Nag-Hammadi	East Naga Hamadi West Naga Hamadi	Sohaq Asyut
Asyut	Ibrahimia	Asyut (small area), East and West Minia, Beni Suef, Fayoum and Giza, Ismailia, Salhia
Delta (Damietta)	Ismailia Sharkawia Tawfiki Basusia Darawa	Sharkia Kalubia Kalubia, Sharkia and East Dakahlia Kalubia Menufia
Delta (Rosetta)	Menufi Rayah Nagal	Menufia , Gharbia, West Dakahlia and Kafr El Sheikh
	Beheira Rayah Nasiri Rayah	Menufia Beheira, West Beheira, Nubaria and Nasr
Zifta	Mansouria Zaglula	East Dakahlia and Damietta East Dakahlia
	Abbasi Rayah Omar Bey Dahtura	Gharbia, West Dakahlia and Kafr El Sheikh Gharbia Gharbia
Edfina	El-Mahmodia El-Rashidia East El-Rashidia West	El-Behera Kafr El -Sheikh
Farascour	El-Sharkawia El-Salam canal	Damietta West Dakahlia

Table 2-3 List of main canals and areas served

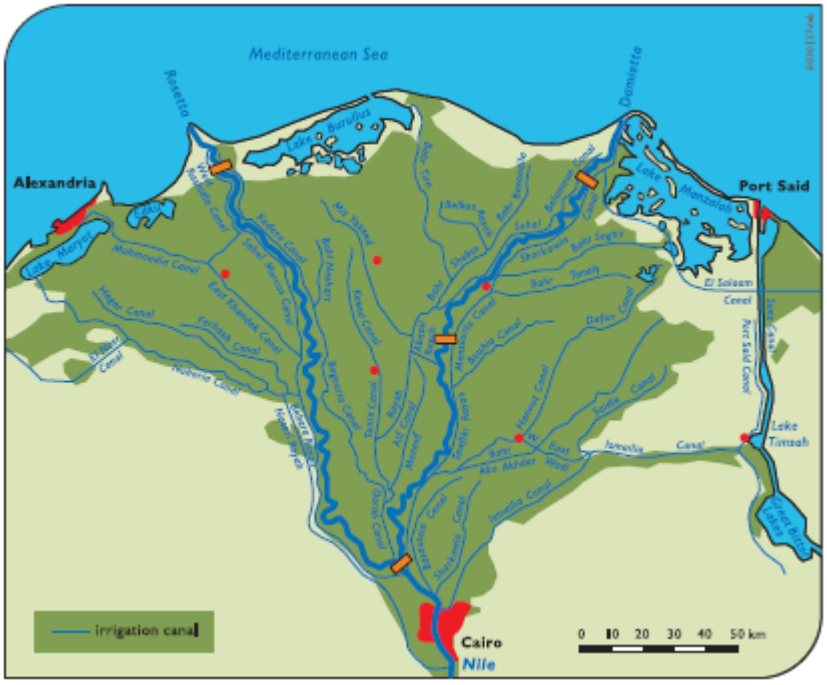


Figure 2-5 Irrigation canals in the Delta

Figure 2-6 Main drainage canals in the Delta

c. Pumping stations

Besides the gravity diversion of Nile water, water is also diverted by more than 100 major pumping stations along the Nile and its branches (Table 2-4).

Nile reach	Number of pumping stations
Aswan – Esna	60
Esna – Naga Hamadi	8
Naga Hamadi – Asyut	4
Asyut - Delta Barrage	33
Damietta Branch	4
Rosetta Branch	4

Table 2-4 Major pumping stations

Hydropower station	Capacity (MW)
High Aswan Dam	2,100
Old Aswan Dam	615
Esna Barrage	90
Nag Hamady	5

Table 2-5 Hydropower stations

d. Hydropower

Hydropower is generated at the High Aswan Dam, the Old Aswan Dam and the Esna and Nag Hamadi Barrages (Table 2-5).

e. Drainage system

The drainage water from agriculture and the effluents from municipalities and industries are collected and transported by an extensive drainage network. This system comprises field drains (open drains or sub-surface drains), collector drains, and main drains which either convey the water back to the Nile or discharge into coastal or inland lakes, or directly to the sea. The drainage system is largely by gravity flow, except for a number of pumping stations in the Northern Delta. The main drainage system in the Delta is given in

Figure 2-6. To cope with increasing shortage of irrigation water, reuse pumping stations pump drainage water into irrigation canals where it mixes with fresh water for further downstream use. These pumping stations are located in the Fayoum and the Delta.

f. Water distribution

Figure 2-7 illustrates a typical water distribution through the Nile System for a Nile discharge of 55 BCM/yr. It shows the order of magnitude only.

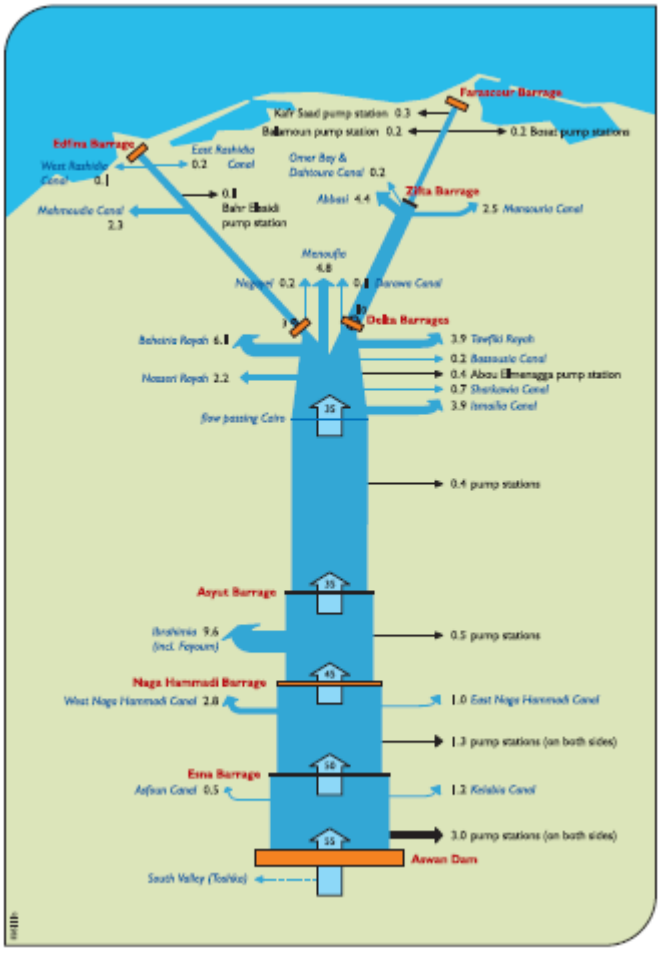


Figure 2-7 Water distribution Nile System (source: NAWQAM project)

g. Nile water resources at Lake Nasser

Figure 2-9 shows the natural flows of the Nile from 1870 onward. These natural flows are the flows at Aswan, corrected for upstream diversions. Hence, they present the situation in which the Nile were still pristine, without constructions and diversions. It appears that the average natural flows before 1900 where significantly larger as compared with the flows after 1900. The driest sequence of years occurred in the 1980s, when the level in Lake Nasser approached the dead storage level.

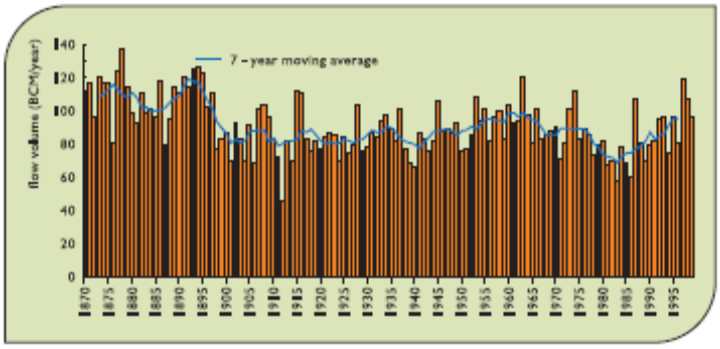


Figure 2-9 Natural flows of the Nile at Aswan (source: Nile Water Sector)

According to an Agreement with Sudan signed in 1959, Egypt's share of the water available from the Nile is 55.5 BCM/yr whereas Sudan's annual share is fixed at 18.5 BCM. These allocations are based on an average natural inflow into Lake Nasser of 84 BCM/yr (period 1900 - 1959) and an estimated 10 BCM/ yr of reservoir losses. However, the actual use of Nile water by Sudan during the past period was about 14.5 BCM/yr. Because of this lower abstraction and the higher than average flows of the Nile in recent years, the level in Lake Nasser rapidly rose and significant volumes of Nile water were spilled to the Toshka depression through the Toshka spillway.

The reservoir operation is based on a simple rule: the maximum reservoir level on the 1st of August should not exceed 175m above mean sea level. Any water that has to be released from the HAD to avoid higher water levels is not to be considered as part of Egypt's share of the Nile water.

In case of persistent years with low flow, when the reservoir level drops below about 160m above MSL, corresponding to a reservoir storage of 60 BCM, a sliding rule is applied to reduce the release below the 55.5 BCM/yr. This reduction in release was only applied once during a prolonged dry period in the 1980s. The lowest reservoir level occurred in 1987 and the corresponding release during the 1987/88 season was 52.9 BCM.

h. Groundwater

Although in terms of quantity the contribution of groundwater to the total water supply in Egypt has been very moderate, groundwater is the sole source of water for people living in the desert areas. Because of limited options to increase the Nile water availability, there has been an increasing interest during the last decade to further develop the groundwater resources.

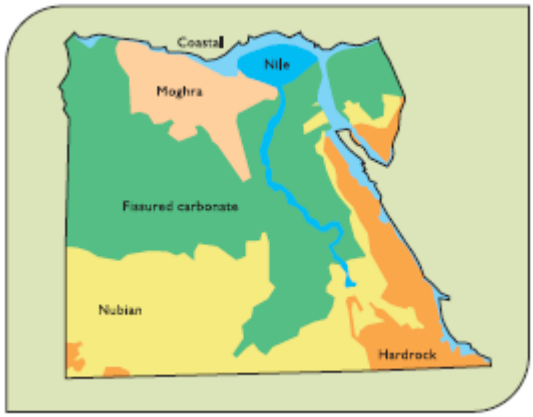


Figure 2-10 The major aquifer systems in Egypt

The major groundwater systems in Egypt are the following (see Figure 2-10):

- Nile aquifer
- Nubian sandstone aquifer
- Fissured carbonate aquifer
- Moghra aquifer
- Coastal aquifer
- Hardrock aquifer

Some major features are summarized below.

i. *Nile aquifer*

In terms of abstraction the most important aquifer in Egypt is the Nile aquifer (about 87% of the total groundwater abstraction in Egypt). However, since the aquifer is recharged by infiltration of excess irrigation water, and since the source of this irrigation water is Nile water released at Aswan, the groundwater in the Nile aquifer is not a separate resource.

