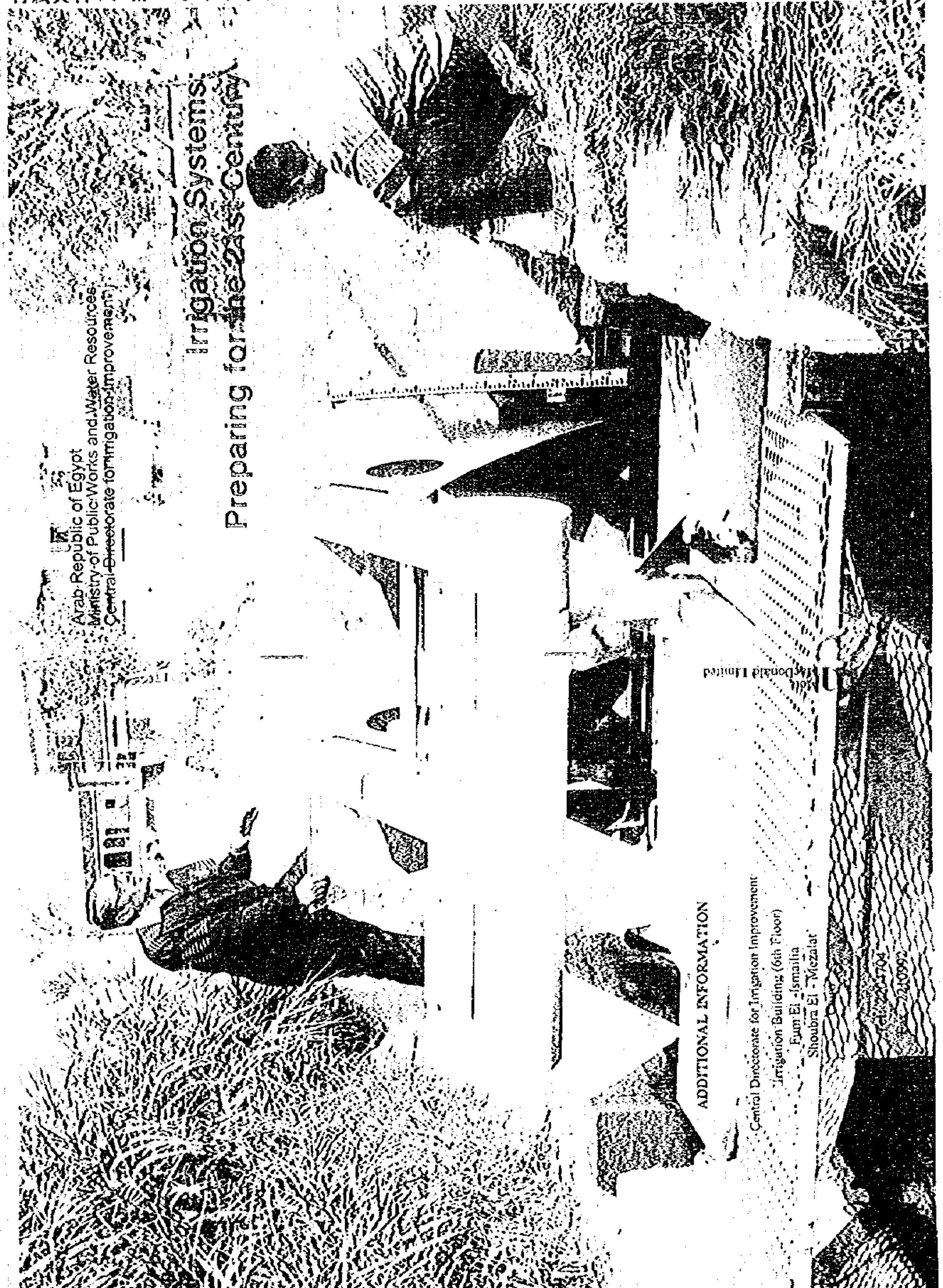

Arab Republic of Egypt
Ministry of Public Works and Water Resources
Central Directorate for Irrigation Improvement
Irrigation Systems
Preparing for the 21st Century
ADDITIONAL INFORMATION
Central Directorate for Irrigation Improvement
Irrigation Building (6th Floor)
Fum El -Ismailia
Shoubra El - Mezalat
Mott MacDonald Limited

INTRODUCTION

By international standards, present per capita water availability in Egypt is low. Developments in agriculture and industry, coupled with the needs of a growing population with expectations of a higher standard of living, will exert further pressure on these scarce water supplies. As one of a range of measures to address this forecast crisis in water availability, the Irrigation Improvement Project is planned by government to:

- improve overall efficiency of water use and thus to reduce the outflow of water to the sea
- remove water supply constraints on the achievement of optimum crop production.

The project has developed in phases over a twelve year period, primarily with grant assistance from USAID, and to a lesser extent from UNDP. Many of the principles now widely adopted throughout the project are derived from this pilot work. As an indication of the importance that government attaches to the project, a loan agreement was signed in December 1994 with the World Bank to extend the project to an area of 250,000 feddans in the command of Mahmoudia canal in Beheira Governorate, and El Wasat and El Manaifa canals in Kafr El-Sheikh Governorate.

The project will bring about fundamental changes to the irrigation system of the country and the way it is managed. In addition to physical improvements to irrigation infrastructure using modern technology, an integrated approach to canal management is to be developed in which responsibilities for operation and maintenance are shared by government staff and farmers.

PROJECT OBJECTIVES

Physical

- Delivery System: improvements to main and branch canals.
- Meska Improvements: providing raised lined meskas or piped meskas with single lift pumpstations.
- Drainage Re-use: installation of a number of small drainage re-use pumpstations.

