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COUNTRY PAPER ON HARMONIZATION AND INTEGRATION OF WATER SAVING OPTIONS IN EGYPT

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INTRODUCTION

The rising demands for water and the rapid increase of the population make Egypt facing strong pressures with respect to the country's limited water availability. Water resources in Egypt are fixed to the country's share of Nile water and minor amounts of rainfall and groundwater. The rising demands of water have made it mandatory to improve the irrigation system performance and increase water use efficiency in the face of future water shortages and likely water crisis.

Water is one of the most important inputs of the economic development. Size, type, location of socio-economic developments depends on the nature, quantity, quality, and location of the available water resources. The less the water resources are, and the more the demand is, the more valuable water is. This is the case in Egypt, where rainfall is rare and desert covers most of the country area, except for a narrow strip of cultivated land and urban areas along the Nile river course and Delta. The quota of Egypt from the Nile River, which represents the main source of water, hasn't changed since 1959. The Nile River in Egypt has played great role in Egypt's civilization, which lasted more than seven thousands years where the Egyptians, throughout the history, exerted great efforts to efficiently utilize the Nile water.

Increased pressure on the available water 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 are increasing and needs should have unique measures to be balanced. Such developments and changes will have impacts on the decisions of water management and use. Therefore, performance of water delivery systems, particularly irrigation systems, needs to be well defined and assessed under these current or expected stressed conditions. Improvement of irrigation system performance is not only achieved by technical interventions, but more important, by reform in the institutional framework that enhance the effectiveness and efficiency of system management, operation and, maintenance. Enhancing farmers and private sector participation in operation and maintenance of the irrigation system is now being adopted as policy by the Egyptian Ministry of Water Resources and Irrigation.

Late in 1996, the Ministry of Water Resources and Irrigation formulated a water policy program to assist the ministry identifying, evaluating, and implementing policy adjustments and institutional reforms that would lead to improved water use in agriculture. Over the last three years, the ministry's water policy program has swiftly taken on a life of its own. Specialized teams assemble to address key issues, examine constraints, and review the feasibility, merits, and costs of various strategies. Workshops, focus groups, and surveys solicit the opinions and encourage the participation of private sector, farmers, and other stakeholders in policy formulation. The issues examined are diverse and complex, ranging from legislative reform and measures to protect water quality to increased private sector involvement in water management of Egypt's irrigation system.

This paper highlights the efforts exerted towards improving the water use efficiency through harmonization and integration of the water saving options and the promotion of water saving policies and guidelines.

IMPROVEMENT OF ON FARM WATER Improvement of On-Farm Water Management Practices

On-Farm water management practices could be improved through the integration and harmonization of different water saving options and techniques.

Land leveling

The main objectives of land leveling are given attention to:

- Achieve water application uniformity in the field to avoid having areas of water logging and others 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 leveling, particularly laser leveling is practiced on a large scale in either by the governmental, public and/or private sector. The very pronounced example is that applied in sugarcane fields where the government is subsidizing the laser leveling in these fields by about 50% of its cost. Another type of this land leveling is that being implemented in rice cultivation areas, where leveling 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 extensions. 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 aimed to build new and/or improve field ditches (Merwa) to reduce/prevent water losses.

Crop Diversity

Due to the fact that water varies in terms of its quantity and quality along the canal system, and that the soil characteristics and climate conditions vary over the different water management zones, the agricultural practices are consequently affected by such varying conditions. Selection of crops to be grown over these zones has to be considered. In Upper Egypt, the government encouraged growing sugarcane, while 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

Improvement of tertiary canals (mesqas) constitutes the major part of improving irrigation performance. It includes replacement of the existing system with improved ones. The old system is usually earthern and low level ditch with non-organized water withdrawals through multiple pumping/lifting points along its length. Two types were recommended for improving the old system, open elevated mesqa and buried low-pressure pipe. Elevated one 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. 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 100 meters. Such types of mesqas, elevated or pipe line, are intended to reduce the seepage of water to minimum. The end of mesqa is closed to prevent water losses to drains.

The stated primary goal of the Irrigation Improvement Project (IIP) is to increase water use efficiency and agricultural productivity in Egypt’s old lands. Increasing water use efficiency is used in a broad sense with a connotation of improving irrigation water management rather than in the sense of the traditional definitions of water use efficiency. This is to be accomplished by implementing a series of interventions at the irrigation delivery system and on-farm levels, designed to remove irrigation related constraints to increased agricultural production, and considering a full range of technical, economic, environmental and social factors impacting irrigation water management.

