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EGYPT'S IRRIGATION IMPROVEMENT PROGRAM
I. Performance Assessment
II. Proposed National Strategy

Report No. 7

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Part 1: Performance Assessment

In Part I of this report an overview and summary of the Egypt's Irrigation Improvement Program (IIP) is presented. The purpose of this assessment is to evaluate the IIP relative to accomplishment of its specific goals. The assessment also evaluates the potential of IIP activities as means for accomplishing/supporting desired water policy objectives of the Ministry. The goal is to identify what is working well with IIP and the major constraints that may be reducing performance.

The history of IIP was reviewed, prior to and including the formal addition and funding of an IIP pilot demonstration project as a component of the Irrigation Management Systems Project. This pilot program has been conducted over a seven-year period, 1989-1996, and irrigation improvements were demonstrated in 11 canal command areas around Egypt. Among many accomplishments, the program has a number of key impressive achievements including:

- development of institutional capacity within the Ministry to continue irrigation improvements,
- implementation and demonstration of innovative downstream control and continuous flow availability technologies which significantly enhance equity of water distribution, farmer satisfaction with adequacy of the water supply, and minimization of water wasted to drains,
- development and successful passage of national legislation allowing the formation of private water user associations,
- a well-documented and effective phased approach to water user association organization and development,
- an Irrigation Advisory Service to provide technical assistance to water user associations,
- development and passage of national legislation allowing cost recovery of mesqa improvements.

This assessment has focused on evaluating the performance of IIP using criteria of effectiveness in accomplishing goals and objectives; equity and distribution issues; economic, financial and fiscal considerations; political and social acceptability; public health effects and environmental considerations; and program sustainability and administrative feasibility

The IIP is a socio-technical irrigation improvement process involving the development of farmer participation in improvements and the subsequent management of improved systems. It is relaxing/removing a number of irrigation-related constraints to agricultural production and water use efficiency in Egypt:

- Irrigation efficiencies (the ratio of water beneficially used to the water delivered) are improved, primarily through reduction of delivery system operational losses. These efficiency improvements translate to water savings (in a global sense) that can be transferred or reallocated to other uses when the improvements occur in areas where

irrigation losses and return flows are to salt or pollution sinks. In any situation, these efficiency improvements translate into "local water savings", meaning the freshwater entering a command area is not lost to drains serving the command area.

- Equity of water distribution is improved. Evidence shows substantial head-end/tail-end inequities are relieved and tail-end farmers previously reliant on pumping of drain water to augment their short water supplies no longer need to perform this activity. Land values at the tail ends of canals and mesqas have increased as a result. Positive environmental and health impacts result since farmers no longer need to pump polluted and/or saline drain water.
- Fresh water losses by direct flows from canals and mesqas to drains are eliminated, thereby preserving fresh water quality and reducing or eliminating the degradation of these waters which occurs when they enter polluted drains,
- Farmers are organized in private, legally-recognized WUAs using a tested and monitored seven phase process which is supported by the Irrigation Advisory Service. There are many examples of functional WUAs actively operating and maintaining their improved mesqas.
- Farmers report high degrees of satisfaction with their improved mesqas.
- Farmer's irrigation costs (labor, pumping and mesqa maintenance) are substantially reduced.
- Farmers report water supply adequacy (availability, reliability, distribution, etc.) is much improved,
- Farmers report less conflicts over water and better communications among themselves and with irrigation officials,
- Increased crop productivity trends are evident, but **available data are not comprehensive enough to support strong conclusions for or against the program.** This may in part be due to incomplete implementation of the improvement package as well as incomplete monitoring and evaluation of program impacts. Overall, it is unclear if the combination of inconclusive productivity impacts, but substantial irrigation cost savings, positive equity impacts, positive environmental and health impacts, and positive social impacts result in economically feasible rates of return on improvement investments. It is difficult to assign an economic value to the positive equity impacts, positive environmental and health impacts, and positive social impacts of IIP.
- Farmer willingness and ability to pay for improvements were studied extensively in support of the mesqa improvement cost recovery legislation (Law 213). However, if actual economic benefits are less than estimated, then willingness and ability to pay may need to be re-evaluated.

Several key issues have constrained the IIP program and reduced its effectiveness. These must be addressed and resolved before any widespread national irrigation improvement effort is implemented.

1. The rate of implementation has been slower than expected.

    - Much of the concern about this would appear to be exaggerated. It should be noted that IIP is an innovative and unique program within the Ministry. Considerable effort and time must be expended in developing institutional capacity within the Ministry to implement IIP. Additionally, the development of trust and subsequent

education of farmers in IIP areas concerning the program and its benefits is a time-consuming process that cannot be circumvented.

- Of concern, however, are the fact that the rank and file of IIP/IAS staff were spread much too thinly (i.e., never fully staffed) for the IIP pilot program areas, and, in the case of IAS staff, given many additional duties to perform. Contracting procedures and contractor performance is also of concern in this regard. Contractor non-performance not only caused project delays but seriously undermined farmer confidence in the IIP and its abilities.

- Strategy development for future irrigation improvement projects should address staffing and contracting issues and effectively relieve these constraints.

2. Costs of improvements are high.

   - This is partially attributable to a lack of developed construction contractor expertise (for the sizes/types of construction contracts) to implement construction improvements, to poor construction contracting, and to significant time overruns.

   - Costs should be expected to reduce as private sector capability to design and construct improvements develops and competition for services increases. Cost overruns due to time delays would be expected to decrease with more private sector participation in contracting.

   - Costs can be expected to reduce as improvement alternatives are researched and developed. This includes promising developments using locally manufactured and/or locally adapted construction materials for lower cost mesqa improvements.

3. IIP/IAS staffing, staff turnover, losses of trained staff, lack of adequate training, lack of career opportunities and low salaries unattractive to new engineers, lack of support for field staff, and other internal management problems have been repeatedly identified as constraints to IIP/IAS performance. IIP/IAS staff shortages are hampering the effective implementation of the World Bank-funded IIP project and the completion of the USAID IIP sites. USAID IIP project funding ended in September 1996. As a result of staff shortages and lack of funds these original pilot sites have not been fully completed.

4. WUAs and WUA federations will require technical water management and organizational assistance long after IIP staff have moved on to new areas i.e.. IIP design and construction oversight requires only a temporary transitional presence in the improvement areas. It has been recommended in several instances that the IAS needs to be strengthened and to have a permanent home within the MPWWR to provide continuing WUA support. **Effective water user participation in irrigation system improvement, operation, maintenance and management is a policy objective of the Ministry. The expenditure of public funds to support a government service, such as the IAS, to initiate and enable the organizational process may be justified to support this policy objective**. The effectiveness of IIP is dependent on farmer organizations and socio-technical assistance to these organizations. Once WUAs and other organizations are fully operational, private sector opportunities and capacity to provide the necessary supporting services may be

encouraged and developed as a long-term goal. In all cases where the private sector can provide irrigation support services at a profit, then the MPWWR should facilitate and encourage those activities. On the other hand, irrigation advisory and support services which are not profit-making will need to be provided by government. Over time the government role should be continually assessed to provide only those services.

5. Monitoring and evaluation of IIP interventions to provide feedback for improving implementation processes, and equally important to provide supporting data and information to justify the investments in IIP has been incomplete. Documented agricultural productivity benefits do show positive trends, but at rates less than estimated in feasibility studies. Substantial labor and energy cost reductions have resulted from IIP. The net effect of these results is an unclear picture regarding the economic and financial feasibility of the improvements. **An independent Monitoring and Evaluation Unit within the MPWWR is recommended for designing and implementing comprehensive evaluation programs and for analyzing data and information needed to support policy decisions regarding programs like IIP. Such capability is should be considered requisite component of <u>any</u> program the Ministry undertakes in which economic efficiency, equity impacts and environmental impacts must be known with a degree of certainty before decisions regarding resource allocation can be made.**

6. Many improved mesqas in several of the pilot command areas were completed before main system improvements were completed and continuous flow could be implemented. As a result farmers and WUAs became somewhat disenchanted with the program. Continuous flow availability in the branch and distributary canals is the key and lead technology of IIP. **Efforts should be made to implement improvements that allow continuous flow and which support the district engineer to operationalize continuous flow in the command area. This must occur prior to improved mesqas coming on line. This can be accomplished in a phased participatory approach in which a branch canal water user organization works cooperatively with IIP engineers and the irrigation district engineer to plan, design and implement branch canal improvements.** These improvements would include control gates on low level unimproved mesqas. Branch canal water user organizations would assist with the management of these control gates.

7. An on-farm water management technical assistance program has not been implemented. It is possible that this has contributed, in part, to less than expected crop productivity benefits. Furthermore, local improvements in irrigation efficiency stand to be gained from improved on-farm water management. These efficiency improvements support the long-term potential for adjustment of irrigation water duties resulting in fresh water for **local** redistribution within the command area and/or regional reallocation.

8. The IIP package of interventions and improvements has not been fully completed in most of the pilot sites (unit command areas in El Minya, such as Beni Ebeid and Herz-Numaniya are complete except for the implementation of WUA federations). It is possible that this also has contributed, in part, to less than the full range of expected benefits being realized. Additionally, the impact of the full package of improvements, especially crop productivity impacts, may not materialize until the improvements have

been in place for at least two years. These facts have two important implications for future Ministry efforts regarding IIP. First, the pilot sites should be fully completed as quickly as possible using a suggested set of prioritization criteria. Second, there is a compelling need to begin an independent, comprehensive, well-designed monitoring and evaluation of IIP to fully document benefits and costs. These pilot sites lend themselves well to case studies.

Part II: Towards Development of a National Strategy for Irrigation Improvement

Although there are questions concerning its economic efficiency**, irrigation improvement is nevertheless a major and recognized component of MPWWR policy over the next several decades**. Part II of this report begins with a brief review of current MPWWR strategy for irrigation improvements. The current strategy is ambitious and proposes to improve irrigation systems serving 3.5 million feddans by the year 2017.

Four alternative strategies for future irrigation improvement activity in Egypt are proposed. The advantages and risks of each strategy are discussed. The four proposed strategy alternatives are:

1. Plan and execute economic efficiency studies prior to making further improvement decisions.
2. Adopt the current MPWWR plan with no changes.
3. Implement improvements and studies under a focused scope of effort combining elements of (1) and (2).
4. A modified IIP implementation scheme with a focused scope of effort, a specific and rationalized set of site prioritization criteria, and concurrent supporting studies.

Strategy alternative 1 derives from conclusion number 5 above. Strategy alternative 2 simply adopts the current MPWWR plan for IIP. Strategy alternative 3 builds upon the concepts and objectives of alternatives 1 and 2.

Given that current MPWWR policy is to move forward with irrigation improvements, and a relative and qualitative comparison of the advantages and risks of each of the proposed strategy alternatives, strategy alternative 4 is recommended for MPWWR consideration. It addresses a number of issues and constraints identified by the performance assessment. Several innovations are suggested with goals of reducing overall improvement costs and improving the effectiveness of the improvement process.

Under the recommended alternative strategy, several innovative modifications to IIP implementation are proposed. These innovations envisage new roles and responsibilities for the MPWWR and the private sector in IIP, but do not change the package of interventions. These innovations address identified constraints on IIP performance. The proposed modifications to implementing improvements strengthen the alignment of IIP with MPWWR water management policy objectives. Specifically, the proposed modifications bring IIP to the forefront in support of Ministry objectives to increase participation of water users in irrigation management.

A specific and rationalized set of prioritization criteria is proposed for selecting future improvement areas. Higher priority is placed on those command areas in the northern Delta, at the tail ends of the Nile Irrigation System, where irrigation losses and return

flows are to salt and/or pollution sinks (e.g., Mediterranean Sea, northern lakes, polluted collector and main drains). Highest priority should be assigned to areas having irrigation return flows to drains from which the drain water is pumped to the Sea or northern lakes in order to reduce both the water losses and pumping costs. Higher priority should also be placed on improving areas where water shortages have been documented and where there is strong water user support for the improvement process at the branch canal level.

The proposed alternative includes the following:

- Adopt and execute a revised implementation scheme in which branch canal water user organizations are developed as the first step in the improvement process.
- Branch canal water user organizations, working closely with the district engineer, the IAS and the IIP engineers, participate in the planning and implementation of the necessary improvements to the branch and distributary canals, mesqa offtakes, tail escapes, etc. to allow continuous flow implementation. The branch canal water user organization would have a self-policing operational oversight role in which they would work with the district engineer to monitor and regulate water delivery to unimproved mesqas until mesqas improvements are accomplished.
- Encourage and facilitate private sector mesqa improvement. The goal is for mesqa improvement to become a private sector activity, demand-driven by farmers, with IIP/IAS oversight and guidance. Funding and credit mechanisms for mesqa WUAs to make mesqa improvements would be established with MPWWR assistance. MPWWR would provide training on design requirements and guidelines/standards, contracting, etc. to private sector design/construction firms.
- Perform the necessary actions to establish an Irrigation Advisory Service Central Directorate within the MPWWR and strengthen its ranks with well-trained, supported and motivated professional staff.
- Develop, implement and adequately support an independent monitoring and evaluation program within the National Water Research Center. The initial activities of this program would include implementation of a well-designed, comprehensive study of the net economic impacts of IIP and farmer willingness and ability to pay for improvements.
- Prioritize irrigation improvement implementation in newly selected command areas and in the completion of existing USAID pilot sites and World Bank sites using a strategic set of criteria designed to maximize benefits gained from IIP, and which support MPWWR policy objectives. Higher priority is placed on improving areas where real water savings will occur and where there is strong water user support for the improvement process at the branch canal level.
- Focus implementation efforts in a limited number of strategically selected areas to further develop capacity and knowledge regarding the implementation of the modified approach.

The proposed strategy for IIP supports accomplishment of possible additional future MPWWR policy objectives. Specifically, the infrastuctural developments of IIP can be easily adapted to provide water measurement and volumetric flow control capability. Careful water control and measurement is needed for a program of controlled deliveries of specific water allocations. Branch canal water user organization development for the purposes of participating in improvement planning, design, implementation, operation and maintenance establishes an institutional linkage between the private sector and the irrigation department. This will facilitate the implementation of possible future

management strategies such as controlled water allocations. Irrigation district water management centers housing the irrigation district engineer, the IAS engineer, and the drainage engineer and their respective staffs consolidate institutional capabilities at the local level in support of increased water user participation in irrigation management.

Summary of Policies Supporting Proposed National Strategy

A summary of policies supporting the proposed strategy is included as a final chapter of the report. These include:

1. Implement a modified approach to irrigation improvement in all new improvement areas, in the USAID pilot IIP command areas, and the World Bank IIP command areas.

    - IAS establishes a presence in the improvement command area and begins the development of branch canal water user organization.
    - Branch canal water user organization, irrigation district engineer, IAS engineers and IIP engineers jointly plan, design and implement branch and distributary canal improvements in the command area and establish continuous flow and downstream water level control.
    - Branch canal water user organization participates in operation and maintenance of the new system.
    - IAS and branch canal water user organization jointly develop mesqa WUAs.
    - Mesqa WUAs plan, design and implement mesqa improvement with financial/credit support from the IIP Mesqa Improvement Revolving Fund. Mesqa WUAs enter into their own turnkey contracts with private sector design and construction firms for implementation of improvements. IAS engineers provide design guidance and oversight.

2. Implement improvements in total irrigation districts or full canal command areas taking into consideration the development of a strong on-farm water management technical assistance program to be developed jointly by the MPWWR and MALR.

3. Use the suggested strategic set of criteria for selecting and prioritizing improvement areas.

4. Focus improvement efforts in a limited number of command areas until implementation processes and issues are tested and adapted, and a cadre of well-trained and experienced IIP and IAS staff, from field technicians to General Directors, is established.

5. Establish an IAS Central Directorate within the MPWWR and strengthen its ranks with trained and motivated professionals. It is imperative that **all** future MPWWR irrigation improvement activities funded by international donor or lending agencies and the GOE include specific line item support for the IAS in the final approved budgets of these activities.

6. Establish a Monitoring and Evaluation Unit within the National Water Research Center to continuously provide feedback on improvement impacts and implementation issues such that the improvement process can be modified and adapted to increase

program efficiency and effectiveness. It is imperative that **all** future MPWWR irrigation and drainage management activities funded by international donor or lending agencies and the GOE include specific line item support for program monitoring and evaluation in the final approved budgets of these activities.

7. Establish multi-purpose district water management centers to be the major services provision and information dissemination point to water user organizations.

8. Assist farmers with the adaptation and implementation of modern irrigation techniques and practices where appropriate.

1 INTRODUCTION

1.1 Overview

Egypt's Nile River water resource is under increasing stress due to increasing competition for available water. Irrigation needs are expanding, as are domestic and industrial water needs due to population and industrial growth. An increasing load of pollutants is threatening Egypt's water quality, environment and the health of its citizens. The Ministry of Public Works and Water Resources (MPWWR) is the primary Egyptian governmental agency charged with the management of water resources. Keenly aware of the need to improve the utilization efficiency, productivity, and protection of water resources in Egypt, the MPWWR and the US Agency for International Development (USAID) in 1996-97 developed a "water resources results package" based upon years of earlier joint experience in water resources management projects.

The package had four major results: 1) improved irrigation policy assessment and planning process, 2) improved irrigation system management, 3) improved private sector participation in policy change, and 4) improved capacity to manage the policy process. The MPWWR and USAID designed the water resources results package aimed at policy analyses and adjustments leading to improved water use efficiency and productivity. Specific objectives are:

1. To increase MPWWR knowledge and capabilities to analyze and formulate strategies, policies and plans related to integrated water supply augmentation, conservation and utilization, and to the protection of the Nile water quality.
2. To improve water allocation and distribution management policies for conservation of water while maintaining farm income.
3. To recover the capital cost of mesqa improvement, and to establish a policy for the recovery of operation and maintenance costs of the main system.
4. To increase users' involvement in system operation and management.
5. To introduce a decentralized planning and decision making process at the irrigation district level.

Early in 1997, the water resources results package was folded into the USAID Mission's Agricultural Policy Reform Program (APRP). APRP is a broad-based policy reform program involving five Egyptian Ministries (Ministry of Agriculture and Land Reclamation (MALR), MPWWR, Ministry of Trade and Supply (MOTS), Ministry of Public Enterprise (MPE) and Ministry of International Cooperation). APRP has the goal of developing and implementing policy reform recommendations in support of private enterprise in agriculture and agribusiness.

USAID supports the MPWWR in five program activities under APRP. These five activities are: 1) water policy analyses, 2) water policy advisory unit, 3) water education and communication, 4) main systems management, and 5) Nile River monitoring, forecasting and simulation. USAID supports the Ministry's efforts through cash transfers (tranches) based on performance in achieving identified and agreed upon policy reform benchmarks and technical assistance.

Technical assistance for the water policy analysis activity is provided through a task order (Contract PCE-I-00-96-00002-00, Task Order 807) under the umbrella of the Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ) between USAID and a consortium headed by the International Resources Group (IRG) and Winrock International. Local technical assistance and administrative support is provided through a subcontract with Nile Consultants.

1.2 Purpose of the Report

A memorandum of understanding between the Arab Republic of Egypt and USAID listing mutually agreed policy reform benchmarks for the APRP Tranche II period (1 July 1997 – 30 June 1998) was signed on 24 September 1997. Benchmark 7 of Section C of the APRP medium/long term policy goals: Agricultural Land and Water Resource Investments, Utilization and Sustainability states:

> "The GOE will develop a national strategy for improving water use efficiency and agricultural productivity through irrigation improvement projects. This strategy will include priorities for implementing the desired improvements."

In support of this policy benchmark activity, a task to assess the performance of Egypt's Irrigation Improvement Program (IIP) was included in the EPIQ Water Policy Reform Program project implementation plan (80).

The purpose of this report is twofold:

1. Assess the performance of the IIP regarding the accomplishment of its goals and objectives, identify constraints on performance and alternative solutions to those constraints, and evaluate the potential of IIP as a means for accomplishing or supporting the desired policy objectives of the MPWWR.
2. Present and discuss alternatives for the consideration of MPWWR regarding a national strategy for irrigation improvement projects. Included in this are recommendations for prioritization of improvement implementation. The performance assessment provides the background information and the basis for the alternatives presented.

The identification and discussion of alternative strategies is based upon recognition of several fundamental issues currently driving Egypt's water resources planning and management:

- The Government of Egypt's plan for horizontal expansion of irrigated agriculture in the Western Desert and the Sinai, and the additional demand for water that these projects represent will put stress on the supply of water available to the old lands of the Nile Valley and Delta.
- Increasing or maintaining the productivity and overall utilization efficiency of Nile River water in the old lands is vital in light of the increasing water demands of horizontal expansion programs and increasing municipal and industrial demands associated with Egypt's projected population and economic growth.
- Protecting water quality and the environment. This has at least two components related to tightening of the freshwater supply: a) sustaining irrigated agricultural land productivity through appropriate salinity and drainage management practices will become increasingly important, and b) protecting water quality in view of the increasing water pollution loads (salts, nutrients, municipal and industrial wastes) and less freshwater available for dilution.
- Over the medium to long term the MPWWR will need to proactively plan for, and then implement an improved capability to manage and equitably distribute reduced

allocations of water to the old lands. The current irrigation delivery system does not support the capability to equitably distribute a water shortage (whether imposed or due to drought).

- The MPWWR has actively pursued a policy objective of increased participation of water users in irrigation management (planning, operation and maintenance) activities over the past decade and is taking steps to continue this development into the future.
- The Government of Egypt has been actively pursuing policy reforms in the agriculture sector over the last decade that are aimed at liberalizing the agriculture economy, removing government controls, and promoting private sector participation to achieve economic growth through open and competitive agricultural markets.

1.3 Organization of the Report

This report is organized in two main parts. Part I presents an overview and assessment of the IIP program. Included in Part I is an introduction to the Egyptian Irrigation Improvement Program with a brief description of its history, the package of interventions and planned implementation. This is followed by reviews of the findings of previous IIP evaluations and a summary of the USAID IIP project completion reports. The majority of Part I describes the approach and methods used in this performance assessment, presents the results of the assessment, and discusses conclusions drawn from the assessment.

Part II presents alternatives for MPWWR consideration regarding a national strategy on irrigation improvements. An overview of the current MPWWR strategy regarding irrigation improvements is presented first. Presentation of alternative irrigation improvement strategies for the Ministry's consideration and a brief discussion of the advantages and risks of each follow this. Given the fundamental issues driving water resources policy and management in Egypt presented earlier in this section, a recommended set of objectives for future irrigation improvement activities is presented. Based on these objectives, criteria and supporting rationale for prioritizing sites/areas for irrigation improvement are then discussed. The main components of a recommended strategy for future irrigation improvement projects are presented next. Several suggested adjustments to the current approaches used for irrigation improvement projects in Egypt are described. A restructured implementation scheme, based upon lessons learned, problems, and constraints encountered in previous irrigation improvement efforts, is proposed.

Irrigation improvement will play a key role in future water use and management policy in Egypt. A future vision of the relationship and importance of irrigation improvement activities in Egypt in this regard is presented and discussed as an extension of the proposed strategy. The report is concluded with a summary listing of proposed policies supporting the proposed strategy.

1.4 Sources Of Information

This assessment is based on information obtained from a variety of sources and methods. These include:

1. Field visits to USAID IIP sites and World Bank IIP sites
    - Qiman/El Arus
    - Qahwagi
    - Balaqtar
    - Bahr El Saidi
    - Saidiya
    - El Manaifa
    - El Mahmoudia
2. Field visits to non-IIP sites
    - Nubariya
    - Fayoum
    - Mansouria
3. Reviews of numerous IIP documents, reports and previous studies of IIP including feasibility study reports, socio-economic impact evaluations, interim progress reports, interim evaluation reports and assessments of progress, workshop proceedings, etc. A numbered list of reference documents reviewed in support of this assessment is included at the end of this report. Where specific information from these references is utilized in this report the number of the reference document is given.
4. Interviews/discussions with key stakeholders in IIP including:
    - farmers and water user association members regarding their perceptions of the IIP program, it's strengths and weaknesses, their expectations of IIP, perceived benefits of IIP, and their ideas/recommendations for improvement of the program,

- IIP/IAS officials and staff regarding the details of many facets of the IIP program, benefits and costs, etc. Additionally, their views of the needs of the program in terms of sustainability, staff training, staff turnover problems, appropriate mix of disciplines, incentives for field staff to work farmer's hours, cooperation/collaboration with MALR extension system, etc. were solicited.
- irrigation sector and irrigation district engineers in IIP areas regarding their perceived problems and constraints of implementing continuous flow in IIP command areas, and the potential impacts of IIP on water supply and demand,
- USAID staff and expatriate consultants formerly involved with the USAID IIP program.

5. Interviews with El Minya and Kafl El Sheikh NWRC/WDISRI team members who have been involved with IIP evaluation studies.

PART I: PERFORMANCE ASSESSMENT

2 OVERVIEW OF THE IRRIGATION IMPROVEMENT PROJECT

2.1 Introduction

The MPWWR, as the primary Egyptian agency responsible for water resources management, is responsible for planning, construction, operation, management and maintenance of the irrigation and drainage network in Egypt.