Institutional

- Introducing new management and operational systems for water delivery.
- Forming, developing and strengthening of water user groups to assist in planning and implementing improvements to, and in subsequently operating and maintaining, meskas.
- Federating water user groups to share responsibilities with government staff in planning water allocations at branch canal level.
- Establishing an irrigation advisory service to assist water users in group management, financial management, water management, conflict resolution, etc.
- Introducing a programme of cost sharing under which both government and irrigators contribute to capital and operating costs.
- Establishing a Communication Unit to design and produce publicity, training and extension materials for the project and to coordinate production and delivery of information releases to mass media.

CONSTRAINTS

Egypt's present irrigation network has developed in the hands of generations of skilled planners and engineers. The competing demands of modern agricultural production, navigation interests, and municipal and industrial requirements mean that the time has now come for a radical overhaul of the system and the way it is operated.

Agricultural production is adversely affected by water delivery problems caused by the physical characteristics of the canal system, its method of operation, and the aggregate behaviour of the many millions of individual farmers. Particular features of this system are:

(a) Significant diurnal fluctuations in water supply. Summer irrigation is concentrated in the early morning with maximum water usage typically at around 09.00hrs, equivalent to 300-400% of daily average demand.

(b) Erratic water availability with shortages occurring during times of peak need, especially in the tail reaches of many canals.

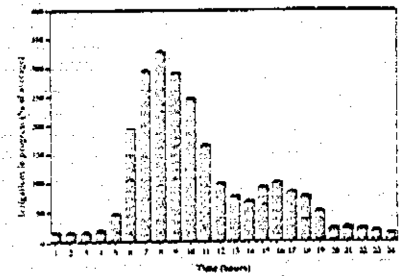
(c) Night-time irrigation is required for farmers to achieve adequate deliveries.

(d) Inequitable distribution of water both between and within branch canal command areas, resulting in tail-end shortages.

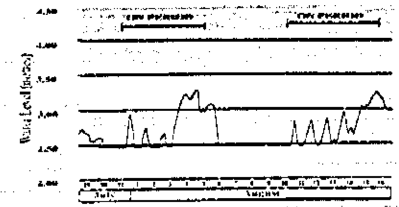
(e) Inadequate water supplies at the tail end of long meskas, necessitating supplementary irrigation from drainage channels.

(f) Wastage of water due to direct losses from canals and meskas to the drainage system.

Environmental nuisance caused by existing meskas



Pattern of irrigation during Summer months



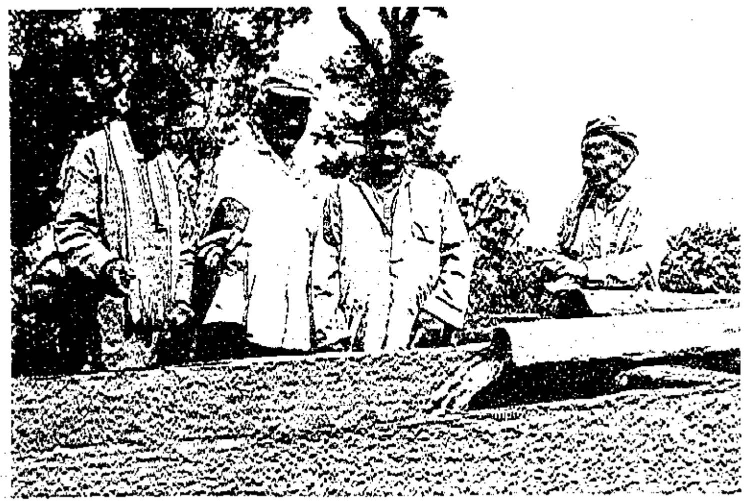
Scheduled as compared with actual water deliveries

Traditional system of irrigation using a sakia

STRATEGY FOR WATER MANAGEMENT

A number of general guidelines underlie the improvement strategy:

- to introduce a system of continuous flow to provide greater flexibility to irrigators
- to continue the long-standing principle of below-grade supplies up to the meska
- to provide the maximum feasible degree of overnight storage of water in canals to provide for day-time peaks in demand so as to reduce the need for night-time irrigation
- to transfer to a system of management and operation of the irrigation system based on discharges rather than levels, providing regulation of discharges at an "intervention point", the interface between scheduled operation from upstream and demand operation from downstream
- to simplify system operation through the adoption of a strategy of minimum intervention using automatic downstream control regulating structures and, in appropriate circumstances, remote control
- to construct improved meskas served by a single pumpset under the management of a Water User Group
- to control water wastage by a programme of loss control works including the elimination of leakage at tail escapes, and to eliminate gravity command conditions wherever possible
- to instal small, modular drainage re-use pumping stations in the Delta to make more water available at peak times and to minimise the loss of Nile system water to the sea.



ROTATIONS vs CONTINUOUS FLOW

Rotational flows predates the introduction of fully controlled perennial irrigation in Egypt. It is an easily administered method of regulating supplies and constraining demand. It does, however, have a number of disadvantages:

- rotation periods are not always well matched to the irrigation intervals preferred by farmers
- the effective period for which supplies are available to tail-end farmers is reduced because of the time taken to refill canals and because of the tendency for head-end farmers to take water preferentially
- because of the problems of tail-end farmers, rotation periods are extended during critical periods, upsetting the schedule
- the regular emptying of canals during off periods contributes to the deterioration of canal side slopes.