The aquifer is composed of a thick layer of sand and gravel with clay intercalations. The sediments are covered by a clay cap of varying thickness, up to 50 m in the northern part of the Delta. The high productivity of the wells and the shallow depth of the groundwater table allow the abstraction of large quantities of water (100-300 m^3/hr) with relatively shallow wells at relatively low pumping cost. In some areas the groundwater is used by farmers in conjunction with surface water, especially during periods of peak irrigation demands.

j. Nubian Sandstone aquifer

Besides the Nile aquifer, by far the most important groundwater body is the Nubian Sandstone Aquifer which covers a total area of roughly 2 million km^2 and extends into Libya, Chad and Sudan. Its northern boundary is a fresh/salt water interface that follows a fault line north of Siwa oasis, crosses the Nile Valley between Minya and Beni Suef and bends north-east into the Sinai. The aquifer is phreatic in the south-western part of Egypt; elsewhere it is confined by a thick cover of carbonate rocks. The saturated thickness of the fresh part of the aquifer ranges from 200 m in East Oweinat to 3,500 m in the Great Sand Sea north-west of Farafra (see Figure 2-11). Discharge takes place in the oases in

the Western Desert through artesian wells and pumping. The total volume of fresh water stored in the aquifer has been subject of many studies and probably exceeds 150,000 BCM. However, this value merely is of academic interest since development in large areas will not be viable because of the large depth of the groundwater table (up to 2000 m). The groundwater is of fossil origin and flows in a northern direction. The flow velocity in the aquifer is about 1 m/yr. This means that the travel time from the Sudanese border to the Qattara depression, over a distance of 800 km, would be roughly 800,000 years. During this time many climatic changes have taken place, including wet periods during which the aquifer system has been replenished. The transition to the current arid conditions has started some 8,000 years ago. The age of the groundwater in the central part of the Western Desert varies between 20,000 and 40,000 years which indicates that the aquifer has indeed been recharged by local rainfall.

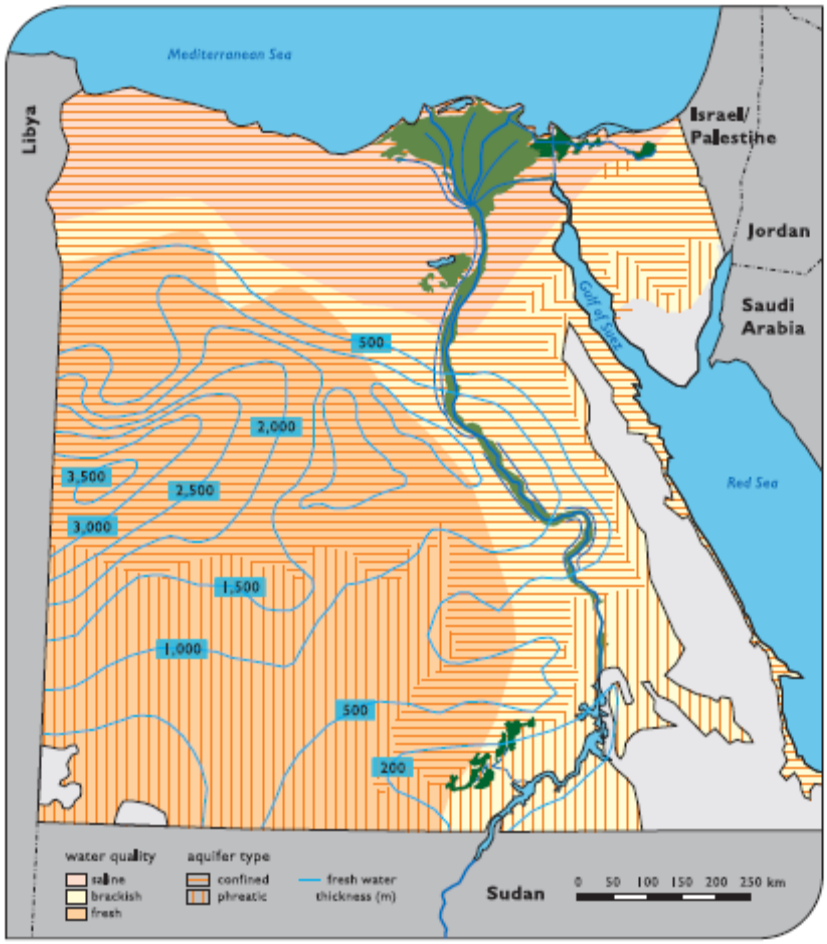


Figure 2-11 Extent and main characteristics of the Nubian Sandstone Aquifer in Egypt

k. ***Fissured carbonate aquifers***

The fissured carbonate rocks occupy more than 50% of the surface area of Egypt and act as a confining layer on top of the Nubian Sandstone Aquifer. This aquifer system predominates in the northern part of the Western Desert and is also present in the Eastern Desert (with negligible recharge) and large areas of the Sinai (with recharge from

rainfall). The aquifer has not received enough attention as regional aquifer system, irrespective of the fact that many natural springs occur. The aquifer recharge is unknown but is expected to be limited. Because of its low porosity, groundwater occurrence is restricted to isolated pockets of sedimentary deposits, fissures and fault systems. No reliable figures are available about the total groundwater potential. In Siwa the productivity of wells shows a large variation: from 5 to more than 300 m^3/hr.

l. Moghra aquifer

The Moghra aquifer is found at the surface from Wadi Natrun and Wadi Farigh towards the Qattara depression. It consists of coarse sand, gravel and sandstone with clay and silt stone intercalations. The groundwater flow is in general directed towards the Qattara Depression. The aquifer is recharged by rainfall and lateral inflow from the Nile aquifer; the total yearly recharge of the aquifer is unknown. The aquifer contains fresh groundwater only near its eastern border (Wadi El Farigh). The salinity increases rapidly towards the north and west. Due to the sharp increase in abstractions for groundwater-based reclamation projects and industrial and municipal supply, notably in the western fringes of the Nile Delta, the water quality and sustainability of this resource is at risk. Water levels are dropping and the water quality has deteriorated due to salinization and pollution.

m. Coastal aquifer systems

The coastal aquifer systems occupy the northern and western coasts. These aquifers are recharged by rainfall. Quantities that can be abstracted are limited due to the presence of saline water underneath the fresh water lens.

n. Fissured and weathered hard rock aquifer system

This Pre-Cambrian aquifer system, predominates in the Eastern Desert and the Southern Sinai. The aquifer system is recharged by small quantities of infiltrating rainwater.

o. Other water resources

Other water resources in Egypt are very limited in amounts and often of local importance only. They include water from local rainfall and flash flood harvesting schemes along the Mediterranean and in the Sinai and the use of desalination in the tourist areas along the Mediterranean and the Red Sea. There is some potential to further develop these resources.

p. Water balance of Egypt

On its route from Lake Nasser to the Mediterranean the water of the Nile River is re-used several times. In the Valley water is abstracted from the river for irrigation. Part of that water is returned to the river as drainage water and can be used again downstream. The same applies to the abstractions for drinking water and industrial water. This reuse of the water makes the water balance of Egypt quite complex.

In Egypt, water can be used more than once. In fact, some of the users ‘consume’ only a fraction of the water they withdraw. The remainder is discharged back to the system. Examples are the Municipal Use that consumes only 0.9 BCM of their water withdrawal

of 4.7 BCM in 1997, and Fishery that consumes (evaporates) only 0.4 BCM of their demand of 1.3 BCM. The water balances of Egypt for 1997 including the reuse are given in Figure 4-10. These water balances provide some more detail and show the gross demand of the various uses and their return flow.

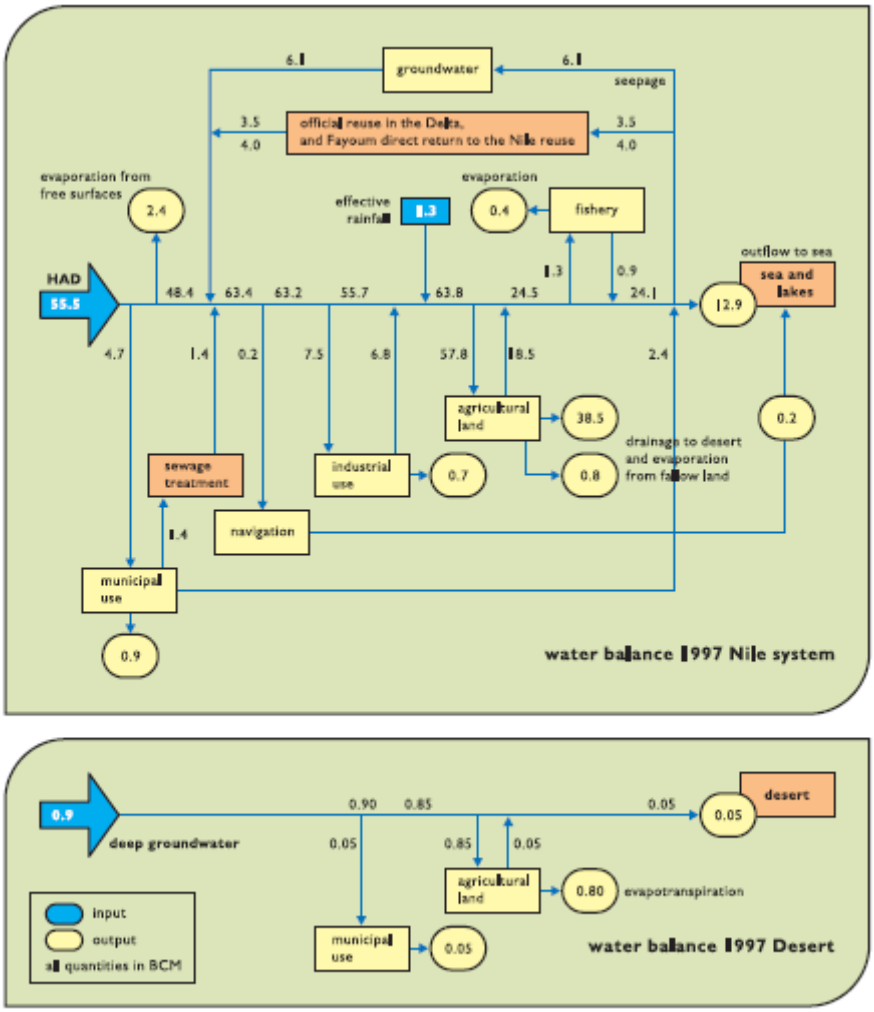


Figure 4-10 Water Balance Egypt 1997 including reuse

2.3 Policy and legal framework for water resources management

Water resources are of great economic significance for the population of Egypt. Water is an important input for agriculture and industry and other sectors in the economy. Investments in water management will contribute to the development of the country. The need to feed the population and to strengthen the economy requires an anticipatory and proactive role, not only by the public administration but also by other stakeholders. Water resources also play a key role with regard to social objectives. In fact, water resources are of importance in increasing employment in all sectors of society and in creating an

acceptable distribution of the national income. Possibilities to safeguard the national food security fall within the social objectives of the government's policy.

Public health threats and environmental degradation are a major concern for the Egyptian government. Deterioration of surface water quality and groundwater quality can cause serious problems for public health and ultimately it can cause economic damage. Public administration and all other stakeholders have a shared responsibility to face these challenges.

On the national level various Ministries have responsibilities related to water resources arrangement. Through their policies these ministries influence the national water resources. Occasionally other ministries are involved as well such as the Ministry of Electricity (hydropower) and the Ministry of Tourism (tourist related navigation on the Nile, water quality along Northern Coasts). Co-operation between all relevant ministries is necessary to strengthen water resources related policies.

In addition to these national actors, Integrated Water Resources Management IWRM has to incorporate the policies and views of the regional and local stakeholders, i.e. the governorates, districts, water supply and sanitary drainage authorities, water boards, water users associations, and, of course, the general public.

Different kinds of stakeholders are the upstream Nile Basin countries. Although the national water resources plan focuses on the national aspects of Egypt's water resources, a continuation of the co-operation between the Nile Basin states both on a bilateral and regional basis is of utmost importance to safeguard the water resources. Moreover, by co-operation additional resources for Egypt and other riparian countries can be made available.

Water management needs the support of an adequate legal framework that provides the water managers with guidelines and instruments for the planning of new developments, for the allocation of water, for the operational management and maintenance of the irrigation and drainage system, for the management of water quality and for financing all these activities.