The MPWWR distributes irrigation water to Egypt's old lands by diverting water at various points from the Nile River to principle canals (rayahs), which, in turn, feed a complex network of main or primary canals. Most of the main system operates on gravity flow. A key feature, however, is that water is generally supplied throughout the network below the surrounding farm ground level, which requires farmers to lift water from the watercourse supplying their farms. Exceptions to this include the Fayoum area and some canal commands in Upper Egypt, where deliveries to farm turnouts are by gravity flow.

Main canals operate on a continuous flow basis. They feed branch and distributary (secondary) canals, which are generally operated on a rotation basis. Rotations vary by crop and season. They are generally either two-turn, i.e., the on-time equals the off-time, such as 7 days on and 7 days off; or three-turn, i.e., the on-time equals one half of the off-time, such as 5 days on and 10 days off.

Offtakes from branch and distributary canals feed smaller canals (tertiary canals) called mesqas. These offtakes are, by law, the point where the public sector role and responsibility for water delivery ends and the private sector role and responsibility begins. In other words, mesqas are considered private watercourses under the control and responsibility of farmers to operate and maintain. Mesqas may serve anywhere from 20 up to 500 feddans[1]. Most farmers lift water directly from mesqas to accomplish irrigation of their farm fields, although in many areas farmers practice "extra legal" irrigation directly from branch and distributary canals. This activity tends to result in water shortages to farmers at tail-ends of canals and mesqas, who resort to drain water pumping

[1] One feddan equals 0.42 ha and approximately 1.04 acres.

to augment their water supplies, with potentially negative environmental and health impacts.

The combination of rotational water deliveries and required lifting of water by farmers are water supply organization attempts to control and discourage excessive water use by farmers.

2.1.1 Background of the IIP

In 1981, the MPWWR initiated the Irrigation Management Systems (IMS) Project with USAID funding. The general goal of IMS was to increase the capacity and capability of the MPWWR to plan, design, operate and maintain the Egyptian irrigation system to result in more effective control of Nile waters. Particular objectives were to optimally allocate water to and within the agriculture sector to help increase agricultural productivity, and to improve the operating efficiency of the water distribution system.

The IMS Project was amended in 1984 to take advantage of the seven-year Egypt Water Use and Management Project (EWUP, 1977-84). EWUP's interdisciplinary applied research at three project areas (upper, middle and lower Egypt) included problem identification, evaluation of alternative solutions for technical and socio-economic feasibility, and demonstration of solutions to improve the social and economic livelihood of Egyptian farmers through improved irrigation water use and management and related agronomic practices. A package of solutions was developed including: a) on-farm irrigation system improvement using precision land leveling, irrigation scheduling, and improved crop production/management practices; b) water delivery improvements including continuous flow availability (versus rotational deliveries) and mesqa improvements; c) formation of water user organizations; and d) educational and technology transfer assistance to farmers through an Irrigation Advisory Service.

The Regional Irrigation Improvement Project (RIIP) was initiated in 1984 under the IMS with the purpose to improve a specific canal command area in El Minya Governorate using the package designed and tested under EWUP. Up to December 1987 a total of 3,400 feddans had been improved under RIIP.

As a successor to EWUP and RIIP, the Irrigation Improvement Project was added as a component of IMS in 1987. Project plans called for the improvement of irrigation systems serving a gross area of 394,000 feddans in eleven canal command areas distributed throughout Egypt. A budget of $105.9 million was approved for a planned project duration through 1991. Amendments to the project scope (area of improvements) and budget ultimately resulted in a seven-year project (1989-1996) with a total budget of $70.94 million of which $67.03 million were expended (26).

2.1.2 Goals and Objectives of the IIP

The stated primary goal of the IIP is to increase irrigation water use efficiency and agricultural productivity in Egypt's old lands (13, 26). Increasing irrigation 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 (77). 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.

As a component of the IMS Project the purpose of the USAID-funded Irrigation Improvement Project was to strengthen the MPWWR's capacity to plan, design, implement, and operate a rehabilitation/modernization program. The objectives of the IIP program (13, 26) were to:

- strengthen the MPWWR institutional capacity to continue irrigation improvements with limited expatriate assistance,
- develop a rational, interdisciplinary approach for planning, designing, and implementing the renovation of specific canal commands identified in the MPWWR development plans,
- develop an Irrigation Advisory Service (IAS) to provide water management technical assistance to farmers and water user groups,
- organize water user associations (WUAs) in all IIP areas to provide farmer input to the improvement process, to communicate local concerns to government officials, to coordinate water scheduling on improved watercourses, to perform maintenance, and to resolve disputes,

- establish policies and procedures for recovery of a portion of irrigation system operation and maintenance costs, and 100% of costs of farm level improvements.

2.2 Description of IIP Package Components

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 are described in the following subsections.

2.2.1 Renovation and Improvement of Branch and Distributary Canals

Main delivery system branch and distributary canal improvements provided by IIP are primarily physical infrastructure enhancements to increase conveyance efficiency and improve the equity of water distribution. These include rehabilitation/renovation of deteriorated canal cross sections, renovation/construction of tail escapes at the end of these watercourses to prevent irrigation water spillage directly to drains, and the installation of automatic downstream water level control structures.

2.2.2 Downstream Water Level Control

Automatic downstream water level control gates (float-operated radial gates) are installed to provide water "on demand" to downstream water users. The gate responds to downstream water levels, opening to bypass more flow as downstream withdrawals increase, and closing to reduce the flow as downstream withdrawals decrease. With careful, coordinated design and rehabilitation of the watercourse embankments and tail escape, the downstream control gate closes completely as the downstream water level rises to within approximately 10 centimeters of the crest of the tail escape. Operational spills to drains and overtopping losses through deteriorated canal sections during nighttime and other low water use periods are prevented.

These technical innovations allow the generally flat sloping and over-excavated branch and distributary canals to serve as storage reservoirs during periods of lower water demand, thereby also providing some buffering of water level fluctuations as demand increases.

Volumetric control of the water entering the branch and distributary canals is intended to be achieved by installing flow control gates at the heads of these canals. Baffle sluice-gate distributors have been tested by the IIP in this regard.

2.2.3 Conversion from Rotational Flow to Continuous Flow

Continuous flow (availability) water delivery in improved branch and distributary canals is introduced. In combination with the automated downstream flow control gates, farmers are provided with greater flexibility in timing of irrigation applications to meet crop water requirements compared to the rigid rotation schedules of the traditional system.

The required canal flow capacity for continuous flow is smaller than that for rotational flow deliveries. For example, in the case of a two-turn rotation, the continuous flow rate is one-half of the rotational flow rate, and in the case of the three-turn rotation, the continuous flow rate is one-third of the rotational flow rate. It is important to note that in each method of water delivery, the same volume of water enters the canal command area over a given rotation period. Thereby, total flow requirements of the primary canals serving these secondary canals do not have to be increased.

Water is available in the branch and distributary canals continuously as a result of this intervention. Farmers along mesqas must still organize and take turns irrigating. Depending upon pumping capacities into improved mesqas, a degree of scheduling coordination and cooperation among mesqas may also be necessary.

2.2.4 Mesqa Improvements

Mesqas are improved by converting from below grade (low level) earthen ditches with multiple pumping/lifting points to elevated and lined, or buried low pressure-pipe, gravity flow mesqas served by a single point pump lift at the head of the new mesqa. Farmers are able to turn water by gravity flow into their farm fields through slide gate or valve turnouts.

Mesqa conveyance efficiency (the ratio of total farm turnout water deliveries to total water inflow at the head of the mesqa) is improved by nearly complete elimination of seepage losses (thereby also reducing waterlogging and high water table problems near these watercourses) and elimination of operational spills. The single point lift pump(s) is meant

to be the only means of introducing water to the mesqa and it is operated only to accomplish irrigation. Operation and maintenance costs are reduced (one versus many pumps).

2.2.5 Organization of Farmers Along Mesqas into WUAs

Farmers along improved mesqas are organized into Water User Associations (WUAs). The objectives of WUAs are to:

- build, maintain and control their own WUA,
- improve water delivery at the mesqa level,
- operate and maintain improved mesqas, and,
- improve the efficiency of water use.

WUAs are responsible for a number of activities including participating in the mesqa improvement process (selecting the type of mesqa, locating the new mesqa, locating mesqa turnouts, etc.), operating and maintaining the single point lift pump, scheduling turns among water users, resolving disputes, and mesqa maintenance.

2.2.6 Water Management Technical Assistance through the Irrigation Advisory Service

The primary mission of the Irrigation Advisory Service (IAS) is to facilitate and assist private water users to establish, maintain, and manage their own sustainable water user associations (WUAs) for improving irrigation performance. The Irrigation Advisory Service also provides continuing water management technical assistance to WUAs and farmers in IIP areas.

2.3 Implementation of IIP in Egypt

2.3.1 USAID IIP Pilot Program

IIP was added as a component of the IMS Project in 1987. The original project paper called for improvements on eleven canal commands covering an estimated area of 337,000 feddans. Feasibility studies were to be completed on a total of nearly 394,000 feddans (26). The command areas selected for study and improvement was distributed throughout Egypt (see Figure 2-1 and Table 2-1). The project took on several additional levels of complexity (compared to previous improvement work) including:

- feasibility studies of each command area or sub-command areas were required prior to implementation of improvements,

- the basis and procedures for a cost recovery program were to be developed,
- the legal basis for WUAs was to be investigated and formally established.

A contract for expatriate technical assistance, training and commodity procurement assistance was signed in December 1988. The contract was for a period of three years through September 1991. The IMS Project was extended until September 1995. The TA contract for IIP was extended two times with a final completion date of September 1996. USAID-funded IIP pilot program accomplishments are summarized in Chapter 4.

2.3.2 World Bank IIP Project

In fall 1993 and spring 1994, IIP staff participated in reconnaissance survey studies and project preparation for command areas planned for improvement using World Bank loan funds (63). Approximately 248,000 feddans in Beheira (El Mahmoudia) and Kafr El Sheikh (El Wasat and El Manaifa) Governorates in the northern Delta were planned for improvement. The project was initiated in October 1995. Progress is summarized in Chapter 4.

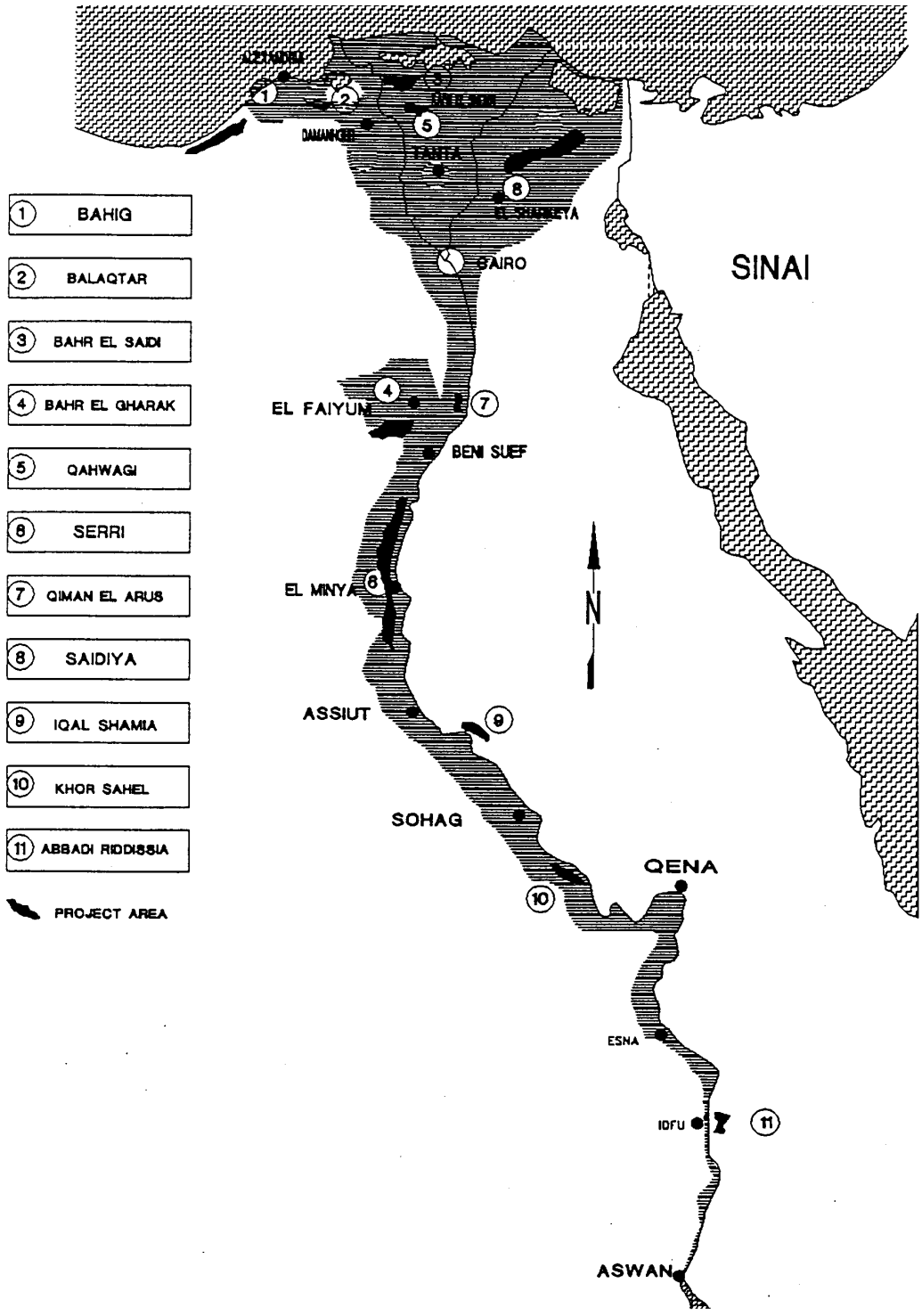


Figure 2-1. Map of Egypt (not to scale) Showing IIP Pilot Program Command Areas (45).

Table 2-1. IIP Pilot Program Command Areas (adapted from 26).

No.	Directorate	Command Area	Area (feddans) Gross	Net	Feasibility Study
1	Damanhur	Bahig	33,600	30,000	x
2		Balaqtar	12,000	11,484	x
3	Tanta	Bahr El Saidi	30,600	26,668	x
4		Qahwagi	12,800	11,779	x
5	Zagazig	Saidiya 1 [1]	8,050	7,160	x
		Saidiya 2	17,180	15,340	x
		Saidiya 3	52,100	47,200	x
6	El Minya	Bahr El Gharak	59,000	47,043	x
7		Qiman El Arus	7,160	6,250	x
8		Serry [2]	95,849	90,435	x
		Ashruba	4,000	3,665	x
		Beni Ebeid	5,000	4,455	x
		Mantout	11,340	10,700	x
9		Iqal/Shamia	20,245	17,470	x
10	Esna	Abbadi	5,885	4,960	x
		Radissia [3]	8,900	8,500	
11		Khor Sahel	9,960	7,810	x
Total			393,669	350,919	

[1] Saidiya 1,2 and 3 are part of the Saidiya Canal Command Area.
[2] Ashruba, Beni Ebeid and Mantout are part of the Serry Canal Command Area.
[3] Radissia is part of the Abbadi-Raddisia Canal Command Area. The Radissia area study was discontinued due to economic unfeasibility.

3 ASSESSMENT METHODOLOGY

3.1 Approach

This chapter briefly summarizes the approach used in this assessment of Egypt's Irrigation Improvement Program. Results are presented in Chapters 4 and 5.

3.1.1 Review of Progress

A review of the progress and the current status of the IIP program is presented in Chapter 4. The results of three evaluations/reviews of components of the IIP, or of the total program, conducted during the course of the program are briefly summarized. The results and achievements of the USAID-funded IIP pilot program are then presented. This is followed by a brief overview of the current status of the IIP including the World Bank funded IIP program.

3.1.2 Purpose Of This Assessment

The purpose of this assessment of IIP is to evaluate the performance of the IIP program in meeting its goals and objectives, with particular emphasis on potential future strategies and policies the MPWWR may consider for enhancing water resources management. It is important to understand the IIP experience to date regarding technical, economic, political and social feasibility of the implemented improvements. It is equally important to understand the extent to which the program's original objectives have been met and factors that may constrain the full realization of goals and objectives. In the context of water policy reform and a future in which the MPWWR wishes to do more with less water, it is of particular interest to understand whether the IIP is positively impacting irrigation water management and agricultural productivity.

3.1.3 Assessment Criteria

Each of the goals and objectives of IIP can be assessed using a variety of inter-related performance criteria (39). These criteria, and the context in which they might be used to evaluate IIP performance, are discussed briefly below. Not all of the criteria are necessarily applied equally to each IIP goal, objective or component.

- Effectiveness. Interventions, strategies, policies, etc. should have a commensurate payoff in the effective fulfillment of their goals. Goals need to be carefully defined,

well understood, and agreed to by all involved. In the case of IIP, are the goals of increased agricultural productivity and irrigation water use efficiency effectively being achieved?

- Economic/Financial Efficiency. In an economic sense, are the actual (i.e., verifiable) benefits of the program exceeding the actual costs of the program? Are the improvements financially viable? Are mechanisms in place to promote the financial sustainability of the improvements?
- Equity and Distribution. Groups (e.g., poorer farmers, tail-enders, etc.) suffering from inadequate/unreliable water supplies or who endure high personal/social costs to obtain water should benefit from interventions and policies (and at the very least, not be worse off). Those previously better off should not receive a disproportionate share of benefits.
- Sustainability. What are the long-term effects of interventions on water use and management? Are there cumulative effects? Successful changes in user habits, successful technological adaptations, etc. are more sustainable. In a physical sense, are infrastructure improvements being maintained so that the improvements function as designed? In an organizational/institutional sense, are WUAs functioning and suitably handling intended affairs? Are any operational changes (e.g., continuous flow) required of the irrigation department accepted and supported/implemented?
- Public Health Impacts. Public health impacts are closely related to equity and distribution effects. The poor or disadvantaged (i.e., tail-enders in a situational sense) often suffer greater health impacts because they may have reduced access to fresh water supplies. It is of paramount importance to provide adequate freshwater supplies and minimize the health impacts of using heavily polluted drain water.
- Environmental Considerations. What are the impacts of IIP on land and water quality? Land effects include water-logging and soil salinity. Runoff and deep percolation from irrigated fields (irrigation return flows) may carry sediments, nutrients, and salts to drains and the groundwater table, potentially degrading water quality. Relatively good quality irrigation return flows, which may be reused in downstream command areas, enter agricultural drains. However, untreated sewage flows and other municipal and industrial waste flows also enter agricultural drains. Water quality degradation is significant when these two sources of drainage flows

commingle. Potential further uses of the water in agriculture, fisheries, wildlife habitat, etc. downstream can be seriously diminished.

- Fiscal Impacts. On a national scale, does the intervention have a positive impact on the finances of the central government or agency? Is major capital spending avoided? Have mechanisms for reducing the cost burden (subsidies, cost sharing, cost recovery) on the government been designed and implemented?
- Political and Social Acceptability. Ideally the improvement program and all components should be acceptable to all stakeholders (farmers, MPWWR engineers, etc.). If the net benefits of the irrigation improvements are not equally distributed, some will benefit more than others, and some may actually lose. Are stakeholders informed of costs and benefits? As the program of improvements progresses and becomes visibly demonstrated, is demand created in adjacent or outlying non-project areas?
- Administrative Feasibility. Conservation measures require qualified and trained advisory staff to educate water users about improved water management and use methods and practices. This must be supported and championed at a high level within the responsible government agency. What appear to be easy approaches/solutions may not be feasible when intensive monitoring, maintenance, policing, etc. are required. Is there an effective program for monitoring and evaluation of the interventions, designed to provide feedback regarding the process, the benefits, the costs, etc., so that the improvement effort can be modified to enhance effectiveness?

3.2 Potential Market Failure Considerations

In addition to the above evaluation criteria, a number of other factors may be constraining the IIP from achieving its goals and objectives (i.e., contributing to a market or policy failure of IIP) (78). These include:

- lack of information/awareness of the program among farmers, MPWWR and other government agency officials
- high transactions costs
- unequal distribution of benefits
- lack of credit/lack of collateral
- property rights issues.

4 PROGRESS OF THE IRRIGATION IMPROVEMENT PROGRAM

This chapter provides a review of the progress and the current status of the IIP program. The results of three evaluations/reviews of the IIP, in part or in total, completed during the course of the program are briefly summarized first. Following this a summary of the results and achievements of the USAID-funded IIP pilot program is presented. This is followed by a brief overview of the current status of the IIP including the World Bank funded IIP program.

4.1 Previous Reviews and Evaluations

4.1.1 Internal Review and Assessment of IIP's Irrigation Advisory Service

MPWWR Decree 53 (35) established the Irrigation Advisory Service (IAS) in 1989. The primary mission of the IAS is to facilitate and assist private water users to establish, maintain, and manage their own sustainable water user associations (WUAs) for improving irrigation performance. The objectives of WUAs are to:

- build, maintain and control their own WUA;
- improve water delivery at the mesqa level; and,
- improve the efficiency of water use.

An internal review and assessment of the IAS was completed in July 1992 by Dr. Robby Laitos (14) after three years of operation. Since the IAS and WUAs are inexorably linked, the purpose of the evaluation was assess the IAS operational strategy, staffing, status of WUA formation and progress, training, and support infrastructure.

The evaluation was conducted while the IIP program was still developing institutional capacity relatively early in its life. Fifty-five recommendations were formulated with a primary focus on making the IAS and WUAs more sustainable. These were grouped into three critical issue areas having important policy implications for the MPWWR:

1. the organizational status of the IAS within IIP and the MPWWR,
2. a vision of what the IAS is and how it will operate,
3. the role of the IAS with regard to WUA formation and continuing development.

A number of issues regarding the status of the IAS within the Ministry were brought to light by the evaluation. While there was considerable expressed support for the IAS by

senior Ministry officials, the IAS was not recognized as a viable and identified entity within the Ministry. Confusion and uncertainty were found concerning the actual levels of resource commitment and support of IAS. Staffing patterns and problems of unfilled positions and/or staff transfers were noted. Budgetary control; support for training of IAS staff, other IIP personnel, WUA leaders and members, etc.; and policies regarding incentives for field staff were also highlighted for improvement.

A need was identified for the IAS to have a clear and mutually shared vision of what it is and how it would operate. Concern was expressed that there existed lack of a coherent understanding within the IAS ranks, Ministry officials and other organizations regarding the appropriate role of the IAS as an enabling and facilitating entity rather than an implementing agency.

With regard to the continuing role of the IAS in WUA formation and development, the evaluation reported effective farmer participation did exist in some areas, but that it was haphazard and effectiveness was variable. Many factors/questions were evident regarding project implementation at this stage of the project's life including issues of pump procurement and cost sharing. These were causing problems with WUA sustainability; WUA members were expressing concern about project implementation delays. It was emphasized that WUAs need continuing IAS support.

4.1.2 Evaluation of the Irrigation Improvement Project Component of the IMS Project

In Fall 1993, USAID contracted with Devres, Inc. to perform a progress evaluation of the USAID-funded IIP pilot program. A team of expatriate and Egyptian experts spent three months in Egypt reviewing and evaluating the project progress to that point, identifying constraints to effective implementation, and making recommendations addressing these constraints for improved project sustainability and cost effectiveness. A comprehensive evaluation report was prepared (13).

The general conclusion of this evaluation was that the IIP Project was making satisfactory progress towards its goal, purpose and objectives, but that the ambitious target levels of output were not being reached. This statement was made in the context of evaluating the Project as a prototype, "revolutionary in the Egyptian context " (13, p. xiv), in terms of the development process for improving water control and application that includes

construction, training, capacity building, institutional and policy changes. The Project was viewed as an action program aimed at developing a replicable methodology on a national scale.

The team noted considerable progress was made with building of institutional capacity for irrigation improvements within the Ministry including design of improvements, specifications and contracting for construction, and training. A main Cairo IIP office, seven field IIP directorates and two IIP inspectorates were established. The IAS was found to be quite effective. It had established a phased approach, a seven-step process, for developing farmer participation and forming water user associations. WUA formation was found to be on a successful path.

The evaluation team noted major project delays. Although IIP was authorized and added as a component of the IMS Project in the 1987, the technical assistance team did not arrive until early 1989. Key TA team personnel were replaced during the first year further delaying implementation. An apparent lack of understanding between USAID, the MPWWR and the TA contractor regarding specific tasks and activities, in particular the conduct and updating of feasibility studies, further delayed implementation. The first construction contracts were not let until late 1990. The inability of the IIP to provide pumps as part of the mesqa improvement package was noted as a constraint to field improvements becoming operational.

The evaluation team recommended the IIP Project should be supported as planned through the anticipated completion date and that serious consideration for a follow-up project be given, since it was evident the IIP activities in the selected command areas would not be completed by the project anticipated completion date. The team recommended an analysis of the organizational structure of IIP. They noted a lack of staff necessary for completion of IIP goals and a continuous shifting of IAS personnel affecting continuity in project activities. Additional TA assistance was recommended, especially in the development of an effective monitoring and evaluation program of project activities. It was recommended that IIP build its social science staff in this regard.