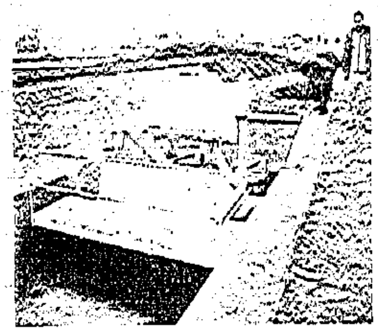
The adoption of continuous flow is an important new principle which is being introduced under the project, offering a number of significant advantages:

- it would increase the flexibility of the system, allowing farmers greater independence of action over the timing of irrigation
- it would overcome capacity constraints in the system by reducing maximum discharges by one half to one third of those required under rotations
- the effective channel storage capacity, in relation to average discharges, would be increased.

It would also result in a reduced cost of new structures due to the smaller design discharges, and improve water supply for non-irrigation purposes such as domestic washing and livestock watering.

A main objection to continuous flow is that it could lead to increased wastage of water. At meska level, since water will continue to be pumped, there is no reason to suppose that field losses will be increased. And since there would be greater flexibility and certainty of supply, the tendency to over-irrigate would reduce. Distribution losses, however, are directly related to contact time. In areas in the delta where the canals are below-grade, seepage losses are negligible. Elsewhere, gravity command conditions should be eliminated, where possible. A programme of loss control will be used to eliminate losses at tail escapes in the main and branch canals.

Structures will be used to ensure constant water levels in branch canals



CONTROL STRUCTURES

Canal control structures are used to control discharges or levels or both. At present, canal regulation is mainly based on maintaining specified water levels. In general, the only points in the canal system at which discharges are routinely controlled and recorded are the heads of principal canals and the boundaries between irrigation directorates. Under the project, the regulation of discharges will be extended to the head of branch canals and at canal cross regulators, serving irrigation blocks of about 2,000 feddans, although in some cases much larger. This interface or "intervention point", will be the lowest point in the system at which discharges will be regulated and will be the interface between scheduled upstream operation and demand operation from downstream. Within branch canals, downstream of intervention points, it is intended to provide downstream control using specialist gates.

A mixed system of control will be provided through the project giving downstream control within branch canals so as to offer farmers a system which responds to their needs, but with the ability to restrict flows at "intervention points", so that an upper limit may be set on flows into individual irrigation blocks.

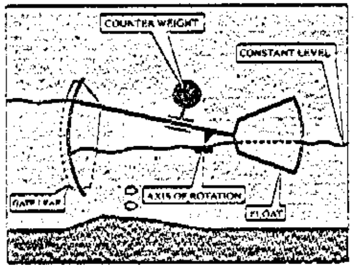
Automatic devices will be used to fulfil the project strategy of minimum intervention:

(a) Discharge regulators

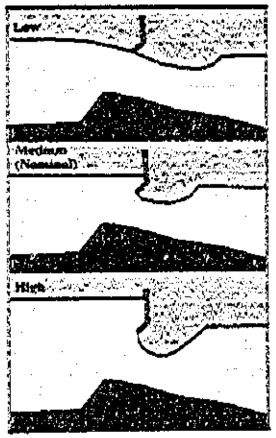
Baffled distributors are modular discharge regulators which supply near constant flows to an offtaking canal over a range of upstream water levels. Under the project, they will be used as head regulators and cross regulators to divide canals into separate irrigation blocks. The throttling effect of a distributor will be used as a means of enforcing equity along a branch canal. Distributors will be designed to allow for planned night storage, with provision in some cases for overflow to the downstream reach should levels exceed this range of upstream water levels.

(b) Constant Downstream Control Gates

Constant downstream water levels in branch canals will be maintained through the use of specialist automatic gates which respond to changing downstream conditions through adjustments to the gate opening irrespective of upstream conditions. Flows through the gate are directly related to downstream abstractions. Because they provide neither control nor measurement of discharge, the gates are not, in general, suitable for use as intervention point structures.



Working principle for downstream control gates



Working principles for distributors

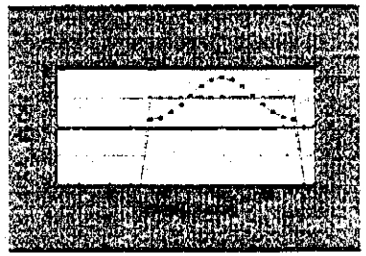
Constant flow for varying upstream water levels

MODE OF OPERATION

The IIP design approach assumes that branch canals will be supplied with a near-constant discharge via a discharge regulator at the head, and that water stored in the branch canal overnight will be mobilised to provide the peak water requirements. The branch canal system does not then depend on mobilising storage in the main system at times of peak water use. A combination of automatic downstream control regulators and constant discharge distributors is used to achieve this mode of operation.

The maximum required storage volume in a branch canal is estimated from the expected pattern of daily water demand.

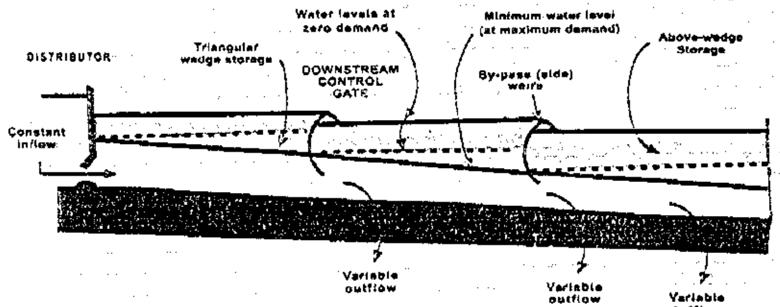
Demand patterns



Legend
- Average
- Adjusted
- Simulated

The available storage volume in a canal is that between the maximum and minimum permissible water levels in the reach. In rare cases, sufficient storage volume may be available during normal operation of downstream control regulators. In most cases, however, it is expected that the required storage volume will only be obtained by allowing the water level to drop below minimum downstream operating levels ("below wedge storage") and/or to rise above the normal maximum downstream operating level ("above wedge storage") in the canal reach. Otherwise, any temporary shortage in available storage in the canal reach in question can only be met by mobilising storage from upstream reaches. In this case, storage in the main canal must be sufficient to meet the simultaneous demands of all branch canals for water.

