CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) – PART I

PD-AAR-065

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION
Egypt Water Use and Management	263-0017	USAID/Cairo

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 85-15

☒ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES	6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY____ B. Final Obligation Expected FY____ C. Final Input Delivery FY____	A. Total $ ____ B. U.S. $ 13 million	From (month/yr.) 6/76 To (month/yr.) 3/85 Date of Evaluation Review

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. The project is essentially completed, but USAID will consider addressing the following issues under appropriate components of the Irrigation Management Systems Project:	AGR/ILD	
a. make the methodologies and technologies developed under the project operational;		6/86
b. establish an official role, guidelines and incentives necessary for the organizations of water user associations;		6/86
c. extrapolate the economic cost-benefit of large scale implementation of project findings;		12/85
d. improve data collection;		12/85
e. explore additional adaptations of methods and equipment to Egyptian small farms;		N/A
f. continue work on water conveyance structures and materials to improve the delivery system;		N/A
g. maintain experienced interdisciplinary staff for extension of project findings;		N/A

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☐ Other (Specify) _____
- ☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

A. ☐ Continue Project Without Change

B. ☐ Change Project Design and/or ☐ Change Implementation Plan

C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

WCarmack, AGR/ILD
EStains, AGR/ILD
DSchaer, AD/AGR
JConly, DPPE/PO
GLaudato, AD/DPPE
AHandly, DD

12. Mission/AID/W Office Director Approval

Signature: Frank B. Kimball

Typed Name: Frank B. Kimball, DIR

Date

AID 1330-15 (3-78)

CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Control Symbol U-147

1. PROJECT TITLE

2. PROJECT NUMBER

3. COUNTRY/AID/W OFFICE

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each F

☐ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES

A. First PRO-AG or Equivalent FY____

B. Final Obligation Expected FY____

C. Final Input Delivery FY____

6. ESTIMATED PROJECT FUNDING

A. Total $ _____

B. U.S. $ _____

7. PERIOD COVERED BY EVALUATION

From (month/yr.) _____

To (month/yr.) _____

Date of Evaluation Review

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
h. improve coordination with the Ministry of Agriculture;		N/A
i. continually monitor and review projects to make adjustments in implementation;		N/A

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

☐ Project Paper
☐ Financial Plan
☐ Logical Framework
☐ Project Agreement
☐ Implementation Plan e.g., CPI Network
☐ PIO/T
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☐ Other (Specify) _____
☐ Other (Specify) _____

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12. Mission/AID/W Office Director Approval

Signature

Typed Name

Date

AID 1330-15 (3-78)

2

NEAR EAST EVALUATION ABSTRACT

PROJECT TITLE(S) AND NUMBER(S)	MISSION/AID/W OFFICE
Egypt Water Use and Management (263-0017)	USAID/Cairo

PROJECT DESCRIPTION

The project purpose is to demonstrate replicable improved irrigation water management and associated practices that increase farm production by funding pilot programs in three governorates.

AUTHORIZATION DATE AND U.S. LOP FUNDING AMOUNT	PES NUMBER	PES DATE	PES TYPE
6/30/76 $13 million	85-15	March 1985	☐ Regular ☐ Other (Specify) ☐ Special ☒ Terminal

ABSTRACT PREPARED BY, DATE	ABSTRACT CLEARED BY, DATE
burg, DPPE/FO	EStains, AGR/ILD

The evaluation team was composed of an irrigation engineeer, an irrigation agronomist, a social anthropologist, and an economist. Since the project had ended at the time of the team's work and all CSU team members had departed, the evaluation relies heavily on the large amount of project documentation. The only previous evaluation of the project (1980), made 14 recommendations which were incorporated into the project's plan of work. The final evaluation team consi dered both these revisions and the project's original goals in their evaluation.