While it was evident the private sector was involved in some of the construction contracting, it was recommended that additional opportunities be explored for involving

the private sector; these ranged from the conduct of feasibility studies to making mesqa improvement a farmer demand-driven process. It was noted that construction was behind schedule. More vigorous enforcement and supervision of individual contracts was recommended, implying that contracting problems and contractor non-performance may have been underlying reasons for construction delays. The evaluation team also recommended that pumps be provided as part of the mesqa improvement package.

At the time of this evaluation, key aspects for the long-term success and sustainability of the Project had not yet been accomplished. These were the process development and legislative approval for both the legal basis and recognition of WUAs and for the mesqa improvement cost recovery program. The evaluation team recommended a greater lobbying effort regarding the legalization of WUAs, and the collection of statistically sound data to develop the basis of the cost recovery program and for eventual justification before the People's Assembly.

4.1.3 The Role of the Private Sector in Egypt's Irrigation Improvement Program

In 1995 USAID funded a study to assess the role of the private sector in Egypt's Irrigation Improvement Program. Under a contract with Agricultural Development Consultants (AGRIDEC), a team of eight expatriate and Egyptian specialists assembled to perform this study during a three-month period. Results of the study were presented in a two-volume report (59).

This study was predicated on the hypothesis that enhancing the private sector role in irrigation improvements may help to speed up the pace of the canal and mesqa improvement program. It was noted that progress at this point in the project life remained extremely slow and that coordination between main system level (i.e., branch and distributary canals) improvements and mesqa improvements was not satisfactory. Additionally, the study team devoted considerable effort to analyzing potential concurrent private sector development of a wide range of support services for all irrigation and crop husbandry operations, finance and credit, etc. needed to significantly increase Egypt's agricultural productivity and profitably (such increases necessary to justify investments in irrigation improvements).

The summary presented here is concerned with only the IIP-specific conclusions and recommendations of the AGRIDEC study. These include:

- The IIP should begin to work more directly with the private sector and should begin to behave more like a private entity modeled after the Drainage Authority. In this sense, an IIP authority would recover improvement costs (or some portion therof) directly from farmers. The funds would go into a revolving fund to pay for the costs of premises, staff, operations and future improvements.
- Public sector companies should not be eligible for IIP contracts unless they post a penalty bond ensuring adequate performance. This is in reference to continuing problems with inadequate construction contractor performance, delays in completion of construction, etc.
- Better coordination is needed between canal level improvements and the mesqa improvement program, but overall the technical package of improvements is quite good. The improvements to branch and distributary canals allowing downstream flow control and continuous flow availability are the lead technology of IIP and are absolutely necessary for the benefits of the mesqa improvements to be realized. In many of the pilot command areas, canal improvements and continuous flow lagged behind mesqa improvements and WUA formation. Farmers were becoming disenchanted with the program as a result. They liked the improved mesqa technology but felt the improvements were of limited usefulness without continuous flow.
- The IIP should withdraw entirely from mesqa level construction. WUAs should contract directly with local, private firms for the design and construction of their mesqa improvements. The IIP should work to plan and facilitate only.
- The IAS role should be limited to what it has been doing best: helping farmers organize into WUAs, provide a linkage between the WUAs and the irrigation department, provide training to WUA leaders and members on WUA operations and water management, carry out monitoring and evaluation activities. It was expressed that where mesqas are improved and functioning that IAS support may not be needed, and that the IAS team should then be able to move on to new improvement areas.
- WUAs should be likely be multi-purpose organizations and work closely with a variety of other rural support organizations. Many members of IAS and IIP, however felt that the WUAs, not fully matured, would be overburdened if they take on more

activity in addition to participation in the mesqa improvement and eventual O&M of the new mesqa.

- Formal WUAs federations (step 6 of the IAS strategy for WUA development) for water management are not particularly needed at this time. Informal contact groups among WUAs along a branch or distributary canal can probably reach agreements on equitable water sharing.
- On-farm water management requires much less attention than it has received. On-farm irrigation scheduling assistance and high tech irrigation methods were not considered necessary on old lands farms.

4.2 Accomplishments and Current Efforts

4.2.1 USAID-Funded IIP Pilot Demonstration Project

The completion date of the USAID-funded IIP pilot program was September 1996. The TA contractor, a joint venture of Morrison Knudsen Engineers and Louis Berger International, issued a comprehensive project completion report (26) at that time. The following summary of accomplishments of the IIP through September 1996 is synthesized from that report.

Considerable institutional capacity was developed within the MPWWR to plan and implement irrigation improvements. Functional units within the IIP program and key to its sustainability were developed and staffed with trained personnel. These include main delivery system design, mesqa design, construction management, feasibility studies, and the IAS. Training needs were identified and considerable on- and off-shore training of IIP staff was carried out.

An interdisciplinary approach for conducting feasibility studies was developed. Socio-economic surveys of 1910 farms in the eleven canal command pilot areas were completed (20, 21, 22, 23, 24, 25) in support of the feasibility study effort, as well as important baseline/background information of existing conditions in these areas prior to improvement work. Feasibility studies (43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54) were completed on the 17 command areas identified in Table 2-1. In addition to the feasibility studies staff also participated in additional studies (17, 18, 19), including reconnaissance appraisals of the World Bank IIP command areas.

Design staff prepared design and contract documents for 91 IIP construction contracts. The 91 construction contracts were completed having a value of LE 112 million ($32.94 million[2]). Staff prepared several design, operation, management and maintenance guides (11, 30, 31, 32, 33).

Figure 4-1 illustrates the total land area served by improvements in the 11 pilot command areas as a result of the feasibility studies, and design and construction implementation. Main delivery system improvements were completed on canals serving 129,000 feddans. Total cost of these improvements was reported as LE 27 million ($8 million). As a result of this effort, continuous flow availability could be implemented on areas totaling 106,000 feddans. Eleven hundred mesqas serving a total mesqa command area of about 67,000 feddans were improved. Total mesqa improvement costs were reported as about LE 63 million ($19 million). Figure 4-2 shows the numbers of mesqas improved by command area. To reduce confusion comparing Figure 4-2 to Table 2-1, it is pointed out that: 1) Beni Ebeid, Mantout and Ashruba are part of Serry Canal Command Area, 2) no

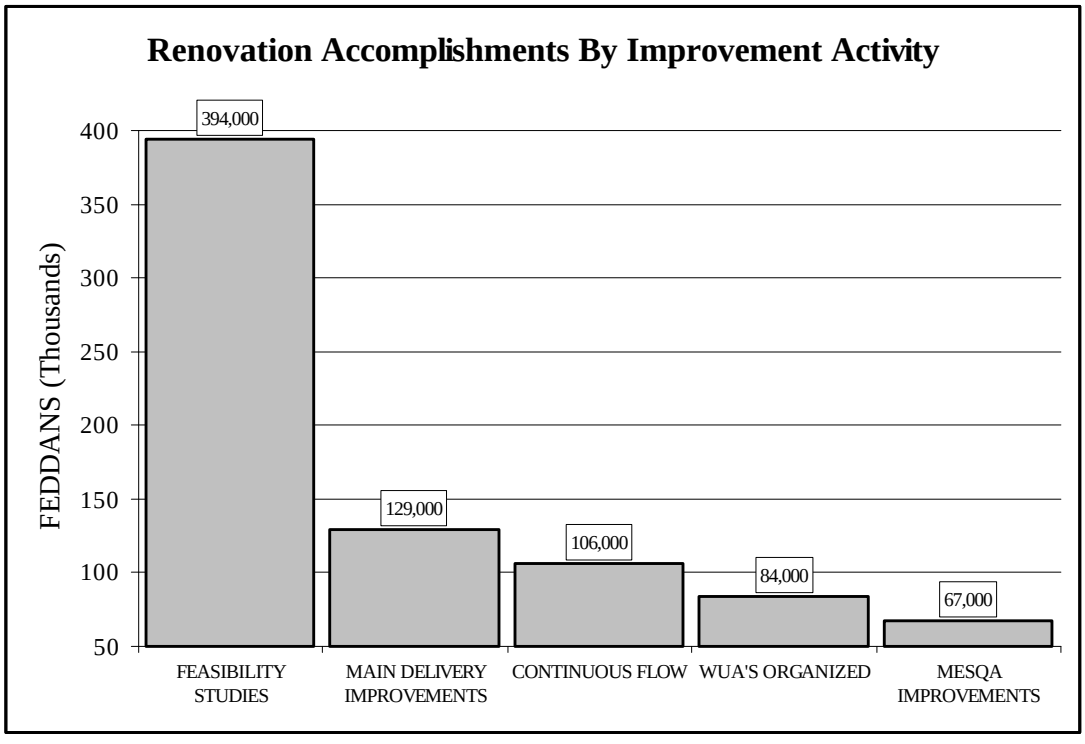


Figure 4-1. Improvements Accomplished by the USAID IIP Pilot Project. (26).

[2] Using an exchange rate of $1 = LE 3.40.

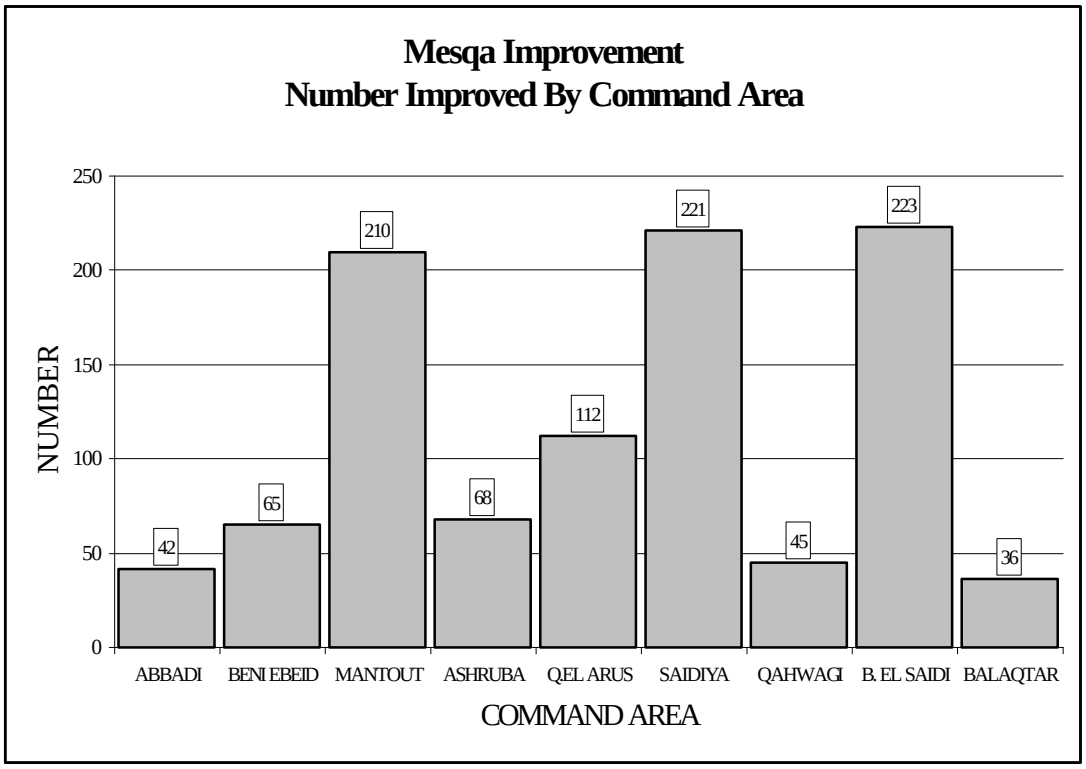


Figure 4-2. Numbers of Mesqas Improved by Command Area Under the USAID IIP Pilot Project. (26).

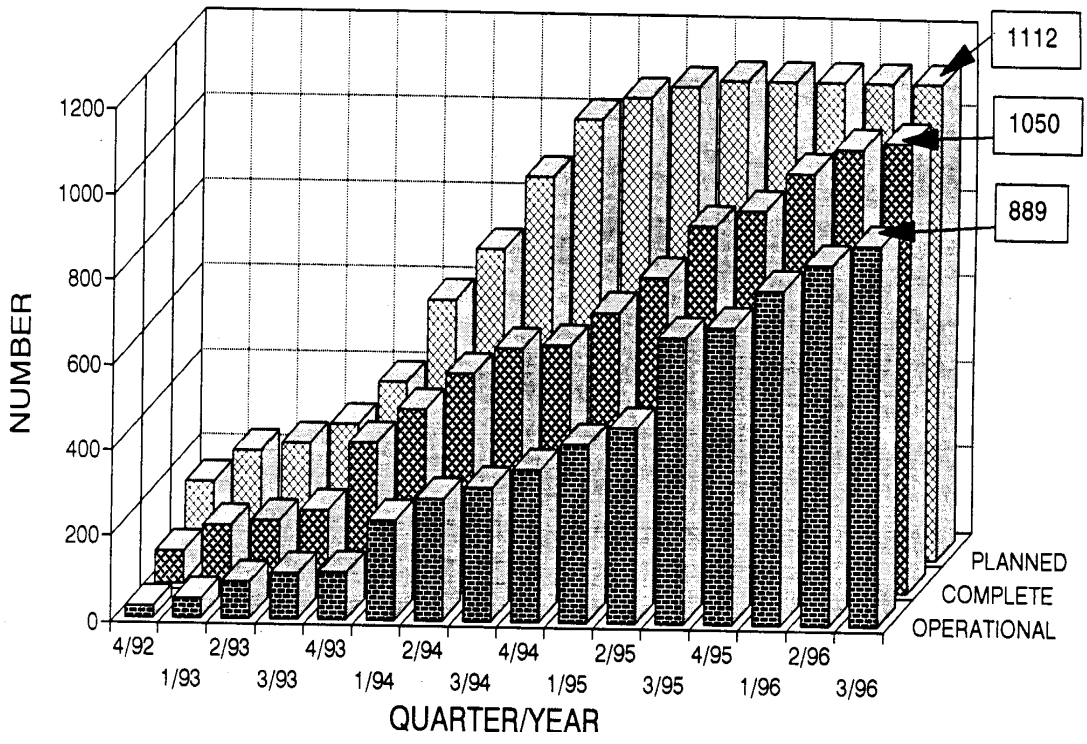


Figure 4-3. Status of Mesqa Improvement Completion Activity in the USAID IIP Pilot Project. (26).

construction work was completed in Bahig and Khor Sahel Command Areas, 3) one mesqa was improved and is operational in Bahr El Gharak, and 4) two mesqas were improved and are operational in Iqal Shamia.

Water users were organized into fully operational WUAs on the eleven hundred improved mesqas. Figure 4-3 shows the progress of completion of mesqa improvements and their activation (turnover) to operational WUAs through the third quarter of 1996. It is significant to note the rapid growth in activity after the 1992 internal review of IAS (14) and the 1993 USAID commissioned review (13), indicating these reviews may have helped to identify constraints impeding progress and potential solutions. On the other hand, the growth of improvements in the field after 1992 is more likely due to the fact that much of the early phase of the program was consumed in institutional capacity building and the completion of feasibility studies.

A trained and capable Irrigation Advisory Service staff was established in the Cairo main office and in each IIP directorate. The IAS was responsible for organizing more than 1100 WUAs and training over 9,000 WUA leaders in organizational functions of the WUA and operation, maintenance, and management of their improved mesqas. IAS staff also conducted demonstrations of precision land leveling on demonstration farms in each command area.

A significant accomplishment was the development and passage of national legislation providing the legal basis for WUAs and for the mesqa improvement cost recovery program. Law No. 213 (27) was passed in 1994 as an amendment to the Irrigation and Drainage Law No. 12 of 1984. By-laws were developed and approved, and Ministerial Decree No. 14900 was issued in February 1995 (34) for the implementation of the legalization and registration of WUAs and for mesqa improvement capital cost recovery.

There was extensive training provided to Ministry IIP staff. Two IIP staff engineers completed Masters Degrees at US universities. One hundred and eighty-eight IIP staff participated in short term off-shore training and study tours, while 3,166 IIP staff received short term training in-country.

A number of problems and constraints were noted over the life of the project. These were felt to have caused significant delays in implementation:

- unclear specification of responsibilities and methodologies regarding the completion of feasibility studies consumed one and one-half years early in the project life,
- inadequate staffing levels and high staff turnover rates (e.g., there were 7 project directors, 23 general directors, and 19 IAS directors over the course of the contract; 41 trained engineers left the IAS),
- many construction contracts ran over contract time by a year or more,
- providing pumps for improved mesqas was a long drawn-out problem not resolved until summer 1994 causing farmers/WUAs on completed mesqas to become disenchanted with the program; further complicating this problem, many issues delayed actual pump installation until summer 1995.
- construction and operations funds from USAID were frozen for varying lengths of time in an effort to encourage the MPWWR to solve staffing problems, resolve the mesqa pump issue, and push for legislative action on WUAs and cost recovery,
- a per diem allowance intended for field staff required to work farmer's hours (rather than office hours) was not effectively utilized for this purpose, resulting in low field staff morale and a severe constraint on field operations.

Technical problems and constraints were also noted and recommended actions developed:

- Continuous flow implementation was, and continues to be, a major problem. Irrigation department staff did not fully understand the hydraulic principles involved nor the need for continuous flow. Continuous flow in a canal command could not be implemented until provisions were made to prevent direct flow to drains or flooding of low areas through severely degraded canal sections. From another vantage, many improved mesqas could not be activated because main delivery improvements allowing continuous flow had not been completed. It was recommended that in all future work, main delivery improvements should be completed before any improved mesqas are scheduled for completion.
- The IIP package of improvements provide the facilities (physically and institutionally) to make considerable irrigation management improvement gains, however, the greater portion of anticipated benefits of IIP (as estimated in the feasibility studies) were expected to result from on-farm water management improvements. This did not

receive the attention needed, partially due to the limited pay incentives for field staff previously noted. Precision land leveling demonstrations were conducted, however, other components of a complete irrigation water management package (such as on-farm irrigation scheduling assistance, improved surface irrigation methodology, etc.) were largely ignored. It was recommended that the Ministry support the practical field implementation of the on-farm water management training it has conducted. Additional trained staff for field work and information transfer is needed. The Ministry should commit itself to properly supporting these staff if the full benefits of IIP are to be realized.

4.2.2 World Bank IIP Project

The World Bank IIP project was initiated in October 1995. Improvements are planned for three irrigation command areas serving approximately 248,000 feddans of net irrigable area in Beheira Governorate (El Mahmoudia command area 131,000 feddans) and Kafr El Sheikh Governorate (El Wasat command area 75,000 feddans and El Manaifa command area 42,000 feddans) in the northern Delta. The project is the result of a detailed feasibility study of the three project command areas performed by the existing IIP/IAS project staff in 1994. A World Bank Staff Appraisal was completed in October 1994 (63). Total project costs were estimated to be $182.3 million, of which approximately 30% were GOE funds. The project is financed primarily from World Bank and KfW (Germany) loans and some grant money from KfW and the Netherlands (NGDIC). Anticipated project completion date is June 2002.

A separate project director, who reports to the undersecretary of the Irrigation Improvement Program Sector, has been appointed. Support staff were to be added to the existing design and IAS sections of the main IIP offices in Cairo to handle the increased workload of the new areas. Project implementation activities were based in two existing IIP field directorate offices (Kafr El Sheikh and Damanhour). The IIP Sector is working to complete the USAID pilot sites. Main and field office staff have not been augmented as planned (77).

Much of the initial field level efforts of the project are focused on providing advance information and education to farmers in the three command areas. This initial education focused on developing a clear understanding of the cost recovery policy aimed toward

water users. As an initial step towards forming Water User Associations at the mesqa level, intensive communication and education efforts are aimed at informing farmers about the project. These mesqa WUAs are being organized in the well-documented and tested seven-step process developed by the IAS under the USAID IIP program. Figures 4-4 and 4-5 (provided by World Bank IIP/IAS) show the progress that has been made in this regard. Figure 4-4 presents the numbers of WUAs organized in each of the three World Bank Project command areas and the progression in the seven-step organizational process as of the end of January 1998. Figure 4-5 uses the same format to present the number of feddans represented by these newly forming WUAs. It is noted that none of the WUAs yet have moved into phase IV: participation in mesqa improvement activities indicating that construction has not started.

Progress towards construction implementation of improved canals and mesqas appears to have fallen considerably behind schedule, with the initial advertisements for bid tenders and letting of contracts not done until late 1997/early 1998. The proposed tender processing schedule (63) indicates considerable tender preparation, processing, and bid award activity in the three command areas should have been initiated by mid-1995.

4.2.3 Current Status of IIP Efforts

The IIP Directorate of the MPWWR continues to actively implement and complete planned irrigation improvements in both the USAID pilot command areas and in the World Bank command areas subject to many constraints (not the least of which are understaffing, lack of trained staff, and lack of a training budget). Table 4-1 gives the current status of mesqa improvements in the USAID pilot command areas. Comparison of these data with data given in Figures 4-2 and 4-3 indicate some continuing progress in the USAID pilot areas. Table 4-2 gives the current status of WUA organization and development in both the USAID and World Bank command areas.

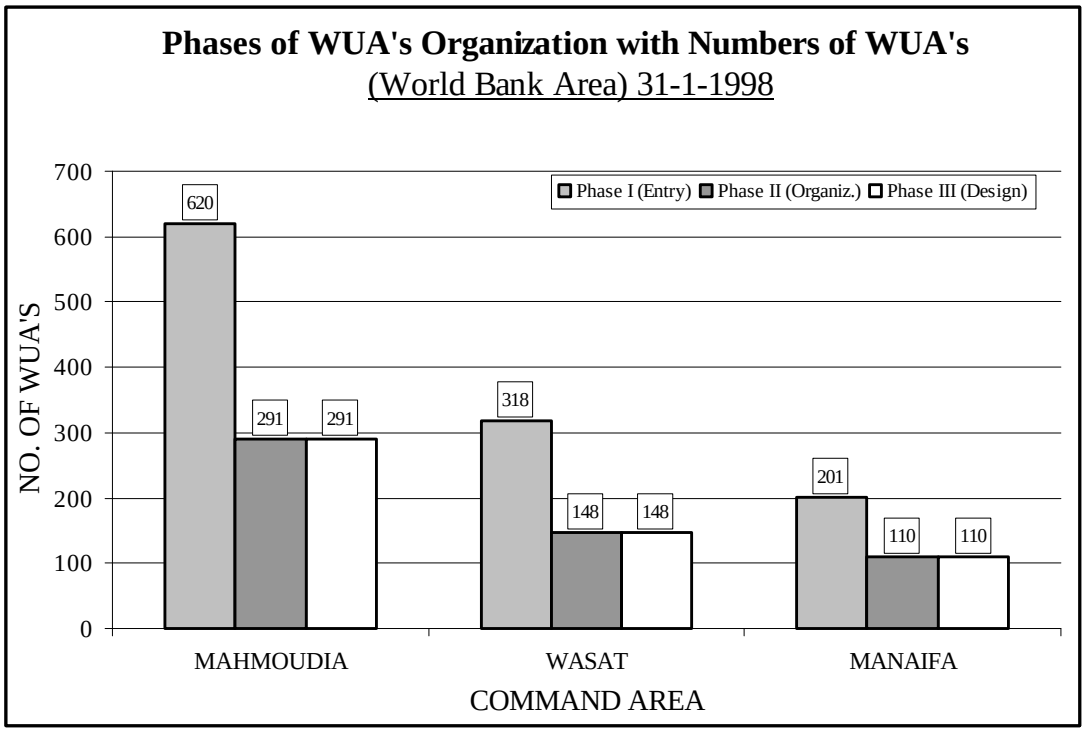


Figure 4-4. Status of WUA Development in World Bank IIP Command Areas, Numbers of WUAs. (Source: IIP Staff).

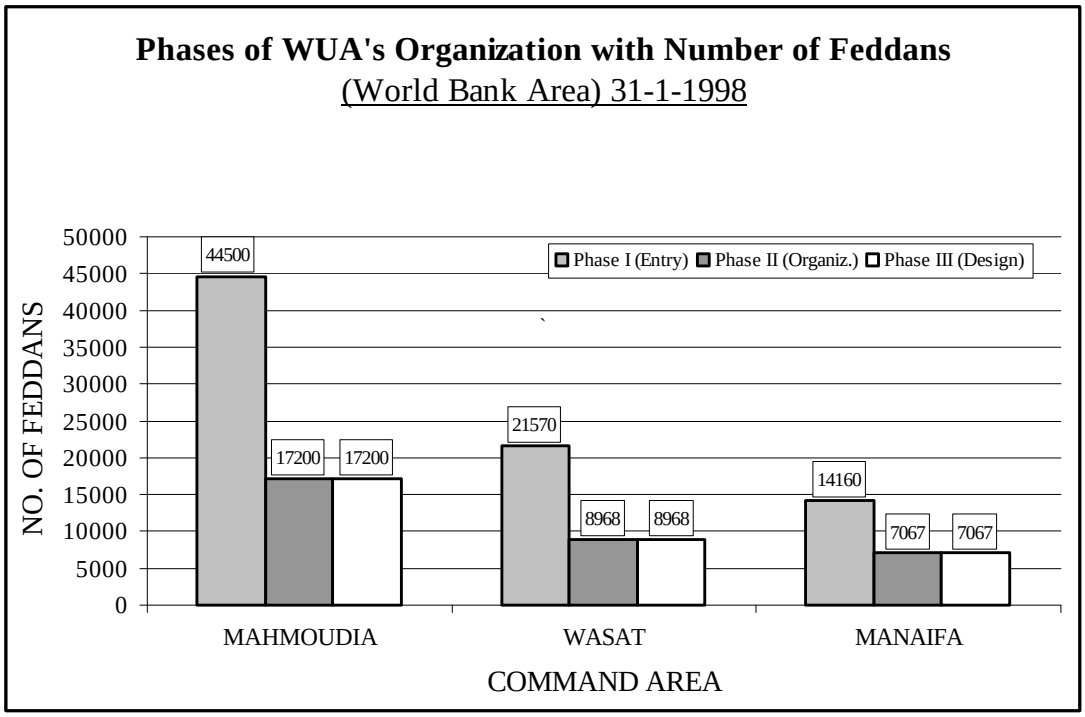


Figure 4-5. Status of WUA Development in World Bank IIP Command Areas, Numbers of Feddans Represented. (Source: IIP Staff).