A small volume of storage (the triangular wedge) is available between the maximum and zero flows (see diagram below). A more substantial additional above-wedge storage in a reach controlled by a downstream control regulator is mobilised by allowing a part of the inflow to bypass the regulator via side weirs. Where limited freeboard is available, this in turn may not be achievable without raising canal bank levels, unless the section is oversized.



Storage in canals

MESKA IMPROVEMENTS

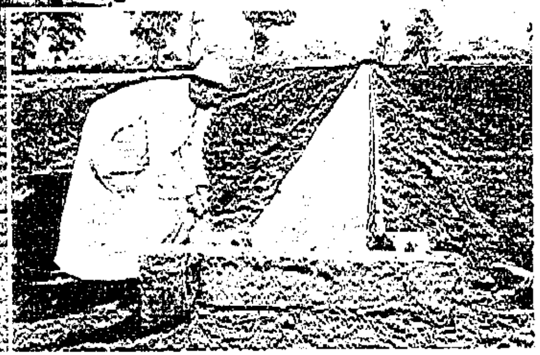
At meska level, the intention is to implement a series of measures to: ensure equity of water delivery between head and tail; reduce irrigation costs; provide individual farmers with greater direct control over water use; reduce maintenance costs; and improve environmental conditions. The measures will include:

(a) Single point lifting at the head of the meska using a pumpset owned by a Water User Group comprising all irrigators on the meska. This economises on pump operating costs, over the existing system under which individual farmers along a meska pump water into their marwas.

(b) Replacement of the existing below-grade meska by either a raised lined meska or a buried pipe system.

Alfalfa valve outlet fed via header tank and pumphouse in right background and replacing the sakia shown in left background

A single pumpset serves the improved meska



Gravity command from the improved meska

IRRIGATION ADVICE

After improvement, each meska will be operated and managed by the irrigating farmers. Typically, for each meska, this will require some 60 farming families to jointly agree on water allocations to each plot, and for the collection and administration of payments for operation of the pumpstation at the head of the meska. In future, it is intended that farmers will contribute to the operation and management of branch canals. This will be achieved through the representation of farmer organisations on branch canal management committees.

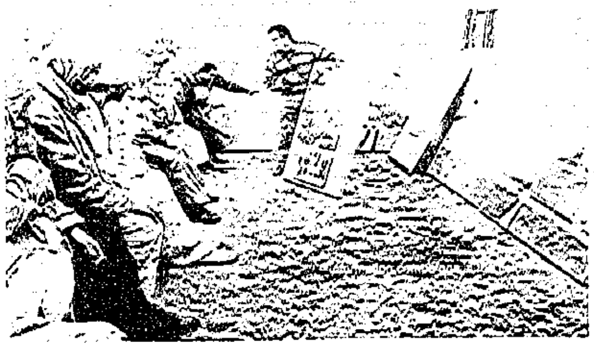
Technical and managerial advice will be needed by farmer groups to enable them to organise and manage communal irrigation. Skills will be required in group management; in organising the collection and administration of charges for the operation of the meska; arranging water deliveries to a range of crops of varying water requirement on different soils; operating and maintaining the pumpstation; and maintaining the meska.

A new cadre of technical advisors has been formed to assist the farmers in developing these skills, the Irrigation Advisory Service (IAS). IAS staff are trained in developing the water user groups through a structured process of long term assistance: in group organisation; planning and overseeing meska improvements; and in operating the new meska. To ensure that the changes are sustainable, IAS staff will be concentrating on a service-orientated delivery which responds to farmer needs.

New irrigation bye-laws, based on the June 1994 amendment (Law Nr 213) to the 1984 Irrigation Act (Law Nr 12), were approved by the Legislative Council in January 1995. The bye-laws define the roles and responsibilities of Water User Groups and offer practical guidance in the management and administration of meska level irrigation.

IAS officers in the field

IAS staff holding group discussions with farmers



COMMUNICATION

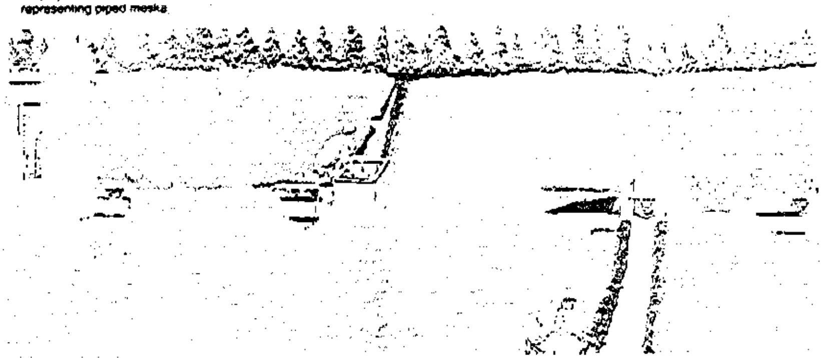
Although the overt objective of the project is the improvement of physical infrastructure, the sustainability of the measures hinges upon the successful involvement of farmer groups in the planning, implementation and operation of the improved system. The complexity of the project and the wide range of individuals and organisations who are involved in planning, implementation and operation requires good communication. A specialist unit within the project will assist in advertising and communicating, to both technical and non-technical audiences, the aims and objectives of the project. The unit assists design and IAS staff to prepare materials for the wide range of audiences which the project is to reach: designers, operators, farmers and contractors.

