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IRRIGATION SYSTEMS PERFORMANCE IN EGYPT

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SUMMARY - Water is one of the most important inputs of the economic development. Size, type, and location of the economic activities depend on the nature, quantity, and quality and location of the available water resources. The less the water resources are and the more the demand is, the more important water is. This is the case in Egypt, where rainfall is rare and the desert covers most of the country area, except for a narrow strip of cultivated land and urban areas along the Nile river course. The quota of Egypt from the Nile River, which represents the main source of water of the country, hasn't changed since 1959. The Nile River in Egypt has supported the longest civilization over the world, which lasted more than seven thousands years. Egyptians, throughout the history, were skilful enough to efficiently utilize the Nile water. During this century, they installed an invaluable water structure; High Aswan Dam (HAD), which controlled the water releases pattern over the year. Like other large rivers, Nile river ends up with a unique delta region that extends over an area of about 6.0 million feddans of alluvial soils. Another batch of alluvial soils extends over about 2.5 million feddans along the Nile stem in the upstream. The Delta region is characterised with large tracts of rich fertile agricultural land, overpopulation, unique and delicate environmental conditions caused by the mixing of drainage and fresh water, unique flora and fauna, and problems associated with low lying areas such as sea water intrusion. Management of these unique natural resource areas has become more critical as the ecological balance in these areas becomes threatened due to an increase in water exploitation to support population growth and resource development. Moreover, the competition between water sectors is increasing and needs to have unique measures to be balanced. Therefore, performance of water delivery systems, particularly irrigation systems, needs to be clearly defined and assessed under these current or expected stressed conditions. This paper highlights the irrigation/drainage context and water management zones in Egypt. It presents the operation criteria and mechanisms, and the role of government and users in operation and maintenance of the system. Efforts for improving performance of the irrigation system at the macro and micro levels are addressed.

Key words: water management, irrigation systems performance, performance indicators, Egypt.

INTRODUCTION

Water is one of the most important inputs of the economic development. Size, type, and location of the economic activities depend on the nature, quantity, and quality and location of the available water resources. The less the water resources are and the more the demand is, the more important water is. This is the case in Egypt, where rainfall is rare and the desert covers most of the country area, except for a narrow strip of cultivated land and urban areas along the Nile river course. The quota of Egypt from the Nile River, which represents the main source of water of the country, hasn't changed since 1959. The Nile River in Egypt has supported the longest civilization over the world, which lasted more than seven thousands years. Egyptians, throughout the history, were skilful enough to efficiently utilize the Nile water. During this century, they installed an invaluable water structure; High Aswan Dam (HAD), which controlled the water releases pattern over the year.

Like other large rivers, Nile river ends up with a unique delta region that extends over an area of about 6.o million feddans of alluvial soils. Another batch of alluvial soils extends over about 2.5 million feddans along the Nile stem in the upstream. The Delta region is characterised with large tracts of rich fertile agricultural land, overpopulation, unique and delicate environmental conditions caused by the mixing of drainage and fresh water, unique flora and fauna, and problems associated with low lying areas such as sea water intrusion. Management of these unique natural resource areas has become more critical as the ecological balance in these areas becomes threatened due to an increase in water exploitation to support population growth and resource development.

Increased pressure on these resources, such as increased urbanization and intensification of agricultural development, would result in adverse impacts namely water quality and pollution issues. Competition between water uses such as agricultural, drinking water supply, fisheries, and recreation are increasing and needs to have unique measures to be balanced. Such innovations and changes will have impacts on the decisions of water management. Therefore, performance of water delivery systems, particularly irrigation systems, needs to be clearly defined and assessed under these current or expected stressed conditions.

This paper highlights the irrigation/drainage context and water management zones in Egypt. It presents the operation criteria and mechanisms, and the role of government and users in operation and maintenance of the system. Efforts for improving performance of the irrigation system at the macro and micro levels are addressed.

WATER SUPPLY AND DEMAND

Water resources in Egypt are represented with the quota from the Nile water; the limited amount of rainfall on the coastal areas; the shallow and renewable groundwater reservoirs in the Nile Valley, the Nile Delta and the coastal strip; and the deep (mostly non-renewable) groundwater in the eastern desert, the western desert and Sinai. The non-traditional water resources include reuse of drainage and waste water, and desalination of seawater and brackish groundwater.

After the completion of the HAD in 1968, Egypt started a new era of development through more controllable Nile water releases to different water users. Water users include agriculture, municipalities, industry, navigation, hydropower generation, and fisheries. For the time being, agricultural sector is considered the most water-consuming sector, as it consumes about 85% of the Nile water. Navigation and Hydropower generation are non-consumptive uses, as water releases are only needed to maintain their operating water levels. Recently, water demand for municipal and industrial sectors started to compete with agricultural water demand due to the rapidly growing population.