In the opinion of the review team, the project had taken actions to implement all of the recommendations in the first evaluation. In general, the necessary equipment for project work had been procured as specified, although there were problems in the timing of deliveries. In some instances, project training was too academic or not sufficiently comprehensive to allow them to handle the multiple responsibilities assigned by the project. However, participant training was augmented by practical, on-the-job training with TDY expertise. The project has produced outputs with significant potential for improved irrigation system management, though these outputs are somewhat different from the original project paper and contract. This difference was due to: 1) the conflict between the project design calling for a water management research effort, and the stated project objective, which was more appropriate to an on-farm production project, 2) several assumptions underlying the project (and unstated in the original logical framework), were fallacious. The evaluation describes these assumptions and the reasons why they were unsound under Egyptian conditions. Instead of producing a replicable package of water management technologies, the project developed a replicable methodology that could be applied over time and different circumstances.

The stated project goal of improving the social and economic conditions of small farmers by boosting crop production and income was unrealistic given the planned project inputs and outputs. The most direct benefit of the project has been the formal and on-the-job upgrading of the skills of Egyptian technical personnel. The second most significant project benefit is the substantial quantities of data it produced on Egyptian irrigation, agronomic, and social conditions germane to a wide range of future activities in irrigation systems improvement. The Project also provided direct services such as land levelling and mesqa improvements to a limited number of farmers. While crop production increased significantly in the project area, these increases cannot be attributed solely to project activities because they were combined with other interventions in a technical package.

One of the most significant findings of the Project is that effective Water Users Associations can have a very large impact on the maintenance and management of water resources in Egypt, especially at the local level. The project found that the presence of sociologists greatly facilitated the organization of such groups. However, the project did not create a completely replicable process for the organization of local water users associations and their effective interface with the Ministry of Irrigation. Another important conclusion of the project is that gravity irrigation in Egypt is technically feasible, socially acceptable, and offers significant benefits to farmers without wasting water. The evaluation report provides comprehensive recommendations concerning the lessons and findings of EWUP for future irrigation projects in the areas of: 1) research processes, 2) irrigation parameters, 3) farmer involvement, 4) systems management, 5) agronomic and structural changes, and 6) training.

XD-AAR-065-A
ISN: 39339

END OF PROJECT EVALUATION REPORT
OF
EGYPT WATER USE AND MANAGEMENT PROJECT

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THE GOVERNMENT OF EGYPT
and
UNITED STATES AGENCY FOR INTERNALATIONAL DEVELOPMENT

Cairo Egypt
March 1985

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ACKNOWLEDGEMENT

The evaluation was made possible with the advice and cooperation of many people in the Ministry of Irrigation, the Ministry of Agriculture and USAID. For fear of missing someone we will not attempt to mention names but hope that each of you will accept our sincere appreciation. We appreciate and express our thanks to the Water Distribution and Irrigation Systems Research Institute (WDIS), Water Research Center, MOI, for providing office space, secretarial assistance and escorting us to the research sites.

Sincere thanks and appreciation is extended to Mervat Hassan for her patient and diligent efforts in typing our manuscripts into the word processor and retrieving a final draft. We also thank Mary Halim especially for editorial help and for her assistance in obtaining copies of all project reports, staff papers and other relevant publications and materials.

Finally, we want to express our special thanks to Dr. Mona El-Kady, Deputy Director of the Water Distribution & Irrigation Systems Research Institute, for taking us to the research sites, being always available to answer questions, providing council and guiding us through the maze of published material regarding EWUP activities.

As team leader I also wish to express my thanks to team members for their dedication to the review task, mutual cooperation and around the clock efforts in completing the report in the short time available.

Alvin Bishop

Team Leader

I. SUMMARY AND RECOMMENDATIONS

The Egypt Water Use and Management Project (EWUP) was initiated in 1977. The contractors first team members arrived October 1977 with a full team January 1978. Through four amendments the contract was extended until December 31, 1984.

A Final Report was issued in March 1984 although some work is ongoing and a number of technical reports have been issued since that time. The interdisciplinary project identified a number of water management and agricultural production constraints along with practices and interventions to relax the constraints. Applied research was conducted at three field sites representative of the various crop, soil, water and climatic conditions of Egypt. Practices and interventions were applied as a package and evaluated. The results are contained in 77 technical reports, 7 manuals and 115 staff reports. There is no attempt here to summarize all of these results.