Table 4-1. Status of Mesqa Improvement (as of 31 January 1998) in the USAID Pilot Command Areas. (Source: IIP Staff).

Directorate:	# OF MESQAS																		
Command Area	Planned		Construction Complete		Under Construction	Construction not Started	Turnover Complete	Operational With Pumps											Total
								Gravity	Demo.	Korean	Farmers	WUA by Coop	WUA by PBDA	WUA by IIP	Type* PL	RL	ILL	CLL	
	# of Mesqas	Area Served	# of Mesqas	Area Served															
Esna:																			
Abbadi	42	3175	42	3175	-	-	28	42	-	-	-	-	-	-	42				42
Minya:																			
Beni Ebied	65	4450	65	4450	-	-	58	-	7	-	10	-	19	29	27	38			65
Ashrouba	68	3665	68	3665	-	-	68	-	1	-	15	3	19	30	30	38			68
Mantout	210	9600	210	9600	-	-	210	-	3	-	148	-	2	57	90	120			210
Herz Numania	85	3400	60	2300	4	21	29	-	-	-	25	21	12	-	10	48			58
Iqal Shamia	4	200	2	46	-	2	?	-	2	-	-	-	-	-	2				2
Beni Suef:																			
Qiman El Arus	112	5650	112	5650	-	-	112	-	26	-	5	13	-	47	58	36			94
Bahr El Gharag	1	292	1	292	-	-	1	1	-	-	-	-	-	-	1				1
Zagazig:																			
Saidiya #1	91	6531	81	6035	10	-	81	5	17	1	0	1	7	50	75	1		5	81
Saidiya #2	158	10837	141	8930	17	-	135	3	19	2	1	-	1	109	130	3	3		136
Tanta:																			
Qahwagi	45	2720	45	2720	-	-	42	-	5	-	8	-	-	25	26	7	1		39
Bahr Saidi	224	14237	224	1427	-	-	212	-	-	-	5	-	1	127	116	5	11		144
Damanhour:																			
Balaqtar	41	3322	41	3322	-	-	27	-	18	-	6	4	13	-	11	28		2	41
Total (all)	1146	68079	1092	64462	31	23	1003	51	98	3	223	42	74	474	618	324	15	7	981

* Type: PL = Pipe Line RL = Raised Lined ILL = Improved Low Level CLL = Concrete-lined Low Level

Table 4-2. Current Status of WUA Organization and Development (as of 31 January 1998) in the USAID Pilot Command Areas and the World Bank Command Areas. (Source: IIP Staff).

Command Area	Phase I		Phase II		Phase III		Phase IV		Phase V		No. of WUA's Registered	Last Date
	No. of WUA's	Area Served	No. of WUA's	Area Served	No. of WUA's	Area Served	No. of WUA's	Area Served	No. of WUA's	Area Served		
A-Damanhour:												
Balqatar	51	11500	46	3834	46	3834	41	3322	41	3322	40	30/01/98
El-Mahmoudia	620	44500	291	17200	291	17200	-	-	-	-	4	
B-Esna:												
Abbadi	59	4395	54	3886	42	3175	42	3175	42	3175	33	26/12/97
Khor Sahel	64	3250	37	1730	31	1283	-	-	-	-		
C-Minya:												
Herz Numania	99	3400	85	3400	85	3400	60	2300	58	2150	21	11/1/98
Mantout	330	9600	215	9600	210	9600	210	9600	210	9600	110	
Beni Ebied	194	4450	65	4450	65	4450	65	4450	65	4450	27	
Ashrouba	123	3665	68	3665	68	3665	68	3665	68	3665	33	
B.El Gharak	1	292	1	292	1	292	1	292	1	292	1	
Qiman El Arus+B1	112	5650	112	5650	112	5650	112	5650	94	4750	94	1/1/98
Iqal Shamia	4	200	4	200	4	200	2	86	2	86		
D-Tanta:												
Qahwagi	107	9600	107	9600	79	5000	45	2720	39	1902	20	24/01/98
Bahr Saidi	270	19636	224	14237	224	14237	224	14237	144	10442	42	
Wasat	318	21570	148	7250	121	7250	-	-	-	-	47	31/01/98
Manaifa	201	14160	86	5587	86	5587	-	-	-	-	37	
E-Zagazig:												
Saidiya #1	91	6531	91	6531	91	6531	91	6531	81	6035	36	31/01/98
Saidiya #2	158	10837	158	10837	158	10837	153	10037	136	8495	67	
Saidiya #3	5	720	5	720	5	720	-	-	-	-		
Total (all)	2802	173236	1792	107949	1714	102191	1114	66065	981	58364	612	

Note:
Phase I: Entry Activities
Phase II: Organizational Activities
Phase III: Preparation for Mesqa Improvement Activities (Design)
Phase IV: Participation in Mesqa Improvement Activities (Construction has started)
Phase V: Regular Operation and Maintenance (Improved Mesqa Fully Operational)

5 ASSESSMENT RESULTS

Assessment results for each of the following goals, objectives and components of IIP are reported in this chapter using the criteria described in Chapter 3:

- increase irrigation water use efficiency and agricultural productivity in Egypt's old lands.
- improve the water delivery subsystem (branch and distributary canals): installation of downstream flow control structures, implementation of continuous flow.
- improve the farm level subsystem: mesqa improvements including new mesqa designs and construction, single point lift pumps, improvements in on-farm irrigation water management practices.
- develop water user associations and monitor performance.
- develop an Irrigation Advisory Service.
- develop and establish cost recovery policies and procedures.
- institutional capacity building and strengthening: staffing, training, retention of trained and experienced staff, incentives to work in the field, rational interdisciplinary approach to planning, designing, and implementing improvements, monitoring and evaluation.

The accomplishments of the USAID-funded IIP Pilot Program (26) summarized in Chapter 4 support, in part, the notion that the program reached or was within reach of many of its objectives. Main system and mesqa level irrigation water delivery systems were improved. The IAS was established and 1100 WUAs were formed. National legislation establishing the legal basis for WUAs and for a mesqa improvement cost recovery program was formulated and passed. An irrigation improvement sector was established in 1996 in the MPWWR (headed by an undersecretary) to house the established institutional capacity of the IIP.

While these achievements are impressive, the effectiveness of the project is often questioned, particularly regarding a slower than expected implementation rate and the overall cost of the program relative to the benefits to Egyptian farmers and the nation. IIP, as a socio-technical irrigation improvement process, is removing a number of constraints to improved irrigation water management and agricultural production in Egypt. This is supported by a brief, but not exhaustive, review of key IIP results presented in the

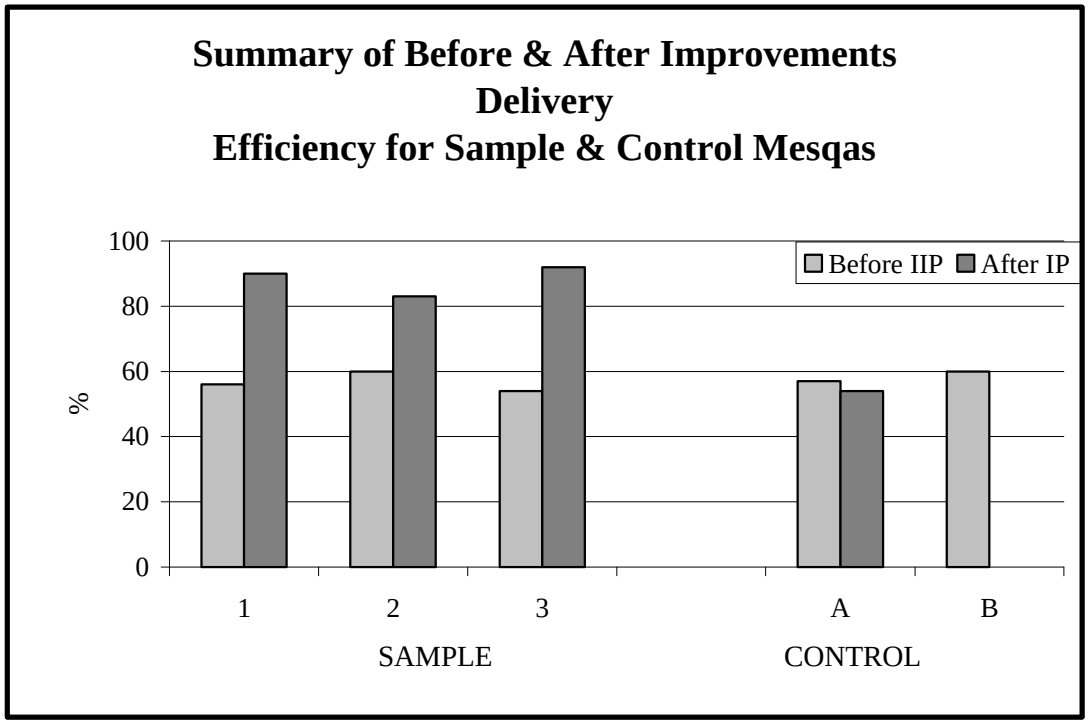
following subsections. Concurrently, this review points out several problems and issues that have constrained the IIP program.

5.1 Effectiveness, Equity and Distribution

Improvements in irrigation efficiency (the ratio of amount of water beneficially used to the amount of water entering the command area) have been measured in IIP command areas. These have been reported in a number of different IIP monitoring and evaluation reports (12, 16, 29, 56, 62) and accomplishment reports (65, 67, 68). Irrigation efficiency improvements have come primarily in the form of improved conveyance (or delivery) efficiencies due to the extensive canal and mesqa improvements implemented under IIP. Operational conveyance losses from branch and distributary canals and from mesqas have been estimated to range from 20% (69) to 50% (41). These losses are direct flows of freshwater to drains, and while their may be an opportunity to reuse these waters in downstream areas, water quality is often seriously degraded. The canal improvements including downstream flow control, canal section rehabilitation, and closing of tail escapes, and mesqa improvements (lined, open mesqas or buried pipelines), effectively reduce operational and other conveyances losses to minimum levels.

Figure 5-1 shows conveyance efficiencies (the ratio of farm turnout water deliveries to the amount of water entering the mesqa) on mesqas before and after IIP improvement, and on unimproved "control" mesqas. Figure 5-2 shows similar 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" translate into improved adequacy of the farm level water supply (discussed in Section 5.3) and reduced water quality degradation (discussed in Section 5.4).

Several IIP studies conducted among farmers in the IIP command areas showed groups of farmers (i.e., poorer farmers, tail-enders, etc.) suffer from inadequate/unreliable water supplies caused by unequal distribution of water (12, 20, 21, 22, 23, 24, 25, 62, 65, 72). Primary technical factors reducing this problem are improved branch and distributary canals, downstream control, continuous flow availability, and mesqa improvements. Primary social factors affecting this problem are the water user associations. Figure 5-3 shows that about 70% of the 137 farmers interviewed along three canal commands.



Notes:

1 = 59 Observation on 6 IIP Mesqas (1991 - 1992)

2 = 43 Observations on 7 IIP Mesqas (1992-1993)

3 = Comparative Data on 8 Control Mesqas by IIP (1978-1980)

A = Observation on 8 Control Mesqas by IIP (1992)

B = 10 Observations on 4 Mesqas by IIP (1992-1993)

*** "Before IIP Measurements and Control Mesqas Show an Estimated Average Mesqa Delivery Efficiency of 60 Percent.

*** "After IIP" (under conditions of the new mesqas) delivery efficiencies ranged from 90 to 98 percent.

Figure 5-1. Comparison of Mesqa Conveyance Efficiency Before and After Improvement on Sample and Control Mesqas. (12).

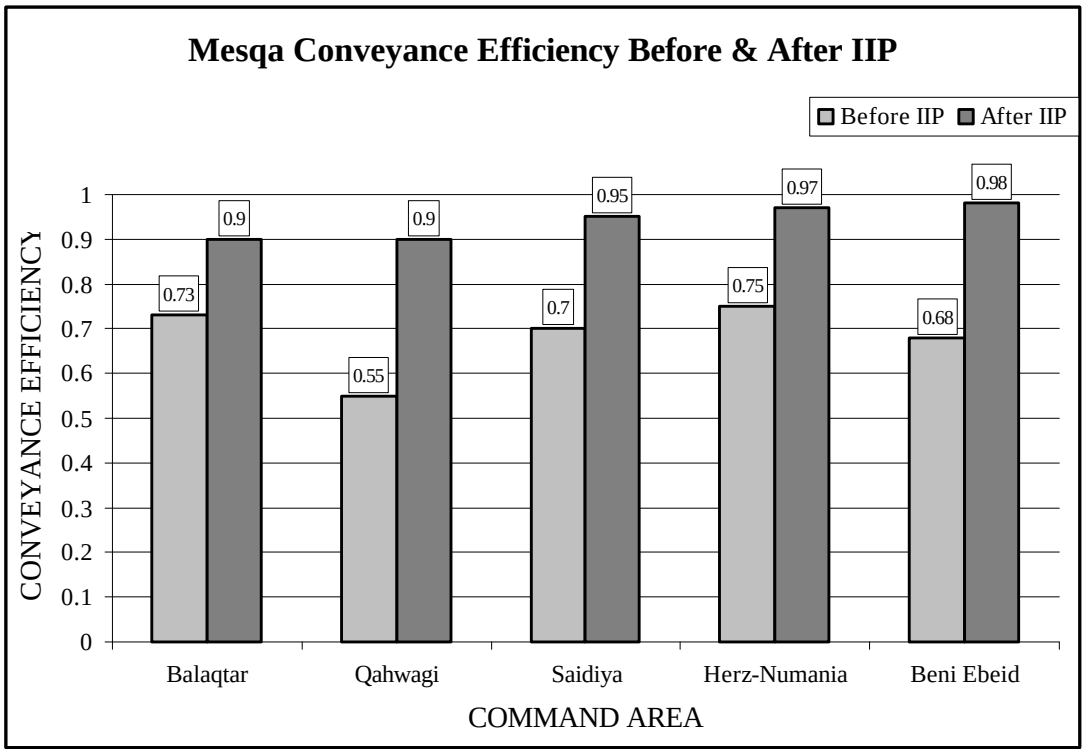
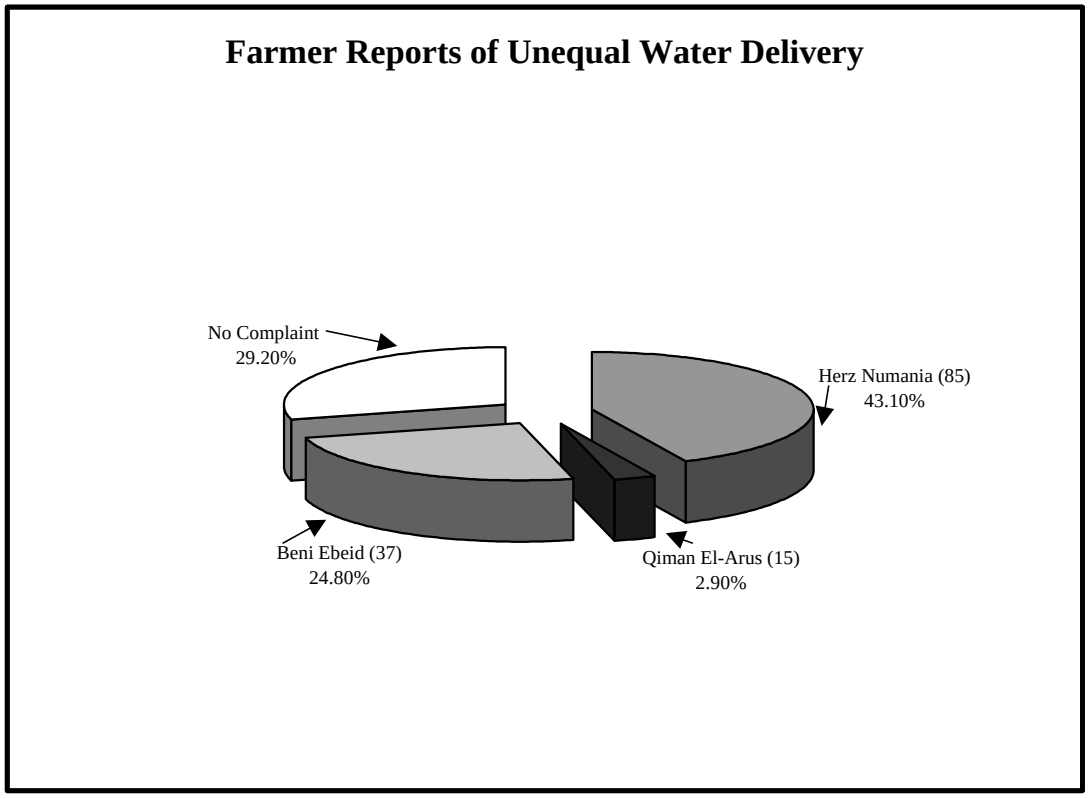


Figure 5-2. Comparison of Mesqa Conveyance Efficiencies Before and After Improvements in Several Command Areas (62).

reported problems with unequal water delivery between head and tail reaches of their watercourses. After IIP improvements, these same farmers reported no problems with water distribution along their mesqas.

The IIP monitoring and evaluation unit defines the Water Use Index (WUI) as the ratio of water delivered to the water required in a mesqa command area (62). Figure 5-4 shows WUI data for the high, summer water-demand months of June-September at the head and tail reaches of an IIP-improved mesqa in Beni Ebeid. These WUI values illustrate high levels of uniformity of water distribution to head and tail reach farmers as a result of improvements. It is also important to note that the WUI values in Figure 5-4 reflect not only more uniform distribution but also adequate water availability (discussed further in Section 5.3) as well.

While it appears water delivery efficiencies and distribution uniformities along canals and mesqas have improved significantly as a result of IIP initiatives, on-farm water application



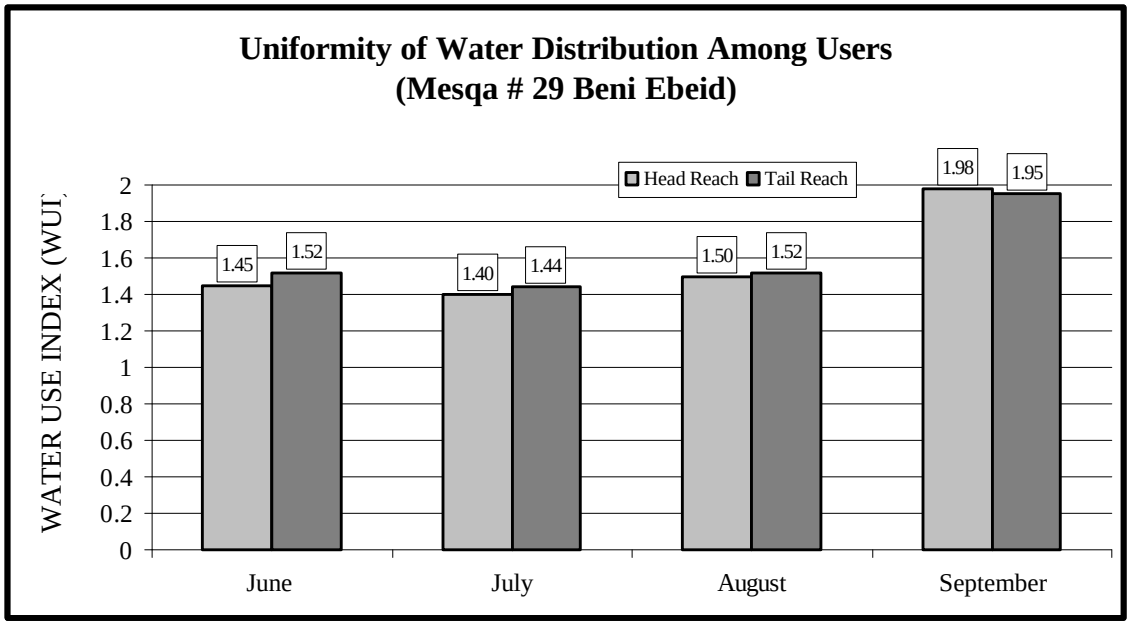
Notes:

*** Percent of total sample (n=137 farmers) reporting a difference between water deliveries at the head and the tail of the mesqa.

*** Data collect by Hvidt (72) on three canal commands in 1991-1992 show that many farmers reported that there were unequal water supplies for mesqa tail reach farmers.

*** After IIP mesqa improvements, none of the 137 sample farmers reported unequal delivery of water to tail reach of mesqas.

Figure 5-3. Farmer Reports of Unequal Water Delivery Problems Before and After IIP (72).



$$(WUI) = \frac{\text{Amount of water delivered}}{\text{Crop \& soil water requirement}}$$

Figure 5-4. Water Use Index (WUI) Values at Head and Tail Reaches After Mesqa Improvement (62).

efficiencies have not been equally improved. IIP efforts in this regard have been limited to demonstrations of precision land leveling on demonstration fields in each pilot command area. The IIP Final Report (26) states (wording in brackets added for clarification):

> "[on-farm water management] has not received the attention needed to fully realize the IIP benefits". And later: "[…the socio-technical innovations of IIP provide the necessary infrastructure and] facilities to improve irrigation water management but do not by themselves improve on-farm water management".

Low on-farm water application efficiencies in IIP improved areas are evident in the September WUI data presented in Figure 5-2. Additional WUI data are given in Table 5-1 for both improved and unimproved mesqas. WUI values between 2.00 and 5.00 were measured for both conditions, even in high water demand months. WUI values greater than about 1.5 indicate significant overirrigation is occurring and there are high losses of water to drains as surface runoff or deep percolation. The implementation of a full

Table 5-1. Water Use Index Values for Several Improved Mesqas and Control Mesqa (62).

COMMAND / MESQA	WD [1]	CWR [2]	WUI [3]
(Herz) Mesqa 31			
February, 1993	9.917	5.700	1.70
March, 1993	3.647	3.046	1.20
April, 1993	10.049	6.594	1.50
(Raised lined)			
(Herz) Mesqa 33			
February, 1993	13.259	6.772	1.96
March, 1993	22.161	16.740	1.30
April, 1993	25.539	18.363	1.40
(Raised lined)			
(Qahwagi) El-Kadomy Mesqa			
April, 1993	51.089	21.367	2.38
May, 1993	109.322	21.890	5.00
June, 1993	150.081	49.655	3.00
July, 1993	152.459	50.710	3.00
(Pipeline)			
(Qahwagi) El-Taree Mesqa			
April, 1993	39.873	25.036	1.59
May, 1993	115.207	68.910	1.66
June, 1993	213.714	77.891	2.70
July, 1993	271.762	68.911	4.00
(Pipeline)			
(Qahwagi) Control Mesqa			
June, 1993	373.360	167.242	2.20
July, 1993	600.645	203.797	2.94
(Low Level Un-improved)			

(1) WD = Water Distribution in Cubic Meters
(2) CWR = Crop Water Requirements in Cubic Meters
(3) WUI = Water Use Index = CWR/WD
*** Note that when WUI is greater than 1.2 to 1.5, this shows over-irrigation and losses to drains.

package of on-farm water management improvements (as researched and developed by EWUP (64)) 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 (64).

Continuous Flow. The lead technology for IIP is continuous flow availability in the branch and distributary canals (8, 26). Considerable applied research was conducted under EWUP documenting the problems with rotational water deliveries in Egypt (64). Continuous flow water delivery versus rotational deliveries was first tested by EWUP in the Mansouria area near Cairo. Benefits were documented and a recommendation was made to convert Egypt's water delivery system to continuous flow wherever possible (9). Continuous flow availability has the following advantages compared to traditional rotational deliveries (8, 9).