Mass communication techniques (television, radio and newspapers) are used to pass information about the project to all irrigators. Multi-media exhibitions are used to advertise the project to farmer groups in new contract areas by means of posters, leaflets, flip charts, audio-visual presentations, and informal discussions with both project staff and farmers from areas improved under the project.

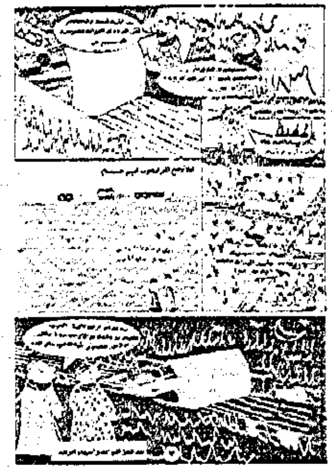
Special emphasis is given to the design of extension materials for use amongst farmer communities so that project messages are portrayed clearly and simply.

Surveys to obtain the information needs of farmers

Display board representing piped meska

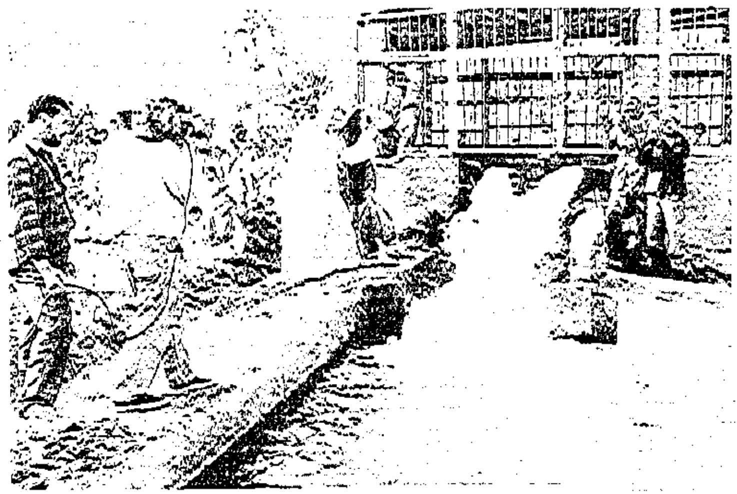


Display boards advertise the project



Extract from comic explaining purpose of downstream control gates

A scene from a drama about the project shown on national television as part of the series "Secret of the Land"



PROJECT OUTPUTS

Flow Measurement Equipment Supplied:

- 40 Mobile Flow Measurement Units
- 45 Work Boats (4.25 m) with Motors
- 2 Flow Measurement Boats (5.5 m)
- 2 Hydrographic Survey Boats (7.0 m)

Meteor Burst Telemetry System:

- 200 Remote Data Acquisition Units
- 2 Master Stations
- 22 Submaster Stations

Voice & Data Collection Telemetry System:

- 630 Remote Data Acquisition Units
- 21 Submaster Stations
- 1 Remote Real Time Console
- 1 Master Station
- 1 Mimic System Display Board

Pilot Canal Automation System:

- 13 Regulators Automated

Data Management System Programs:

- Historic Data Base
- Property Management System
- Meteor Burst Maintenance Program
- VDCS Maintenance Program
- Training Data Base

Maintenance Organization:

- Fully Equipped Facilities
- Trained Staff In-Place

Training & Technology Transfer:

Master of Science Degree	8
Computer Science Certificate	4
Short Term Off-Shore	91
Short Term In-Country	1300

Other:

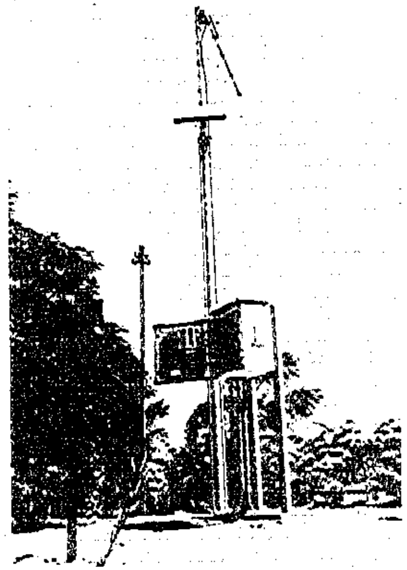
- Constructed Central Operations Building
- MSM Integrated Into MPWWR Organization
- 15 Seminars for Directorate Staff
- Quarterly Communication Bulletin

TELEMETRY PROJECT

FUNDED BY: U. S. Agency for International Development (USAID)

TECHNICAL ASSISTANCE: Harza Engineering Company, Chicago, U.S.A.

TELEMETRY PROJECT



IMPLEMENTED BY:

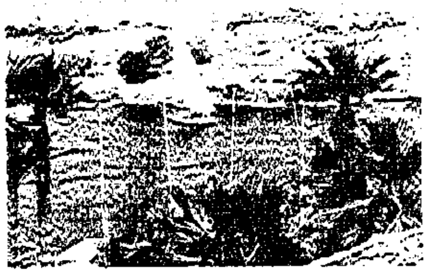
MINISTRY OF PUBLIC WORKS AND WATER RESOURCES
ARAB REPUBLIC OF EGYPT

INTRODUCTION

The Irrigation Management Systems (IMS) Project was intended to strengthen the capability and capacity of the Ministry of Public Works and Water Resources (MPWWR) in the areas of planning, design, operation, management, and maintenance of the Nile River Irrigation System in Egypt. The Main Systems Management (MSM) Component was one of ten components of the IMS Project. The MSM Component was funded by a grant from the United States Agency for International Development (USAID) and was implemented by MPWWR with technical assistance provided by Harza Engineering Company.