Recommendation: That WRC/WDRI, as a next stage, be supported in a project to specifically convert methodologies and technologies developed during EWUP into an opertional system.

A major accomplishment of EWUP was its creation of several site specific interdisciplinary teams, composed of agronomists, economists, engineers and social scientists, who collaborated in the identification, design and implementation of project activities. To assure farmer participation, the EWUP sociologists organized the farmers along each *mesqa* into Water User Associations to administer water distribution among themselves, be responsible for *mesqa* maintenance and interface with project technical staff. An important outcome of these activities was the vivid demonstration it provided concerning the feasibility and efficacy of an interdisciplinary approach to water management and the vital role that local Water User Associations can play in the process. MOI now faces the challenge of institutionalizing both this methodology and the role of Water User Associations in a fashion adaptive to extension to large geographic and administrative contexts.

Recommendation: Further considerations should be devoted to establishing an official role, guidelines, and incentives necessary for the organization of WUA's along with a definition of the functional responsibilities and authority of the WUA.

An economic review of EWUP activities show that some good reports have been produced but that benefits accruing to the farmer in terms of increased production and income are not well enough established to allow for future projections. However, reports show that there are potentials for water savings and improved efficiency in water use which is a justification per se. All farmers receive some benefits but not all farmers realize the same benefits nor to the same extent. With this high variability of impact and the small number of farmers involved in the EWUP study it is not possible to project the benefits and costs to a national or even a regional level.
Recommendation: The economic cost-benefit of large scale implementation of EWUP findings need to be extrapolated in a pre-feasibility study with respect to the on-farm as well as the national level. Data collection and methodology needs additional emphasis.

Precision land leveling was a component of the management practices at all sites. It was effective and accpeted by the farmers. As a results of this success there is a separate AID supported Farm Machinery Project in MOA with land leveling for water management as its main objective.
Recommendation: Additional adaptations of methods and equipment to the small farms of Egypt should be explored.

Methods for canal lining were evaluated using concrete cast-in-place, concrete pre-cast units, butyl rubber membrane, plastic membrane, plastic membrane with covered cement tiles, and asphalt. The asphalt rappedly deriorated and the membrane were soon damaged by animal and/or weeds.
Recommendation: Work should continue on water conveyance structures and materials to improve the water delivery system.

Replacing the *saqia* as a method of water management with gravity delivery to the farmers' fields was tested. Eliminating the many *saqias* with a single pump on the *mesqa* or by gravity direct from the canal provided gravity flow. The substitution of gravity delivery to the fields coupled with a strong water users assoication and scientific water control is believed to be replicable and applicable to large areas of Egypt.

Recommendation: An expanded project to further test this management intervention on a large scale. This could be incorporated in the IMS project or stand by itself as a new AID supported activity.

The results from the various field sites that demonstrated improvement in crop management was required to gain the benefits from irrigation improvements. One short coming of the EWUP study was the lack of data from individual farmer fields. Agronomic improvements and insect control were found to have in general a higher payoff and replicability potential at a lower per *feddan* cost than some of the irrigation improvement alone. This interpretates to mean that the farmers were in general doing a better job of irrigating than they were doing of the agronomic components.

Recommendation: In an expanded regional project GOE and USAID should direct more resources to assist agronomic interventions such as micro-nutrient application, pest control, improved cultivation practices, calibrating fertilizer tests for nutrient requirements, increasing plant populations and introducing improved varieties. All of these practices are accepted by most farmers. To facilitate the advisory program a service laboratory should be provided. Such a facility would test the soils from the individual farms to determine the fertilizer requirement and the need for soil amendment such as gypsum. Water quality determinations could also be made. Such a laboratory can operate on a mass production basis.

A major success of the project was the training program. Some staff members were supported for formal training (9 mo) in the US, others in Egypt. Short course training and field trips were conducted in the US and Egypt. A total of approximately 85 people received practical on-the-job

experience. This reservior of experienced scientists and technicians will serve as a nucleus for an expanded program.