The most important laws in this respect are:

a. Law 12 (1982), "Concerning the Issue of the Law on Irrigation and Drainage";
b. Law 213 (1994), "Regarding Farmer Participation";
c. Law 48 (1982), "Concerning the Protection of the River Nile and Waterways from
d. Pollution", implemented by Decree 8/1982 of MPWWR; and
e. Law 4 (1994), "Law for the Environment."

2.4 Institutional Framework for Water Resources Management

The governmental structure of Egypt consists of three levels. The first level is the central government (Ministries). The de-central government is structured in Governorates (2nd level) with districts and some cities as 3rd level units (*markaz* level). The Ministry of Water Resources and Irrigation is the prime responsible ministry for water resources management.

National level - MWRI
The Ministry of Water Resources and Irrigation has a central organization in (and around) Cairo. The Ministry has strategic and operational tasks. The operational tasks include both national activities (such as the implementation and operation of the Nile related infrastructure, the irrigation and drainage canals and the coastal lakes) and activities at district level. The central organization of the Ministry includes various departments and sectors. From the point of view of NWRP the most important are:

a. Planning Sector
b. Nile Water Sector
c. Irrigation Department, including
d. Irrigation Sector
e. Groundwater Sector
f. Horizontal Expansion Projects Sector
g. Irrigation Improvement Sector
h. Nile Protection Bureau
i. Egyptian Public Authority for High Dam and Aswan Dam
j. Egyptian Public Authority for Drainage Projects (EPADP)
k. Mechanical and Electrical Department (pumping stations)
l. Water Quality Management Unit)
m. Institutional Reform Unit

iv National Water Research Centre (NWRC)

At de-central level MWRI distinguishes 22 Irrigation Directorates, subdivided into 62 Inspectorates and about 206 Districts. An inspectorate covers about 4 districts. The area of a district is between 20,000 and 60,000 feddan (about 40,000 – 100,000 farmers). Other organization units used in the management of irrigation are:

a. Feeder Canal level (between 10,000 – 100,000 feddan / 15,000 – 150,000
b. farmers);
c. Branch Canal level (between 1,000 – 12,000 feddan / 1,000 – 15,00 farmers);

Mesqa level (between 10 – 100 feddan / less than 100 farmers);

The management of the drainage system is set-up in a similar way as the irrigation system with about the same Directorates, Inspectorates and (145) Districts. However, the organization was separate. The Ministry is in a process to integrate the irrigation, drainage and groundwater management into 'Integrated Water Management Districts' (IWMD). Two pilot IWMD's have been established in December 2001. The further development of IWMD's will be part of the Integrated Irrigation Improvement and Management Project (IIIMP), that will also include the formation of Branch Canal Water

Boards /WUAs and possible scaling up of the Branch Canal Water Boards to District Water Boards. The Ministry is in a process to turn over part of its management responsibilities at district and lower level to Water Boards and Water User Associations (WUA). WUAs operate at *mesqa* level. At this moment there are some Water Boards that operate at Branch Canal Level. There are plans to upgrade these Water Boards to District level

2.5 Water Resources Management Issues and Challenges

The challenge

The growing population of Egypt and related industrial and agricultural activities have increased the demand for water to a level that reaches the limits of the available supply. The population of Egypt has been growing in the last 25 years from a mere 38 million in the year 1977 to 66 million in 2002 and is expected to grow to 83 million in the year 2017. The present population of Egypt is strongly concentrated in the Nile Valley and the Delta: 97% of the population lives on 4% of the land of Egypt. To relieve the pressure on the Nile Valley and Delta, the government has embarked on an ambitious program to increase the inhabited area in Egypt by means of horizontal expansion projects in agriculture and the creation of new industrial areas and cities in the desert. All these developments require water.

However, the water availability from the Nile River is not increasing and possibilities for additional supply are very limited. Up till now Egypt had sufficient water available and the current management is very successful in distributing the water over all its users. Thanks to the enormous capacity of Lake Nasser to store water, the supply of water to these users is every year guaranteed and nearly constant. Now that Egypt is reaching its limits of available water this will not be possible anymore and Egypt will have to face variable supply conditions.

Moreover, the population growth and related industrial developments have resulted in a severe pollution of the water. This pollution is threatening public health and reducing the amount of good quality water even further. Major programs are already being implemented to provide good drinking water to the population and to treat domestic and industrial sewage water. Still, those programs are not sufficient yet and water quality in many areas is below standard.

The government of Egypt has to face these challenges. It will have to further develop its activities to improve the performance of the water resources system, to ensure that the national economic and social objectives are achieved and that environment and health are protected.

The Ministry of Water Resources and Irrigation plays a key-role in the development and management of the water system in the country. This plan tries to achieve the national objectives by developing new water resources, improving the efficiency of the present use and to protect environment and health by preventing pollution and by treatment and control of polluted water. Many of these activities are carried out in co-operation with other ministries such as the Ministry of Agriculture and Land Reclamation, the Ministry

of Housing, Utilities and New Communities, the Ministry of Health and Population and the Ministry of Environment.

The main issues

The main issue involved is how Egypt can safeguard its water resources in the future under the conditions of a growing population and more or less fixed water availability. Assuming that all available additional resources will be developed, the main questions with respect to water quantity that have to be answered are:

a. how can the efficiency of the various uses be increased?
b. how can the agricultural expansion policies of the government be supported and what are the priorities and limitations in this expansion, given existing water resources, optimum efficiency and priority for drinking and industrial water use?
c. how should Egypt manage its water resources system under variable supply conditions?

With respect to water quality, health and environmental aspects the key questions to be answered are as follows.

a. what is the best mix of prevention, treatment and protection measures that results in a water quality that complies with reasonable standards?
b. what is the level of investment needed to provide all people with safe drinking water and adequate sanitation facilities?

Implementation of the answers to these questions leads to the following institutional question: what institutional mechanisms should be developed that can best cope with the increased pressure on the water resources in the country?

3 THE IWRM CONCEPT

3.1 Current definitions and guiding principles

IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP, 2000).

3.2 How the concept is understood in the Egypt

The concept of Integrated Water Resources Management (IWRM) has been developing since the beginning of the nineties. IWRM is the response to the growing pressure on our water resources systems as a result of growing population and socio-economic developments. Water shortages and deteriorating water quality have forced many countries in the world, in developed and developing countries alike, to reconsider their options with respect to the management of their water resources. As a result water resources management (WRM) has undergone a drastic change world-wide, moving from a mainly supply-oriented, engineering biased approach towards a demand-oriented, multi-sectoral approach, often labeled Integrated Water Resources Management.

In the international fora opinions are converging to a consensus about the implications of IWRM. The concept of IWRM let us move away from 'water master planning', which focuses on water availability and development, towards 'comprehensive water policy planning' which addresses the interaction between different sub-sectors, seeks to establish priorities, considers institutional requirements, and deals with the building of capacity.

A key aspect of IWRM is that the management and development of the resources should take place in interaction with the users (the socio-economic system), the environment and the institutions involved. IWRM applied in this way considers the use of the resources in relation to the social and economic activities and functions. These also determine the need for laws and regulations for the sustainable use of the water resources. Infrastructure, in relation to regulatory measures and mechanisms, will allow for effective use of the resource, taking due account of the environmental carrying capacity.

IWRM practices depend on the context of the specific application. This means that IWRM as applied in Egypt will have to take into account the particular situation of Egypt with respect to the geographic and hydro-meteorological conditions as well as the social and cultural values of the country. IWRM should not be seen as a 'model' that has to be enforced upon the country.

3.3 The right emphasis: focus on the means or the end?

The National Water Resources Plan is based on a strategy that has been called 'Facing the Challenge' (FtC). FtC includes measures to develop additional resources, make better use of existing resources, and measures in the field of water quality and environmental protection.

The possibilities to develop additional resources are limited. Deep groundwater withdrawal in the Western Desert can be increased to 3.5 BCM/year, but, being fossil water, this is not a sustainable solution and should be carefully monitored. Small amounts of additional resources can be developed by rainfall and flash flood harvesting and the use of brackish groundwater. Co-operation with the riparian countries of the Nile Basin is expected to lead to additional inflow into Lake Nasser.

Measures to make better use of existing resources aim at improving the efficiency of the water resources system. They include a careful evaluation of planned horizontal expansion projects and a scheduled implementation of the projects in relation to the availability of required water. The water use efficiency in agriculture can be improved by many measures, in particular by continuing the Irrigation Improvement Project (IIP), by implementing the Integrated Irrigation Improvement and Management Project (IIIMP), by continuing the Drainage Improvement (EPADP) activities and by reviewing the present drainage water reuse policy, e.g. by applying intermediate reuse and by allowing the use of water with a higher salinity content. Moreover, a different water allocation and distribution system that will be based on equity will decrease the losses in the system. To implement such a system and to improve operation and maintenance (O&M) it will be required to have a good institutional structure with strong Water Boards and Water Users Associations. The municipal and industrial water use efficiency can be improved by a mix of infrastructural and financial incentives or measures. Various research topics are formulated to identify further options to increase the efficiency of the system.

The strategy on protecting public health and environment includes several packages in which infrastructural, financial and institutional measures are combined. Priority is given to measures that prevent pollution. This includes reduction of pollution by stimulating clean products and relocation of certain industries. Agriculture will be encouraged to use more environmentally friendly methods and products. If pollution can not be prevented, treatment is the next option. The plan includes a considerable increase in treatment of municipal sewage and wastewater. Domestic sanitation in rural areas requires a specific approach. In both cases cost recovery is needed to maintain the services. The last resort will be to control the pollution by protecting the people and important ecological areas from direct contact with this pollution. Additional attention is required to protect sensitive areas, e.g. around groundwater wells and intakes of public water supply.

The strategy also includes a number of general institutional measures. The initiated process of decentralization (to Water Boards) and privatization will be strengthened, including a restructuring of the role of MWRI, e.g. by establishing Integrated Districts at local level. Cost sharing and cost-recovery mechanisms will be implemented to make the

changes sustainable, in particular with respect to operation and maintenance. The planning process at national level will be continued as an ongoing exercise, including the improvement of data and information exchange among different authorities and the co-ordination of investments. Finally, the role of the real stakeholders in water resources management, i.e. farmers and citizens should be enhanced by involving them better in the various water management tasks but also by strengthening their 'ownership' feelings towards public property. The specific role of women in water management issues is acknowledged and receives special attention.

3.4 Implementation challenges

The growing population and related socio-economic activities require an increasing amount of water. The Nile River is an abundant source of water but also this source has its limitation and at some point in time demand will outgrow the available supply. Efficiency improvement may delay that point in time but sooner or later Egypt will have to face that situation, and decisions have to be made now on how to deal with this. What are the challenges involved?

Securing water for people etc
Water is essential for life and access to safe drinking water is the first requirement that has to be met. Quantity is not the problem in this case. The challenge is to take care that the quality is according to health standards and to provide the necessary facilities such as drinking water plants and distribution systems.

Securing water for food production
Agriculture is a major economic activity in Egypt. Although the agricultural sector represents only 17% of the GDP nowadays (down from 40% in 1960), it still provides employment for about 40% of the labor force and plays an important role for many people as sustenance farming. However, agriculture is a major water consumer, especially in an arid country as Egypt where nearly all agriculture depends on irrigation water. Agriculture accounts for about 95% of the total net demand in Egypt (with 4% for municipal and industrial water and 1% for fish ponds). Population growth in combination with the horizontal expansion plans of the government will increase the demand for irrigation water. A considerable increase in efficiency is needed to make this additionally needed water available. Such an efficiency improvement will have important social as well as economic impacts, e.g. when changes in the cropping pattern are required (shift from crops with high water demand to less sensitive crops).