MSM is commonly known as the "Telemetry Project" and since that name has come into common usage for many years, it will be used throughout this document.

BACKGROUND



Egypt's supply of water from the Nile has been adequate to meet its needs in the past, but rapid growth in population and industry has resulted in increased water demand. Egypt's share of the Nile water is fixed by international treaty and cannot be increased. It has become clear to the government of Egypt that its share of the Nile water must be used wisely and that historical conservation measures must be improved in order to maximize this precious, but limited resource. The Ministry of Public Works and Water Resources is charged with managing the Nile River and developing new sources of water supply. Since agriculture is by far the largest user of water in Egypt, the Ministry is concentrating on improving management of the irrigation system to increase efficiency of agricultural water use.

The Ministry, under the leadership of Minister Dr. Abdel Hadi Radi is aggressively attacking the issue on four fronts as follows:

1. *Improved distribution and elimination of wasteful water practices.*
2. *Reuse of agricultural irrigation water.*
3. *Protection of the quality of the Nile flows.*
4. *Development of groundwater sources to augment the Nile supply.*

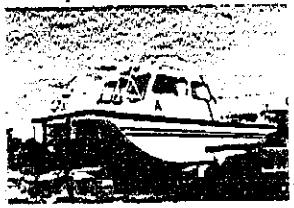
The Telemetry Project consists primarily of installing a country-wide telemetry system that will provide the Ministry with real time data related to the physical status of the Nile River Irrigation System. This ability to know water levels and discharges at any point along the Nile and its extensive canal system on a real time basis is considered to be the key element for achieving items 1, 2, and 3 stated above. The telemetry data collection system also has the capability to: remotely control water regulators and pump stations; report times when pumps are turned on and off; and report water quality and climatologic parameters measurable by electro-mechanical sensors.

Specifically, the Telemetry Project undertook the following seven tasks:

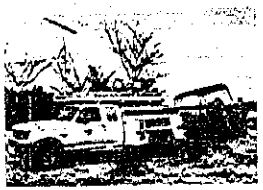
1. *Establish improved water measurement capabilities within the Ministry.*
2. *Install a country-wide, near real time data collection system using meteor burst technology.*
3. *Install a real time Voice and Data Communication System (VDCS) using VHF radio technology.*
4. *Provide a data management system to allow decision makers easy access to the data in formats that would be usable for their respective purposes.*
5. *Test the canal remote control capability provided within the VDCS in one pilot canal automation area located on the Serry Canal in El Minya Directorate.*
6. *Establish an Operation and Maintenance organization within the Ministry that is equipped and trained to operate and maintain the various electronic equipment included in the telemetry system.*
7. *Provide staff training encompassing all of the above activities.*

All of these tasks were successfully completed during the project implementation period of 1989-1995.

FLOW MEASUREMENT



It was recognized during the project design phase that real time water level data would be of great benefit to water managers, but improved water management would require shifting from management by using water levels to management by using flow. The conversion of water levels to flow requires initial calibration with updates performed on a regular basis. The Telemetry Project provided state of the art stream flow measurement equipment in an effort to facilitate this task. The equipment provided consisted of: meters, tools and accessories all packaged in special vehicles, 4.25 m work boats with motors, 5.5 m work boats for large canals and the River Nile, and 7.0 m boats equipped for hydrographic surveying and flow measurement of the River Nile. Training in the use of all this equipment was also provided. The flow measurement equipment provided by the Telemetry Project has been in use since 1991 resulting in significant improvement in the accuracy of regulator calibrations.



DATA COLLECTION

General

The Telemetry System consists of two subsystems that were implemented in phases. Phase I consists of the Meteor Burst Data Collection System with 200 remote sites. Phase II consists of a Voice and Data Communication System (VDCS) with 630 remote sites.

The telemetry system covers the entire country of Egypt, from Lake Nasser to the Mediterranean Sea. Each Directorate (local governorate) has a meteor burst and a VDCS submaster station located at each Ministry Directorate Office to collect data from that Directorate's area of interest. The master stations for each system are located at Qanater (vertex of Nile River Delta area) and they collect the data from all of the submaster stations. Thus, a local data base containing data of interest to local operations resides at each Directorate and a master data base containing data from the entire country resides at the Qanater Operations Center. This Operations Center is located in a new building constructed by the Telemetry Project.

The Operations Center at Qanater is linked to the Ministry Headquarters building at Imbaba (just North of Cairo) via a dedicated communications line. A mimic board to graphically display the system data is located at the Telemetry Office in Imbaba. This mimic board is driven by the VHF master station realtime data base and provides a means of rapidly reviewing the irrigation system status on a real time basis.

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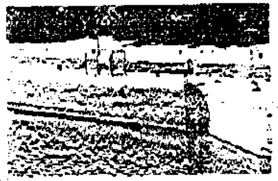
The Historic Data Base (updated hourly) located at the Operations Center is also linked to the MPWWR Headquarters Building in Imbaba. A Local Area Network within the Imbaba Headquarters allows interested entities to have direct access to data that is less than one hour old.