Recommendation: Whenever the EWUP program is extended to a region, the experienced field and main office interdisciplinary staff should be maintained for major imputs into the broadened program. Senior American scientists should be made available on a long-time as well as short-time bases. They should function early during the implementation and assist in the formulation of work plans. The project should be more closely monitored to ensure compliance and to provide good liaison between agencies.

Coordinated implementation of the irrigation and agriculture improvement programs will ensure utilization of the research findings. This coordination between the MOI and MOA is viewed as essential to improving the information transfer for both Ministries.

Recommendation: Strategy for extending the water management lessons learned from EWUP should incldue a matching program funded in both Ministries (MOI & MOA).

The project has essentially achieved its objectives with some exceptions. A "replicable package" as such was not produced. What was produced was a proven procedural package. An interdisciplinary team is in place and functioning. It is not, however, large enough to staff and manage a greatly expanded regional program. A specific methodology and work plan for the extension of the interdisciplinary process has not been completed. These objectives seem to have been unrealistic and unobtainable.

Recommendation: That continual monitoring and periodic review be an integral component of such projects so any need for changes in objective and scope of work are recognized and made through amendments.

II. PROJECT BACKGROUND

The Egypt Water Use and Management Project (EWUP) was funded jointly by the Arab Republic of Egypt and by the United States Agency for International Development (USAID). It was implemented under the auspices of the Ministry of Irrigation's Water Distribution and Irrigation Systems Research Institute and in collaboration with both the Ministry of Irrigation and the Ministry of Agriculture through the Soil and Water Research Institute which provided the Project with personnel and services.

The project was designed to contribute critical technological information to the irrigated agricultural sector of Egypt and hence provide an input which would increase the productivity of the sector. The project had two major "internal" objectives; 1) the generation of practical information on the proper use of irrigation water and management of irrigation systems, and 2) the strengthening of institutions which deal with water management research and extension of findings to farmers. The "external" objective of the project was to carry out pilot area operations. This was done with farmers and irrigation system managers in three areas in the country. It was to be demonstrated how to best use both the water and non water resources to increase farm production.

As designed in the Project Paper, the applied research and extension program is being conducted in three pilot areas that represent three different soil, climatic, social, agronomic and cropping areas of Egypt. One area, Mansuriya, is near Cairo. It grows vegetables, is at the interface of the desert and the Nile Valley (has sandy soils interlain with heavy clay) and farmers can and do work in Cairo. The second area, Kafr El-Sheikh, is near the city of that name in the northern delta. Principal crops are cotton and rice with secondary crops of beans, berseem, corn and wheat. Soils are heavy clay, and drainage and salinity are problems. The third area, El-Minya, is in Upper Egypt near the city of that name. Principal crops are cotton , maize, wheat, sugarcane, beans, and berseem. Soils are clay loam,

lighter than delta soils. Irrigation is by gravity, lift or combinations of the two. All three areas are representative of much larger regions with similar conditions. Farm size in all project sites is typical for Egypt with an average size of about three *feddans*. They also include a few large farms of around 25 *feddans*.

The grant agreement for the project was signed in September 1976 between GOE and USAID. The Consortium for International Development (CID) was selected as the contractor with the first team members arriving in Egypt in October 1977 followed by the full contract team in January 1978. Through four amendments the project and consultants' contract were extended to December 1984.

III. EVALUATION METHODOLOGY

The evaluation scope of work (see Appendix A) called for a multidisciplinary team to conduct the evaluation over a 21-day period including production of a final evaluation report. Several major constraints existed given the time frame: 1) the project has produced a prodigious amount of literature: over 80 technical reports and manuals, a large number of draft working papers, several volumes of TDY reports and memos, all of which required perusal and selective study, in addition to previous evaluation and audit reports and other relevant documentation (see bibliography); 2) the three pilot field sites had to be visited; 3) efforts had to be made to look outside WRC and MOI for relevant institutional connections; and 4) minor attempts at verification of findings, mainly through comparison with non-project documentation were called for. Moreover, the fact that the project has ended meant all CSU team members had departed and, therefore, their perspectives and actual responsibilities had to be reconstructed solely from documentation.