Securing water for industry, services and employment
To improve the welfare of the people and given the limitations in the water supply for agriculture, Egypt will have to give priority to the development of other livelihood opportunities than agriculture, in particular in the industrial and services sectors. Also in this case the challenge is not quantity but quality and to provide adequate facilities not only for the supply of the water but also with respect to the sewage water that will be produced.

Developing a strong institutional framework
Water resources management in Egypt, like in many other countries in the world, has historically been very centralized, fragmented and sector oriented. The concept of IWRM stimulates cooperation between stakeholders, decentralization and privatization. This requires a different set-up of the institutional system around water management and appropriate ways to coordinate policy making, implementation and management across sectoral, institutional and professional boundaries. It also requires that the institutions involved have sufficient legal and financial means to carry out their tasks. To this end it will be needed to apply cost-recovery and cost-sharing principles.

Creating popular awareness and understanding
The limitations in the supply of water and the urgent need for water quality improvement require public awareness of these issues. This awareness is needed to mobilize effective support for sustainable water management and induce the actions required to achieve changes in behavior. Additionally, public awareness and subsequent pressure for action may help in stimulating the political will to act.

Protection and restoration of vital ecosystems
The aquatic ecosystems in Egypt are seriously threatened by the deteriorating quality of the water. The remaining systems are limited and fragile and in dire need to be protected. Moreover, polluted systems as the coastal lakes should be restored to their original states. Not only will this benefit the ecosystem involved, also the socio-economic 'use' of these systems will improve considerably (fishing, recreation, etc.).

Co-operation with Nile Basin countries
Egypt, being the most downstream country of the Nile river, will be influenced by developments upstream, in particular in Sudan and Ethiopia. Co-operation with Nile Basin countries is needed to ensure an equitable development of the Nile Basin as a whole. Egypt has a major interest in this co-operation. Many opportunities exist for the further development of the Nile water resources system, among others resulting in more water available for the riparian countries.

Stimulating the political will to act.
Finally, it is necessary to have political attention and commitment to ensure good decision making and the necessary investments in the development of the water resources in Egypt. Bringing water resources issues to the top of the political agenda is fundamental to the long term success of sustainable water resources management.

4 IMPLEMENTATION STATUS OF IWRM

Implementation process

I. Implementation of NWRP–a coordinated effort of all stakeholders, supervised by the National Water Council
II. Required investments and recurrent costs – to be incorporated in annual and 5-year plans of the stakeholders
III. Total NWRP 2003-2017 costs for investments are BLE 145, and total operational and maintenance costs are approximately BLE 44 for the same period.
IV. Communication and consultation – crucial elements in implementation

4.1 General level of recognition of linkages between IWRM and poverty. reduction

Ensuring safe water supplies and adequate sanitation throughout the developing world are the most effective measures for curbing poverty and improving health.

A World Bank report says agriculture can provide pathways out of poverty for millions of rural poor who would otherwise be left behind in transforming economies. It says one way out is through a high-value agricultural revolution. Incentives to diversify into high-value horticulture, poultry, fish and dairy products could be provided via pricing reforms and an overhaul of subsidy supports for cereals.

About one quarter of Egyptians live in poverty. The Human Development Index ranks Egypt 111th of 177 countries (Human Development Index 2006). One reason for this is widespread unemployment, which also affects many school and university graduates. Although Egypt has invested in the education sector in recent years, the high rate of illiteracy (more than 30 per cent) points to serious shortcomings in the education system. Every year another 800,000 or so school leavers flood onto the labor market, and only about 250,000 of them manage to find a job. Women are disproportionately affected by poverty and unemployment. Thus one of the major challenges facing the Egyptian government is to create new jobs, especially for graduates.

High unemployment is one reason for Egypt's poverty. Official figures put unemployment at about 10 per cent – whilst some estimates put it at over 20 per cent. There are fewer and fewer jobs in agriculture and in state institutions. Women and young people are particularly hard hit. Fewer than one third of the more than 800,000 young people who flood onto the labour market for the first time every year manage to find a job.

Despite good performance on a number of macro indicators, Egypt has been less successful in reducing poverty. There may be various contributing factors including

policy constraints, a work force growing faster than job creation and an educational system which is not providing all the skills and skill levels needed by the economy and low levels of investment in training. The sustainability of infrastructure services requires opportunities for private sector investment dependent on improved regulatory policies and cost recovery systems. Key environmental issues -- reducing urban/industrial pollution, improving the use and quality of Nile River water resources, preserving Red Sea natural resources, and promoting energy efficiency -- continue to demand attention. Fertility must fall further to help contain expenditures for social services and to reduce the growth of the labor force and the persistence of poverty.

4.2 General level of recognition of the importance of IWRM as a tool for water resources development and management planning,

One of the 'measures' of NWRP is to continue water sector planning. Planning should be regarded as a rolling exercise. The present plan has a planning horizon up to 2017, is based mainly on 1997 data and was completed in 2004. Circumstances will change, lessons will be learned from experience and new insights will be gained. The monitoring, progress reporting and evaluation will also provide input to update the National Water Resources Plan.

This National Water Resources Plan should be seen as a first step towards real IWRM, requiring a process of full cooperation of all stakeholders, including the public and the various governmental levels. This first step can and should be followed by next steps. The cooperation between the stakeholders in the High Committee and Technical Committee for the NWRP should be continued in the National Water Council. Steps to involve also other stakeholders have been brought forward and first ideas about involving lower governmental levels have been developed. All above arguments lead to the need to consider planning as a continuous process. Such continuous process would include: An updating of NWRP every five years, in line with the Government's operational planning cycle, and covering a 20-year planning horizon; and

Initiation of a 2-level planning process by means of a pilot plan at the local level.
The present plan can be updated and extended with the experience gained so far. It can also accommodate new data that has become available. Hence, drafting the next plan as such does not have to be a major exercise. What will take time and effort is the continued discussion between the stakeholders on how to further tune their activities towards full IWRM.

A new plan will also enable to develop consistent operational plans, in particular the Five-Year plans of the individual stakeholders. Like the present plan it will be required that the Cabinet approves the next NWRP. The process of decentralization will strengthen the role of decentralized agencies and it can be expected that these agencies will start to play a major role in strategic planning, too. This makes sense because those agencies have a much better insight in the problems in their area and the ways these problems can be solved. It also is in line with the concepts of IWRM that emphasize the importance of bottom-up processes. The institutional structure in Egypt at the decentral

level is not sufficiently equipped yet to start a full 2-level process now. A pilot project will be initiated to gain experience with this kind of integrated planning at the local level. A decision still has to be taken which region will be used as a pilot.

4.3 General level of mainstreaming of IWRM principles in national policies and plans

The Government of Egypt has since long recognized the vital role of water for the economic and social development of the country and has initiated major programs to improve the performance of the water system. Examples are the ongoing horizontal expansion projects, the Irrigation Improvement Project (IIP) and the many drinking water and sewage treatment plants that have been and are being built.

The current Water Policy (of January 2000) of the Ministry of Water Resources and Irrigation (MWRI) covers many of the aspects mentioned and follows already an 'integrated' water resources management approach. The policy tries to achieve those objectives by:

a. improving the efficiency of the present use of the water resources;
b. developing new water resources, e.g. deep groundwater; and
c. protecting environment and reducing water related health hazards.

The expanding economy of Egypt, the limitations in developing new water resources and above described 'challenges' necessitate the development of a new policy. This new policy is building upon the present (2000) policy but extends it and includes new aspects. In particular the new policy:

- extends the approach of integrated water management, not only by taking all policy objectives into account, but by making the plan a 'national' plan and not a plan of MWRI only;
  a. hence, is based on the involvement and co-operation of all stakeholders;
  b. includes institutional change;
  c. pays specific attention to the implementability of proposed measures;
  d. includes an update of the water availability assessment and an update of the demand projections by 2017; and finally,
  e. is based on tools (including computational tools) that enable a trade-off between the various aspects involved.

General objectives of the national policy related to water resources development include:

a. To increase the economic growth to 6.8% in the period 1997 - 2002 and to 7.6% in the period 2003 - 2017, to increase the per capita GDP from 1,250 USD to 4,100 USD in 2017 and to increase employment to 97-98%.
b. To increase the inhabited space of Egypt (5.5% of the population living outside Nile Valley and Delta to be increased to 25%). The present policy of developing new cities outside the Nile Valley will be expanded by developing areas in Sinai and the Western Desert.
c. To develop Northern Egypt concentrates on El Salam Canal in the Eastern Delta (220,000 feddan) and Sinai (400,000 feddan). Other plans include the

development of 250,000 feddan in Middle Sinai and the development of harbours, industry and tourism. The basis for the development of Southern Egypt is the construction of the New Valley Canal that will irrigate some 500,000 feddan, and the expansion of oases where 447,000 feddan are planned to be irrigated using groundwater resources. Support will be given, besides to agriculture, to the development of industry and tourism.

d. To protect the Nile and other fresh water resources from pollution.
e. To promote integrated pest control and limitations on the use of agro-chemicals.
f. To extend sewage networks and wastewater treatment plants.
g. To promote water conservation in domestic use, in agriculture and in industry.

These long-term national objectives are translated into Five-Year plans. The Five-Year Plan 2002- 2007 has taken into account the slowing-down of the world economic growth of recent years and has somewhat reduced the growth objective. On the other hand public spending is likely to increase.

4.4 Level of mainstreaming of IWRM considerations in the Legal Framework

Water management needs the support of an adequate legal framework that provides the water managers with guidelines and instruments for the planning of new developments, for the allocation of water, for the operational management and maintenance of the irrigation and drainage system, for the management of water quality and for financing all these activities.

The most important laws in this respect are:

I. Law 12 (1982), "Concerning the Issue of the Law on Irrigation and Drainage";
II. Law 213 (1994), "Regarding Farmer Participation";
III. Law 48 (1982), "Concerning the Protection of the River Nile and Waterways from Pollution", implemented by Decree 8/1982 of MPWWR; and
IV. Law 4 (1994), "Law for the Environment."

The main characteristics of these laws are summarized below:

Law 12 (1982): Irrigation and Drainage

Irrigation and drainage are regulated by Law number 12 of 1982 "Concerning the Issue of the Law on Irrigation and Drainage". The Law defines public properties related to irrigation and drainage, for example the River Nile, the main canals, public feeders and public drains and their embankments. It also defines the use and maintenance of private canals and field drains and specifies arrangements for the recovery of costs of drainage works. The rules for water allocation, for example the winter closure, rotations and the planting of rice are provided, as well as rules for the construction of water intakes along the Nile and public canals and the need for consultations with land owners before making changes to water intakes.

The Law regulates the use of groundwater and drainage water (construction of wells or the use of drainage water and water pumps). It provides the regulations for the development of new land and the price that has to be paid for the irrigation and drainage of land. The Law regulates the protection against flooding, navigation and coastal protection, the authority to recruit people to guard and protect the banks of the river Nile (and irrigation establishments) against flooding, as well as measures to protect the irrigation system against damage. Section VII of the Law describes the penalties for violations (for example growing rice in areas without a license can be punished with 30 to 100 LE per feddan) and gives the irrigation engineer the right to demand repairs of damages to irrigation or drainage works. Finally some provisions are given to settle disputes and a fund for the repair of irrigation works is established.

Law 12/1982 is primarily aimed at irrigation as the dominant water user and the Ministry of Irrigation (now MWRI) as the water manager that has to give permission for all abstractions of water. Other water users are not mentioned in particular. No priority rules are given in case there might be conflicts between various categories of water users.

The Law does not provide an adequate legal basis for water resources management in a era of scarcity, which demands the involvement of stakeholders in the water sector in the planning and allocation of water resources. A revision of Law 12 has been drafted and submitted to the Cabinet, which enables user organizations to play a role in the management of irrigation water at the levels of mesqa and above in all categories of irrigated land in Egypt.