Agricultural Sector

The current cultivated area is in the order of about 8.2 million feddans, The agricultural year is divided into two seasons, i.e. summer and winter. Consequently two crops are usually grown; summer crop and winter crop. In some cases, farmers tend to cultivate a third crop during the period between summer and winter, which may extend for about two months. At the same time there are areas cultivated with annual crops, such as sugarcane and fruit trees. This crop diversification makes the total cropped area 13.7 million feddans, i.e. crop intensity of 172%. Among different regions in Egypt, crop diversification varies according to the climatic and soil conditions. There are two main crops of high water consumptive use, namely sugarcane and rice. The area of sugar cane of about 265,000 feddans is concentrated in Upper Egypt, where temperature is relatively high. The Nile Delta is the main area of growing rice especially in its northern part where the soil is affected by the sea water intrusion.

Municipal and Industrial Sector

Municipal and industrial water requirements have the highest priority in Egypt. However these requirements are small relative to the agricultural sector. Furthermore, water consumption in municipalities and industries is relatively low, where it doesn't exceed 20% of the water use(WMP, 1978 and NWRP, 2002). The current water use of this sector, reached about 8.8 BCM/y (4.2 BCM/y for municipalities and 4.6 BCM/y for industry).

CONTEXT OF THE IRRIGATION SYSTEM IN EGYPT

The Canal System

Released water downstream the HAD is distributed among regions through canals and pumps that divert water from the Nile river. These canals are called main canals. Further down, the canal hierarchy includes secondary, branch and distributary canals. This canal system is called public canals where the government is responsible for its operation and maintenance. The public canal system delivers water to private channels called “Mesqas” serving an area from 50 to 200 feddans. Mesqas feed farm ditches, which are called “Merwas” serving up to 20 feddans. Operation and maintenance of Mesqas and Merwas are done by the water users, who benefit from the extension services offered by the agricultural cooperatives.

Water delivery to each canal is determined based on the anticipated water demands for different purposes; agriculture, municipalities and industries, etc. Mathematical models are used for this purpose. This water quota is set at the beginning of the year on 10-day basis. Daily monitoring of the water levels and flows is made for the check points on the canal system to ensure equitable water distribution. Water delivery is made on continuous bases for main and secondary canals. The branch and distributary canals system is operated according to agricultural rotation principal. There are two systems of rotation; two-turn rotation and three-turn rotation. Under the two-turn rotation, the canal system is divided into two groups. Each canal group is opened for 7 days and closed for another 7 days resulting in a length of irrigation interval of 14 days. Under the three-turn rotation, the canal system is divided into three groups. Each group is opened for 5 days and closed for another 10 days giving an irrigation interval of 15 days. The rotation system for rice is usually two-turn rotation with 4 days on and 4 days off.

The Drainage System

An intensive open drainage network was constructed along the Nile system downstream Aswan dam in order to transfer the excess irrigation water safely to the Mediterranean Sea and terminal lakes. This drainage network helped in improving the agricultural conditions such as lowering water table and leaching soil, which consequently increased the crop yield. Construction of open drainage system started at the end of the nineteenth century when the soil was affected dramatically by the high water table and an increase in the salinity level. The open drainage network, at present, covers the whole cultivated land in the Nile valley and Delta with a total length of about 16,686 km, of which 67% is in the Delta region and the rest is in Upper and Middle Egypt. In the Delta region, the open drainage network diverts about 12 BCM/year of drainage water out of the system with average salinity greater than 2000 ppm. In the Nile Valley (Upper and Middle Egypt except for Fayoum) the open drainage system diverts about 4.0 BCM/y to the Nile stem from Aswan to Cairo. The drainage water of the Fayoum governorate is released to Lake Qaroun and Wadi Elrrayan at about 0.5 BCM/year.

WATER MANAGEMENT ZONING IN EGYPT

The nature of the irrigation network and system of the Nile river is rather unique. Water lost from one point is usually used in the down stream, and hence the global water use efficiency is relatively high. Due to this recycling of water, water quality problems may be arisen in downstream areas. The end of the system is characterized by the sea coast where drainage water is disposed to the sea. Sea intrusion and high water table usually affects areas close to the sea. In addition to these hydrologic conditions, there is a clear variation in climatic conditions over the system, as the river extends over more than 1200 km. The southern parts shows a higher temperature where the northern parts shows less temperature and some rainfall in the winter. These hydrologic and climatic conditions have its impact on crop selection and crop calendar. Therefore, it is necessary to categorize zones in terms of how water could be allocated taking into considerations most of the conditions affecting allocation. According to figure (1), the following zone classification could be made:

Zone I: The Nile Valley in Upper Egypt that represents the old irrigated batch along the Nile and extends between the HAD and upstream Assuit Barrages. This zone has the following characteristics:

- The irrigated Area is about 1.0 million feddans, 35% out of which is irrigated through pumping from the river
- Higher temperature compared to the northern areas
- Sugar cane represents the major crop. The second competing crop is maize in the summer and wheat in the winter
- Drainage water returns to the river by gravity.