Given these circumstances the team looked upon itself as potential clients who would approach EWUP and WRC to see what could be provided as to new understandings of on-site water management in Egypt and what solution had been developed to

respond to identified needs. In assessing the response, team members relied on their own expertise and experience, general tenets in their technical specialties, and the self analysis of WRC and project staff as provided in internal documents and direct conversation.

In terms of its final evaluation of the project's performance, the team weighted its findings against three fundamental questions: 1) what was promised (in terms of applicable research, replicable methodology, increased production, and socio-economic benefits to farmers); 2) what was actually produced, and most important of all; 3) what is indicated as the appropriate next steps for irrigation sector activities in general and USAID support activities, such as EWUP and IMS, in particular.

IV. EXTERNAL FACTORS RELEVANT TO PROJECT DESIGN, PERFORMANCE AND REPLICABILITY

One underlying assumption of EWUP operations was that any package of practices had to be adaptable to site specific conditions yet be applicable to a large area. A minimal awareness of the following circumstances surrounding existing irrigation practices and administration is valuable to both understnding their evolution and for predicting the direction of their future development.

1. <u>Traditional Egyptian View of Controlling Water Use through Requiring On-farm Water Lifting Rather than Gravity Delivery</u>.

   As discussed elsewhere, lift irrigation is the method of water delivery practiced in Egypt. The strong allegiance to this practice within MOI, probably necessitated Egyptian-generated experience in order to reopen consideration on the merits of alternative methods. EWUP's research and findings have directly responded to this need and served this purpose. The generation of data permitting a reconsideration of this issue has been one of EWUP's accomplishments.

In terms of its final evaluation of the project's performance, the team weighted its findings against three fundamental questions: 1) what was promised (in terms of applicable research, replicable methodology, increased production, and socio-economic benefits to farmers); 2) what was actually produced, and most important of all; 3) what is indicated as the appropriate next steps for irrigation sector activities in general and USAID support activities, such as EWUP and IMS, in particular.

2. Mass Migration of Labor to Other Countries

The on-going exodus of males from rural areas continues to raise the price of rural labor, to increase the responsibility of women and children for on-farm labor, and to make labor and time intensive farm production technologies that were previously acceptable now non-adaptive. Some concern has been raised as to what will happen if the foreign job market declines and the country must reabsorb this labor. While the concern is real, it must also be realized that this phenomenon itself represents a major new orientation and modernization of the rural labor force. It is producing workers who are better able and more willing to adopt new management styles, less willing to play the traditional role of the overworked and under remunerated *fellah*, and who possess increased quality of life expectations. All of these pressures for an upgrading of the basic farm production system argue against any attempt to keep antiquated, excessively wasteful, labor intensive technologies solely for the sake of increasing marginal employment opportunties.

3. Rapid Population Growth

Egypt's present population growth rate of over 2.4% per annum means steadily increasing demands for water for agricultural and non-agricultural purposes, as well as increasing urban encroachment on present agricultural land. Various scenarios have been projected for the increasing demand on water. Indications are that the situation will remain manageable until the year 2000.

However, the year 2000 is only fifteen years away. At some point thereafter, if not before, critical allocation problems, local or national, may well arise and the design of future operating systems must attempt to assure that minimal water waste occurs.

4. Past and On-going Changes in Egyptian Agrarian Social and Political Structure

The pre-1952 agrarian structure was dominated by many influential large landowning estates and a pervasive system of private contractual arrangements that were highly exploitative of the majority of the rural peasantry. The Nasser period ushered in agrarian reform that resulted in dissolution of these estates and substantially increased small farmer income. However, overall farm sector freedom to operate independently vis-a-vis government probably decreased with the loss of powerful owners and the introduction of a philosophy of state management and central planning. The Sadat and Mubarak eras have seen an opening up to increased privatization and renewed contractual freedom and the reorganization of government for the decentralization of appropriate political authority to governorates, cities and villages.