The IIP package includes a combination of physical and institutional improvements to the main irrigation delivery system and the farm level irrigation delivery and application systems. These improvements include renovation and improvement of branch and distributary canals, downstream water level control, conversion from rotational flow to continuous flow, mesqa improvements, organization of farmers into water users associations, and water management technical assistance through the Irrigation Advisory Service (IAS).

There were dramatic improvements in mesqa conveyance efficiencies before and after IIP improvements. Conveyance efficiencies appear to increase from an average of around 60-65% to around 90-95% as a result of improvements. These “local water savings” are translated into improved adequacy of the farm level water supply and reduced water quality degradation.

While it appears that water delivery efficiencies and distribution uniformities along the canals and mesqas have improved significantly as a result of IIP, on-farm water application efficiencies have not been equally improved. IIP efforts have been paid to demonstrations of precision land leveling on demonstration fields in each command area. The implementation of a full package of on-farm water management improvements can be expected to gradually result in additional “local water savings”. The improved control and management of water in the delivery system resulting from IIP offers the mechanism to capture and distribute these savings locally in the system. Reduced on-farm irrigation losses can also be expected to result in less water quality degradation. In addition, improved on-farm water management contributes to increased crop yields and crop quality.

The primary expected benefit of IIP, contributing in large part to the economic and financial feasibility of the improvements, the increased agricultural productivity. This was expected to occur primarily from yield increases and secondarily from productivity improvements on previously fallow or partially fallow lands. Limited yield data have been collected for some crops in some command areas. IIP yield monitoring data show an increased wheat yields ranging from 0-35%, increased alfa-alfa yields of 8-10%, increased cotton yields of 7-15%, increased rice yields up to 18%, and increased maize yields of 16-30%.

Gated and perforated pipe system for sugarcane fields

Sugarcane is considered one of the high-consumptive water crops in Egypt. Investigations and trails of assessment of water application to sugar cane and field water losses showed that there are significant water losses resulting from using the traditional basin irrigation. Therefore, Ministry of Water Resources and Irrigation in collaboration with the Ministry of Agriculture and Land Reclamation 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 leveling, 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 greatly, which means increasing applied water efficiency. Water requirements of sugarcane at the field are expected to reach 8000 m^3/feddans/year compared to a figure of 12000 m^3/feddans/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 sugarcane areas.

Short Duration Rice Varieties

Since liberalization of farmer choice of cropping patterns, the number of feddans on which rice is grown has almost doubled, from about 800,000 feddan in 1988 to 1.56 million feddans in 1997, replacing cotton and maize in the summer season. Early indicators suggest even greater rice increase was planned by farmers in 1998. The rapid increase in rice cultivation has resulted from increasing its profitability relative to other crops and rotations, as well as other factors.

The drastic increase in water use in rice cultivation is putting added pressure on water supplies, and threatens to undermine the availability of water for the “new lands”. Further, the capacity constraints on certain canals in the system coupled with expanding rice cultivation prevent enough water from being delivered to newly reclaimed land at the tails of the canals. On the other hand, Egyptian farmers are among the fore front of the world in productivity per unit of land for both rice and sugar cane. Reducing rice cultivation will result in significant losses to farmers and, perhaps, to the Egyptian economy as a whole.

The Field Crop Research Institute of the Ministry of Agriculture and Land Reclamation has devoted several years in developing short season varieties of rice which allow reduced water application and consumption and ensure high productivity levels. The efforts have been quite successful. At least three varieties of rice have been produced to shorten the cultivation period from normal 160 days (Giza 171) to 120 or 125 days (Giza 177 and Sakha 102, 103, and 104) in experimental farms. Sakha 101 and Giza 178 reduce the cultivation period to 140 and 135 days, respectively. Giza 178 is more salt-tolerant than the other short duration varieties. In those same experimental trials, the short duration varieties produced yields higher than the longer duration varieties. In fact, over the past years, increase in rice cultivation has been devoted to these short duration varieties. In 1997, about 14% of rice grown was short duration varieties, and in 1998, about 50%was short duration varieties.

Sprinkler/Drip Irrigation

In new areas in the fringes of the Nile Delta and Valley, modernized irrigation (sprinkler or drip) is being applied due to the fact that the soil is characterized by relatively higher permeability. The present area under modern irrigation system is about 6% of the total irrigated area. Modernized irrigation is now becoming a must, (by law) in the newly reclaimed land in Egypt.