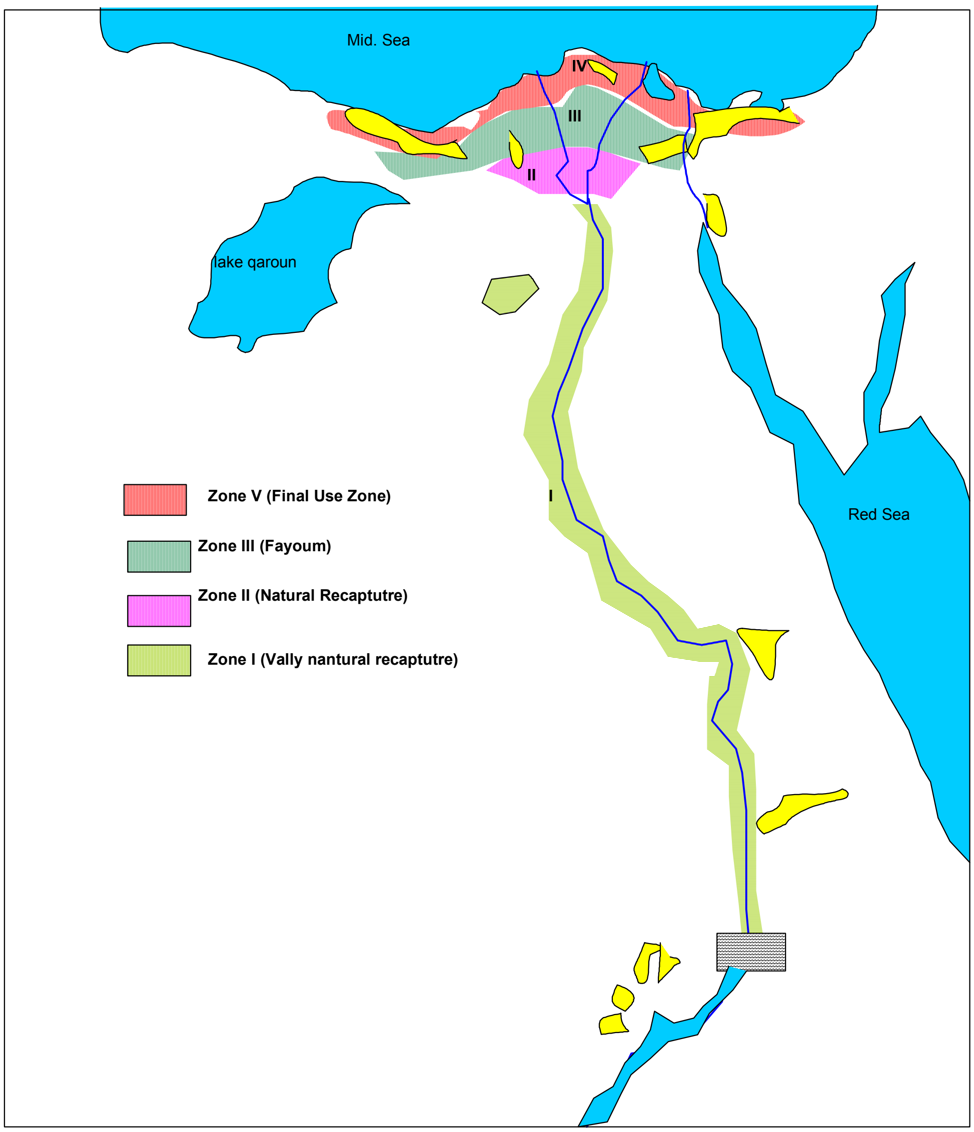


Fig. 1. Water Management zoning in Egypt

Zone II: The Nile Valley in the Middle Egypt that represents the old irrigated batch along the Nile and extends between Assuit Barrage and upstream the Delta Barrage. This zone has the following characteristics:

- The irrigated Area is about 1.1 million feddans where very little area irrigated by pumping from the river (not more than 4%) and located on the eastern side of the river
- Less temperature compared to Zone I, and the reference crop evapotranspiration (ETo) is about 10 % less

- Cotton and maize are the major dominant crops in the summer, while wheat and berseem are major crops in the winter
- Drainage water returns to the river by gravity.

Zone III: Fayoum area; natural closed system in the desert where water delivery system is different and characterized by steep hydraulic gradient and water allocation is made on continuous basis. It has the following conditions:

- The irrigated Area is about 0.4 million feddans where very little area irrigated by pumping
- Less temperature compared to Zone I and the reference crop evapotranspiration (ETo) is about 10 % less
- Cotton and maize are the major dominant crops in summer, while wheat and berseem are major crops in winter
- Drainage water flows, by gravity, to Lake Qaroun and Wadi Elrayyan depression in the desert.

Zone IV: The old irrigated area in southern Delta that extends over the region from Cairo to about 10 km northern Tanta where groundwater is of good quality. It has the following conditions:

- The irrigated Area is about 1.2 million feddans
- Less temperature compared to Zone II & III and the reference crop evapotranspiration (ETo) is about 10 % less
- Cotton and maize are the major dominant crops in the summer, while wheat and berseem are the major crops in the winter. Rice is allowed to be grown in the governorate of Sharkia
- Groundwater is available and of a good quality.