The direct relevance of these circumstances to EWUP are three:

First, the direction towards greater farmer participation in irrigation system management that EWUP activity support is in keeping with the new prevailing political climate of liberalization of practices, increasing encouragement of private management and decision making, and the decentralization of authority. Second, in terms of decentralization of authority, new local level organizational structures have already been put in place to which the creation of water user associations would be complement and not a foreign implant. Third, new institutional arrangements will continue to be determined by prevailing political conditions. Rather than waste its energy on futile attempts to determine matters over which it

has little control, USAID should concentrate support on those already operating progressive institutional forces, of which the Water Research Institute is one. However, while support to WRC was and is most positive in this sense, to some extent the divergence between purpose and outcome in the EWUP is due to USAID's desire to see in WDIS something other than it is, i.e., an applied research center, not a project development and management institute.

V. KEY PROJECT ASSUMPTIONS

The "important" project assumptions listed in the project paper logframe were in reality basic administrative/logistic requirements applicable to almost any project. These included items such as: "contractor with required expertise will be available"; project personnel from different ministries will collaborate; necesary commodity inputs will be provided, and; there would be no drastic change in existing favorable macro-economic circumstances. All these assumptions proved basically true. However, the logframe did not reflect some important implied underlying conceptual assumptions which did not prove true, and which, consequently, explain much of the divergence between officially projected and actually obtained project outcome.

A discussion of four of these challengeable implied assumptions is considered to be valuable, primarily for future project considerations, and are as follows:

1. <u>Applied research, if successful, leads directly to replicable results</u>:

   In fact, such an assumption reduces what is at least a three stage process into two deceptively simple steps. Applied research, if practical, justifies further investment in developing a viable operational strategy for mass production or extension. Applied research methodologies, such as very intensive research focused on concentrated highly flexible interactions with a small sample population, is rarely adapted <u>ipso facto</u> to rapid cost effective replication. Moreover, entire areas that may be crucial

to effective large scale development project implementation, such as regional planning, cadastral surveys, contractor training, or highly regulated operation and maintenance practices may play a minor role during initial small site program development.

2. Increased socio-economic benefits to small farmers is equatable with increased farm production or vice-versa:

Since the Project has never looked at on-farm production as a total economic system there is no way of knowing with precision what benefits are really accruing to farmers, and how savings in time and labor are being invested elsewhere, (e.g. increased farm activities, off-farm job opportunities, education of children, increased out-migration or leisure). A decrease in the extremely burdensome labor requirements of traditional agriculture, which often falls on women and children, would seem a significant social benefits per se. From all indications, such benefits should be accruing to farmers but exactly which really are cannot be known without a special effort at beneficiary analysis which was not included in the project scope of work.

3. The primary justification for efficient water management is to increase on-farm production:

While increased farm production is one reason for more efficient water management, water saving is justification per se given the increasing demands being made on Egypt's water supply. The present farming system functions because there is enough water to allow farmers to rectify delivery system irregularities by compensatory practices such as flooding fields more than would be necessary for a single watering if a supply was assured, or pumping from wells or illegally piping water from major canals to field inlets. In the future, with a growing population and increased urban, industrial and agricultural demands and stricter quality standards that will limit reuse, per capita supply of water will no doubt be reduced and wasteful practice will have to be curtailed and replaced by more efficient system allocation.

4. <u>The Project involved no significant policy issues (specifically so claimed in the project paper)</u>:

While it is true that no major policy issues confronted the EWUP pilot activities themselves, their replication touches on at least three potentially important policy areas.

a) Can one justify public financing of major infrastructure investment on private agricultural lands that can then be sold for private profit for urban develpoment that destroys the value of the original investment.

b) The conflicting roles of the MOA agricultural extension services as supposed farmer advisor but really national agricultural policy imposers and enforcers.

c) The confusing destortion of farming economics is that farmers are subsidized in water delivery and other inputs but highly penalized by being required to produce crops (especially cotton) that must be sold to the government at below market rates that rarely yields any return for the labor invested. In addition, there is no way to compensate the farmer for the lost opportunity to cultivate more profitable produce.