Law 213 (1994): Farmer Participation

Law 213/1994 (FWMP, 1996) provides MPWWR (now MWRI) the legal basis for the establishment of farmer participation at the mesqa level for improved irrigation systems. It also establishes a fund to finance projects related to the development and maintenance of improved mesqas and to promote awareness with respect to the use of water. The Law originally only concerned water users organisations on new lands. Recently the Law has been adapted to include organisations on old lands (such as IIP WUAs, branch canal WUAs and Water Boards) as well. The Law enables the recovery of costs in case the landowner neglects his duties with respect to the maintenance of the irrigation or drainage system or if he violates the authorisation for irrigation of new land.
Although Law 213/1994 enables farmer participation in the management of improved irrigation systems at the mesqa level and provides the legal basis for water users organisations on new lands, organisations on old lands can only acquire a legal personality in conformity with Law 32/ 1964 on Private Associations and Unions (FWMP, 1996).

Law 48 (1982): Protection of Nile from Pollution

Law 48/1982 provides the basis for the protection of surface and groundwater against pollution. In the law a distinction is made between the Nile and the irrigation canals which are referred to as ‘potable’, and the drains, lakes and ponds, which are referred to as ‘non-potable’. MPWWR (now MWRI) is made responsible for the licensing of wastewater discharge, whereas the Ministry of Health is responsible for monitoring

effluents. Only discharge of treated wastewater is permitted, while treated wastewater from animal or human sources can only be discharged to "non-potable" water. In addition, the reuse of drainage water is regulated, as well as weed control and waterway pollution by agro-chemicals. It establishes a fund from the revenues of levies, fines and costs recovery, which can be used for administration, donations, research and rewards.

The executive regulations of Law 48 provide water quality standards for (1) the Nile river and canals), (2) treated industrial discharges to the Nile, canals and groundwater; (3) domestic and industrial discharges to drains, brackish lakes and ponds, (4) reuse water to be mixed with Nile river or canal waters, and (5) the drains, lakes and ponds themselves.

Law 48 of 1982 and its executive regulations have been reviewed in a number of studies. Comments are related to the nature of the standards and their strictness, which hampers compliance and enforcement, the distribution of responsibilities and the relation between this Law and Law 4/1994, which was established for the protection of the environment in general.

Strict enforcement of the present regulations would mean very large investments by industry and municipalities, which are in the present situation not realistic and even counterproductive. It would also forbid the reuse of treated municipal wastewater.

The application of Law 48 needs to become more flexible; adaptations of the Regulations are necessary to convert it into an effective tool in an overall action plan for pollution control. A revision of Law 48 is in preparation within MWRI for submission to the Cabinet.

Law 4 (1994): Environment

Law 4/1994 concerns the environment in general. During the preparation of the law it has been decided not to integrate Law 48/1982 into this new law. Instead, Law 4/1994 refers to Law 48/1982 for specific regulations on water quality. An important element of Law 4/1994 is the establishment of the Egyptian Environmental Affairs Agency (EEAA). From the viewpoint of Integrated Water Resources Management Law 4/1994 provides regulations for the protection against pollution of sea shores, ports, etc that are not covered by Law 48/1982.

The co-existence of Law 4/1994 and Law 48/1982 makes that the division of responsibilities between various agencies with respect to the management of the water quality in the river Nile, the canals and the groundwater is not always clear.

4.5 Level of mainstreaming of IWRM considerations in the Institutional Framework and implementation/enforcement mechanism

The strategy Facing the Challenge FtC includes a large number of policy decisions and measures that will be implemented in the coming years. Many stakeholders are involved in this implementation and careful planning and coordination is required. This implementation framework will have an 'open' and 'rolling' character, meaning that it is

not static or prescriptive, and leaves room for individual stakeholders to further elaborate upon in relation to their own responsibilities. At the other hand this implementation framework will be concrete, by translating the strategy FtC into specific activities and assigning clear responsibilities for carrying out the activities involved. It also includes the budgetary requirements for the implementation, including investments and recurrent costs.

The framework will specify:

I. *what*: the concrete actions that have to be taken
II. *who*: the stakeholder that will be the prime responsible and who will take the lead in the implementation of the action;
III. *how*: the steps to be taken and the consultative process involved; and
IV. *when*: the planning time.

The implementation of the National Water Resources Plan will follow the five-year and annual planning system of Egypt. The most recent five-year plan covers the period 2002-2007. This five-year plan includes investment allocations that cover various elements of NWRP and, hence, already provides room to implement NWRP. It appears that implementation of the NWRP will require some additional budget compared to the present five-year plan. More specific allocations for investments and other strategy elements of NWRP will be included in the Annual Plans as developed by the stakeholders. The implementation of NWRP will be an element of the overall planning and coordination structure of the water sector. Actually, the implementation framework covers the bottom part of the planning cycle. The main elements of this framework are:

The National Implementation Plan
The National Implementation Plan will provide an overview of the actions to be taken. It includes a listing of the actions and required budgets for investments and/or recurrent costs involved and indicates which stakeholder will be first responsible to take action. Moreover, the National Implementation Plan will describe how the actions of the individual stakeholders will be coordinated, monitored and evaluated.

The Operational Plans
The operational plans of the individual stakeholders contain the translation of the National Implementation Plan into concrete activities of the stakeholders and the assignment of the responsible organizational units. Some of these operational plans have a national nature, others a more local one. They are all to be included in the regular 5-year and annual planning cycle of the stakeholders. The stakeholders will have the full responsibility for their own plans. Therefore, these operational plans will not be included in the NWRP. Coordination of the operational plans over the various stakeholders will be taken care of by the (intended) National Water Council (NWC).

Monitoring, progress reporting and evaluation
The stakeholders will also be responsible for the monitoring, progress reporting and evaluation of the implementation. This monitoring will follow the progress of implementation and provide feedback on the impacts of the implementation on the water

resources system. As such it will contribute to the next round of planning. The monitoring, progress reporting and evaluation will be overseen by the National Water Council.
Above description of the elements of the implementation framework illustrates that the main responsibility for the implementation remains with the individual stakeholders. This is similar to the present situation. What is new is that the implementation of the various measures is placed in an overall national context (the National Water Resources Plan), coordinated at a national level (the NWC) and that the results of the implementation will provide feedback for the next round of planning.

Restructuring of MWRI and establishment of integrated MWRI Districts Institutional reform unit
Decentralization and privatization will result in a different role for MWRI. This is already recognized and an Institutional Reform Unit (IRU) within MWRI has been set-up to initiate Decentralization of government services and co-ordinate the decentralization and privatization activities. Given the ambitious agenda for institutional reform in water management the establishment of such a dedicated unit is important. It will ensure that the reforms remain on track and well paced.

Establishment of integrated MWRI Districts
The transfer of authority to Water Boards means that the role of MWRI is changing from an operational into a more strategic and supervisory one. The strategic role comprises the leading role of MWRI in national planning and policy making. Their supervisory role will have to be taken up by Districts. These Districts will enable local water management to be carried out by Water Boards and WUAs within the national regulatory policy framework. The Districts will ensure that the MWRI's operational planning is increasingly based on the local needs expressed by the water users. The planning for the establishment of Integrated MWRI Districts is to achieve full coverage by 2022. By 2007, the structure was operational in 4 Governorates. It should be noted that pilot experience will help to recognize whether the District is the right level to integrate MWRI services.

4.6 Challenges Related to Implementation of IWRM in Egypt

A key aspect of IWRM is that the management and development of the resources should take place in interaction with the users (the socio-economic system), the environment and the institutions involved. IWRM applied in this way considers the use of the resources in relation to the social and economic activities and functions. These also determine the need for laws and regulations for the sustainable use of the water resources. Infrastructure, in relation to regulatory measures and mechanisms, will allow for effective use of the resource, taking due account of the environmental carrying capacity.

IWRM practices depend on the context of the specific application. This means that IWRM as applied in Egypt will have to take into account the particular situation of Egypt with respect to the geographic and hydro-meteorological conditions as well as the social

and cultural values of the country. IWRM should not be seen as a 'model' that has to be enforced upon the country.

IWRM challenges for Egypt

The growing population and related socio-economic activities require an increasing amount of water. The Nile River is an abundant source of water but also this source has its limitation and at some point in time demand will outgrow the available supply. Efficiency improvement may delay that point in time but sooner or later Egypt will have to face that situation, and decisions have to be made now on how to deal with this.

On the national level various Ministries have responsibilities related to water resources management (see text box). Through their policies these ministries influence the national water resources. Occasionally other ministries are involved as well such as the Ministry of Electricity (hydropower) and the Ministry of Tourism (tourist related navigation on the Nile, water quality along Northern Coasts). Co-operation between all relevant ministries is necessary to strengthen water resources related policies.

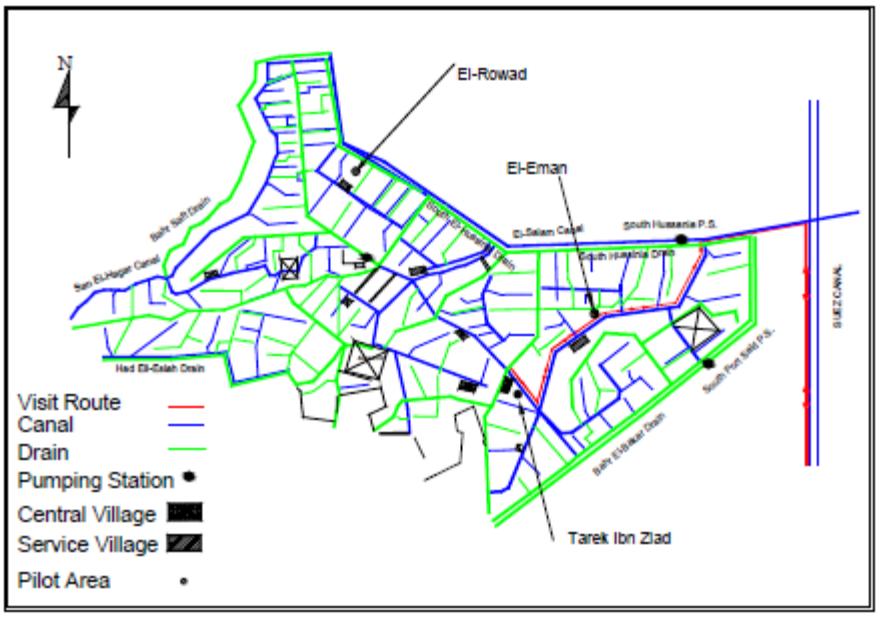
In addition to these national actors, IWRM has to incorporate the policies and views of the regional and local stakeholders, i.e. the governorates, districts, water supply and sanitary drainage authorities, water boards, water users associations, and, of course, the general public.

Different kinds of stakeholders are the upstream Nile Basin countries. Although the national water resources plan focuses on the national aspects of Egypt's water resources, a continuation of the co-operation between the Nile Basin states both on a bilateral and regional basis is of utmost importance to safeguard the water resources. Moreover, by co-operation additional resources for Egypt and other riparian countries can be made available.

5 CASE STUDIES OF IWRM INITIATIVES IN Egypt

5.1 Case 1: Analysis of salinity Changes in selected Pilot Areas

This study is concerned with identifying the effect of soil salinity, irrigation water salinity and the farmer's level of investment on the soil characteristics, crop productivity and crop quality. To achieve the objectives three pilot areas were selected in south EL-Hussenia area and were irrigated using water from El-Salam canal (mixture of fresh and drainage water). Interaction between irrigation water salinity, soil salinity and crop yield and



quality are analyzed taking into consideration the effect of farmer investment ability.