Zone V: The old irrigated area in Middle Delta that extends north of Zone IV till the end of the old irrigated areas in the north. It has the following conditions:

- The irrigated Area is about 1.5 million feddans
- Less temperature compared to Zone II & III and reference crop evapotranspiration (ETo) is about 10 % less
- Cotton, maize and rice are the major dominant crops in the summer, while wheat and berseem are major crops in the winter.
- High water table
- Drainage water reuse is one of the main water practice features in this Zone.

Zone VI: The final use zone *represents the newly irrigated areas* that extends north of Zone V till the coast of the sea and lakes (including Salam Canal area). It has the following conditions:

- The irrigated Area is about 1.0 million feddans
- Less temperature compared to Zone V and reference crop evapotranspiration (ETo) is about 10 % less.
- High water table and higher soil salinity
- Rice is the major dominant crop in the summer, while vegetables and berseem are major crops in the winter
- The disposal zone of drainage water to the lakes and the sea.
- Drainage water reuse is one of the main water practice features in this Zone.

IMPROVEMENT OF ON-FARM WATER MANAGEMENT PRACTICES

Land Leveling

The main objectives of land levelling can be listed as follows:

- To achieve water application uniformity in the field to avoid having parts of water logging and parts of water stress. Uniformity of water application will thus contribute to increased crop production.
- Water losses could be minimized through reducing farm water run-off.

In Egypt, land levelling, particularly Laser levelling is practiced on a large scale in either by the governmental, public and/or private sector. The very pronounced example is that followed in the sugarcane fields where the government is subsidizing the laser levelling in these fields by about 50% of its cost. Another type of this land levelling is that implemented in rice cultivation areas, where this levelling is done under water by a wooden beam using animal traction. This is to minimize the water infiltration and losses by percolation through the soil profile.

Maintenance and Operation of Field Ditches

Field ditches (Mesqa and Merwa) are operated and maintained by farmers. They are cleaned manually under the supervision of the agricultural administration. Due to the importance of having these ditches capable of conveying water to the fields, the government had started a project for improving these ditches. This project is funded by the German government through JTZ to build new field ditches (Merwa) to reduce/prevent water losses.

Crop Diversity

Water varies in terms of its quantity and quality along the canal system. The soil characteristics and climate conditions vary over the different water management zones. Agricultural practices are consequently affected by these varying conditions. Selection of crops to be grown over these zones is then affected. In Upper Egypt, the government encouraged growing of sugarcane through establishing considerable number of sugar factories. In Northern Delta where lands are affected by high water table and increased salinity in irrigation water, rice crop is the most dominant crop over there as it can resist relatively saline water.

Irrigation Improvement Project (*New Mesqa*)

Improvement of Mesqa constitutes the major part of the improving irrigation performance. It includes replacement of the existing Mesqa with improved one. The old mesqa is usually earthen and low level ditch with non-organized water withdrawals through multiple pumping/lifting points along its length. Two types was recommended for improving the old Mesqa, open elevated Mesqa and buried low-pressure pipe. Elevated Mesqa is an open ditch, but lined and elevated. Normal water level in the elevated Mesqa was set to permit gravity flow to fields at 15 cm above the field level. Alternatives for elevated Mesqa include a rectangular concrete cast-in place section and pre-cast concrete “J” section as shown in Figure 2. Low-pressure PVC pipeline Mesqa is another option for replacing the old Mesqa. It is set at approximately one meter below grade and are provided with risers at spacing of about 100 meters. Flow from each riser is controlled by an alfalfa valve. Such types of these Mesqas, elevated or pipe line, are intended to reduce the seepage of water to minimum. The end of the Mesqa is closed to prevent water losses to drains. Figure 3 shows a schematic for pipeline Mesqa.

Fig. 2. Improved Field Ditch (Mesqa)