It is not obvious that any or all of these questions should or could be directly dealt with in any new project expanding EWUP's findings to a major development action. They should, however, be considered while designing such an activity with a clear determination on the merit being made as to whether or how to deal directly with them.

VI. PROGRESS SINCE LAST EVALUATION

The project is now terminated as a USAID project and the final report was issued in March of 1984. However, from the GOE point of view much of what was started is still on-going. The only project evaluation was made in 1980. It contained 14 recommendations, the first two being that the project be continued and expanded which it was. The additional recommendations were incorporated into the plan of work.

At the time of the 1980 evaluation, work was just reaching the point where data was being produced at the three experimental sites. It is interesting to note that of the 72 technical reports listed in the final report only four were issued before 1980 and two during 1980 with an additional twenty-five as of March 1984 for a total of 31 issued and 41 still in progress at that time. At this writing (March 1985) the list of technical reports has been expanded to 79 with number 70 being cancelled and number 44 being made into a manual for a net of 77. Only eight are still in progress. Thirty six technical reports in progress when the final report was issued a year ago are now finished and have been circulated along with six manuals. Although technical reports are but one measure of progress, they indicate that most of the progress has happened since 1980 and considerable since the final report a year ago.

So far as the review team can determine all recommendations coming from the 1980 evaluation were considered and actions taken before the termination of the project. For example, it was suggested that short term consultants be at the intiative of the Egyptian project direction. This resulted in more specific consultant advice and fewer consultants. It was also recommended that the distribution of project results be formalized and subjected to internal reviews before being issued, this was done. Further discussion of the evaluation is included under section XIV of this evaluation.

VII. INPUTS

The inputs provided by USAID were essentially as specified in the logical framework. In general, the equipment was provided as specified although there were some problems in timing of delivery. In some instances the training of Egyptians was not complete enough for them to be able to handle the multiple responsibilities. Some training in the U.S. was of an academic nature and not particularly appropriate for the individuals. They took classes that were "available" while there. Through the use of a large number of TDY specialists an attempt was made to deal with the more practical aspects of training and compensate for a deficiency in academic training.

The GOE provided personnel such as staff officers, scientists and technicians. Also provided was local equipment, office space and supplies. In addition there was supervisory and evaluatory services.

VIII. OUTPUTS

The Project has obtained outputs with significant meaning and potential consequences for irrigation system management in Egypt. The sociological component of the Project proved one of the indispensable components for achievements to date. The technical reports required by the Project and contract amendments have been produced though not to the operational specificity intended. What outputs have been achieved, however, are significantly different from objectives specifically laid in the original Project paper and contract.

This is predominantly due to two reasons. First, there is a conflict between the actual activity design which was for a water management research effort and the stated objectives which would more appropriately have fitted an on-farm crop production project. Second, several unstated assumptions underlying the expectations for Project outputs, purpose and goal were fallacious. (see section on Project assumptions).

Instead of the specific package of practices or plans sought, the Project has produced the outlines of a process for achieving these in the future as appropriate to the site specific needs. In so doing it has also generated and recorded substantial data and experience on Egyptian irrigation, agronomic and social conditions germane to a wide range of future irrigation development activities.

Specifically, Project outputs include the following:

1. EWUP worked to improve several important components of agricultural production, giving attention to water delivery and on-farm water management. A set of twenty four recommendations were developed based on the experiences. These are included in Appendix D.

2. Over 80 technical reports and manuals, of somewhat varying quality in terms of data and analysis but, overall, providing valuable information and orientation for future activities in irrigated agriculture and water management projects.

3. A major contribution was upgrading the skills of project's personnel, other MOI personnel, and some MOA staff through both U.S. and in-country training in the various disciplines involved in Project activities. A more complete coverage of the training component is given in "Special Comments."

4. An admirable achievement of Project implementation through the creation of flexible interdisciplinary teams capable of extended applied field work in pursuit of a shared objective. Such an effort is often advocated and occasionally tried, throughout the world, but rarely reaches the level of true integration apparently obtained by EWUP.