- Farmers have a more flexible water supply, which can be better utilized to match irrigation timing and amounts with crop needs. Under the rotation system, farmers are unsure of the reliability of their water supplies. As a means of "insurance", head-end farmers often irrigate at the beginning and end of an "on" period. Tail-end farmers suffer at least two net effects of this: reduced volumes of water reaching the ends of the watercourse, and the increased time necessary for water to reach them due to the smaller flow rate (8, 64). The result is a serious mismatch of the amount and timing of irrigation needs at the head end (excessive irrigation amounts) and tail end (excessive irrigation intervals, small volumes).
- In combination with downstream water level control, tail end farmers have much improved irrigation water supplies. Water is always available in the branch canal, but is not flowing freely to drains during the low demand periods. The inequity of distribution that results from head end farmers taking irrigation water at the beginning **and** end of an "on" period, coupled with the long lag times required for water to reach the tail end as canals are refilled is mitigated.
- In combination with other main system improvements, water losses to drains are eliminated. These losses have been estimated to range from 20% (69) to 50% (41).

Water lost to drains is potentially degraded in quality, and, depending on location, may be lost to the system

The major disadvantage of continuous flow is a requirement to establish improved water control in the command area, and changes in system operation. Improved water control includes volumetric water management, meaning water measurement and control of water flow on a volumetric basis rather than a water level basis. System operators (district and directorate engineers) must be given training and the appropriate support to move from a water level based operation to a water measurement based operation.

Increased water deliveries (flow rates) to improved branch canals, from continuously flowing main canals, are not required when converting branch canals to continuous flow. More check structures (cross regulators) may be required, however, in order to check water levels up to the necessary flow depths. The required canal flow capacity for continuous flow is smaller than that for rotational flow deliveries. For example, in the case of a two-turn rotation, the continuous flow rate is one-half of the rotational flow rate, and in the case of the three-turn rotation, the continuous flow rate is one-third of the rotational flow rate. **It is important to note that in each method of water delivery, the same volume of water enters the canal command area over a given rotation period**. Thereby, total flow requirements of the primary canals serving these secondary canals do not have to be increased.

Water is available in the branch and distributary canals continuously as a result of this intervention. Farmers along mesqas must still organize and take turns irrigating. Depending upon new pumping capacities into improved mesqas, a degree of scheduling coordination and cooperation among mesqas may also be necessary. This emphasizes one of the needs for organization of mesqa WUAs into federations.

The improvements necessary for continuous flow implementation are canal section rehabilitation, closing of tail escapes and in cases where mesqas are not yet improved, installing control gates at mesqa headworks. Unfortunately, a number of planning and implementation problems resulted in many improved mesqas in several of the pilot command areas being completed, before main system improvements were completed and continuous flow could be implemented (13, 26, 29). As a result, farmers and WUAs

became disenchanted with the program. The TA Contractor for the USAID IIP Pilot program recommended that in future projects the main system improvements should be completed in anticipation of bringing the first improved mesqas on line (26).

Mesqa Improvement. The improved mesqa technology with single point lift pumps requires continuous flow availability in the branch or distributary canal (8, 29). On other hand, as just noted, continuous flow implementation requires some minimal mesqa offtake improvement (and management) to prevent direct water loss to drains or land flooding. As will be seen in the next section, the predominant mesqa improvement packages (raised and lined, or low pressure pipelines) installed by IIP are expensive. Cheaper alternatives were tested in many pilot areas, including low level improved earthen mesqas and low level lined mesqas. Low level improved mesqas had reduced construction costs and relatively high B/C ratios (1), but higher maintenance and farmer pumping costs. Experience has shown, however, that distribution of water along the mesqa is not improved with these lower cost alternatives. During field visits and inspection (79) of a low level lined and improved mesqa in Balaqtar, significant amounts of trash and debris were found in the mesqa. Even in this situation where the mesqa had been pipe through most of a village, pipe intakes and culverts under bridges were clogged with debris. Discussions with farmers at the middle and end of the mesqa indicated they were not satisfied with the results and that they wished to install an elevated mesqa.

5.2 Economic, Financial and Fiscal Considerations

The cost of the IIP package as implemented under the USAID program is approximately LE 1560 per feddan ($1092/ha) (source: unpublished data supplied by IIP, 1998). This figure includes LE 425 per feddan ($297/ha) for civil works improvements to the main delivery system, LE 35 per feddan ($25/ha) for main delivery control gates, and LE 1085 per feddan ($760/ha) for mesqa improvements. Mesqa improvement costs represent approximately 65-70% of the total cost of the program. Actual improvement costs have been shown to be relatively consistent with the IIP feasibility study estimated improvement costs (1).

The primary expected benefit of IIP, contributing in large part to the economic and financial feasibility of the improvements, is increased agricultural productivity. This was expected to accrue primarily from yield increases and secondarily from productivity

improvements on previously fallow or partially fallow lands. Only limited yield data have been collected for some crops in some command areas. Figure 5-5 shows percentage of yield increases for beans, cotton, maize and sugarcane in the Herz-Numaniya command area (56) measured one year after improvements were completed. Other IIP yield monitoring data show:

- increased wheat yields ranging from 0-35% and increased berseem yields of 8-10% (16), and,
- increased cotton yields of 7-15%, increased rice yields up to 18%, increased maize yields of 16-30%, increased berseem yields of 5-16% (12).

These data were collected in three of the eleven IIP pilot command areas, were based on small numbers of observations, were from single cropping seasons, and were measurements made relatively early after mesqa improvements. They do indicate encouraging positive trends. Other IIP data, having similar bases, have not shown yield

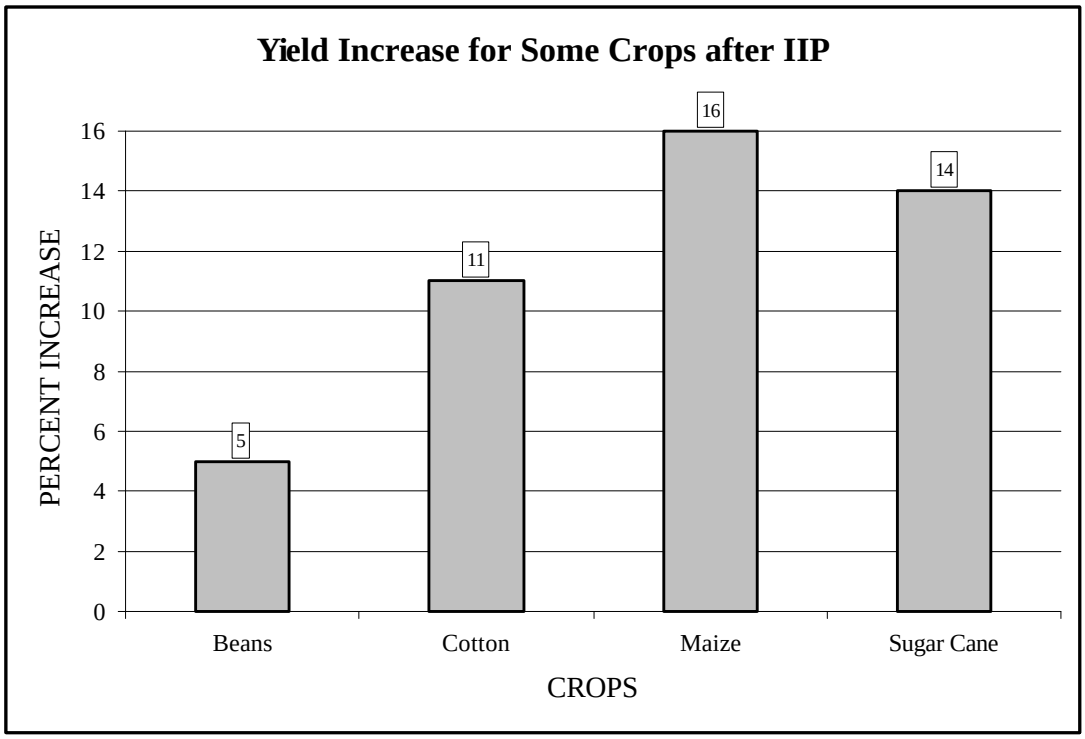


Figure 5-5. Yield Increases for Various Crops in the Herz-Numaniya IIP Command Area (56).

increases (12, 16). The EPIQ Team conducted a limited cropping pattern and yield assessment. These data were obtained from a few pairs of IIP and neighboring non-IIP districts in each of Saidiya and El Minya. A high degree of variability of data among districts was noted. Statistically based conclusions supporting or rejecting hypotheses of positive or negative IIP yield impact cannot be drawn due to data variability, the small sample size, and the fact that data from only one season of data were being compared.

A well-planned, statistically-sound crop production monitoring and evaluation program, consistently implemented over a large number of "paired" IIP and non-IIP areas, and of several years duration, is needed to fully establish the impacts of IIP on crop productivity. This has not occurred to date within the existing programs.

The available crop production data (12, 15, 56) tend to indicate that crop yields have not been positively affected to the levels anticipated in the feasibility studies (43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54). These studies showed the following average estimated yield increases by crop due to IIP: 15-20% for wheat, 25-35% for rice, 20-25% for cotton, 25-30% for maize, 10-20% for sugarcane, 15-30% for broadbeans. Several possible explanations regarding the lack of a consistent, measurable positive yield impact due to IIP have been offered:

- a number of crop production factors affect yields other than water supply and water control,
- it should be expected that several years might be necessary for the measurable yield improvement impacts of IIP to accrue; the majority of IIP improvements have only effectively been in place since 1995,
- it was previously noted that the IIP program did not give the required attention needed to improving on-farm water management.
- monitoring and evaluation programs have not been appropriately designed and supported.

The IIP feasibility studies included sensitivity analyses of program costs and benefits to determine the necessary level of benefit decrease and/or cost increase required to cause economic and financial infeasibility (i.e., benefit-cost ratios (B/C) fall below unity or net present values (NPV) of investments fall below zero). Average benefit decreases of about

20-30% for the raised, lined mesqa option and only 5-10% for the buried pipeline mesqa option (which was more expensive) were generally necessary for this to occur. Benefits accruing due only to crop productivity increases were not separately allocated in these studies. Thereby, it is difficult to judge whether the "indicated" yield increases (being less than the estimated yield increases) support B/C ratios greater than unity or positive NPV's.

Several other important benefits of IIP have been found which positively affect not only farmer's net incomes but also their expressed levels of satisfaction. These benefits generally accrue as a result of improved water availability and reliability, and farmer organization and cooperation within their WUA. The values of the benefits that can be quantified, in and of themselves, may not be sufficient to support financial viability of the IIP package to the farmer. If the social values (see discussion in Section 5.3) of the package could be quantified in an economic sense, the picture would be much more clear in favor of the positive economic impacts of IIP.

Land savings is a secondary benefit of the mesqa improvements. Figure 5-6 compares cross-section characteristics of old and new open channel mesqas. Figure 5-7 shows estimated land savings in IIP mesqa commands resulting from installation of buried pipeline mesqas. It was shown that given the high value agricultural land values in the Nile Delta, $35,000 to $45,000 per hectare, a one-percent land savings of 0.38 hectares in an average mesqa command area of 38 hectares has a value of $13,300 to $16,400 (67). While this "saved" land may not always be brought into production to further increase the net incomes of individual farmers, it has considerable value to farmers in the command area by providing better access roads to their fields.

Studies have shown the improved mesqa technology and farmer cooperation within their WUA resulted in a 50% to 60% reduction in the time required to irrigate one feddan of various crops (12, 16, 56, 72). Figure 5-8 (adapted from 72) shows the hours required to irrigate one feddan of various crops has reduced from around 6 to 6.5 hours to around 2.5 to 3 hours. It was shown (67) that the labor savings resulting from this reduction could amount to a savings of LE 65 per feddan ($46 per hectare).

Farmer's average hourly pumping costs were found on average to have decreased by 33%, from an average of LE 3.60 per hour to an average of LE 2.18 per hour (16). See Figure

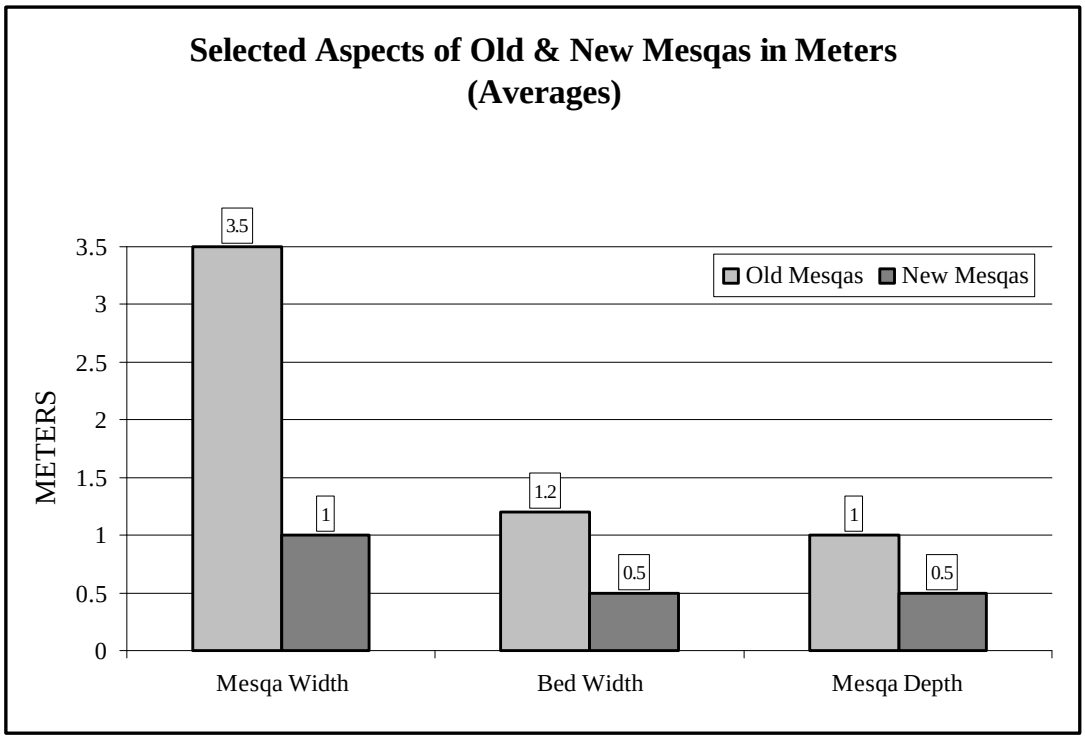


Figure 5-6. Comparison of Cross-Section Characteristics of Old and New Open Channel Mesqas (16).

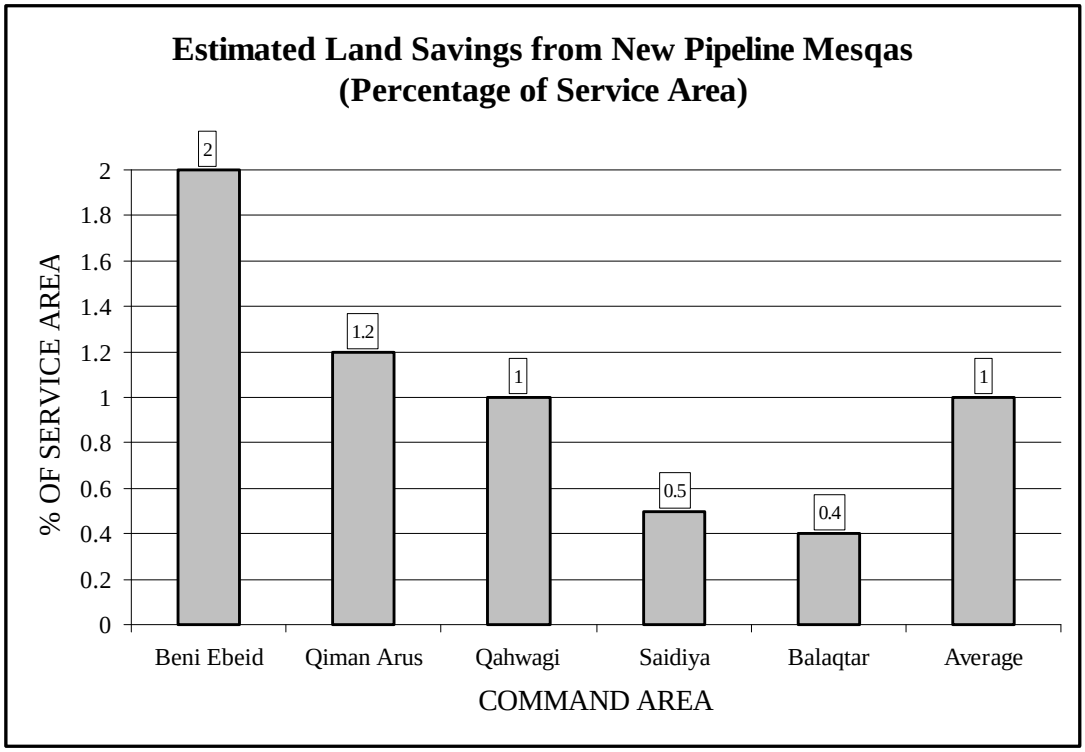


Figure 5-7. Estimated Land Savings in IIP Mesqa Commands Resulting from Installation of Buried Pipeline Mesqas (16).

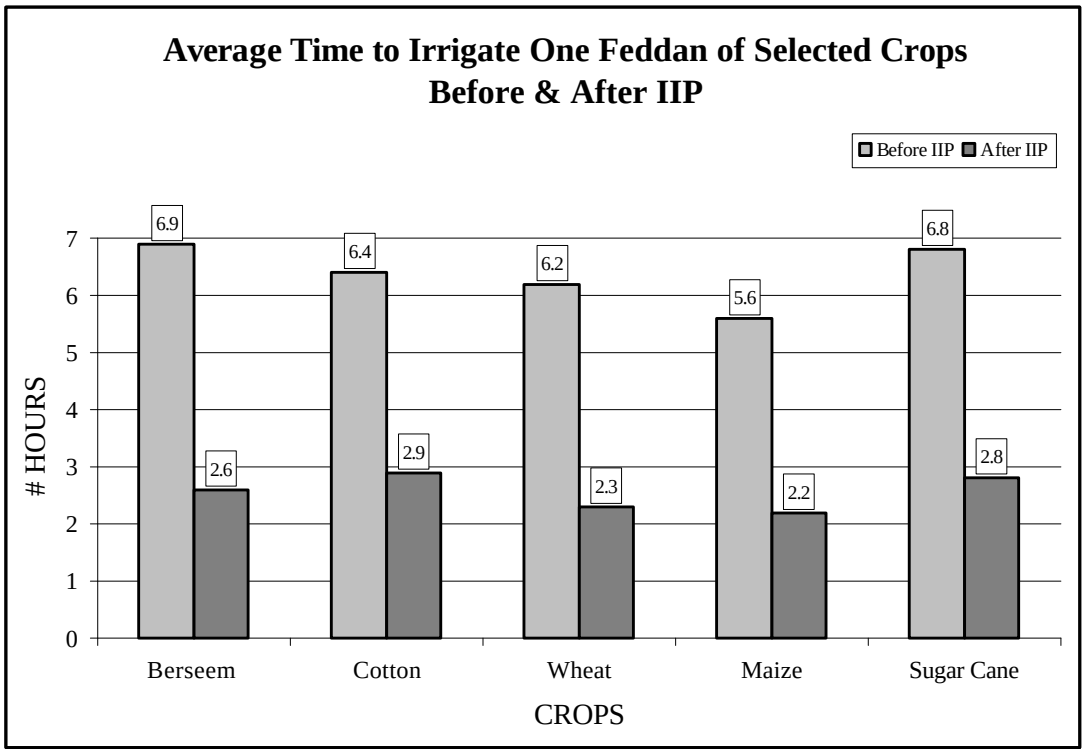


Figure 5-8. Average Time Required to Irrigate One Feddan of Various Crops Before and After IIP (12, 16, 56, 72).

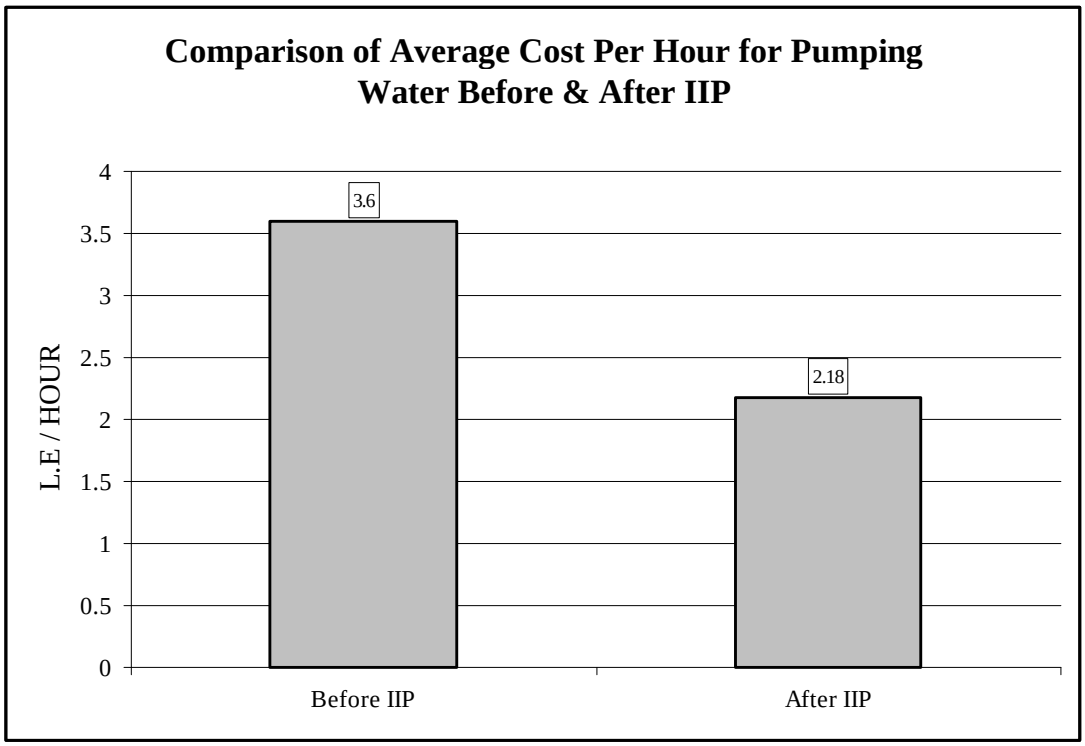


Figure 5-9. Average per Hour Pumping Costs Before and After IIP (16).

5.9. Over two cropping seasons per year this has been estimated to amount to LE 97 per feddan ($68 per hectare) (67).

Due to the reduction in irrigation time and the reduced pumping costs, farmer's irrigation costs per feddan were found to have reduced by about 50% across most of the IIP command areas (12, 16). See Figure 5-10.

A strong trend for reduced mesqa maintenance costs due to IIP is evident (see Figure 5-11). It should be noted, however, that the maintenance cost data shown in Figure 5-11 were collected relatively early after the improved mesqas were operational and maintenance requirements were minimal.

The average cost of IIP mesqa improvements presented earlier was $760/ha. The average irrigation labor cost savings, $46/ha, and pumping cost savings, $68/ha, due to IIP total $114/ha. For 10, 20 and 30-year useful lives of improvements, the rate of return of only these cost savings on the improvement investment is 8.4%, 13.9%, and 14.8%, respectively.

Fiscal Impacts. Benefits of IIP to the nation including improved water management, improved agricultural productivity, higher standard of living for farmers, etc. are evident in some of the results presented thus far. However, neither the full realization nor full documentation of these benefits occurred. The major capital spending of IIP is a major burden on the finances of the GOE. It is not financially sustainable without major donor agency grant funds or loan funds, and private sector sharing in improvement costs.