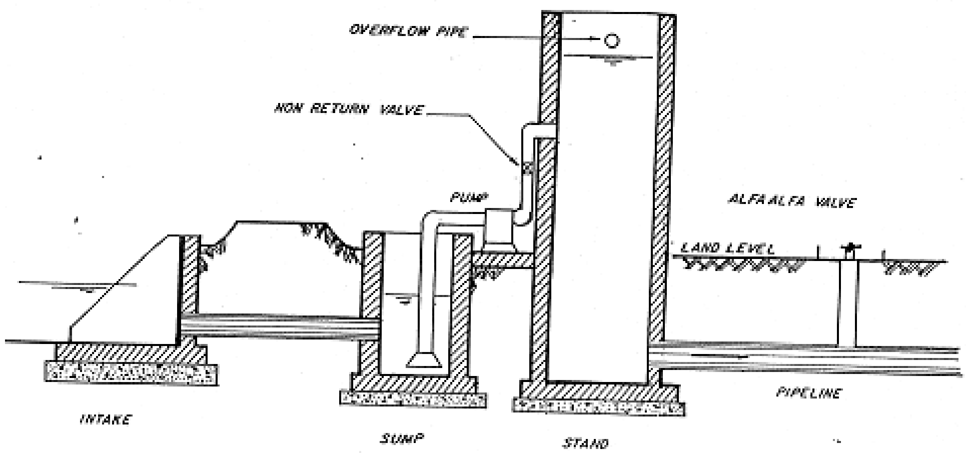


Fig. 3. Pipe line Mesa

Gated and Perforated Pipe System for Sugarcane Fields

Sugar Cane is considered one of the high-consumptive water crops in Egypt. Investigations and trails of assessment of the water application to sugar cane and field water losses showed that there are significant water losses resulted from using the traditional basin irrigation (APRP, 1998). Therefore, Ministry of Water Resources and Irrigation (MWRI) in collaboration with the Ministry of Agriculture and Land Reclamation (MALR) initiated a program for improvement of on-farm water management in sugarcane fields. The program has been implemented in several pilot areas in Upper Egypt. The program included a package of improvements such as laser land levelling, introduction of improved irrigation system (gated pipes), widening spaces between furrows, and balancing fertilizer requirements. Monitoring programs have shown increase in yield up to 25%. In addition, irrigation application losses were dropped down to almost zero, which means increasing applied water efficiency. Water requirements of sugarcane at the field is expected to reach 8000 – 9000 m^3/feddan/year compared to a figure of 15000 m^3/feddan/year used in the traditional irrigation practices. Therefore, the government has decided to extend the applications of the improved surface irrigation system to private farms in other sugar cane areas.

Sprinkler/Drip Irrigation

In New areas in the fringes of the Nile Delta and Valley, modernized irrigation (sprinkler or drip) is applied because the soil is characterized by relatively higher permeability. The present area under modern irrigation system is about 483,185 feddans i.e. about 6% of the total irrigated area (MWRI unpublished data, 2002). Modernized irrigation is now becoming a must, by low in the newly reclaimed land in Egypt.

IMPROVEMENT OF THE WATER DISTRIBUTION SYSTEM

Improved Water Delivery System

To achieve on-time water deliveries, Egypt started a national program on improving the main delivery system (branch canals). This involved improvement of the main delivery system through:

- Rehabilitation of water structures along these canals such as intakes, cross regulators and tail escapes to minimize water losses from canals end to drains.
- Replacement of the old structures with new ones with radial gates to provide automatic control for the downstream water levels to cope with farmers' demand and abstraction.
- Remodelling the canal cross-section to improve the canal characteristics and conveyance efficiency. This means bringing the cross section up to the standards of the original design. The remodelled cross section was made to allow for water storage during the non-irrigation times; particularly during night time as shown in Figure 4.
- Turn-outs and off takes are also planned to be installed along the branch canals such as facilities at the head of each Mesqa; pumps, pump stands and pump sumps. Energy dissipation basins are also constructed at the head of each Mesqa.

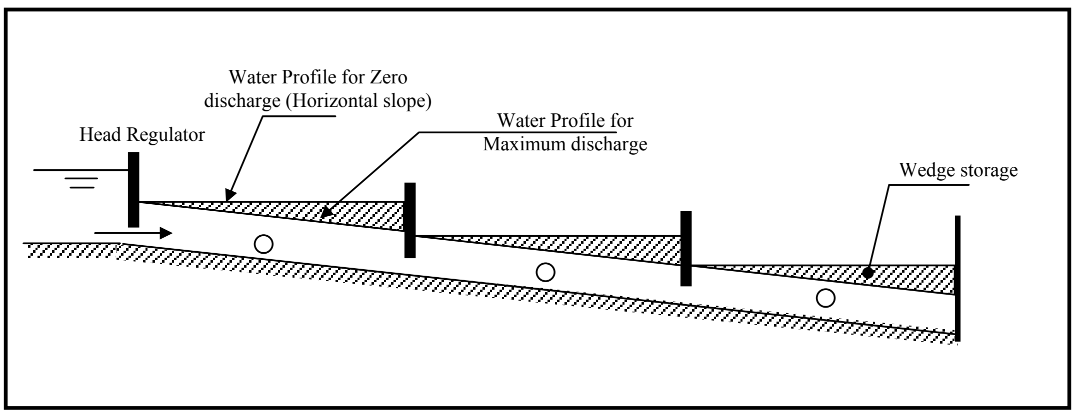


Fig. 4. Remodelling of Canal Storage

Telemetry

To improve water management and irrigation system performance, a telemetry system was installed on more than 800 locations on the irrigation network. This system enables collecting real-time data and information on water flow every two hours. It utilizes a volumetric Basis for water allocation and distribution. The system makes use of two data transmission technologies: meteor burst (about 200 sites) and VDCS (Voice Data Communication System, about 600 sites). Each uses a radio to transmit the data; the meteor burst actually bounces the radio signal off ionised particle trails of meteors passing through the Earth's atmosphere. Under each system the remote sites include a level measurement device and a radio transmitter. The remote sites transmit their measurements either directly or indirectly to the sub-master stations at the directorate level. This is where the water management decisions will be made based on the data received. The directorate engineer thus has access to data from all remote sites in his area of responsibility regardless of the technology used to transmit them.