Harmonization and Integration of Water Saving Options

The different water saving options could be integrated and harmonized to save water on the farm level, through the different options:

- Leveling the farm land,
- Lining the farm ditches and mesqas or using pipelines in place of the earth ditches,
- Cultivating crops which are suitable to the climate of the area where the evapotranspiration is low,
- Using gated pipes in the areas where sugarcane is cultivated,
- Using sprinkler/drip irrigation in the newly reclaimed land,
- Cultivate short duration rice varieties,
- Maintain the field ditches, and enhance farmer’s involvement,
- Continues flow and night irrigation, and
- Establish water users associations and private sector participation.

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 canal.
- Replacement of the old control structures with new ones with radial gates to provide automatic control for the downstream water levels to cope with farmers demand and abstraction.
- Remodeling the canal cross-section to improve the canal hydraulic characteristics and conveyance efficiency, and to ensure bringing the cross section back to the standards of the original design. The remodeled cross section was made to allow for water storage during the non-irrigation times, particularly during night time.
- 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.

Telemetry Systems

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 remote sites transmit the measurements information either directly or indirectly to the sub-master stations at the directorate level. This is where the water management decisions are made based on the data received. The directorate engineer thus has access to data from all remote sites area of responsibility regardless of the technology used to transmit them.

Drainage Water Reuse

Since the large-scale of field sub-surface tile drainage was started in the late 1960s, a well-designed and well-constructed agricultural drainage system has been operating in the Delta. Numbers of main drains and branch or lower-order drains collect and transport drainage flows from the south to the north of the Delta plain. More than forty lifting pump stations and twenty two main reuse mixing stations are in operation in the 22 drain catchments of the Delta region. Presently an annual amount of about 4 milliard m^3 drainage water reuse is made available through the official drainage reuse program.

The monitoring program revealed that the average annual drainage reuse amount has increased from 3 milliard m^3 of 1984-1990 to 4 milliard m^3 of 1991-1996. The official reuse levels in the East and West Delta regions have almost remained constant in the past decade. It took about a decade to obtain 1 milliard m^3 reuse expansion in the Delta, mainly from the increased reuse in the Middle Delta region in the 1990s.

The practically achievable reuse pumping potential in the Delta will be 9.6 milliard m^3 per year, which is 5.3 milliard m^3 more than the 1995-96 reuse level of 4.3 milliard m^3. This 5.3 milliard m^3 additional reuse pumping potential could be achieved by capturing all the drain water with salinity concentration below 2250 ppm, except for unacceptably polluted drain water.

Efforts to recapture drain water salinity levels higher than 2250 ppm will not be efficient and meaningful, since the incremental capture after that salinity level will be limited to 0.2-0.3 milliard m^3. The only way to achieve more reuse beyond the 9.6 milliard m^3 reuse potential is to remove and/or treat the municipal and industrial wastes according to health standards and make the water available in the Bahr Bagar drain (East Delta) and several other polluted drains reusable (according to health standards).

One of the options and potentials for reducing pollution constraints in drains is by adopting intermediate reuse. Intermediate reuse will be supplementary to, but not a replacement for, the current main reuse system. The technical merits of intermediate reuse are the capturing of the good quality drain water before it gets mixed with poor quality drainage water and replacing unofficial reuse at the canal tail, where canal deliveries are in short supply.

One of the recommended policies is to restrict unofficial drainage pumping in the areas where major reuse projects exist. This is to secure the drain water availability for the miga reclamation projects, which are already in operation. The action should be seen as an effort to reallocate water resources for a broader national development interest.

Over the next decades, the reuse of drain water may remain as the first supply augmentation measure due to its easy handling and low cost. In the long-run with less drain water volume and increasing salinity concentration, the potential for expanding reuse, or even continuing the current reuse level, may be limited.

Cropping Systems and Water Requirements

A comparison of crop yields between old lands and new land soils shows that some tree fruit yields were as high in the new lands as in the old lands. Most vegetable crop yields were lower on small farms in the new lands, but higher yields were reported for some crops such as tomatoes, with considerable variation among crops. Soybean yields were higher in the new lands.

Experiences of successful farmers indicate that oil seed crops, have an advantage in sandy lands. Part of that advantage is due to soil properties and part is due to fewer diseases. Most fruits and vegetable crops can do as well or better on the new lands compared to old lands, when managed properly. Currently most cereal crops (wheat, maize, etc.) seem to be less productive on the sandy soils, but this is based on varieties, which have been bred for old lands. Even with available varieties, high grain yields are reported on some large farms.