Provisions to reduce the exclusive government funding of improvements are addressed in the national legislation (27) and by-laws for implementation (34) of water user associations and mesqa improvement capital cost recovery. It is expected this will eventually reduce the fiscal burden on the GOE to modernize its irrigation system, and provide a much-needed revolving fund for continuing improvements. In the context of cost recovery, farmers in IIP areas are expected to repay the capital costs of mesqa improvements over a 20-year period (with a 5-year grace period) and zero interest. Farmers are also responsible for procuring the single point lift pump for their new mesqas. Using capital discount rates ranging from 12 to 15.5%, estimated equivalent annual farm

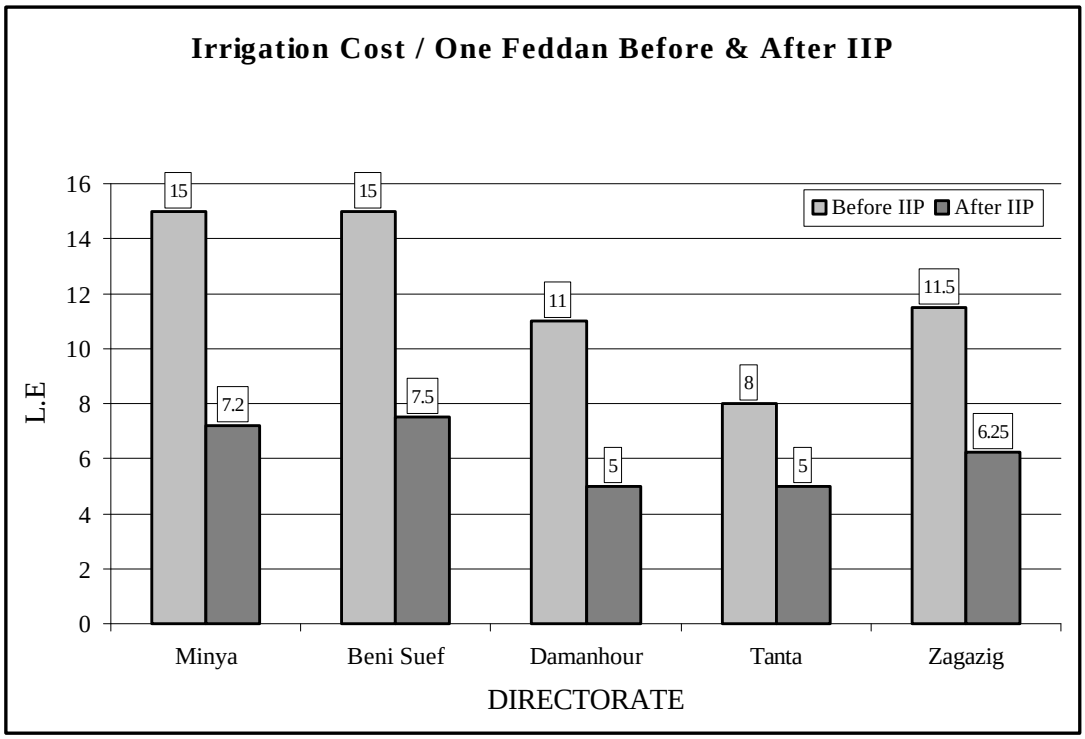
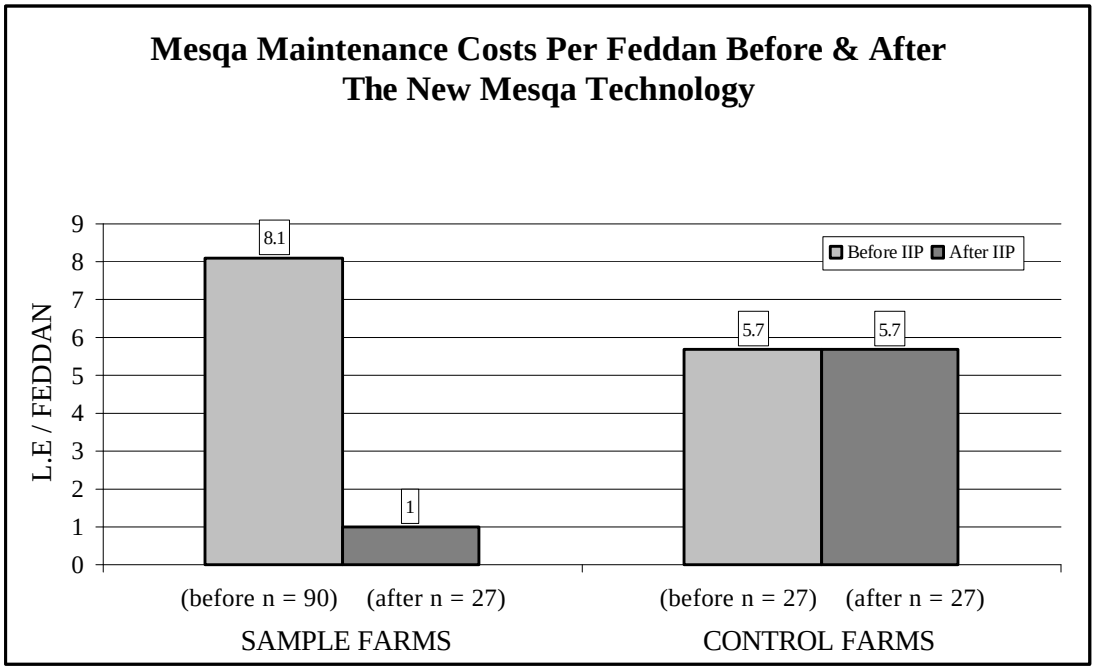


Figure 5-10. Average per Feddan Irrigation Costs Before and After IIP (16).



* Estimated cost after (1.00LE / Feddan); longer time needed to obtain realistic data.

Figure 5-11. Average per Feddan Mesqa Maintenance Costs Before and After IIP (16).

level payments for mesqa improvements range from LE 55 to LE 65 per feddan (1, 72). Under these conditions, it was estimated farmers would repay approximately 15% to 35% of the real capital cost of mesqa improvements (1,72). Studies on cost recovery and farmer ability to pay (10, 13, 72) suggested the benefits farmers would receive as a result of IIP would be sufficient for this level of repayment. It is noted, however, that the benefit attributed to increased crop yields, approximately LE 440/feddan/year (13), a level similar to estimates in the feasibility studies, has not been realized.

While the implementation status of the cost recovery program is currently unclear, it has been suggested the program has yet to be effectively implemented in any improvement area. A recent high-level judiciary ruling indicates the cost recovery law will apply only to mesqa improvements initiated after the decree (34) implementing the law was issued in 1995.

This section has shown the financial returns to net farm income and resulting farmer-ability to pay for IIP improvements are not entirely clear. There are definite and measured positive economic impacts (labor savings, pumping cost savings, land savings). Trends for increased crop yields are indicated but not conclusive. Further detailed studies are needed to determine the net economic impact of the IIP program, and to determine farmer willingness to pay under scenarios of reduced net benefits (as compared to those found in the IIP feasibility studies). Farmer utility and expressed levels of satisfaction have increased significantly due to IIP. This is discussed further in the next section.

5.3 Political and Social Acceptability

The political acceptability of the IIP package of innovations and improvements is perhaps best illustrated by the fact that IIP follows upon years of applied research and demonstration efforts focused on improving irrigation water management in Egypt. These efforts were accomplished through the EWUP and RIIP projects.

Political support within the MPWWR for the concept and establishment of the IAS as a fundamental component of IIP is demonstrated by Ministerial Decree 53 in 1989 (35).

The political will and support for the WUA and mesqa cost recovery components of IIP had to develop over time. Significant transaction costs and time were expended in

collecting the required support information, conducting demonstrations, and building confidence and knowledge of stakeholders (farmers, legislators, and MPWWR officials) (5). The fact that national legislation establishing WUAs and mesqa cost recovery (27) was approved in 1994 and Ministerial Decree No. 14900 (34) regarding implementation was issued in 1995 further reinforces this political will and support.

The social acceptability of IIP improvements among the most important stakeholders, the farmers, has been well documented (5, 12, 16, 36, 37, 56, 59, 62, 65, 67) and continues to be strong (73). The best indicators of social acceptability of the IIP program are the continuing expressed opinions of farmers in IIP areas regarding: 1) significant improvements in water supply availability and adequacy, and 2) improved communication and cooperation with the Irrigation Department. Table 5-2 summarizes the results of interviews of 90 farmers conducted by the IAS concerning their views about improved mesqas (74). Farmers agreed or strongly agreed that the improved mesqas resulted in less labor for operation and maintenance, reduced pumping costs and irrigation time, reduced maintenance costs, reduced conflicts among farmers, and better water control across six different criteria. Such results indicate farmers perceive financial benefits as well as increased levels of satisfaction.

Figure 5-12 shows the percentages of farmers reporting water supplies were adequate for land preparation for the 1993 summer season on sample and control farms before and after IIP (adapted from 16). Figure 5-13 presents a similar comparison but with regard to the adequacy of the water supply for good crop production for the entire 1993 summer season (adapted from 16). IAS Socio-Economic Studies of the 11 USAID IIP pilot canal command areas (20, 21, 22, 23, 24, 25) showed, that before IIP improvements, a majority of farmers (representing 1910 farms) did not believe that irrigation water supplies were adequate for land preparation or good crop production for the 1990 summer cropping season.

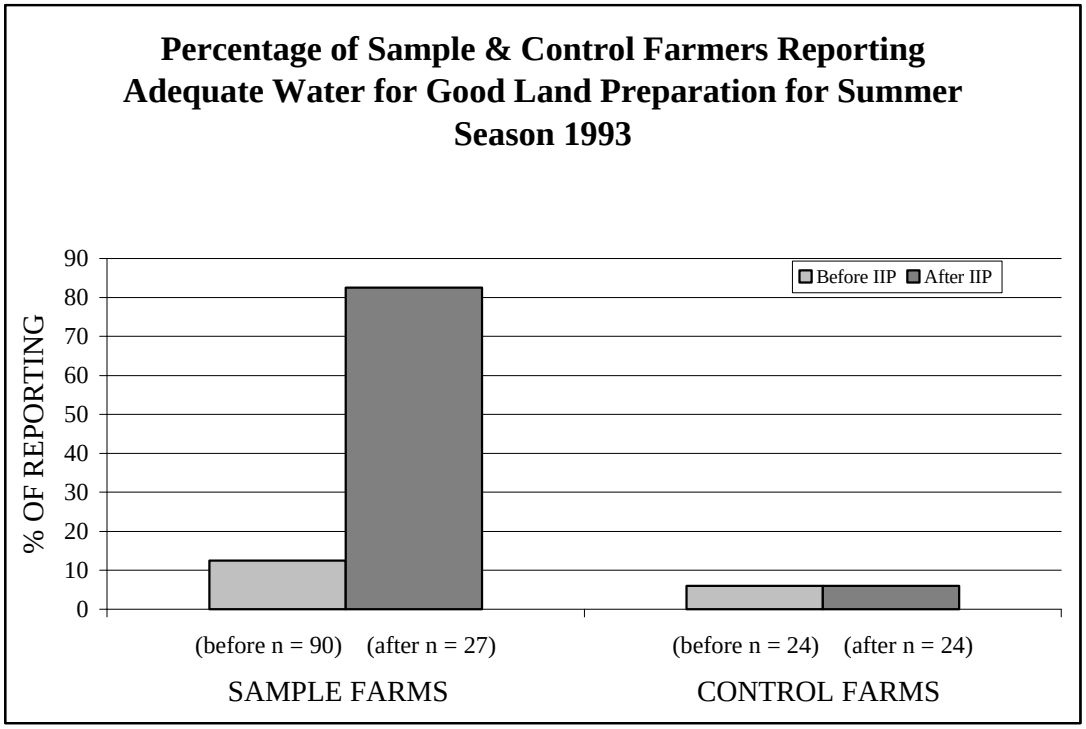
Each of the USAID pilot IIP area feasibility studies (43, 44, 45, 46, 47, 48, 49, 50 ,51, 52, 53, 54) as well as the World Bank IIP appraisal report (63) identified problematic water shortages in the respective command areas, in terms of either aggregate volume of deliveries or seasonal (i.e., peak period) deliveries. Such identified water supply

Table 5-2. Farmer's Comparison of Old versus New Mesqas Showing Percentages Reporting "Agree" and "Strongly Agree (74).

New Mesqas Vs Old Mesqas?	"Agree"	"Strongly Agree"
A) Main Labor Less		
1. Own Labor	28.6	71.4
2. Hired Labor		100
3. Maintenance		100
B) Operational Labor Less		
1. Own Labor	66.7	33.3
2. Hired Labor	18.2	81.8
C) Increased Crop Yields and New Crops Expected		
1. From Old Crops		6.7*
2. Introduce New Crop		100
D) More Savings to Farmers		
1.Pumping Costs Less		100
2. Land Saving	100	
3. Less Time to Irrigate		100
4. Less Maintenance		100
E) Better Water Control		
1. Timing of Irrigation	23.5	76.5
2. Irrigation Flexibility	23.5	76.5
3. Delivery Efficiencies		100
4. Field Applications	11.8	88.2
5. Less Complexities		100
6. Less Pump Break Downs		100
F) Less Water Conflicts between Farmers		100

* Denotes that many of the improved mesqas at the time of data collection had been operating only one season. Yield changes are dependent on many factors other than improved water supplied.

** Questions asked about each of these items had four responses from which sample farmers responded either "strongly disagree", "disagree", "agree", and "strongly agree".



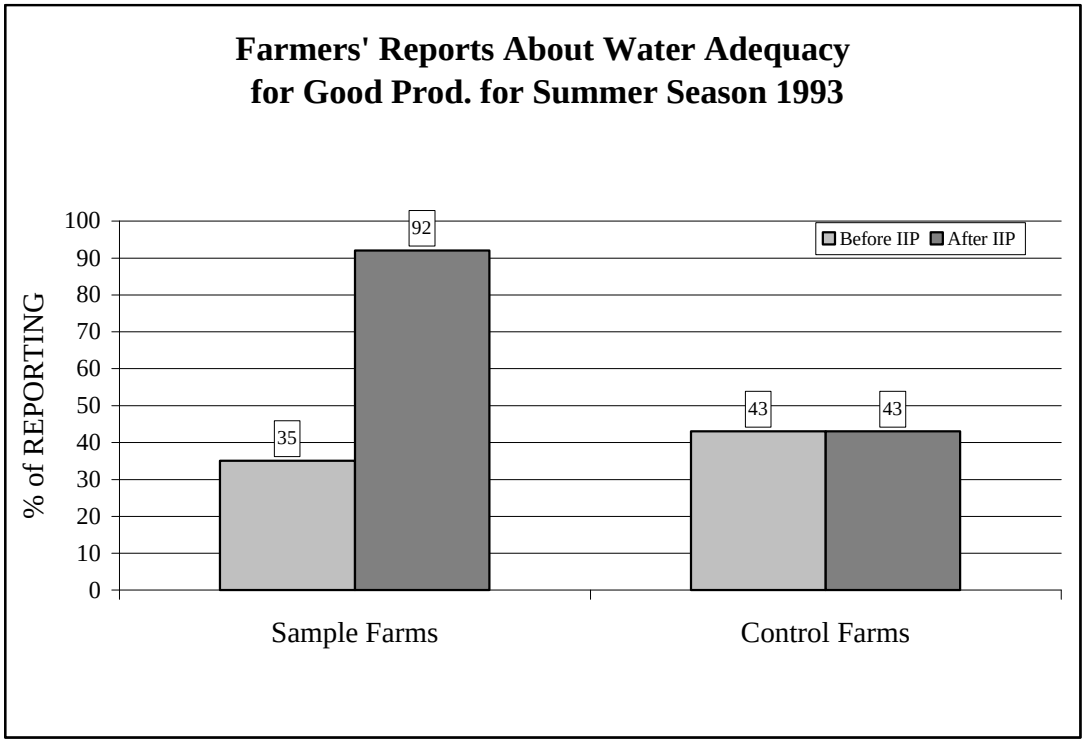
Notes:

*** About 90 percent of sample farmers reported adequate water for good crop land preparation for the summer season of 1993.

*** If continuous flow problems at Balaqtar and Qiman El Arus Command Areas had not been experienced, all the farmers would likely have reported no water problems for land preparation.

*** Before IIP, sample and control farmers reported inadequate water supplies for land preparation.

Figure 5-12. Farmer's Opinions Concerning Adequacy of Water Supply for Good Land Preparation for Summer Season 1993 (16).



Notes:

*** After IIP improved mesqas, note the percentage of sample farmers who reported adequate water for good crop production in the summer season of 1993.

*** Contrast this with sample farmer's reports before mesqa improvements and the consistent reports of farmers on control mesqas with no improvements.

Figure 5-13. Farmer's Opinions Concerning Adequacy of Water Supply for Summer Season 1993 (16).

inadequacies were found to be magnified at tail ends of canals due to poor condition of canals and structures and the resultant lack of control of irrigation water and inability to distribute irrigation water equitably.

5.4 Public Health Impacts and Environmental Considerations

The public health impacts of IIP are very closely related to improved equity and distribution of water. Poor or disadvantaged farmers (i.e., tail-enders) often suffer greater health impacts because they have reduced access to fresh water supplies. The improved distribution and availability of fresh water at tail ends of canals and mesqas means tail enders don't have to pump polluted drain water. This has at least two important implications.

- First, land productivity at the tail ends of canals and mesqas becomes potentially more sustainable because higher quality (less saline) water is being used for irrigation. Experience and observation has shown this results in increased land values at the tail ends of canals and mesqas (79).
- Second, farmer exposure to pathogens is reduced. There is speculation that continuous flow in canals helps to break the life cycle of the parasite causing bilharzia (schistosomiasis) by reducing favorable living conditions for snail hosts. Buried pipeline mesqas completely remove the open water environment for the snail hosts.

A significant environmental impact of IIP is the elimination of direct flows of fresh water from canals to drains, and potentially the reduction of runoff and deep percolation from irrigated fields (irrigation return flows). Irrigation return flows may carry sediments, nutrients, and salts to drains and the groundwater table, potentially degrading the quality of the receiving waters. On the other hand, irrigation return flows throughout most of Egypt (except perhaps in the western and eastern fringes of the Nile Delta, the Northern Delta, and a few other locations where salt loading may be occurring) are of relatively good quality and may be reused in downstream command areas after mixing with freshwater.

However, untreated sewage flows and other municipal and industrial waste flows also enter agricultural drains and significantly degrade the quality of the drain water and all other waters entering the drains. This may potentially occur to the degree that further

reuse of the water in downstream agriculture, fisheries, wildlife habitat, or other areas is not recommended.

IIP has resulted in more fresh water being available in improved areas. It is important to note that planned irrigation department water deliveries have not been increased, rather they are better controlled and distributed, and operational losses directly to drains are eliminated. Many farmers, who previously pumped polluted drain water to augment their water supply, no longer need to perform this practice. Since more fresh water is available in the command area, and, in aggregate, is of better quality than before IIP, leaching requirements for salinity control are less. Reduced leaching volumes mean drainage requirements are lower, potentially averting high water table and waterlogging problems. This directly supports the long-term sustainability of irrigation, drainage and crop productivity in Egypt's old lands

As the Egyptian irrigation system becomes more efficient internally as a result of IIP, careful monitoring and evaluation of water and soil salinities will be required to be certain adequate leaching is performed and the environmental benefits of IIP are sustained.

5.5 Sustainability and Administrative Feasibility

Two important institutional components of IIP have demonstrated significant results, and continued self-assessment and strategy development toward sustainability of improvements. These are the Irrigation Advisory Service and the Water User Associations they help to develop and support. A number of studies and planning exercises have been conducted by the IAS in this regard (7, 12, 16, 36, 37, 40, 55, 57, 58, 60, 61, 66, 73). Others, both within the MPWWR and external to it, have recognized the fundamental importance of this capacity-building to sustainable irrigation improvement in Egypt (5, 6, 13, 26, 38, 59, 72, 75).

Results would tend to support the premise that the IAS has been effective in developing, supporting and promoting WUAs. A seven step phased process (described in 5, 66) for this activity was formulated and implemented. According to the data in Table 4-2, nearly 1,000 WUAs have been moved through the fifth phase, at which time they have taken over the operation and maintenance of the improved mesqa. Large numbers of WUAs in the World Bank sites are still in the early organizational phases (I, II, and III). There can be

no substitute for advance efforts to inform and educate farmers about the IIP strategy and philosophy prior to the implementation of any design or construction efforts. At the same time, WUAs in improved command areas are expected to need continuing support beyond the time when IIP design and construction efforts are completed in a command area. This necessary advisory support focuses on developing mechanisms for cooperation among mesqa water user associations along a branch or distributary canal (federations), continued improved communications linkages with the irrigation department, and development of participation in irrigation system management, operation and maintenance above the mesqa level. These indicate a need for a continuous presence of IAS staff (in varying degrees of level of effort over time) in improvement areas, starting well in advance of improvements and continuing after design and construction efforts have moved on to new areas.

Conservation measures such as IIP require a cadre of qualified, trained and highly motivated advisory staff to educate water users about improved water management methods and practices (39, p.23). This must be supported and championed at a high level within the responsible government agency. These criteria are essential to sustainability, but appear to be only partially satisfied in the case of IAS. The IAS was the first program of its kind within the MPWWR and Egypt, and has been significantly constrained by inadequate staffing, turnover of key trained staff, and inadequate training support (26). Also, as previously stated, because of staffing and other constraints the IAS has not been able to adequately develop a complete water management technical assistance program, particularly with respect to on-farm water management. Earlier reviews of IIP (13, 14, see Chapter 4) recommended that the Ministry establish a permanent institutional home for IAS. Given the unique mission of the IAS, its recorded impact, and the important future policy implications of enhanced water user involvement in irrigation improvement, system operation, and maintenance, it is appropriate to reiterate the need for the MPWWR to establish and fully support the IAS as a normalized unit within its ranks.

An effective program for monitoring and evaluation of system improvements, operations and activities of the WUAs, etc., that will provide feedback regarding program effectiveness, benefits, costs, and development processes, is essential for long-term sustainability. A Monitoring and Evaluation Unit has indeed been a component of IAS/IIP. The M/E Unit has collected and documented much valuable information

regarding IIP (12, 16, 62). At the same time, information regarding crop productivity benefits, impacts of continuous flow, and water budgets has been found to be less comprehensive than is needed to fully evaluate program impacts. This shortfall can be attributed to staffing and internal management problems discussed in the previous paragraph. . Monitoring and evaluation information is essential so that the improvement efforts can be continuously enhanced, modified and adapted to local conditions.

In a recent note (76), a longtime consultant to the IIP, states the success and sustainability of WUAs (and thus the IIP) is directly related to the number and strengths of positive incentives over perverse incentives. Positive incentives are those that water users perceive as offering greater benefits than costs. Perverse incentives are those such as corruption, free riders, rent-seeking, and other extra-legal activities which discourage rather than encourage transparency and equity.

In a recent study (73) regarding WUAs and IIP, the incentives reported by 141 stakeholders (i.e., WUA members, irrigation and agriculture officials, etc.) in Egypt's IIP program, indicate there are apparently attractive financial and social incentives to the program. These incentives are summarized and reported by rank in Table 5-3 (adapted from 73). The reported incentives and their ranking indicate strong water user satisfaction with forming and participating in their own private WUA. The fostering of these incentives over time will strengthen and enhance the long-term sustainability of WUAs.

Perverse or negative factors causing concern about progress, performance and sustainability of IIP activities have been identified (13, 26, 76). Perverse incentives noted in (76) are:

> "..perverse incentives for contractors in the present IIP relate to poor construction, delays in construction and abusive behavior [by contractors] with farmers. There is ample evidence of poor construction quality, inadequate testing of underground pipelines and poorly constructed alfalfa valves. Contractors have had perverse incentives to complete projects in time and in some cases water users have been waiting from three to five years after they were organized for completed mesqas. The present contracting system and payments are such as to make it profitable for contractors not to complete their work in a timely manner. Supervision of contractors is weak and this impacts the quality of works completed. Another

Table 5-3. Ranking of Incentives to Form and Participate in Private WUAs as Reported by Stakeholders (n=141) in IIP WUAs (73).

Item	% Reporting	Rank
Improved trust, communication and cooperation among water users and Irrigation Departments	71.6	I
Uniform allocation and distribution of water to continuous flow and reliability	59.6	II
Savings in time. Labor, O&M costs and land	50.8	III
Improved problem solving with members and Irrigation Department	33.8	IV
Participation in decision making with MPWWR, the Irrigation Department and WUA members, builds ownership and leadership	33.2	V
Water savings and value of water	31.6	VI
Better scheduling and timing of irrigations and applications of water	23.6	VII
Improved yields and quality of crops	21.3	VIII

> source of perverse incentives for contractors is payoffs to engineers and large commissions on supplies and materials…it is estimated by some that payoffs range from 15 to 25%…".

A restructured approach to implementation of improvements may be useful in reducing opportunities for perverse incentives to arise. A greater private sector (i.e., WUAs, WUA federations, and branch canal water user organizations) role in making the arrangements for turnkey design and construction contracts, being the responsible party entering into these contracts, and oversight of improvement design and implementation works is recommended. Government agency roles would be to uphold design specifications, approve designs, and continuous development and upgrading of construction standards with private engineering design firm participation. On a similar note, greater organized water user involvement and participation with the district engineer in branch and

distributary canal operation, management and maintenance may help reduce opportunities for perverse incentives to arise at that level.

5.6 Potential Market Failure Considerations

If net benefits are as great as described in the IIP feasibility studies (17-19, 43-54) and the World Bank appraisal report (63), farmer demand for improvements should have increased and private sector opportunities should have developed for design and construction contractors, O&M support, etc. Factors that may be contributing to a "market failure" of IIP, and/or hindering the rate of acceptance and implementation are discussed below. The majority of this discussion is adapted from material prepared by the former EPIQ Resource Economist (78).

5.6.1 Lack Of Information/Awareness Of The Program

Farmers outside of IIP command areas are perhaps not aware of the program and its potential benefits. Private sector costs of providing information/awareness to a large number of unorganized farmers may exceed the benefits to be gained by a private sector entity performing this activity, i.e., in an attempt to generate business.

5.6.2 High Transactions Costs

Farmers may be aware of the benefits of IIP, however, as individuals or even small groups, they may lack the capacity and resources to effectively organize into a water user association without external intervention and assistance. Another form of high transactions cost exists with IIP regarding the current division of responsibilities of the public and private sectors. Even though farm level benefits of IIP may appear attractive, farmers have little chance of realizing these benefits without concurrent MPWWR action to improve the main system and provide better irrigation delivery service. In other words mesqa improvements alone will not achieve the expected IIP benefits. Government action to improve water delivery service must come first.