Automation

One of the objectives of irrigation system improvement is to increase the reliability of irrigation water supply to meet the water demand more efficiently and effectively. Water supply that meets demand could be either on rotational basis or continuous basis. Continuous supply requires stable water levels in the main and secondary canals. The gate hoisting mechanism on the canal control structures are operated manually. This causes difficulties to adjust gate openings in response to rapidly changing demand. As a result, there was often too much or too little flow in the canal. Fluctuation of water levels in the canal would promote bank instability and unreliable supply to the secondary canals. To resolve this issue, the government initiated some programs and trails to introduce automated operation of water structures. Three projects have been implemented in Egypt. All of these projects are mainly including two major parts of automation; (1) replacement of manually operated mechanical hoists with electrically powered, and motorized gates and (2) install of programmable controllers at each regulator and adding remote control and monitoring system. The projects are:

- Serry Canal automation system in El-Menya governorate
- Bahr Saghir in Dakahlia governorate
- Improved water delivery system on Bahr Yousef in Beni Suif and El-Fayoum governorates

MATHEMATICAL MODELS FOR OPERATION AND PLANNING

Improved water management is among the objectives of many rehabilitation projects in Egypt, with computer-based irrigation scheduling viewed as a promising tool. Water allocation, management and distribution models have been developed and updated on regular basis in MWRI, examples of which are:

- *PDM model:* this model is developed by MWRI and Utah State University under USAID funded project in 1994. The model aims at scheduling canal water at branch level to satisfy different uses and utilize existing water resources at local level.
- *SIWARE model:* the National Water Research Centre jointly with Wenand Staring Venter, Wageningen, Netherlands, developed this model. The purpose of this model is to predict the quantity and quality of drainage water generated under different irrigation practices. The objective was to predict future changes of quantity and quality of the drainage water as a result of changing water management practices.

RESERVOIR MANAGEMENT

Forecasting Project

As known, Nile River is the main water source for Egypt. Numerous studies were carried out to predict the river inflows to Lake Nasser upstream the HAD. Therefore, reliable monitoring, forecasting, and simulation of hydrological and meteorological processes occurring in the Nile river basin are considered to be of paramount importance for optimal planning and management of Nile water. For this reason, Egypt's National Forecast Center has been established and staffed by trained hydrologists and meteorologists with the following objectives:

- Primary data distribution system for real time acquisition, primary processing, quality control, display, storage, and automatic transfer of satellite infrared, water vapor, and visible raw image for Nile Basin.
- A meteorological data distribution system for receiving:
    - Real-time raw meteorological data from network of synoptic stations located in the Nile Basin
    - Weather analysis/forecasting products prepared by the European Center for Medium-Range Weather forecast, as well as by German, French, and UK national meteorological centers

- A computer system for data processing, forecasting, and simulation of hydrological and meteorological process in the Nile Basin.
- A comprehensive Nile Basin hydro-meteorological and hydroclimatic database and retrieval system.

The resulting forecast-control and decision support system together with water management models allow for more efficient operation of the HAD for a reliable water supply and maximum hydropower production.

Rehabilitation of Grand Barrages

Egypt has an ambitious program for rehabilitation of the grand barrages along the Nile to move its performance to meet the different water requirements. Esna barrages were replaced in 1995 and have been equipped with a hydropower station. The Nagaa Hammadi barrages are being replaced for improving water control and to provide better navigation conditions. It will be also equipped with a hydropower station.

ORGANIZATIONAL AND REGULATORY FRAMEWORK

The performance of irrigation projects may significantly depend on the organization that distributes water. Poor performance of irrigation schemes can often be traced back to inappropriate organizational structures. Organizational structure is defined as the delegation of responsibilities and the clarification of the line of command between positions inside of an organization and between organizations. The water management organizations are mainly governmental ones. Involvement of water users in decision-making is becoming crucial, particularly the rising water demand will soon exceed the available limited water resources. Therefore, there will be an essential need for institutional reform and involvement of water users in decision making and planning so as to share the available water resources in an efficient and equitable way.

Water Users Associations

MWRI has recently recognized that involvement of water users in operation and management of the irrigation system is an essential instrument in improving water use efficiency. During the period 1977-84, EWUP (APRP,1998) was initiated with a financial support from USAID. The project was instrumental in introducing a system for water users participation. It recommended:

- formalizing water users association at the Mesqa level to be responsible for Mesqa improvement, maintenance and management,
- Supporting WUA with extension professionals (the Irrigation Advisory Services, IAS), and
- Involvement of WUAs in branch canal renovations and equitable water distribution

IIP (Irrigation Improvement Project) started in 1989 with a financial support from USAID and established a number of private WUAs at the Mesqa level as well as the institutional structure for IAS. IAS is responsible for:

- Awareness of water users and dissemination of information
- Establishing WUAs
- Monitoring and Evaluation of WUAs performance
- Technical support ad training of WUAs

Currently there are about 4000 operational water users association in Egypt.

Water Boards

MWRI wishes to extend the involvement of water users in the operation and maintenance of the secondary level of the canal system by scaling up the WUAs at branch canal level. Since 1995, a number of pilot projects, sponsored by the government of Netherlands to formulate Water Boards

(WBs) was initiated in Fayoum governorate. Currently, WBs are being implemented in Delta Region in some pilot areas. The executive board of the WB consists of 5-9 members; Treasurer, Secretary, member for maintenance, member for drainage, member for water distribution, member for residential water management issues, member of complaint management, and member of industrial water management (WBP, 2001). Therefore, the role of water users are scaled up to take care of not only irrigation but also other water requirements such as municipal and industry. Their role is also planned to take care of water pollution control.