Water use efficiency is a critical issue for Egypt as a whole and should be for individual farmers. However, very little information is available on amount of water actually applied per feddan of individual crops in the absence of technical information in farmer lands on yield/water relationships for various crops.

Given the higher cost of water in most of the new lands, farmers have a greater incentive to improve efficiency, but because of lack of information on crop/water relationship and difficulties, small farmers having modern systems, many have reverted to flood system even in sandy soils. In view of the generally low yields of many crops on new lands, it is likely that water use efficiency (yield / m^3 of water) on small farms is low, and perhaps lower than efficiency in old lands. However, there is evidence of some very high levels of output per unit of water, for example, in drip systems in general, and in protected vegetable production in particular.

Land use intensity is often quite high in both new and old lands. Current intensity (number of crops per year per unit of land area) is about 1.7 for small farmers in new lands and about 2.0 in old lands. Climatic conditions in Egypt permit a cropping intensity of non permanent crops of two or more in new lands. Small farmers use over 90 percent of their land for cropping. Larger farmers leave a larger part idle especially in summer when water delivery costs are higher and water shortages are experienced.

The main objectives of the agricultural strategy are to increase agricultural productivity per unit of land and water, through more efficient use of these limited resources. Modern irrigation system along with suitable technology would provide significant benefits in improving crop yield and quality, reducing cost of production and improving environmental benefits, while minimizing environmental impact.

On the other hand, improved design and practice methods for surface systems (Border strips, Basin irrigation, level-Basin and furrow irrigation systems) have proved to be more appropriate and efficient and less expensive than pressure systems. Proper irrigation scheduling and a uniform distribution of water in the effective root-zone for sugar cane are foreseen for increasing water use efficiency. Precision land leveling using laser technology is recommended for improving water application efficiency in surface and non-pressurized irrigation. Meanwhile, the introduction of sprinkler and micro-irrigation (localized) methods to Egyptian agriculture raises debates about the amount of water requirements, water losses, effect on soil characteristics, salinity problems, and the feasibility of the different methods under different farming systems.

Precision land leveling using laser technique has improved water application efficiency for cotton, wheat, barely, and sugar crops. It reduced the applied irrigation water by about 33%, in the same time the crop yield increased by 21%. It is also reported that land leveling on clay loam soils resulted in an increase of 28% in corn yield and about 30% water saving compared with the unleveled field in the same site. Sugar cane yield increase with about 46% in addition to a 28% irrigation water reduction due to land leveling.

Conjunctive Use of Surface Water and Groundwater

As Egypt has limited water resources, the dependence on surface water only in the future to cover the increasing demands will not be adequate. Conjunctive use of surface and groundwater resources to support increased irrigation demands is identified as one of the principle means of raising agricultural production. The pressure upon existing water resources will become more intensive in the future to satisfy the increasing demands. Improper management and poor practice connected with intensive use of groundwater lead to serious problems such as depletion of the resource due to high extractions or water logging due to the rise in the water table from the aquifer recharge. Conjunctive planning and development of surface and groundwater resources results in maximum utilization of the limited water resources, greater yields, and economic returns compared to the separate use of the resources.

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 or continuous flow. 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 certain programs and pilots to introduce automated operation of water structures. Three projects have been implemented in Egypt, and 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 were implemented in:

- 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.

Harmonization and Integration of the Different Water Saving Options

Different water saving options could be integrated and harmonized to save water in the water distribution system through the following mechanisms:

- Improving the water delivery system,
- Using the Telemetry system to improve the system of real-time information and management,
- Reuse the drainage water to increase water use efficiency,
- Conjunctive use of surface water and groundwater,
- Using optimal crop pattern,
- Automation of the irrigation structures.

IMPROVED 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 High Aswan Dam (HAD). Therefore, reliable monitoring, forecasting, and simulation of hydrological and meteorological processes occurring in the River Nile 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.
- 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 (Diversion Dams)

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

Harmonization and Integration of Water Saving Options

Water saving options could be integrated and harmonized through the reservoirs and barrages by the followings:

- Using the forecasting project and the forecasting techniques to better manage the reservoir of High Aswan Dam, and
- Rehabilitate the old barrage to improve their effectiveness in managing the Egypt's water resources along the Nile and consequently saving water.

ORGANIZATIONAL AND REGULATORY FRAMEWORK

The performance of irrigation system significantly depends on the capacity of the organization that manages and distributes water. Poor performance of irrigation schemes can often be traced back to inappropriate organizational structures. Organization structure is defined as the empowerment and 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 manage the available water resources in an efficient and equitable way.