5.6.3 Unequal Distribution Of Benefits

The potential farm level economic benefits of IIP likely increase as the distance along a watercourse from its headworks increases. Tail-enders may receive greater benefits, but may also be expected to pay a higher proportion of costs. The difficulties of negotiation in this regard with large number of farmers operating small parcels of land will make

negotiations costly and time-consuming. Or, a program perceived as having little or no benefit to a "powerful" farmer (it may even cost him) may result in an undermining of organizational efforts.

5.6.4 Lack Of Credit/Lack Of Collateral

Farmers may be aware of the potential economic benefits of IIP, but they may not have the financial resources to pay for improvements. Investments in improvements may be economically viable, but farmers may lack access to financial institutions to obtain credit. Financial institutions may perceive loans as too risky, may have questions concerning appropriate collateral, may question loan repayment responsibilities of fledgling WUAs versus responsibilities of individual farmers, etc.

5.6.5 Property Rights Issues

Mesqas have traditionally been considered as the purview of the private sector. IIP-improved mesqas will require sustained community organizations for operation and maintenance, and the improved mesqa will most likely under some form of common ownership. Due to the fact that benefits may not be equally distributed along a mesqa, farm-level perceptions of repayment and maintenance obligations may vary along the watercourse. This may require a subsidy of repayment and maintenance costs from tail-end to middle and head-end farmers, again resulting in complicated negotiations and high transactions costs.

The MPWWR owns and operates the branch and distributary canals on which a necessary and integral part of the improvement package is focused (i.e., downstream water level control structures and canal other canal improvements). Without clear delegation of rights, farmers may not agree to participate in the operation and maintenance of the improvements. Authority may need to be devolved to some form of water user organization at the branch or distributary canal level to operate and maintain these improved watercourses if the entire package is to be accepted and rendered sustainable.

Reported weaknesses of WUAs (and IIP), by the same group of 141 stakeholders as reporting incentives in Table 5-3, support many of the above market failure indicators (73). These weaknesses are summarized, by rank, in Table 5-4 (adapted from 73). Items ranked first and seventh support the notion of lack of awareness and understanding

Table 5-4. Ranking of Weaknesses of Private WUAs as Reported by Stakeholders (n=141) in IIP WUAs (73).

Item	% Reporting	Rank
Lack awareness, understanding, and lack of Irrigation Department support	52.2	I
Leadership weak and greedy	32.3	II
No maintenance center for spare parts, i.e., for pipelines	29.4	III
Old family conflicts, contractor politics and abuses	27.9	IV
Poor mesqa design and construction	26.5	V
Cost recovery, finances, i.e., lack of savings and no bank accounts	18.4	VI
Scheduling problems and lack of continuous flow	17.6	VII

regarding the program. The item ranked sixth is related to credit and financing problems. The items ranked second through fifth indicate high transactions costs related to effective development of WUAs, participation of farmers in their WUAs, and infrastructure support for IIP construction and maintenance activities.

To the extent that market failure prevents the private sector from initiating economically viable irrigation improvements in agriculture, the MPWWR (or any other appropriate government agency) can be helpful in assisting farmers, contractors, and financial institutions in overcoming the impacts of market failure. In particular, the Ministry can implement programs to address directly the sources of market failure described above.

For example, the Ministry could increase farmer's and other private sector participant's knowledge and awareness with a well-designed and sustained education program regarding the potential costs and benefits of irrigation improvements. Such a program could be conducted within the existing Irrigation Advisory Service with assistance from the MPWWR Water Communications Unit. The cost of such programs may potentially be recovered from farmers and other private sector participants in irrigation improvements.

6 DISCUSSION

Among many accomplishments, the IIP program has a number of key impressive achievements including:

- development of institutional capacity within the Ministry to continue irrigation improvements,
- implementation and demonstration of innovative downstream control and continuous flow availability technologies which significantly enhance equity of water distribution, farmer satisfaction with adequacy of the water supply, and minimization of water wasted to drains,
- development and passage of national legislation allowing the formation of private water user associations,
- a well-documented and effective phased approach to water user association organization and development,
- development of an Irrigation Advisory Service to provide technical assistance to water user associations,
- development and successful passage of national legislation allowing cost recovery of mesqa improvements.

The IIP is a socio-technical irrigation improvement process involving the development of farmer participation in improvements and the subsequent management of improved systems. It is relaxing/removing a number of irrigation-related constraints to agricultural production and water use efficiency in Egypt:

- Irrigation efficiencies (the ratio of water beneficially used to the water delivered) are improved, primarily through reduction of delivery system operational losses. These efficiency improvements translate to water savings (in a global sense) that can be transferred or reallocated to other uses when the improvements occur in areas where irrigation losses and return flows are to salt or pollution sinks. In any situation, these efficiency improvements translate into “local water savings”, meaning the freshwater entering a command area is not lost to drains serving the command area.
- Equity of water distribution is improved. Evidence shows substantial head-end/tail-end inequities are relieved and tail-end farmers previously reliant on pumping of drain water

to augment their short water supplies no longer need to perform this activity. Land values at the tail ends of canals and mesqas have increased as a result. Positive environmental and health impacts result since farmers no longer need to pump polluted and/or saline drain water.

- Fresh water losses by direct flows from canals and mesqas to drains are eliminated, thereby preserving fresh water quality and reducing or eliminating the degradation of these waters which occurs when they enter polluted drains,
- Farmers are organized in private, legally-recognized WUAs using a tested and monitored seven phase process which is supported by the Irrigation Advisory Service. There are many examples of functional WUAs actively operating and maintaining their improved mesqas.
- Farmers report high degrees of satisfaction with their improved mesqas.
- Farmer's irrigation costs (labor, pumping and mesqa maintenance) are substantially reduced.
- Farmers report water supply adequacy (availability, reliability, distribution, etc.) is much improved,
- Farmers report less conflicts over water and better communications among themselves and with irrigation officials,
- Increased crop productivity trends are evident, but **available data are not comprehensive enough to support strong conclusions for or against the program.** This may in part be due to incomplete implementation of the improvement package as well as incomplete monitoring and evaluation of program impacts. Overall, it is unclear if the combination of inconclusive productivity impacts, but substantial irrigation cost savings, positive equity impacts, positive environmental and health impacts, and positive social impacts result in economically feasible rates of return on improvement investments. It is difficult to assign an economic value to the positive equity impacts, positive environmental and health impacts, and positive social impacts of IIP.
- Farmer willingness and ability to pay for improvements were studied extensively in support of the mesqa improvement cost recovery legislation (Law 213). However, if actual economic benefits are less than estimated, then willingness and ability to pay may need to be re-evaluated.

Several key issues have constrained the IIP program and reduced its effectiveness. These must be addressed and resolved before any widespread national irrigation improvement effort is implemented.

1. The rate of implementation has been slower than expected.
    - Much of the concern about this would appear to be exaggerated. It should be noted that IIP is an innovative and unique program within the Ministry. Considerable effort and time must be expended in developing institutional capacity within the Ministry to implement IIP. Additionally, the development of trust and subsequent education of farmers in IIP areas concerning the program and its benefits is a time-consuming process that cannot be circumvented.
    - Of concern, however, are the fact that the rank and file of IIP/IAS staff were spread much too thinly (i.e., never fully staffed) for the IIP pilot program areas, and, in the case of IAS staff, given many additional duties to perform. Contracting procedures and contractor performance is also of concern in this regard. Contractor non-performance not only caused project delays but seriously undermined farmer confidence in the IIP and its abilities.

2. Costs of improvements are high.
    - This is partially attributable to a lack of developed construction contractor expertise (for the sizes and types of construction contracts) to implement construction improvements, to poor construction contracting, and to significant time overruns.
    - Costs should be expected to reduce as private sector capability to design and construct improvements develops and competition for services increases. Costs may also reduce as improvement alternatives are researched and developed.

3. IIP/IAS staffing, staff turnover, losses of trained staff, lack of adequate training, lack of career opportunities and low salaries unattractive to new engineers, lack of support for field staff, and other internal management problems have been repeatedly identified as constraints to IIP/IAS performance. IIP/IAS staff shortages are hampering the effective implementation of the World Bank funded IIP project and the completion of the USAID IIP sites. USAID IIP project funding ended in September 1996. As a result of staff shortages and lack of funds the original pilot sites have not been fully completed.

4. WUAs and WUA federations will require technical water management and organizational assistance long after IIP staff have moved on to new areas i.e.. IIP design and construction oversight requires only a temporary presence in the improvement areas. It has been recommended in several instances that the IAS needs to be strengthened and to have a permanent home within the MPWWR to provide continuing WUA support. **Effective water user participation in irrigation system improvement, operation, maintenance and management is a policy objective of the Ministry. The expenditure of public funds to support a government service, such as the IAS, to initiate and enable the organizational process may be justified to support this policy objective**. The effectiveness of IIP is dependent on farmer organizations and socio-technical assistance to these organizations. Once WUAs and other organizations are fully operational, private sector opportunities and capacity to provide the necessary supporting services may be encouraged and developed as a long-term goal.

5. Monitoring and evaluation of IIP interventions to provide feedback for improving implementation processes, and equally important to provide supporting data and information to justify the investments in IIP has been incomplete. Documented agricultural productivity benefits do show positive trends, but at rates less than estimated in feasibility studies. Substantial labor and energy cost reductions have resulted from IIP. The net effect of these results is an unclear picture regarding the economic and financial feasibility of the improvements. **An independent Monitoring and Evaluation Unit within the MPWWR is recommended for designing and implementing comprehensive evaluation programs and for analyzing data and information needed to support policy decisions regarding programs like IIP. Such capability should be considered a requisite component of <u>any</u> program the Ministry undertakes in which economic efficiency, equity impacts and environmental impacts must be known with a degree of certainty before decisions regarding resource allocation can be made.**

6. Many improved mesqas in several of the pilot command areas were completed before main system improvements were completed and continuous flow could be implemented. As a result farmers and WUAs became somewhat disenchanted with the program. Continuous flow availability in the branch and distributary canals is the key and lead technology of IIP. **Efforts should be made to implement improvements that allow continuous flow and which support the district engineer to operationalize continuous**

flow in the command area, prior to improved mesqas coming on line. This can be accomplished in a phased participatory approach in which a branch canal water user organization works cooperatively with IIP engineers and the irrigation district engineer to plan, design and implement branch canal improvements. These improvements would include control gates on low level unimproved mesqas. Branch canal water user organizations would assist with the management of these control gates.

7. An on-farm water management technical assistance program has not been implemented to the extent needed. It is possible that this has contributed, in part, to less than expected crop productivity benefits. Furthermore, local improvements in irrigation efficiency stand to be gained from improved on-farm water management. These efficiency improvements support the long-term potential for adjustment of irrigation water duties resulting in fresh water for **local** redistribution within the command area and/or regional reallocation.

8. The IIP package of interventions and improvements has not been fully completed in most of the pilot sites (unit command areas in El Minya, such as Beni Ebeid and Herz-Numaniya are complete except for the implementation of WUA federations). It is possible that this also has contributed, in part, to less than the full range of expected benefits being realized. Additionally, the impact of the full package of improvements, especially crop productivity impacts, may not materialize until the improvements have been in place for at least two years. These facts have two important implications for future Ministry efforts regarding IIP. First, the pilot sites should be fully completed as quickly as possible using a suggested set of prioritization criteria. Second, there is an compelling need to begin an independent, comprehensive, well-designed monitoring and evaluation of IIP to fully document benefits and costs. These pilot sites lend themselves well to case studies.

PART II: TOWARDS DEVELOPMENT OF A NATIONAL STRATEGY FOR IRRIGATION IMPROVEMENT

7 CURRENT MPWWR IRRIGATION IMPROVEMENT STRATEGY

Irrigation improvement is recognized as a needed and major component of Ministry policy objectives regarding water management. This is best elucidated by the following quote from a paper given by His Excellency Minister of Public Works and Water Resources Dr. Mahmoud Abu Zeid at the 1997 International Water Resources Association World Water Congress in Canada (82):

> "The Irrigation Improvement Project and other strategies such as drainage reuse and cost recovery have to be monitored and revised in their own progress. Irrigation improvement strategy has a significant role in the recent water policy. It is expected to be the core of the 21st century policy."

The MPWWR presented its strategy for continuing the implementation of irrigation improvement activities in Egypt at a Ministry conference in November 1997 (81). The goals, method of implementation, and package of interventions remain unchanged from those of the USAID pilot project and the current World Bank IIP project.

The following is a summary of the English translation of the Arabic document.

The plan suggested improvements would be made to the irrigation systems serving a total of 3.5 million feddans through the year 2017 (i.e., four 5-year plans) as follows:

- Improvement on 60,000 feddans during 1997/98.
- Annual improvements on 180,000 feddans from 1998/1999 through the year 2017.

This rate of implementation is contingent upon, however, the following suggested structure and staffing plan of the IIP Sector.

- The required and approved structure consists of 6 General IIP Directorates at the Governorate level with 18 District Departments (3 per directorate). These are in addition to the Chairman of the Sector and the Central Departments headed by Undersecretary of State.

- The annual executed area in each General Department is 30,000 feddans giving the total executed area of 180,000 feddans/year.
- The suggested structure and staffing of each General Directorate is as follows:

  1 General Director

  2 Inspectors

  4 Directors of Works

  9 Civil Engineers

  1 Agricultural Engineer

  1 Mechanical Engineer

  Support staff (clerks, secretaries, drivers, etc.)
- The suggested structure and staffing of each district department in the directorates is as follows:

  1 Inspector

  5 Directors of Works

  5 Assistant Directors of Works

  15 Civil Engineers

  3 Agricultural Engineer

  1 Mechanical Engineer

  Support staff (clerks, secretaries, drivers, etc.)

Costs of improvements (mesqa improvements, branch and main canal improvements, land leveling, establishment of water user associations, etc.) are estimated to be LE 2000 per feddan (1997/1998 prices). Additionally, the strategy estimates water conservation due to IIP is about 10%

Priorities for areas to be improved were given as follows:

First Priority:

1. Complete the pilot areas funded by the USAID IIP Project in order to augment the benefits to these areas.
2. Complete the IIP areas in both Beheira and Kafr El Sheikh Governorates, which are funded by the World Bank Group and the German Investment Bank loans, in order to finish all areas according to agreed schedule and to make use of the available loans.

Second Priority:

Complete IIP projects in the Governorates of the northern Delta in order to make use of all water that might be discharged to Sea, since these areas are located at the tail end of the Nile River irrigation system.

Third Priority:

Complete IIP projects in the Governorates of Suez Canal, East and Middle Delta, since irrigation runoff from these areas supplies water to the tail end of the irrigation system.

Fourth Priority:

IIP projects in Governorates of upper and middle Egypt.

The implementation plan suggested that first priority improvement areas should be implemented during the first and second five-year plans. The remaining priorities were to receive the following weighting, in terms of level of effort, to accomplish the stated goal of improving 180,000 feddans per year. This distribution of level of effort is intended to be applied subject to the completion of first priority areas.

- 50 % level of effort second priorities
- 30 % level of effort third priorities
- 20 % level of effort fourth priorities.

8

Four strategy alternatives are proposed in this chapter for consideration by the MPWWR. Each proposal includes a brief description and a discussion of their advantages and risks.

1.
2.
3.
4.

rationalized set of site prioritization criteria, and concurrent supporting studies.

8.1 Alternative 1: Economic Efficiency Studies

This proposed strategy is based upon one of the conclusions of the performance assessment

supporting analyses are available regarding the net economic impacts of IIP and farmer willingness and ability to pay for improvements, these are judged to be too limited upon

for a national program of irrigation improvements may be premature. Economic efficiency studies are needed to justify investment of scarce GOE resources. It is proposed that highest

study of the net economic impacts of IIP and farmer willingness and ability to pay for improvements.

Advantages

comprehensive data and analyses regarding the net economic impacts of IIP and farmer willingness and ability to pay for improvements. Research studies of this type, as well as

needed.

8.1.2 Risks

The primary perceived risk associated with this strategy is the loss of time. There is high

materials costs and continuing degradation of the system). It is well recognized within the

MPWWR that irrigation improvements are needed, especially at the branch canal and mesqa levels. Over 20 years of applied research and demonstration have been conducted in the development of IIP. Implementation of improvements based on this research is needed now. Program value and benefits should not be judged on an economic efficiency criterion alone. Such an approach does not adequately account for the positive social and environmental impacts, which are difficult to quantify in economic terms, but nonetheless are real and evident.

8.2 Alternative 2: Current MPWWR Plan

This strategy proposal is to adopt the current MPWWR plan for expansion of IIP activities as given in Chapter 7. It is implicit in this strategy that no changes are made to the implementation approach or package as compared to the USAID pilot and current World Bank project efforts.

8.2.1 Advantages

This strategy requires very little or no institutional change on the part of the MPWWR. The technical feasibility of the package of interventions to solve targeted problems is quite high. Evidence presented in the assessment indicates a medium to high degree of social acceptability assuming construction implementation problems are resolved.

8.2.2 Risks

This strategy is highly ambitious and heavily dependent upon the development of the proposed IIP structure and staffing plan. The high staffing requirements given in the strategy may not be achievable. The assessment of IIP presented in Part I of this report pointed out several problematic issues regarding the program, ranging from staffing constraints to the logistical problems that resulted when mesqa improvements were completed prior to main system improvements. Additionally, the high costs of the program (which were indicated in Chapter 7 to be increasing) and the slow rate of implementation are not effectively addressed.

To fully complete existing USAID pilot sites (and any other sites) requires the development of the functions, roles and purposes of WUA federations leading to and supporting the legal establishment of these organizations. This legal requirement, however, is inherent in any future IIP strategies calling for full implementation of the improvement package.

8.3 Alternative 3: Economic Studies and Focused Level of Effort

This proposed strategy is a combination of the first two proposals but with a focused scope of effort. A focused scope of effort means that irrigation improvement activities would be limited to the completion of the MPWWR's first priority areas, namely, the USAID pilot areas and the World Bank project areas. Concurrently, the study of the net economic impacts of IIP and farmer willingness and ability to pay for improvements would be implemented. Case studies could be initiated in command areas such as those in El Minya Governorate, where the improvement package has been nearly completely implemented. Other pilot sites could serve as case analyses as they are brought to completion.

It would be expected that as part of this strategy, the Ministry would undertake interim measures and studies to resolve IIP staffing constraints and construction implementation problems and delays, and would execute research into lower cost improvement methods, etc.

8.3.1 Advantages

Under this strategy, irrigation improvement efforts move forward on a limited basis, i.e., the first priority sites of the Ministry's current plan are given focus. These areas serve as case study areas for the concurrent economic studies. The limited scope of effort will reduce the demand on Ministry human and financial resources. The proposed interim studies would be expected to provide answers to many constraints and questions raised by the assessment.

8.3.2 Risks

Expanded implementation of improvements would be delayed and be somewhat dependent on further research studies. So again, the primary perceived risk associated with this strategy is the loss of time. The high potential for improvement costs to become more expensive in the future (due to higher materials costs and continuing degradation of the system) remains. As previously stated, IIP program value and benefits should not be judged on an economic efficiency criterion alone, but should also consider the positive social and environmental impacts, which are difficult to quantify in economic terms, but nonetheless are real and evident.

8.4 Alternative 4: Focused, Modified IIP Implementation

This proposed strategy uses the concepts outlined above in alternative 3 as a basis. Building on this basis, several innovative modifications to IIP implementation are proposed. These

innovations address identified constraints on IIP performance. A specific and rationalized set

prioritization criteria and the proposed modifications to implementing improvements strengthen the alignment of IIP with MPWWR water management policy objectives.

of increased participation of water users in irrigation management.

This proposed alternative includes the following:

- Adopt and execute a revised implementation scheme in which branch canal water user

  and the IIP engineers, participate in the planning and implementation of the necessary improvements to the branch and distributary canals, mesqa

  allow continuous flow implementation. The branch canal water user organization would have a self-policing operational oversight role in which they would, working with the

  improvements are accomplished.
- Encourage and facilitate private sector mesqa improvement. The goal is for this to become a private sector activity, demand driven by farmers with IIP/IAS oversight and

  improvements would be established with MPWWR assistance. MPWWR would provide training on design, contracting, etc. to private sector design/construction firms.

  Institutional strengthening of the IAS.

  Develop, implement and adequately support an independent monitoring and evaluation

  designed, comprehensive study of the net economic impacts of IIP and farmer willingness and ability to pay for improvements.

  Prioritize the selection of new improvement command areas and the completion of

  to maximize benefits gained from IIP, and which support MPWWR policy objectives. Higher priority is placed on improving areas where real water savings will occur and

  level.

- Focus initial implementation efforts in a limited number of strategically selected areas to further develop capacity and knowledge regarding the implementation of the modified approach.

8.4.1 Advantages

The primary advantages of this proposed strategy are:

- Branch canal improvements and a branch canal water user organization to assist operation and maintenance are in place prior to mesqa improvements. This makes improved water delivery service and continuous flow availability powerful incentives for mesqa WUAs to develop and begin making their own mesqa improvements.
- Participation of water users in irrigation management at the branch canal level is developed supporting MPWWR objectives in this regard.
- A set of prioritization criteria that consider water savings and greater farmer participation/privatization is used for improvement planning.
- High improvement cost issues are addressed through greater private sector involvement.
- IIP engineering staff requirements are concentrated in a special cadre of design and construction oversight engineers.
- Significant private sector resources are mobilized to help reduce costs, and eventually, accelerate implementation of irrigation improvements.

8.4.2 Risks

The greatest risk of this proposed strategy is the innovative and untested concept of developing branch canal water user organizations and having them participate in the planning and design of the branch canal improvements that allow continuous flow. Further, these organizations would have a self-policing, operational oversight role in which they would monitor and regulate water delivery to unimproved mesqas until mesqas improvements are accomplished. There is some evidence from irrigation water management work in the Fayoum that such branch canal water user organizations can develop and effectively participate in branch canal irrigation management.

A focused scope of effort is proposed until monitoring and evaluation studies fully document the process and provide supporting data and analyses to justify expansion. There may still be a perceived risk of lost time

The proposal requires commitment to strengthen and develop the IAS. Branch canal water user organization and technical support will not occur without an enabling and facilitating entity like the IAS. The MPWWR will need to develop and support a cadre of qualified professional field staff for this activity. The IAS will also be expected to deliver and expanded program of water management technical assistance to water users.

This proposed strategy requires the development and passage of legislation for the legal basis for branch canal water user organizations.

8.5 Recommendation

Considering the following factors:

- comparison of the relative risks and advantages of the four proposed strategy alternatives,
- MPWWR recognition of the need for improvement to the irrigation system sooner rather than later,
- driving MPWWR water resources management issues with respect to water conservation and enhanced user participation in system operation and management,
- the need to develop better understanding of the net economic and financial impacts of IIP,

strategy alternative 4 is recommended. This proposed strategy is described in more detail in the following chapters.

9 OBJECTIVES AND PRIORITIZATION CRITERIA

9.1 Objectives of the Proposed Strategy

The primary objective of the proposed strategy is to strengthen, enhance and promote future irrigation improvement activities in Egypt and the benefits to be gained from these activities. This objective will be met by executing a series of policy reforms and modifications to implementation procedures, which are based on the assessment of the current program. The purpose of these reforms and modifications is to fully document the net economic impacts of IIP, accelerate the implementation of improvements and reduce the overall costs. Additionally, the strategy provides guidance for prioritization of future improvement areas, using a set of technical, socio-economic, and institutional criteria designed to enhance the benefits gained from improvements.

Under this strategy, the original goals of irrigation improvement are augmented in consideration of the major issues confronting water resources policy and management in Egypt discussed in Section 1.2. The following augmented goal statement is proposed:

> Improve irrigation water management and agricultural productivity by implementing a series of physical and institutional interventions at the irrigation delivery system and on-farm levels, which are designed to:
>
> - remove physical constraints to assure the adequacy (quantity, quality, reliability, flexibility of timing and frequency, and equity) of water supply to the user considering a future in which water allocations to the old lands will be reduced,
>
> - enhance user participation in main system (branch canal) improvement, operation and management, and,
>
> that are based on full consideration of technical, economic, environmental and social feasibility.

9.2 Criteria for Prioritization of Future Improvement Efforts

Irrigation improvements should be planned and implemented using a strategic and technical, socio-economic and institutional/legal criteria for prioritizing improvements that irrigation management. Specifically, areas should be prioritized according to technical feasibility, economic soundness, and social acceptability of water users.

Technical Prioritization Criteria

Disposition of non-evaporative water losses and return flows.

technical factors for ranking candidate improvement areas is the disposition of delivery system operational losses and irrigation water return flows (i.e., deep percolation and

flows are to salt and/or pollution sinks (e.g., Mediterranean Sea, northern lakes, polluted collector and main drains), irrigation improvement will likely result in immediate and real

productivity and protecting the environment can be achieved. This criterion implies that those command areas in the northern Delta, at the tail ends of the Nile Irrigation System,

areas with irrigation return flows to drains which must be pumped (to the Sea or the northern lakes) should be higher priority to both save water and reduce pumping costs.

below, as previous IIP feasibility studies and socio-economic surveys have shown there is

as in the Delta. Selection criteria based exclusively on water savings benefits have the potential to focus improvements in the northern Delta to the disfavor of other areas

- _____ Both physical measurements and farmer perceptions of IIP support the notion that problems with water supply adequacy,

package. A quantitative comparison of historical water deliveries with crop water requirements based on cropping patterns will reveal if the command area suffers from

general or seasonal water shortages. The degree to which similar analyses can be accomplished for sub-areas within the command area will reveal head-end/tail-end and other distribution problems. Water supply to a command area may be adequate in aggregate but inequitably distributed due to infrastructure constraints such as failed and/or poorly maintained watercourse or other delivery structures. Similarly inequity problems may exist due to "extra" legal irrigation activity such as pumping directly from the branch canal or excessive rice cultivation. The degree to which tail-end farmers practice "unofficial" drainage water reuse in an effort to augment short water supplies will further reveal inequity problems. The IIP package will produce higher levels of technical feasibility, i.e., application of the package solves these technical problems, when quantitative documentation reveals the existence of water supply adequacy problems in the command area.