Meteor Burst Telemetry System



The meteor burst telemetry equipment has a communication range of 2,000 kilometers and is very well suited to extremely remote locations. This system is designed to operate with very low power consumption and obtains its power from solar powered batteries. It does not have voice capability, nor is it considered to be real time and, therefore, was not judged to be suitable for control at the time it was procured. This system is relatively simple and easy to install. It was decided, therefore, to install 200 meteor burst sites as a means of obtaining an operational telemetry network quickly. The first 80 sites became operational in early 1991 while the remaining 120 sites were operational by late 1991. Experience with almost five years of operation has shown that this technology is very durable and can meet a 95% reliability criteria on a sustained basis.

Voice and Data Communication System (VDCS)

The VDCS provides voice and data communication services individually within 21 directorates (Submaster stations) and between the Directorates and Operations Center (master station) located at Qanater. VDCS provides for real time, remote data collection of information pertaining to water of the River Nile, primary and secondary irrigation canals and pumping stations. VHF radio communication has been used for data collection and voice communication. A complete communication subsystem of the VDCS is allocated to each Directorate to support its operational responsibilities over irrigation structures and canals within a specific geographical area. Voice communication services are provided by fixed, mobile, and portable radios which operate using one or more repeater stations that cover the Directorate's area of responsibilities.

The entire VDCS consists of the following:

1. 630 Remote data collection units (RTUs) installed at selected irrigation structures and pump stations. The data collected includes the upstream water level, the down stream water level, gate position or pump status, RTU door status, temperature, AC power status, and battery voltage.

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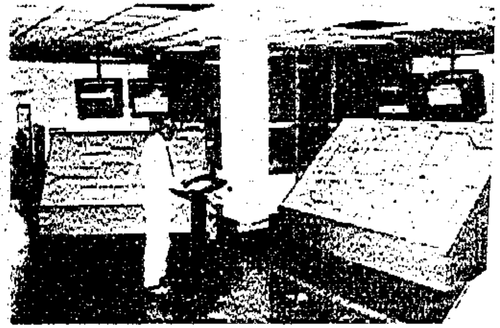
2. One submaster station installed at each of 21 Directorates. Each submaster station consists of the following: one or more repeater stations, two MicroVax 3100 computers with VMS operating system, two Jupiter operator terminals, and radios for voice communication within the Directorate or to the Master station.

3. One master station installed in Qanater. The master station is connected to all the submaster stations through dedicated channels on the Arab Republic of Egypt National Telecommunications (ARENTO) system. The data collected at the submasters is transmitted in a real time sense to the Master Station. These data are used for complete system monitoring at the master station. The Master Station then relays the data to the Mimic display at Imbaba, to two Water Distribution Centers, and to other submaster stations who require data not included in their geographic data base.



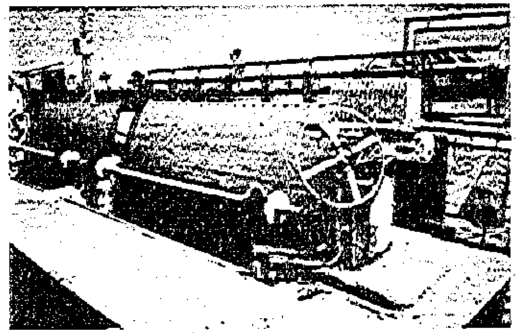
4. Two Water Distribution Centers (WDCs) are installed at Tanta and Assyut. The two WDCs receive hourly data from the master station via dedicated ARENTO lines.

5. The VDCS software includes the capability for remote control of regulators. At Minya Directorate, a pilot canal automation program was implemented to test and evaluate the feasibility of remote automatic operation of the canal regulator gates. Thirteen structures with a total of 43 gates were fitted with electrically operated motorized gate operators. The motorized operators can be operated remotely from the submaster computer or locally at each structure.

6. A Mimic display board is installed at Imbaba to display the status of the entire Nile River Irrigation System. This display provides an easy way for Headquarters staff to review the current status of the irrigation water delivery system.

7. Each submaster can be connected to up to two Remote Real Time Consoles (RRTC). The RRTC is used for system monitoring by offices that do not require a full submaster station. At present the system uses one RRTC at Damietta Directorate connected to the submaster at East Dakhaliya.

The VDCS includes redundancy of hardware and the ability to continue critical functions in degraded mode under certain failure conditions. Computer and peripheral equipment is fully redundant at the Submasters and the Master station with one complete set in the hot standby mode waiting to take over the system whenever failure occurs. The VDCS uses a 3 channel Repeater station where all channels are continuously available to support voice and data communication. Each repeater has three independent channels whose functions of voice and data communication can be reassigned in the event of failure.



The VDCS canal automation feature consists of the ability to perform remote, automatic control of the irrigation structures. Serry Canal in Minya was selected as a pilot project to demonstrate the control functions. The control functions are initiated for each structure by the operator located at the submaster station. The control software includes the following functions:

1. Gate position control, either remote or local.

2. Gate opening control.

3. Upstream water level control.

4. Downstream water level control.

5. Water flow control.

6. On/off control of pumps.

The VDCS provides the operator with a user friendly graphical interface software program. The major canals for each directorate are depicted in semigraphic form on the terminal monitor. Real time water levels, gate positions, control status and computed water flows are displayed adjacent to the relevant canal structure, such as regulators, weirs or pump stations.

DATA MANAGEMENT SYSTEM

The primary goal of the Telemetry Project Data Management System (DMS) is to provide centralized data storage and convenient access to consistent and accurate data in a format that meets the requirements of the decision makers and policy planners in the Ministry. Providing this data to water managers is considered the most powerful tool at their disposal to improve and enhance the water distribution process in the irrigation network.