Integrated water Management District

The smallest management unit of the MWRI structure is the district; irrigation district and drainage district, where engineers are in direct contact with users . This level of management is the most important level to have innovations for improvement of performance of water allocation and management MWRI is now implementing the integrated water management concept in a number of pilot districts. In order to cope with this concept, reorganization at the district level is carried out and the new organizations are called Integrated Water Management Districts (IWMD), which integrate all MWRI activities in each district (IIMI, 1995 and APRP, 2001). The IWMD will have a section for water distribution activities. The IWMD could have also a room for water board federation for the district (District Board) to work closely with the IWMD engineers in receiving the district water qouta under an agreed water schedule. The objectives of such policy were viewed as follows:

- Devolution of operation and maintenance responsibilities and decision-making to the local MWRI entities at the district level.
- Integrate the different water resource within the district into the district water budget and allocation programs. These water resources would include canal water, drainage water, groundwater, rainfall, etc.
- Involvement of water users and non-governmental organizations in water management decision-making at the district level.

Hence, it is expected that the IWMD will have an important role in water allocation. The IWMD will be responsible for scheduling, through consultation with water users (represented by water boards) the pre-set quota of water for the district. Monitoring of water release to districts as well as water distribution to branch canals or water boards will be the responsibility of water boards.

Irrigation Advisory Service (IAS)

Irrigation Advisory Service (IAS) activities started under IIP project in 1989. In 1999 a ministerial decree was issued to establish a Central Directorate for Irrigation Advisory Service (CDIAS) with two general directorates in Upper and Lower Egypt. According to this decree, the following objectives are mandated:

- Help water users associations improve water distribution
- Improve water use practices
- Help farmers in building strong and sustainable water users associations either on private Mesqas or branch canal

IAS proved to be essential for the Ministry efforts to establish water users organizations at the Mesqa or branch canal levels.

Modification of Laws

The Egyptians since a long period have set legislations and laws to regulate the Nile water and control water use. These laws changed from time to time according to the hydrologic conditions of the river and the political and institutional development experienced by the country. Legislations generally deal with several main issues: flood protection, flow regulation and water distribution; protection of water resources from waste and pollution and protection of the river embankments canals and drains; and management of the agricultural drainage works. These issues are governed by three major laws; law 48 of 1983, law 12 of 1984, and law 4 of 1994.

Law 48 of 1982 governs the discharge of wastes and wastewater into the Nile and its waterways and sets standards for the quality of these discharge effluents. The law outlines the responsibilities of MWRI and of other concerned ministries. Although the law is comprehensive, some of the details need additional review particularly those dealing with the required standards of effluents. Law 4 of 1994, concerning environmental protection, gives the Ministry of Environment increased powers and duties. Efforts have been conducted to coordinate the implementation of Law 48 and Law 4 to achieve efficient management of water quality and protection of irrigation water.

Law 12/1984 and its supplementary Law 213/1994 define the use and management of public and private irrigation/drainage system structures; including main canals, feeders, and drains. They also provide legal direction for the use and maintenance of public and private canals, and specify arrangements for cost recovery in irrigation and drainage works. Law 12 regulates the use of groundwater and agricultural drainage water and legislates other factors such as protection against flooding, navigation and coastal protection. Penalties for violation of the Laws and by-Laws are also specified. Modification of these laws to account for water users participation in the operation and maintenance of the irrigation system is being in process of finalization.

Institutional Reform

Ministry of Water Resources and irrigation is currently implementing a program for restructuring the ministry's functions at different levels in order to strengthen the decentralization process. The main goal of this restructuring is to move towards the integrated water resources management that is recently acknowledged as the best tool of improving water use efficiency and irrigation performance. Therefore, a unit for institutional reform (IRU) has been established. The basic strategies of this unit are:

- Involvement of private sector in irrigation activities
- Support decentralization process of decision making
- Conduct awareness program for dissemination of IRU concepts within ministry's sectors and entities.

Awareness

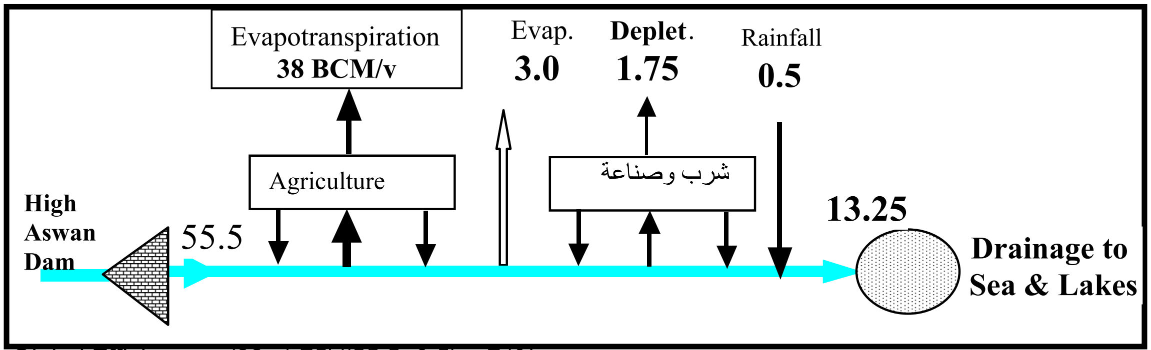
MWRI recognized that an active and comprehensive public awareness program is needed to better implement the strategies defined in the MWRI visions and policies. The public and stakeholders (officials, MWRI staff, water users, farmers, etc) must be made aware on a global level of the limitations of water as a resource in terms of quantity and quality. MWRI in partnership with USAID devloped the Water Communication Units (WCU) in 1992, to provide a strong foundation to coordinate and launch public awareness programs.