Participation and Establishment of Water User Associations

Water User Associations (WUA) is a private organization owned, controlled and operated by member users for their benefits in improving water delivery, water use and other organizational efforts related to water for increasing their production possibilities.

Within the context of institutional reform in irrigation water sector, establishing Water Users Associations allows farmers to perform activities which are more difficult, or impossible, for them to do individually. These associations perform functions which allow the farmers the capability of managing parts of the irrigation system more effectively by providing the following services:

- Administering the irrigation system under their authority;
- Providing a mechanism whereby the government interacts meaningfully with the farmers; and
- Providing a means whereby the farmers can make decisions concerning problems of irrigation.

In terms of administering the irrigation system, a WUA can mobilize local resources to reduce the costs of managing the system for the government. A WUA can provide the procedures and mechanisms whereby the canals and other tertiary channels are cleaned, maintained, and operated on a schedule. In addition, such associations can act as arbiters to local conflicts in the area. Since there is a need for the government to interact with the farmers, the WUA can act as the conduit for such interaction. Through the association, various extension programs can operate. Such organization can also serve as a means to channel the needs and desires of farmers to those government agencies best equipped to meet them. They can provide such services by acting as a communication channel between the government and the farmers.

Integrated Water Management District

The smallest management unit of the Ministry of Water Resources and Irrigation (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. 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 resources 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 and water saving. The IWMD will be responsible for scheduling, through consultation with water users (represented by water users associations) the pre-set quota of water for the district.

Irrigation Advisory Service (IAS)

Irrigation Advisory Service (IAS) activities started 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 time ago have set legislations and laws to regulate the Nile water and control water use. These laws changed from time to time according to the hydrology conditions of the river and the political and institutional development experienced by the country. Legislations generally deal with several main issues such as: flood protection, flow regulation and water distribution; protection of water resources from waste and pollution and protection of the river banks, canals and drains; and management of the water system in general. 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 into the Nile and its waterways and sets standards for the quality of these discharge effluents. The law outlines the responsibilities of MWRI and the other concerned ministries. Although the law is comprehensive, some of the details need careful review particularly those dealing with the required standards of effluents. Law 4 of 1994, concerning environmental protection in general, 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 frame 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 enhance 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 formulating a comprehensive program for restructuring the ministry’s functions at different levels in order to strengthen the decentralization and participation process. The main goal of this restructuring is to move towards the integrated water resources management (IWRM) that is recently acknowledged as the best tool of improving water use efficiency and irrigation performance. Therefore, an institutional reform unit (IRU) has been established. The basic strategies of this unit are:

- Involvement of private sector in irrigation activities
- Support decentralization and participation process of decision making
- Conduct awareness program for dissemination of IRU concepts within ministry’s sectors and entities.
- Ensure capacity building and information availability.

Conducting Public Awareness Campaigns

During the last years, The Ministry of Water Resources and Irrigation took a bold step in introducing a new approach to its programs. The Water Communication Unit (WCU) was established in July 1995, and is responsible for designing and implementing a participatory communication program to support the Ministry’s goals of increasing the understanding of the general public that Egypt has a limited water supply and it will become more limited in the future; and there is a need to change water users behaviors to conserve water and prevent its pollution. The WCU enables the Ministry to more effectively communicate with people and at the same time to better listen to public. The Ministry communication strategy mainly consists of three phases:

- Building the general awareness of the Egyptian public that there is a limited water supply and it will become more limited in the future;
- Strengthening Ministry field staff to work with local groups to support the introduction of water conservation and pollution programs and practices;
- The implementation of campaigns using mass media and interpersonal channels of communication which focus on changing water users behaviors in terms of water conservation and pollution prevention. The communication campaigns are expected to continue for many years addressing continued awareness and behavioral change subjects.

Since the establishment of WCU, different awareness campaigns have been conducted and a lot of communication materials have been produced to increase the awareness of the water users to conserve water and use it efficiently.

Harmonization and Integration of Water Saving Options

Water saving options through the introduction of the organizational and regulatory framework and institutional vision / strategy and action plan, that would develop and enhance the following:

- Establishment of water users associations,
- Establishment of integrated water management districts,
- Strengthen the role of Irrigation Advisory Service,
- Modification of the old Laws
- Continuing the institutional reform, and
- Conducting an awareness campaigns.

CONCLUSION

Different water saving options have been considered and integrated to present the optimal water savings and productivity on the farm level, the water distribution system level, and on the organizational and regulatory framework level. Integrating and harmonizing all the water saving options of the previous highlighted levels will result in an optimal water saving and management on the national level.

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