A database system was developed by the project to collect both the Meteor Burst and the VDCS data into one Historic Data Base (HDB). This data is used to generate daily, monthly, and annual reports. These reports are used by the water distribution managers to monitor and evaluate the accuracy of the water distribution and can be a valuable source of accurate data for planning activities. This data also is used to generate maintenance reports about the performance of the system to help the maintenance engineers in system troubleshooting.

The Operations Center at Qanater and the Telemetry Central Office in the Ministry building in Imbaba both have the system-wide HDB that contains hourly data for remote sites from all over the country. Separate smaller HDBs have been implemented at each irrigation Directorate office where the telemetry system submaster stations are located. Each directorate submaster station database contains a subset of the main HDB.

A Local Area Network (LAN) has been installed in the Imbaba Ministry building to provide all the available telemetry data to the water distribution center, planning sector, the Minister's office, and software and maintenance engineers. Additional users can be connected upon request.

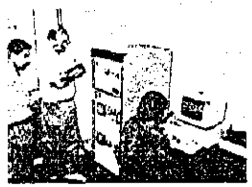
Another goal of the DMS Group is to provide technical support in the field of computers and software to the other project activities and to the irrigation Directorate staff. An example of this is the inventory database system designed and implemented for utilization in the project warehouse.

The DMS Group also provides coordination and cooperation with other related projects and authorities that are interested in Telemetry Project data and in the field of research and studies that require telemetry data for specified sites and/or applications.

SYSTEM MAINTENANCE

Sustainability of the Telemetry Project is heavily dependent on performing adequate maintenance. Adequate maintenance includes both preventive and repair activities. The Ministry established a maintenance staff in each Directorate and provided adequate resources to conduct effective preventive maintenance. Repair of faulty equipment takes place in a centrally located Electronic Repair Laboratory in the project Operations Center in Qanater. This lab is fully equipped with test equipment and tools required to perform the planned repair work. The staff at the lab has been trained both in the supplier's facility in the U.S. and through on-the-job training. Spare parts and required supplies are available in sufficient quantities to maintain expected faults over a period of at least five years.

TRAINING



The Telemetry staff has been provided training in all areas of the project activities. This training provided includes degree programs in the U.S., training at equipment supplier's facilities in the U.S., short courses in the U.S., observation tours, short courses in Egypt, one-year Certificate programs in Egypt, and on-the-job training. All training except for observation tours and on-the-job training was provided through professional training institutes. Selected project staff who have attended such training have been charged with conducting additional training courses in Arabic for their colleagues who did not qualify for offshore training and for new employees. This type of training is taking place at present and will be ongoing.

A VDCS Test and Training Center (TTC) was established at the Operations Center in Qanater. The TTC contains all of the equipment resident at a submaster station. Therefore, training of Directorate staff in the operation and maintenance of a VDCS submaster can be provided at this facility.

The Project also conducted a series of fifteen seminars for Directorate staff (Telemetry end-users) during project implementation. The series started as informational seminars to explain the Project and obtain feedback. The focus of the seminars then shifted to implementation issues and finally to discussing methods of using telemetry data in an efficient manner to achieve improved water management. This latter effort is ongoing.

PROJECT BENEFITS

The potential benefits to water management from effective utilization of telemetry data have not been fully realized to date. However, significant benefits have resulted from the Telemetry Project and as users become more confident in the telemetry data, the benefits are expected to increase. The following benefits have been realized to date:

1. Data has been used to confirm instances of unequal distribution between Directorates and these were resolved.

2. Data has been used to settle disputes where landowners claim lack of adequate supply in canals. The data base usually confirmed that adequate water existed.

3. Data is being used to monitor operational targets. The benefit is that monitoring can be accomplished during the first hour of the working day and timely adjustments made if required. Pre-project condition was that such monitoring was not accomplished until late in the day, or the following day, due to lag time of manual reporting of canal status from the remote sites.

4. Several independent USAID sponsored efforts are underway to assist water distribution managers to use telemetry for active, dynamic operation of the irrigation system rather than as a monitoring tool. This progression of efficiency of utilization of new technology is to be expected and when the staff reaches the next plateau (projected for mid-1997), it is expected that average water usage per feddan will be reduced 5% which is very significant.

5. Having data for an entire day instead of one daily reading is a great benefit that has been underutilized to date, but as water managers achieve the next level of system use, it will result in a significant increase in operational efficiency.

6. Flow measurement equipment provided under the project has been used to increase the accuracy of the Ministry's data base of canal flow vs. water level. Water distribution is, therefore, becoming more accurate because of having more accurate flow vs. level relationships.

7. An electronic equipment repair facility has been established and operating since 1991. The maintenance staff is now well trained and have been successfully repairing project equipment for the past four years.

8. Telemetry Project staff (Ministry engineers trained under MSM) have designed and tested a salinity sensor for the telemetry system that is 25% the cost of sensors purchased from the U.S. These sensors can be manufactured locally and added to existing remote data collection platforms to vastly increase Egypt's environmental data base for salinity.

9. The voice communication capability was extremely beneficial during flash flooding that occurred in late 1994 and early 1995 in Upper Egypt. The ability to communicate to field sites allowed the Ministry to react quickly to mitigate flood impacts and to carry out post-flooding reconstruction efficiently.

10. The voice communication capability has been very beneficial for operation of the irrigation system. Water managers now have much improved communication capabilities with District Engineers and gate tenders (Beharies).

11. The project training activities have resulted in upgrading the human resources within MPWWR.