Figure 1. South El-Husseinia Plain

The study objective was to analyze the interacting relationships between irrigation water salinity and soil salinity and their effect on crop yield and quality. The analysis showed that cultivation using low quality water is still possible with good water management.

Soil Salinity improved by cultivating rice and allowing continuous leaching. Soil Salinity changes are studied along soil profile and throughout the time horizon. In addition, changes in drainage water salinity were observed and studied to investigate the leaching process. Behavior of soil salinity in different plots is categorized to determine factors affecting the behavior of each group.

Three pilot areas were selected for the project based on certain criteria and intensive field investigations. The selected sites are El-Rowad pilot area (435 feddans), Tarek Ibn Ziad pilot area (360 feddans) and El-Eman pilot area (380 feddans). The first two areas are

owned by recent graduates and the third is owned by investors. Soil samples were collected from 21 locations in each pilot area.

Figure 2 Sample Pilot Area (Tarek Ibn Ziad)

Soil monitoring started in both El-Rowad and Tarek Ibn Ziad pilot areas in October 1999 and in El-Eman in April 2000. According to the East Delta Reclamation Study (1998), most of the land is slightly above the level of Lake Manzala. The soil is extremely saline and the ground water depth varies between 0.7 and 1.9 m and is highly saline too.

The study was a preliminary analysis of soil salinity for the collected data including trends in soil salinity changes in the three pilot areas. A soil salinity monitoring program was carried out in the three pilot areas, Tarek Ibn Ziad Pilot area, El-Rowad Pilot area since April 2000 and El-Eman Pilot area since December 1999. These areas were located in El-Husseinia plain in the eastern part of the Nile Delta; it is a part of the coastal plain of Lake Manzala characterized by heavy to medium saline clay soils.

The soil salinity of the three pilot areas is presented. Soil salinity is one of the major factors that affect crop yield and consequently socio-economic conditions. Soil samples are collected for salinity and complete chemical analysis according to the project schedule. The soil samples were tested using saturated soil paste.

Soil Salinity improved in El-Rowad and El-Eman pilot area faster than Tarek Ibn Ziad because the irrigation water is available with lower salinity. In contrast, Tarek Ibn Ziad pilot area has a shortage of water especially in summer times. The salinity of the

irrigation water is high because the pilot area lies at the far end of the canal. Also, the irrigation canal receives seepage from surrounding areas, which has high saline soils. It is recommended to improve the source of the irrigation water for this pilot area regarding the quantity and quality of the irrigation water. Soil Salinity decreased in some plots because of good leaching, while it remained high in other plots, due to poor leaching. In some plots it was noticed that salts are stored in the top soil layer while, in others stored in the bottom layer. Finally, the agricultural activities continued leaching and growing rice help in reducing salinity levels.

The data was collected during the period from 1999-2005 for El- Rowad and El-Eman pilot areas of EL-Hussenia plain during the reclamation process. This data represent changes in irrigation water quality from the salinity point of view, soil salinity, water table depth and salinity and cropping pattern. Data were collected of different time intervals starting for some of it from the early beginning of reclamation or from one of the sub-stages of leaching/cropping stage, ended by the end of leaching/cropping stage in most cases or in some by the normal cropping stage.

The conclusions and recommendations in this report, developed from the practical applications of the reclamation process which took place in the EL-Husseinia Plain, were used to develop the "Operational Drainage Water Reuse Guidelines" report in April, 2006. This experience can be used as a model for such process and it should be applicable for most areas within Egypt having the same boundary conditions. Soil reclamation is the key part of the Guidelines.

5.2 Case 2: Integrated water resources management in Lake Nasser Region

Egypt's water is supplied almost exclusively from the Nile. This water supply however is already at the precarious level of 724 m^3 annually per person well below the definition of the threshold level for water scarcity. This supply situation will deteriorate even more in view of the population growth in Egypt and the growing international competition for the water of the Nile.

The model region of the study comprises the possible zones of settlement in the Lake-Nasser Region in Egypt. This region around the Lake Nasser was selected by the Egyptian government for development as a rural settlement zone. Within this large, previously not developed zone, the two areas of Kalabsha and Garf Hussein have been selected by the Egyptian project partners as the location for R&D.

The study area lies on the bay of Kalabsha, the largest bay in the Lake with a very winding shoreline. The water levels in the lake sway up to 25 m. As a result of falling water levels, the waterline can retreat a number of kilometers. For the Kalabsha bay, this means that with sinking water levels an inundated area of more than 4000 ha emerges which is used as a pasture due to the spontaneous growth of vegetation. On these previously inundated areas, vegetable cultivation is currently being carried out under high water pumping input by farmers who are only seasonally within this area. The

agricultural practices are characterized by intensive use of fertilizer and chemical plant protection. This type of the land utilization is already negatively affecting the economically very important fish supply of the Lake.

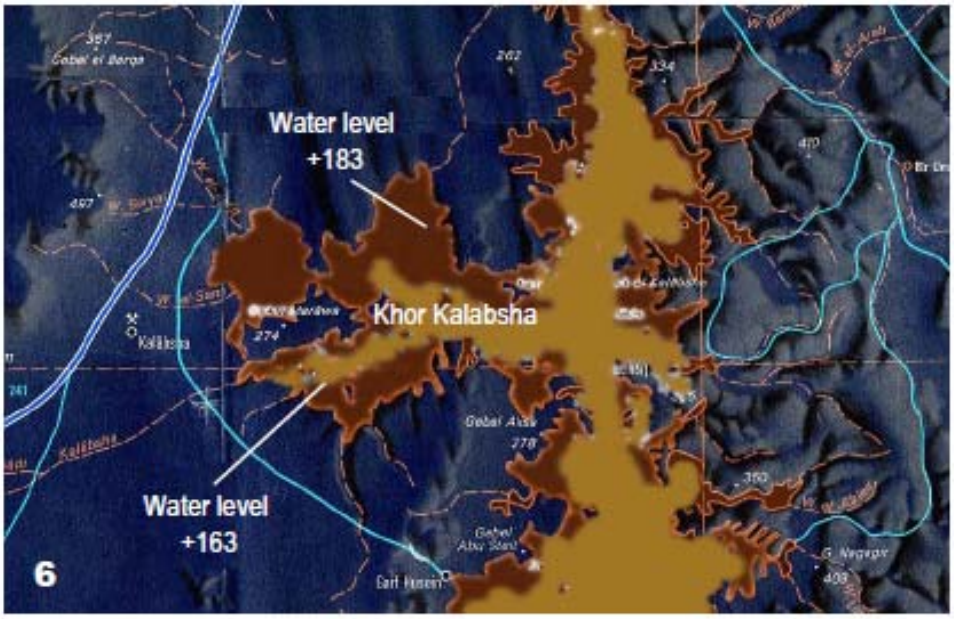


Figure (1) Satellite Image of Study Area

The fish breeding is mainly concentrated on the protected Kalabsha bay. In the established settlements in Kalabsha, there are at present, only ca. 800 persons living there. These settlements are noticeably made up of large numbers of women and children. Here, the irrigated agricultural areas are not adequately used, as there is not sufficient qualified labor force available for the cultivation of the fields. Around 2000 ha of entrepreneurial intensive irrigation agriculture, well above the high water line, show that this region can be economically managed and that previous settlement projects did not target the correct group.

Kalabsha and Garf Hussein can be reached from Aswan, the regional centre over an asphalt road. The distances amount to 85 km, and 140 km respectively. For these two villages there is at present no water treatment. The fresh water is transported through the use of water tank trucks. Along with this there is also neither a sewage network nor an electricity network.

Various Ministries and institutions deal with the utilization and the protection of the water resources in Egypt, among them the Ministry for Water Resources and Irrigation (MWRI), to which the High Dam Authority, the Drainage Authority and the National Water Research Centre NWRC (12 Institutions and 2 research units), and the Ministry of Agriculture and Land reclamation (MALR), to which the Agricultural Research Centre ARC (16 Institutes und 11 Central Laboratories), the Desert Research Centre (DRC) and the Land Development Authority. Of special importance for the research and development in the region is the Lake Nasser Development Authority (LNDA) which is responsible for the settlement of the model region. The Ministry of Environment (MoE)

also plays an ever increasingly important role in the region as it monitors environmental protection as well as water protection. For the financing of agricultural activities the Agricultural Development Bank is of great importance. The Egyptian World Food Program in cooperation with the LNDA aids in the assistance of settlement programs for small farmers.

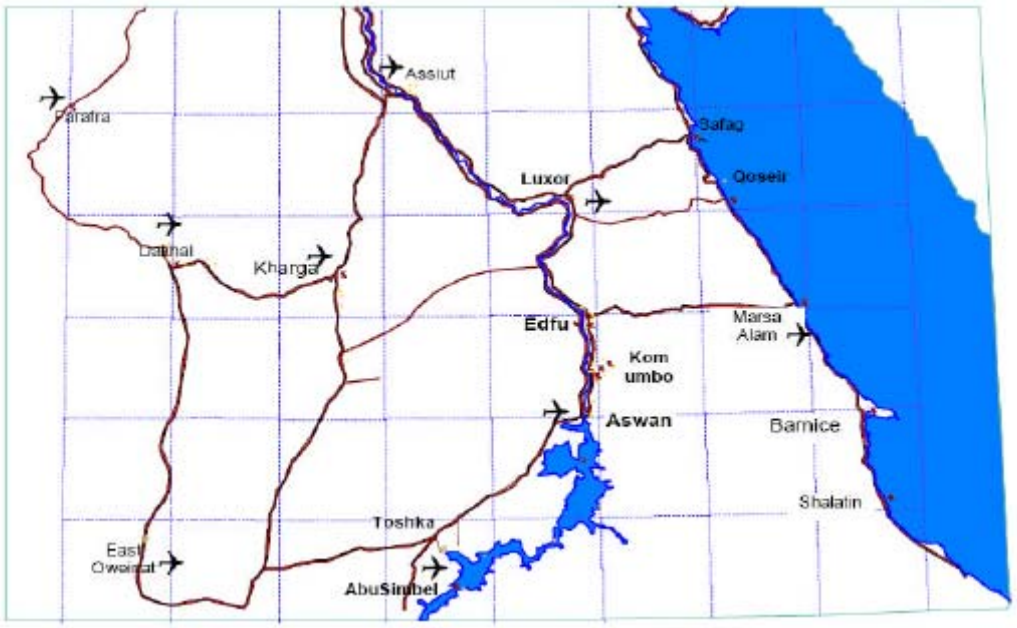


Figure (2) Transportation Network in the Lake Nasser Area

In the last few years water protection in Egypt has gained more and more importance. Thus a national water use strategy has been laid down which determines among other issues the efficiency of water use as well as the maintaining of the quality of the national water resources. The Stalinization, a serious problem in the Nile valley due to lack of functioning drainage, plays just as an important role in the political water guidelines as the deficits in the agricultural irrigation. In these guidelines the use of surface irrigation, i.e. furrow and basin irrigation, outside of the Nile valley are explicitly forbidden. It also stipulated that a multiple use of water and processed water shall take place. Institutionally a strong integration of water users in associations and zone corporations is aimed for. A further politically regulated measure for the waters protection is the introduction of new laws over the treatment of industrial and domestic waste water. Another political aim is the reduction of the use of mineral fertilizer and plant protection, which is why the Ministry of Agriculture promotes ecological farming methods.

With view to the precarious situation of water scarcity in Egypt, absolute priority is given to preserving the Nile water. This is a great national challenge for agricultural production and settlement development. The development of the study region shall be a model for the development of the whole Lake-Nasser-Region, in which the strict ecological principle of absolutely protecting the water body can be applied. Settlements beyond the

upper water line will further be separated from the lake by a green belt of two km width as a protection line.