- Soil conditions and other site characteristics. The complete IIP package improves on-farm water management and reduces overirrigation over the long term. In this sense, command areas having significant cropping area planted in sandy soils should receive higher priority, as irrigation application efficiencies will be improved and losses reduced. In a similar sense, areas suffering from saline/high water table conditions should also receive higher priority. Careful on-farm water management (an intended result of irrigation improvement) will thereby contribute to the long-term sustainability of irrigated agriculture in these areas.
- Size of command area. An overarching technical factor affecting the selection of any command area for improvement is the size of the command area. It is desirable, based on lessons learned from the IIP pilot program that areas be selected based on discrete hydraulic boundaries representing either an entire irrigation district or an entire canal command area. When the improvement unit is either a district or canal command area, the technical feasibility of implementation and sustained operation of continuous flow is likely enhanced. It is expected that the planned implementation of continuous flow over such an area can occur with minimum disruption, and therefore less resistance, to routine water delivery operations. This is in contrast to earlier experiences when continuous flow implementation was impractical due to the nature of water delivery to smaller non-discrete units.

feasibility. In these feasibility studies, greater emphasis should be placed on valuing the social impacts of IIP, while also utilizing more realistic agricultural productivity impacts.

socio-economic feasibility of IIP would consequently be very high. For a demand driven program to develop requires: 1) that farmers are fully aware of the program, its costs as well

participants in all phases of improvement planning, design, implementation, operation and maintenance.

command area is an important selection criterion. It is expected the IAS will be instrumental in this development process in all command areas needing improvement, and must work

will develop more rapidly than will others. Those areas having better farmer understanding and cooperation, stronger willingness to participate, etc. at the branch/distributary canal

of improvements. The program should not be forced upon farmers if they are not yet ready to participate.

due to the improvement package, and improved trust and communication with Ministry irrigation officials have been consistently identified by farmers as the most important benefits

acceptability and support of improvements will be stronger once they are informed and educated about the program. Command areas that do not exhibit these problems, or only to a

developing or may not develop at all.

9.2.3 Institutional and Legal Considerations

Significant consideration in the selection of command areas for improvement is the level of enthusiasm and support from local MPWWR Irrigation Department engineers (i.e., district, inspectorate, and directorate engineers). The fact that irrigation improvement is official government policy alone will not guarantee internal organizational base interest and support. Some engineers at this level of the organization may be expected to view the improvement process as threatening to their status and possibly livelihood. Awareness building, training and education can resolve many of these misconceptions. Until such time as this is realized throughout the ranks of the Ministry, those areas enjoying strong irrigation district, inspectorate and directorate support for improvement should receive priority.

Appropriately crafted, non-constraining legislation establishing the legal basis for branch/distributary canal water user organizations will need to be decreed and implemented. Local politics may or may not be a factor in this respect. Where local political support is strong, both for the temporary authorization of branch canal water user organizations and the ultimate national legislation establishing their legal basis, greater success can be expected.

9.3 Completion of Existing Sites

The prioritization criteria discussed above should be used for prioritizing the full completion of the existing 11 USAID-funded IIP pilot command areas and the three World Bank IIP areas. Ideally, the completion of these areas would be according to the proposed modified implementation scheme and become a farmer demand driven process. This may be more realistically accomplished in the World Bank areas. At any rate, the proposed modifications and policy reforms described in the proposed strategy may be introduced and tested, step-by step, in the different command areas as they are brought to completion, particularly, the development and establishment of water user organizations at the branch/distributary canal level. Monitoring and evaluation of these command areas must be concurrently planned and implemented to gain an understanding of necessary adaptations in the implementation process, and to fully evaluate the net economic benefits of the improvements in these areas.

Implicit in the completion of the USAID and World Bank command areas is the development of branch/distributary canal WUA federations and higher-level water user organizations to work with the irrigation district in operation, monitoring and maintenance of the improved

system. Also, fundamentally implicit in the completion of these areas is the fact that continuous flow availability and downstream water level control will become permanently operational in these command areas. In each circumstance, there is a strong need for concurrent monitoring and evaluation of these activities so that technical and organizational issues can be resolved as needed.

The necessary support for completion of improvements must be assured with appropriate levels of IIP and IAS staff. It is not proposed that each command area have a fully staffed IIP office. Rather, with the 14 existing command areas ranked by the proposed prioritization criteria, IIP staff effort may be concentrated. As design work is completed and construction implemented, IIP staff may be mobilized to the next improvement area.

Appropriately staffed and supported permanent IAS offices must be established in each of the command areas to assure the continuing sustainability and viability of both infrastructure improvements and water user organizations.

Completion of the existing USAID and World Bank IIP areas is justified from the view that these areas may serve for case analyses and as demonstration areas. Egyptian farmers are eager to adopt new technologies, which increase their productivity and incomes. Farmers everywhere often state that “seeing is believing”. Demonstration sites of the entire IIP package will motivate farmers to plan for and adopt the IIP approach and package. Additionally, fully completed IIP areas provide fertile ground for training of new IIP/IAS staff, and opportunities for applied research.

10 MODIFIED IIP IMPLEMENTATION

10.1 Overview

As documented in Part I of this report, the MPWWR has achieved some successes in the IIP pilot demonstration projects. As IIP becomes institutionalized within the Ministry and plans are made for a national program, a clear vision of the future roles of the Ministry and the private sector in the irrigation improvement process is desired. The proposed strategy presented and discussed in this chapter is based on a vision of much-expanded private sector participation in the irrigation improvement process and a narrowing of the scope of the Ministry's role, particularly with respect to design, construction and contracting activities at the mesqa level. **The socio-technical collection of interventions known as IIP is a *package*. This proposed strategy does not suggest the disaggregation of the package, but rather a restructuring and strengthening to mobilize significant private sector resources for reduced cost, and eventually, accelerated implementation of irrigation improvements.**

10.2 Revised Implementation Process

10.2.1 Site Selection

A specific and strategic set of criteria were proposed and discussed in Chapter 9 for prioritizing irrigation improvement areas and activities. Several irrigation districts or discrete canal command areas should be selected and pre-screened using these criteria in a site assessment matrix in which each criterion can be judged on a scale of one to ten, with ten indicating higher priority needs. Based on this pre-screening, four or five higher priority areas should be selected for more detailed feasibility analyses. These more detailed feasibility studies should simply use the same ranking criteria given in Chapter 9 but with greater depth of study. From these analyses, a limited number of highest priority irrigation districts or command areas should be selected for focused improvement efforts. The numbers of trained and readily available IIP and IAS personnel within the Ministry for implementation of improvements in new areas are currently extremely limited. This cadre of professionals must be carefully nurtured, not overloaded, and the ranks gradually expanded as training and experience are gained. Experience must be gained, technical and organizational issues

resolved, and trained staff developed before expanding the scope of this modified implementation approach.

10.2.2 Development of Branch/Distributary Canal Water User Organizations

An IAS office in the irrigation district should be established. This local IAS office begins the process of forming water user organizations at the branch canal level. These farmer/water user entities must be effectively organized, officially recognized, and must actively participate in irrigation improvement planning, design, construction and operation at the branch canal level.

10.2.3 Improve Branch and Distributary Canals

Continuous flow is the key and lead technology of IIP, and is a critical factor to ensure water user interest. The mesqa improvements of IIP lack meaning and are not technically and economically feasible without continuous flow. Thus it is imperative to improve the branch/distributary canals and establish continuous flow in the command areas first.

With branch canal water user organization participation, a systematic program to improve/renovate branch and distributary canals to allow downstream water control and continuous flow will be implemented. At the very least this will include downstream water level control gates and support structures, canal section renovation, tail escape renovation and volumetric water control structures (distributors). In addition, it requires the identification and construction of appropriate interim physical improvements to mesqa offtakes to prevent direct flow of water to low level mesqas once continuous flow is implemented. The branch canal water user organization will maintain operational oversight and they will hire their own mesqa gate keepers to operate mesqa gates until the low level mesqas are improved. Direct irrigation offtakes will need to be dealt with in a similar manner.

IIP design and construction engineers will have a transitory functional presence in improvement districts. These specialized and highly skilled engineers will move from one improvement area to another as main system improvements are designed, constructed and become operational. IIP civil engineering staffing requirements may stabilize at a smaller number than present, allowing the Ministry to offer more attractive salaries, and develop and retain a specialized design and construction oversight staff in its main cadre.

IAS engineers, IAS farmer organizational specialists and technicians will maintain a permanent presence in the improvement area working closely with the irrigation district engineer. Initial efforts will focus on development and technical support of branch canal water user organizations. IAS staff will participate with IIP engineers and the water user organization in the planning, design and operation of the main system improvement process described above. They will assist with mesqa level WUA formation. They will support the mesqa WUA as it plans, develops and implements its own improvements. Finally, they will continue to support water user organizations over the longer term with necessary water management educational and technical assistance outreach.

10.3 Encourage and Facilitate Private Sector Mesqa Improvement

With the participation of the branch canal water user organization and of the respective mesqa WUAs, the IAS will install two demonstration mesqas in the improved command area. All further mesqa improvement activities will be the responsibility of the private sector but with IAS oversight and guidance.

The government's role in mesqa improvement becomes::

- IAS assists the development of mesqa WUAs and provides on-going water management technical support.

- IIP and IAS provide technical oversight and leadership in development and update of mesqa design standards. As private sector design and construction capacity develops, they become active in this standardization process.

- IAS provides technical/organizational development assistance to overcome other legal and institutional constraints that may act to prevent mesqa improvements from becoming privatized.

- MPWWR provides institutional support for mesqa WUAs. This includes better access to credit for financing of improvements; access to loans with favorable terms (such as through the already established Mesqa Improvement Revolving Fund); contracting guidance and support, etc. Private mesqa WUAs would enter into contracts with private sector design and construction firms and manage these contracts themselves with technical assistance and supervision from the IAS.

- IAS provides technical oversight and leadership in development and update of turnkey mesqa design and construction contracting methods and standards.

- IAS provides improved mesqa construction quality control oversight.

The IAS will provide training to private mesqa WUAs on contracting, contract management, contractor non-performance issues, etc. In addition, the IIP and IAS may jointly develop a training course for private sector design and construction firms on mesqa design standards, turnkey contracting, working relationships with WUAs, etc.

10.4 Strengthen the Irrigation Advisory Service

The Irrigation Advisory Service plays a key role in IIP with a seven-stage process for WUA formation and development that has proven to be effective. In this proposed strategy the IAS role is further emphasized. The IAS requires major institutional strengthening inputs in order for it to be able to provide the level of support to water users that is envisaged in this proposal. Funding proposals for IAS institutional strengthening have been developed as part of the continuing strategy development IAS has undertaken for long term sustainability and as described in Part I of this report.

It is proposed the MPWWR decree and implement a policy establishing an IAS Central Directorate within the Ministry's organizational structure, closely linked with the IIP, the Irrigation Department and the National Water Research Center. The formal mission of the IAS would be expanded in scope: a) mesqa WUA formation and development, b) WUA federation formation and development, c) branch canal water user organization formation and development, d) integrated water management technical assistance to water user organizations at all levels of the irrigation district, with a strong on-farm water management improvement component.

The IAS Central Directorate would develop an appropriate staffing plan to deliver the varying degrees of water management technical assistance and support as command areas are identified for improvement, works are completed, and improved command areas become operational. The MPWWR will support this with appropriate training, staff development, career development opportunities, recognition and reward for working long field hours, and

other motivational factors designed to build and retain a highly qualified, trained and active cadre of professionals.

In addition to having a permanent home in the Ministry, key areas identified for strengthening within IAS are the full development of an interdisciplinary professional staff; most notably, rural sociology and agricultural economics disciplines need to be expanded. The IAS must further develop a capacity to deliver comprehensive on-farm water management technical assistance, which goes well beyond such items as demonstration of precision land leveling. Where appropriate, the IAS should develop capability to assist farmers with the adaptation and implementation of modern on-farm irrigation methods and practices.

As a Central Directorate within the Ministry, the IAS would gain a range of flexibility to explore cooperative working relationships with the research institutes of the National Water Research Center, with the Ministry's Water Communications Unit, and with the Agricultural Extension Service. Enhanced working relationships with these other units and agencies would be expected to contribute to and support the full development of an irrigation and water extension education capability, that currently does not exist anywhere within Egypt. In this regard, the concept of Irrigation District Water Management Centers housing the district irrigation engineer, district IAS engineer, district drainage engineer and their respective staffs is proposed and elaborated on in the next chapter. It is possible, that as further private sector capability is developed and greater role and responsibility for branch canal irrigation management is transferred to the private sector, these district centers may also become privatized and molded to fit local needs.

It is imperative that all future MPWWR irrigation improvement activities funded by international donor or lending agencies include specific line item support for the IAS in the final approved budgets of these activities.

10.5 Monitoring and Evaluation Program

Monitoring and evaluation of the socio-economic and technological aspects of the improvement program is essential for providing feedback concerning implementation problems and issues, and suggestions for modifying future efforts to increase program

efficiency and effectiveness. Self-monitoring and evaluation internally by the IIP and IAS are important activities in this regard.

It is equally important to establish a permanent monitoring and evaluation mechanism within the Ministry but external to the IIP. Targeted research on improved systems and established water user organizations provide essential data for modifying future approaches, for policy development and for policy decisions. Research institutes within the National Water Research Center can fulfill this role by establishing close functional linkages with IIP/IAS. Data and information collected will tend to be from a larger sample, more widely disseminated, more intensive, and perceived as less-biased than if the IIP/IAS performed this job themselves. The impacts of improvements and the issues encountered in the process will guide the Ministry in continually streamlining the program and gaining external support.

The following process is proposed for initiating a formal monitoring and evaluation program within the MPWWR. In the short term rapid diagnostic analysis training should be provided to a strategically selected core group of IIP/IAS personnel. These individuals, once trained, could initiate rapid diagnostic analysis activities in selected IIP command areas that are being completed. The purpose of this shorter-term effort is to collect and analyze data and information regarding the net impacts (technically, economically, and socially) in these completed command areas. Concurrently, with a longer-term perspective, a permanent MPWWR monitoring and evaluation unit would be established. Key personnel in the unit would receive extensive training, in such areas as irrigation management diagnostic analysis, remote sensing using satellite imagery, etc.

It is imperative that all future MPWWR irrigation improvement activities funded by international donor or lending agencies include specific line item support for the monitoring and evaluation programs in the final approved budgets of these activities.

10.6 Legal/Regulatory Considerations

The legal basis for mesqa improvement cost recovery, and by-laws and implementation mechanisms, have been established with Law 213 (27) and the supporting Ministerial decree (34). A recent high panel ruling defines to which mesqas and WUAs mesqa improvement cost recovery applies. It is recommended the MPWWR take immediate action to implement the mesqa improvement cost recovery program.

Current irrigation and drainage laws and institutional regulations need to be reviewed and amended or expanded to allow the formation of water user organizations outside of designated IIP areas, at both the mesqa level and at higher levels of the delivery system. The rules and regulations regarding the establishment of these organizations; their roles, responsibilities, and functions; etc. should be flexibly designed and non-constraining to possible future roles of private sector organizations in participatory irrigation and drainage management.

11 IIP: A VEHICLE FOR FUTURE POLICY REFORMS

The EPIQ Water Policy Reform Program is assisting and advising the Ministry in policy enhancements and reforms aimed at improving the utilization efficiency and productivity of Egypt's water resources. With a focus on water conservation in irrigated agriculture, this necessarily means improving the management and use of water at all levels of the Nile Irrigation and Drainage System. Improving the management of water, in this case, is largely dependent upon:

- Physical and infrastructural enhancement and development to allow better control of water, measurement of water, and minimization of operational losses to drains. Additionally, management capability and capacity at the directorate/district levels must be supported and improved as water supplies become tighter and the innovation of continuous flow availability is implemented in larger and larger portions of the system.

- Implementation of appropriate water policy parameters to motivate water user behavioral change towards more efficient/effective water use. These might include policies establishing tradable water rights, water allotments, or water pricing programs which convey to users the true economic value of water such that its efficient/effective use is an important factor in input decisions relative to crop production.

- User participation in system planning, operation, management, and maintenance at levels above the traditionally accepted level (i.e., federations of WUAs or other water user organization at the branch canal level) and concomitant strengthening of the irrigation district engineer's role, responsibilities, accountability and rewards for merit.

- Educational/technical support to WUAs with water management issues and problems at the mesqa and on-farm levels, and with organizational and social issues and problems that WUAs, federations of WUAs, and branch canal water user entities might encounter at the branch canal/irrigation district levels. Increasing the awareness and knowledge of farmers and other water users about important water management issues in this regard is a vital complementary effort. Experience has shown that information development and dissemination can often be effectively accomplished with a well-designed and coordinated educational/technical assistance effort.

The individual components of this program are not sufficient in isolation of the others to bring about the desired changes, but should be viewed as a package. The socio-technical innovations of the original IIP, and thereby of the proposed strategy for irrigation improvement projects presented here, support this program.

11.1 Controlled Delivery of Allocated Water Volumes

The assessment of the IIP presented in Part I of this report indicated the physical infrastructure development and modernization of branch and distributary canals that included downstream water level control and continuous flow availability helped improve the equity of water distribution and resulted in more reliable water supplies to farmers. Further improvement in water management and control of water will require systematic water measurement. The IIP has adapted volumetric flow control and water measurement by using structures such as baffle sluice gate distributor modules.

Future scenarios of water allocation in Egypt will likely spread shortages or reduced allocations equally across command areas, i.e., an imposed water scarcity. The infrastructure improvements of IIP lend themselves well to the equitable, measured and controlled distribution of a specific water allocation to the branch and distributary canal level.

Further motivation of water users to use water more efficiently requires that they realize the full economic value of water in their decision-making. Treating water as a tradable property right with market value, and/or water pricing programs, or combinations of these, have been suggested as necessary conditions to motivating farmers to improve their water management. Again, the infrastructure improvements of the irrigation improvement program can be used to support such economic measures at the branch/distributary canal level

11.2 Increased Water User Participation in Irrigation Management

Increased user involvement in planning, operation and management of the irrigation system from the branch canal to the farm is a desirable MPWWR goal and is supported in the proposed strategy. The development of semi-autonomous and quasi-private irrigation associations or districts (i.e., the western US experience) may be a long-term goal. In such cases, district water user organizations are entirely responsible for the operation, maintenance and periodic upgrading of water delivery and control structures within their districts. A

district board of directors plans, manages and distributes its allocation of water in such a manner that the district allocation is equitably distributed to unit command areas within the district.

The proposed strategy calls for the IAS to assist in the development of and provide support to branch/distributary canal water user organizations. In addition to working with the IIP and IAS to plan and implement the package of irrigation improvements in their command area, these organizations may begin to take on several responsibilities that gradually lead to the complete turnover of the irrigation system at this level.

A suggested first step in this direction is the increased and active involvement of the organization in operation and maintenance of the branch/distributary canal. Gate-keepers would be employed by the organization and be responsible for implementing water delivery schedules among the command area mesqas. The organization would receive input and assistance from irrigation district and IAS engineers. Similarly, the organization would employ its canal maintenance and cleaning labor or contract this out to private sector companies performing these services. The organization might also employ security guards to ensure branch canal structures are not tampered with or destroyed. Technicians may be employed for certain activities related to water measurement, system monitoring, system performance or operational problems. The organization would also cooperate and coordinate planning of future improvement needs with the district engineer and local IAS office.

Another important area where the branch canal water user organization can play an important role, in cooperation with the district engineer, is with regard to the implementation of a controlled water allocation program. The Ministry's Irrigation Department would continue to operate the main delivery system from Aswan High Dam to the branch canal offtakes. The district engineer and branch canal water user organization would jointly develop the annual/seasonal water allocation. The branch canal water user organization (with assistance from the district and IAS engineers) would become entirely responsible for planning and managing the distribution of the annual/seasonal allocation. At the same time, the Ministry would be responsible to operate the main system to reliably deliver an agreed allocation of water to the branch canal.

It is expected that the organization may also take on intermediary channel functions, i.e., acting as a link between WUAs, credit agencies, input and marketing suppliers and other non-governmental organizations.

In addition, a long-term perspective of these organizations may view them as effectively providing important economy of scale functions normally not available to individuals and smaller organizations. These might include bulk procurement and delivery of non-water agricultural inputs and coordination of marketing of agricultural products.

11.3 Strengthening the Irrigation District

The day to day management of an improved irrigation delivery system operating under continuous flow will be a new process for the irrigation district engineer. Management capability and capacity at the irrigation district level must be supported and improved as water supplies become tighter and the innovation of continuous flow availability is implemented in increasingly larger portions of the system.

A mechanism to facilitate and support this increased management capability is the concept of multi-purpose irrigation district water management centers. It is envisioned such centers will include the following facilities and be used for a variety of support activities of the MPWWR and the private sector in management, operation and maintenance of the irrigation and drainage system.

- Office space for the district irrigation engineer, the IAS engineer, and the drainage engineer and their respective technical support staffs.

- Computer center for real time acquisition (by remote telemetry) and processing of water (volume and level) data to support day to day management and decision-making,

- Water quality laboratory to support a minimal level water quality monitoring program on canals and drains within the service area,

- Maintenance center for spare parts and equipment (e.g., distributors, DSC gates, etc.) used in irrigation improvement at the branch canal level. These centers will similarly support maintenance needs of the improved mesqas until private sector capacity is built up to take over this service.

- Training center for training of leaders of the branch/distributary water user organizations, for training of leaders of the mesqa WUAs, for training of technicians and laborers employed by branch canal water user organizations, etc.

- Meeting center for the branch/distributary canal water user organizations.

The irrigation district water management center would operate as a quasi-private institution. The district engineer, the IAS engineer, and the drainage engineer (and their respective staffs) are government employees with the private branch canal and mesqa-level water user organizations in their district being their partners. Increasing end-user participation in, and/or transfer of, various irrigation and drainage management activities could be gradually implemented. The IAS would actively facilitate institutional needs for sustained user participation and also develop and deliver a continuous program in water management technical and educational assistance. In time, the center would be managed jointly by IAS and the organization, such that member farmers would have a sense of ownership and, therefore, take greater interest to tailor the center to fit their needs and to maximize the center's potential.

12 SUMMARY OF PROPOSED POLICIES

In adopting and promulgating this proposed strategy for irrigation improvement projects, the Ministry will develop and implement the following policies:

1. Implement a modified approach to irrigation improvement in all new improvement areas, in the USAID pilot IIP command areas, and the World Bank IIP command areas.
   - IAS establishes a presence in the improvement command area and begins the development of branch canal water user organization.
   - Branch canal water user organization, irrigation district engineer, IAS engineers and IIP engineers jointly plan, design and implement branch and distributary canal improvements in the command area and establish continuous flow and downstream water level control.
   - Branch canal water user organization participates in operation and maintenance of the new system.
   - IAS and branch canal water user organization jointly develop mesqa WUAs.
   - Mesqa WUAs plan, design and implement mesqa improvement with financial/credit support from the IIP Mesqa Improvement Revolving Fund. Mesqa WUAs enter into their own turnkey contracts with private sector design and construction firms for implementation of improvements. IAS engineers provide design guidance and oversight.
2. Implement improvements in total irrigation districts or full canal command areas taking into consideration the development of a strong on-farm water management technical assistance program to be developed jointly by the MPWWR and MALR.
3. Use the suggested strategic set of criteria for selecting and prioritizing improvement areas.
4. Focus improvement efforts in a limited number of command areas until implementation processes and issues are tested and adapted, and a cadre of well-trained and experienced IIP and IAS staff, from field technicians to General Directors, is established.
5. Establish an IAS Central Directorate within the MPWWR and strengthen its ranks with trained and motivated professionals. It is imperative that **all** future MPWWR irrigation improvement activities funded by international donor or lending agencies and the GOE include specific line item support for the IAS in the final approved budgets of these activities.

6. Establish a Monitoring and Evaluation Unit within the National Water Research Center to continuously provide feedback on improvement impacts and implementation issues such that the improvement process can be modified and adapted to increase program efficiency and effectiveness. It is imperative that **all** future MPWWR irrigation and drainage management activities funded by international donor or lending agencies and the GOE include specific line item support for program monitoring and evaluation in the final approved budgets of these activities.
7. Establish multi-purpose district water management centers to be the major services provision and information dissemination point to water user organizations.
8. Assist farmers with the adaptation and implementation of modern irrigation techniques and practices where appropriate.

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