PERFORMANCE INDICATORS

Overall Indicator

Overall water use efficiency can be considered as an overall indicator. The water use efficiency is defined as the percentage of water depleted through crop evapotranspiration and other sectors by the total water delivery to the irrigation system. The level of this efficiency may reach 71% as shown in figure 5 (Allam, 2000).

This level of efficiency could be considered a relatively high efficiency compared to other systems overall the world, taking into consideration that surface irrigation is the prevailing irrigation method in Egypt. Egypt is still implementing water conservation program to raise this efficiency in order to meet the increasing future water demands.



Global Efficiency = (38+1.75)/(55.5+0.5) = 71%

Fig 5. Schematic Diagram for Water Balance of Nile System in Egypt (Source: Allam, 2000)

Agricultural and Water Productivity

The modernization process (Irrigation Improvement Project, IIP) resulted in two main agricultural benefits that both led to enhancement of farmer's income. The first benefit is land saving due to construction of improved Mesqa as compared to areas occupied by old Mesqas. There is about 2% of the total command area has been saved and made available for agriculture.

The second benefit is the increase in crop yield due to the better condition of water availability. The process grantees the fresh water allocated to farmers through continuous flow and new irrigation schedule. Increase in crop yield ranges from 5% to 30% according to crop type (APRP, 1998).

Equity and Efficiency of Water Distribution

Evaluation showed that the equity of water distribution has been achieved in IIP areas (APRP, 1998). The conveyance efficiency in the Mesqa has improved to reach about 98% instead of about 70% before IIP. The conveyance efficiency reflects the ratio of the farm turnout water deliveries to the amount of water entering the Mesqa. The modernization process has also contributed to the improvement of water allocation between the head and tail of the Mesqa. Before the modernization, most of tail end farmers complain from water shortage. Improvement of efficiency was also due to reducing the time of irrigation. Reduction of irrigation time ranged from 50 to 60% of that was before IIP. Reduction in irrigation time was due to implementing land leveling and setting a suitable water head at the farm inlet. Time of irrigation was also reduced because of the continuous flow, which made water available all the time in the Mesqa. Better scheduling of irrigation and higher flow rate at the field level have also contributed to reduced irrigation time.

Economic Indicators

A study on the economic impact of IIP showed that average cost of one irrigation application has reduced from $8.4 to $4.0 per hectare, i.e 51 % reduction for winter crops, while this reduction was 57% for summer crops (Elshinawi & Elgohary, 1996). The cost of irrigation includes different items such as renting a pump, labour and cost of waiting time until water is made available at the head of the field. After modernization, these costs have been reduced thanks to the single point lift and better irrigation schedule that minimizes the waiting time. Collected water fees cover the O&M cost and Water fees.

Farmers Satisfaction

The main goal of the IIP is to move towards the devolution of irrigation water management and maintenance to water users. Then, establishing WUAs and IAS is the key element to achieve such goal. Recent studies showed that IIP provides attractive financial and social incentives. These incentives indicate strong satisfaction of water users with forming and participating in their own private WUAs (MWRI, 1998). These incentives are:

- Improved trust, communication and cooperation among water
- Uniform allocation and distribution of water due to to continuous flow reliability
- Saving time, labor, operation and maintenance costs and land
- Improved problem solving between WUAs and irrigation department
- Better feeling of ownership and leadership among the members of WUAs
- Water saving and hence water reliability
- Better scheduling and timing of irrigation
- Improved yields and quality of crops

Glossary and abbreviations

MWRI	Ministry of Water Resources and Irrigation
IIP	Irrigation Improvement Project
WUAs	Water Users Associations
O&M	Operation and Maintenance
APRP	Agricultural Policy Reform Program
WPRP	Water Policy Reform Program
USAID	United States Agency for International Development
IMS	Irrigation Management System
EWUP	Egypt's Water Use Program
RIIP	Regional Irrigation Improvement Project
IAS	Irrigation Advisory Service
MALR	Ministry of Agriculture and Land Reclamation
SIWARE	SImulation of Water management in the Arab Republic of Egypt
PDM	Planning and Distribution Model
IRU	Institutional Reform Unit
VDCS	Voice Data Communication System
HAD	High Aswan Dam
IWMD	Integrated Water Management District
ISWAIP	Integrated Soil and Water Improvement Project

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