Water which is applied for settlement, agriculture and the green belt has to be saved on in other locations of Egypt. Considering the high evaporation losses during water transport to the present main irrigation areas in the North of the country all measures for increasing efficiency of national water resources have to taken.

Within an Integrated Water Resources Management (IWRM), approaches to introduce water saving technologies are manifold. As a novelty in comparison to furrow irrigation as common practice in the Nile Valley, it is foreseen to develop large areas by implementing only water saving irrigation technologies, i.e. drip or sprinkler irrigation, and functional drainage systems. The latter will contribute in avoiding salt accumulation in the upper soil layers and reusing drainage water.

Also within the housing areas, water saving technologies and water recycling technologies are not yet in use. The livelihood of settlers is limited by the absence of (decentral) water treatment for drinking water and sewage systems. Insufficient income opportunities additionally make life difficult. Chances are seen to benefit from the postulate to practice ecologically safe agriculture within an integrated agriculture framework by generating valuable and thus high priced products. Additional income from animal husbandry and fish farming can secure the income. Via biomass recycling soil improvement for agriculture is achieved, which enhances the soil capacity to absorb nutrients. This prevents Stalinization. An integrated research approach has been developed in accordance with LNDA. This approach considers the interactions within a cyclic resource system. The research object to be integrated via water cycles is the system and its interactions with the system environment.

5.3 Case 3: Integrated Water Resources Management Plan (IWRMP) for Irrigation Districts

Integrated Water Resources Management Plan (IWRMP) is an integration of a range of plans related to water resources management at Integrated Water Management District (IWMD) and Directorate. The main Purpose of the IWRMP is to avoid redundancy and conflicts of plans and have effective operation and management of the irrigation system.

Coordinating between MALR and MWRI is important regarding IWRM. The agricultural sector in Egypt consumes about 85% of the total water available. Therefore, the two ministries works jointly to review the water requirements for agriculture from time to time to conserve water and increase land reclamation. The part of IWRMP that is the responsibility of MALR include:

Indicative/targeted cropping pattern
The MALR used to prepare this indicative cropping pattern every year to show crops that can be grown during the coming year. These crops are in the form of maps and table. The Agricultural cooperative prepares a map that shows the “houds” and crops to be grown.

The MWRI and BCWUAs can participate in preparing such map taking into consideration the water allocation and availability issues and the opinion of BCWUAs. High consumptive water use crops such as rice can be rotated among farmers with the help of BCWUAs. This can relieve the conflict and solve the problem of violation. Figure (1) shows an example of cropping pattern map for Sonbat Village in Santa IWMD. all IWMDs received the indicative cropping pattern for year 2008/2009.

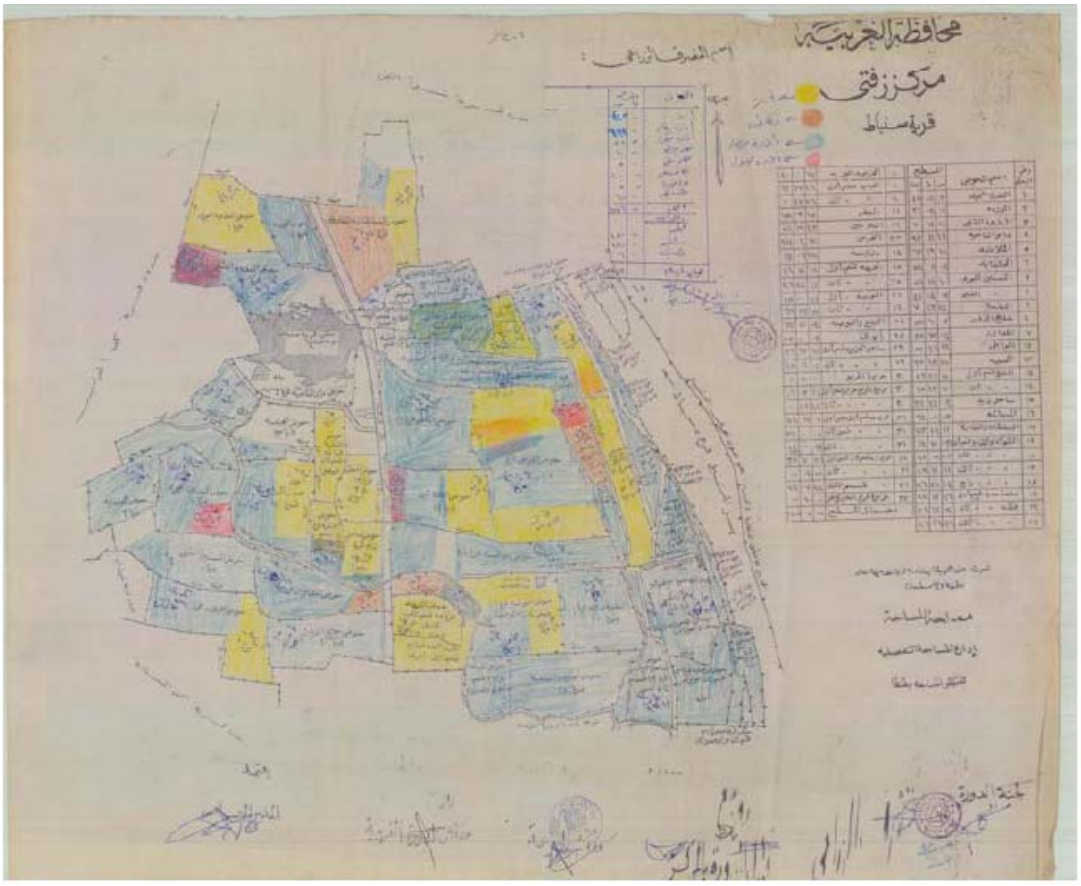


Figure (1) Cropping pattern for Summer season, Sonbat village in Santa

Maintenance of Mesqas plans

The MWRI is responsible for delivering water up to the branch canal. Farmers can get water from BC through their own field ditch called Mesqa. The MALR is responsible for cleaning and maintaining these Mesqas and charging farmers for this service. The uncleaned Mesqas usually causes problems to water distribution along the branch canal. Therefore, maintenance of Mesqas should be implemented through coordination between MWRI, MALR and BCWUAs to ensure that the Mesqa maintenance plan is implemented on schedule. All IWMDs received the MALR plan for Mesqa maintenance

Land leveling

MWRI staff asked MALR to participate on land leveling plans. MWRI can propose some areas that needs LASER land leveling to raise water use efficiency.

NOPWASD Plans (drinking water and sewage effluent*)*
These plans include the drinking water requirements and sewage effluent. Through coordination between MWRI and NOPWASD at the governorate level, the plan of NOPAWSD submitted to IWMDs and Directorate to be reviewed in terms of source of water, availability of water in that source, etc. Also, MWRI proposed some critical places that need sewage treatment before dumping into drains. NOPWASD welcomed this coordinating mechanism that ensures the right implementation of the plan. NOPWASD staff mentioned that some groundwater wells were dug for drinking but water depleted after two years. Hence, coordination with MWRI can help in selecting the appropriate place for groundwater well that has available water with good quality.

The major issue that was discussed during preparing the NOPWASD plan was the water losses in the drinking supply network that was more that 30%. MWRI asked NOPWASD to give more attention to decreasing these losses instead of constructing new drinking pumps.

Industrial water uses and effluent
IWMDs made a survey to collect information on existing and proposed factories and their effluent passage. Data on new factories were not available. However, there is coordination with the governorate on such issue.
Water Recourses management (Supply) plans
Water resources include; Nile water, groundwater, agricultural drainage water, and rains. Each IWMD assessed these resources through coordination with MWRI sectors; Irrigation Sector and Groundwater Sector. A plan for water supply from different sources to each IWMD was prepared.

Groundwater sector provided each IWMD with the hydrological maps and groundwater vulnerability maps. IWMDs and Groundwater Sector have surveyed all existing wells either legal or illegal. Water withdrawal from these wells was also estimated. The plan of groundwater included: planned and proposed wells to be dug by MWRI, a plan for legalizing the illegal wells, a plan for transferring the maintenance and operation of governmental wells to BCWUAs, a plan for protecting the areas vulnerable to groundwater population.

Figure (2) shows the hydrological map for Zifta and Sharkia with IWMDs boundaries were overplayed on

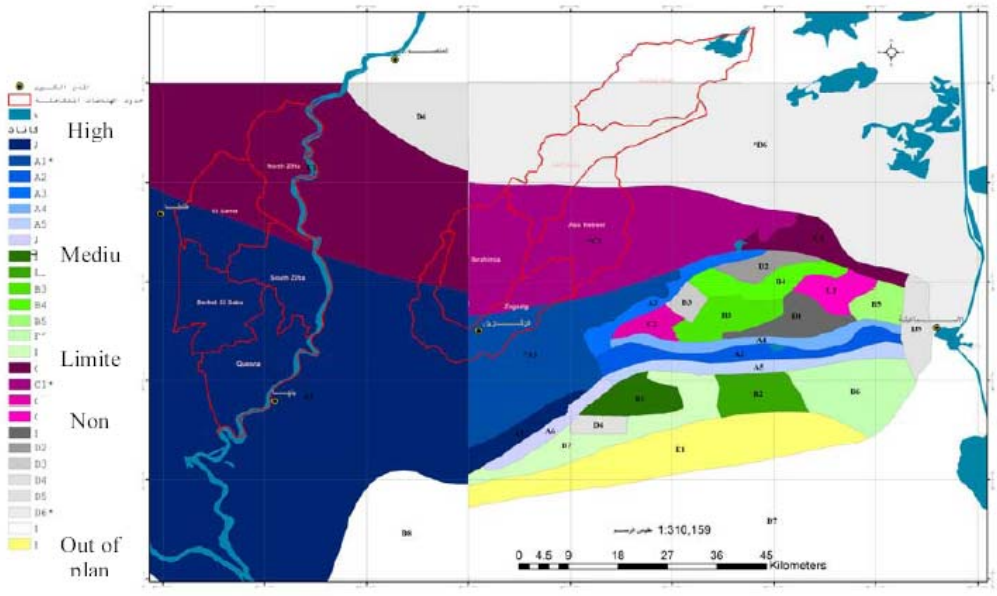


Figure (2) Groundwater potential map

Drainage reuse plans

Each IWMD prepared a plan for drainage reuse (intermediate drainage reuse). The plans included the size of the pump, location, cost of construction, and schedule of operation. The IWMDs inventoried the existing location of drainage reuse and calculated the potential of reuse.

Canal/Nile water targets/plans

After assessing the localized water resources, the required water to be allocated from Nile can then be determined. Irrigation sector and water distribution directorate participated in these plans. Targeted water from Nile is determined taking into account the available water at HAD and lake regulation. Target plans were prepared for each IWMDs and Directorate. In fact this is the first time that IWMDs and Directorates participate in preparing the Nile water allocation plan. A plan was also made by each IWMD to allocate water to all branch canal using rotation table.

Canal network maintenance plans

This plan includes water structures and offtakes that needs rehabilitation and/or eplacement so that water can be allocated more efficiently. Each IWMD proposed a list of priotrized structures to be included in the maintenance plan for year 2008/2009.

Participatory plans

Participatory water management is a major part in implementing the IWRMP. Water users can play an important role in facilitating the implementation of the IWRMP. The IWMD can prepare a list of activities for BCWUAs to be considered in BCWUAs plan.

For example, BCWUAs can participate in rehabilitation of some small water structures, preparing the internal canal rotation, removing water violations.

Water monitoring plan
In order to evaluate the IWRMP, a water monitoring program should be implemented in each IWMD and Directorate. Monitoring program/plan includes: Monitoring of canal main inflow points, drains main points, all branch canals inflow points, and drain water at mixing sites. These plan and program is made buy each IWMDs. The IWRMP shows that calibration of all BCs will be completed by end of year 2009.

5.4 Lessons learnt from IWRM initiatives in the country

The lessons learnt from the three above case studies, which were chosen carefully to address three of the important issues in the implementation of IWRM concept. The first case study is concerned with identifying the effect of soil salinity, irrigation water salinity and the farmer's level of investment on the soil characteristics, crop productivity and crop quality. The latter problem is of significant importance in the newly reclaimed areas for better management of water and soil resources.

The second case study is concerned with the possible zones of settlement in the Lake-Nasser Region in Egypt, considered a rural area of special importance due to the closeness from the lake. The latter case study addresses the issues of organizing the efforts by the different governmental entities responsible for development of the region, improving irrigation practices by the reduction of the use of mineral fertilizer and plant protection, reducing pollution by the introduction of new laws for the treatment of industrial and domestic waste water, and establishing a strong integration of water users in associations and zone corporations.

The third case study tackles an important institutional issue which is the integration of different/individual plans related to water resources management at Integrated Water Management District (IWMD) and Directorate. The main Purpose of the IWRMP is to avoid redundancy and conflicts of plans and have effective operation and management of the irrigation system. The different plans incorporated in the project include drinking water and sewage effluent**,** water recourses management (Supply), drainage reuse, canal/Nile water targets, canal network maintenance, participatory entities, and water monitoring. The latter elements are demonstrated with applications in pilot areas.

It can be seen that considerable improvements are illustrated by the results from the above case studies in the areas of soil salinity, irrigation improvement, integrated management, and institutional reform. Such projects could be repeated not only in other regions with Egypt, but also in similar areas within the Nile Basin.

6 CONCLUSIONS AND RECOMMENDATIONS

The Water resources are of great economic significance for the population of Egypt. Water is an important input for agriculture and industry and other sectors in the economy. Investments in water management will contribute to the development of the country. The need to feed the population and to strengthen the economy requires an anticipatory and proactive role, not only by the public administration but also by other stakeholders. Water resources also play a key role with regard to social objectives. In fact, water resources are of importance in increasing employment in all sectors of society and in creating an acceptable distribution of the national income. Possibilities to safeguard the national food security fall within the social objectives of the government's policy. Public health threats and environmental degradation are a major concern for the Egyptian government. Deterioration of surface water quality and groundwater quality can cause serious problems for public health and ultimately it can cause economic damage. Public administration and all other stakeholders have a shared responsibility to face these challenges.

On the national level various Ministries have responsibilities related to water resources management. Through their policies these ministries influence the national water resources. Occasionally other ministries are involved as well such as the Ministry of Electricity (hydropower) and the Ministry of Tourism (tourist related navigation on the Nile, water quality along Northern Coasts). Co-operation between all relevant ministries is necessary to strengthen water resources related policies. In addition to these national actors, IWRM has to incorporate the policies and views of the regional and local stakeholders, i.e. the governorates, districts, water supply and sanitary drainage authorities, water boards.

6.1 Conclusions on the level of implementation of IWRM

The following will summarize the lessons learned for levels of implementation on financial, institutional, policies, legal, environmental and water management issues:

On the financial issues:

a. Socio-economic development goals and demographic pressures in Egypt necessitates improved water management in the future.
b. Water management is seriously constrained by the lack of investments to finance the different components of the water system.
c. Cost of water supply is increasing dramatically for all types of uses (agriculture, municipal and sanitation etc.) and poses a significant burden on Government finances.
d. Current practices of cost recovery do not - and do not always aim to - cover neither supply costs nor full costs.
e. Incentives to limit water consumption for all types of uses should be introduced.

f. The current policy to shift the role of Government toward planning and monitoring rather than implementation and operation should be continued.
g. The water sector should be established as one economic sector within the general state budget in order to improve economic efficiency.

On the institutional issues:

a. The current institutional set-up in water management is characterized by a fragmented management style based on a sectoral approach.
b. Clear definition of institutional responsibilities, functions and jurisdictions are lacking. Especially with regard to environmental management.
c. The inter-sectoral coordination and communication is currently insufficient to achieve the holistic approach necessitated by IWRM.
d. Capacity issues within the ministries in relation to holistic assessment and planning has to be increased.

On the policies level:

a. Policies and practices which aims for a more integrated, participatory and environmental sound management approach is endorsed and are under implementation.
b. Most policies are developed and set by each ministry and are as such not national policies.
c. Major discrepancies in current policies with implication for the overall water budget are found.
d. Current policies are more "supply" oriented than "demand" oriented.
e. Is current policy based on a consideration of water as a limiting factor for economic development?
f. Water quality issues are not predominant.

On the legal level:

a. The current legislation concerning irrigation and drainage is not adequate for water resources management in case of scarcity.
b. The current legislation concerning farmer participation is not adequate for:
    i. establishment of Water Users Organization in the old land
    ii. establishment of e.g. various organisations at branch canal
    iii. or higher level
    iv. The current legislation concerning water quality and environment is adequate
    v. However standards for industrial waste are very strict and can only be complied by large investment. The law is not enforced.
    vi. Standards for various toxic pollutants e.g. pesticides, herbicides are lacking
    vii. Fines for violation of laws are to low to be effective.
    viii. Sampling procedures are inadequate
c. Generally enforcement of environmental laws is very weak.

On the level of environmental issues:

a. There is a need to establish clear division of responsibilities within environmental monitoring and management e.g. establish a unified environmental monitoring program.
b. Minimum outflows for environmental consideration has to be allocated e.g. for outflows to the Mediterranean.
c. Initialize improved management of wastewater.

On the level of water management issues:

The ability to manage water depends on the O&M of the water infrastructure. Thus the entire irrigation and drainage system require systematic evaluation of their state to assess deficiencies in their ability to perform as expected and to assist in planning and executing the proper system maintenance.

a. Improve and rehabilitate the conveyance system to allow for improved water distribution.
b. Metering of portable water and water for industries should be undertaken, in order to provide incentives for limiting water usage.

6.2 Recommendations for improving IWRM implementations

It is recommended to overcome the major constraints which are:

a. Lack of financing to carry out the change
b. Political will to centralize decisions
c. Conflict between MWRI and MALR

The following are some recommendations derived from the Kigali workshop:

a. To put in place awareness campaigns and education programs for IWRM at all levels from the top decision makers to the community level. This should include:
    i. Mainstreaming WRM in school curricula to create awareness among the future decision makers;
    ii. Campaigning through radio and televisions depending on the target groups.

b. A successful WRM requires both knowledge and feeling to translate knowledge into action.
c. To ensure participation at all levels -- Private sectors, men and women, rich and poor, top-down and bottom-up approaches -- when developing policies, legislation andplans to consider concerns for each group. This promotes ownership and responsibility.
d. To develop clear institutional set up at national and international level with clear linkage to other sector working groups, directorates and catchments levels indicating defined roles and responsibilities to overcome conflicts.
e. To put in place climate change adaptation measures.
f. To put in place the mechanism for information exchange and sharing.

7 REFERENCES

1. for the Future, National Water Resources Plan 2017, Ministry of Water Resources and Irrigation, January 2005.
2. Guidelines for Implementation of Integrated Water Management Districts, USAID, January 2008.
3. Hvidt, Maring, 'Implementation of IWRM as a Measure for Counteracting Changes', Annual Conference of the Association of Development Researchers in Denmark, May 14, 2008
4. Viala, Eric, 'Implenting IWRM in Egypt: From Concept to Reality', USAID.
5. Integrated Water Resources Management Plan, Report No 61, LIFE Integrated Wate Resources Management project, USAID, MWRI.
6. Hasan, Nabil, 'Egypt at the Heart of Regional Cooperation', revision paper, March 2005.
7. Qoaider, Louy, 'Summary report on Nile Basin, Egypt and the Lake Nasser region', March 2005.
8. Towards Integrated Planning of Irrigation and Drainage in Egypt: In support of the Integrated Irrigation Improvement and Management Project (IIIMP), Final Report,FAO, December 2004.
9. Jan Hoevenaars and Roel Slootweg, 'Rapid Assessment Study Towards Integrated Planning of Irrigation and Drainage in Egypt – Natural Resources Perspective', IIIMP, August 2004.
10. New Perspectives for Lake Nasser Flood and Drought Control, IWRM, Planning Sector, Nile Forecasting Center, LNFDC workshop, December 24-27, 2004.
11. Gamal El Din, G. et al, 'Analysis of Salinity Changes in Selected Pilot Areas South El-Hosainiya Plane', Drainage Research Institute, DR-TE – 0103-006-DR, January 2004.
12. 'Integrated Water Resources Management in Lake Nasser Region, Upper Egypt, Final Report, Institute of Tropics Technology, May 2005.
13. Integrated water resources management plan, report No. 61, LIFE Integrated Water Resources Management, September 2008

APPENDICES

8.1. Questionnaire

8.1.1. My comments on the Questionnaire

The questionnaire given has several shortcomings. I am listing the ones that I noticed:

1. Very lengthy
2. Some parts are repeated
3. Not organized in terms of structure, i.e. division into sections and sub-sections
4. Microsoft Word is not used professionally

I edited the file in terms of structures and Word format, and have given the edited version to the stake holders. The following are some of the changes I made to the original text:

- I transformed the titles into proper headings to generate an automatic table of contents that allows a hyper link to the specific sections of the report and put the LOC at the beginning of the Report
- I adjusted the numbering system to include five sections labeled in Roman numbers
- I redesigned the tables with options to choose from and inserted appropriate abbreviations defined before the table.
- I fixed page breaks to appear at logical locations throughout the document
- I fixed some of the automatic numbering was wrong, e.g. page 15 and 18

I am attaching the updated questionnaire.

The questionnaire should have been divided into smaller sections and given to specialized persons who can answer only the sections they are concerned with.

8.1.2. Stakeholders to whom the questionnaire was sent

The original list of stakeholders to whom I sent the questionnaire at the beginning of the project is:

- The Minister's Office, MWRI
- Irrigation Sector office
- Institutional Reform unit
- Head of the strategic research unit
- Head of the planning sector
- Water Resources Research Institute, NWRC
- Drainage Research Institute, NWRC
- Head of the Nile Basin Capacity Building Project

Following the mail from Dr. William Kudoja with regard to stakeholders in the Ministries of Agriculture, Environment and Energy, I sent the questionnaire to the following stakeholders:

- Professors from the Faculty of Agriculture
- Head engineer from the Ministry of Electricity
- Department head at the EEAA, MoSEA

The response from the Hydroelectric department at the Ministry of Electricity was that they did not find related questions to answer and thus they did not fill the questionnaire.
I received the following responses:

- ✓ Dr. Momen El-Sharkawy, Irrigation Water Management Districts
- ✓ Dr. Mohamed Fawzy, Director of Drainage Research Institute
- ✓ Dr. Alaa Abdin, Director of Strategic Research Unit
- ✓ Eng. Nabila, Irrigation Sector Office
- ✓ Dr. Sherif Elsayed, NBCB project manager

8.2. Other Tools

My Comments on the Structure of the Report

I have also slight comments on the structure of the report where I found some parts of it are repeated under different sections, e.g. challenges in items 2.5, 3.4, and 4.6. The term implementation challenges is mentioned under IWRM concept and under Implementation status. In addition I found that some sub-section titles could be made shorter like the use of 'Level of mainstreaming of IWRM' in sub sections 4.3 through 4.5 could be replaced by the rest of the corresponding title to eliminate verbosity.

I am not criticizing as much as trying to improve readability as I am part of the team writing the report and contributing to the final product and not a reviewer.