5. As regards the sociological effort, in particular, EWUP has demonstrated the value of using social science personnel as intermediaries between farmers and other governmental technicians for information retrieval, participant motivation, training, and assistance in designing operational water delivery and management systems acceptable to farmers and adaptive to their specific needs.

6. Valuable Egypt specific data indicating the feasibility and desirability of establishing gravity feed irrigation systems in areas now dependent on lift systems.

7. Proof that farmers will accept, at least temporarily and probably permanently, a combination of field leveling and user reorganization for a gravity feed system, if it is introduced to them with extensive explanation and sensitivity and if it is accompanied by reliable government provisionment of necessary goods and services.

8. Activities related to organization and use of irrigation or water user associations (WUAs) represents perhaps the single most important aspect of EWUP's sociological interventions. A complete coverage of this is in section XIV.

9. Finally, the identification and field testing of irrigation alternatives and interventions to design and improve on-farm water management and develop the technical and engineering adaptations to Egyptian conditions and constraints. More details are given in section XIV.

However, the Project, while creating a basis on which to accomplish the following, did not completely produce several outputs expressed or implied in the Project paper; these include:

1. Immediatelly replicable methodologies for extension to a regional or national program;

2. Worked out program for non-experimental reproduction of Project activities, with accurately estimatable costs and requirements (material and human) per standard unit;

3. A sufficiently large and trained interdisciplinary team (including operation and maintenance specialists) as would be required for a major regional project;

4. A determination of, or the capacity to determine, clearly identifiable and disaggregated individual beneficiaries and specific social consequences of project activities. (see beneficiary section).

IX. PURPOSE

The project purpose as stated in the Logical Framework is as follows:

1. Develop and demonstrate replicable improved irrigation water management and associated practices that increase agricultural production.

2. Increase institutional capacity to develop and sustain an improved on-farm water management program.

Since the project was terminated as of December 1984, the end of the project conditions, shortfalls, outputs and achievements will be treated in other sections of the report where in depth discussions are appropriate.

X. GOAL/SUBGOAL

From the Logical Framework the project goal is "Improve the social and economic conditions of the small farmers." The measure of achievement indicated that "In project area, farmers' crop production and real income will have increased." These indicators are discussed in detail under section XIV D.

XI. BENEFICIARIES

The purpose of the EWUP project was not specifically to benefit a targeted population but to develop a new technolgical package that could in the future do so on a significantly large and replicable basis. At the same time, in pursuing this end, the EWUP project has conferred actual and potential benefits on a fair number of people in several ways.

The most permanent and direct benefits of the project has accrued to the numerous Egyptian technical personnel who received substanial formal and on-the-job upgrading of their professional skills. These benefits are undeniable, observable, and permanent.

The second most direct project benefit is contained in its voluminous technical findings and reports. These too are permanent, easily observable and of substantial potential value. Their potential, however, remains to be developed and cannot be measured at this time.

The third class of benefits, and the beneficiaries to whom they accrued, are the results of the various project trials and the farmers affected. These vary from the direct agronomic field trials that involved under one hundred farmers, to laser leveling that affected about 500 farmers, to the various experiments and improvements of *mesqas* that apparently affected about 2500 *feddans* and a somewhat similar number of farmers. The exact nature and duration of the benefits themselves will be realized over time.

In terms of land leveling the direct improvement to on-farm water control is fairly obvious, permanent and attested to by farmers' reactions. In terms of the *mesqa* improvements, the final benefits depend to a large extent on how the overall system, including MOI delivery of water, pump maintenance, durability of various linings and water user association cooperation will perform in the long run. This includes the resolution of remaining delivery problems such as that of *Mesqa #* 10 at Beni Magdul canal.

One of the major problems affecting a determination of benefits, even in the long run, is the narrow focus in project socio-economic data collection on immediate costs and production. In fact, the concerned farming operations represent diversified production systems both on and off the farm. EWUP sociolgical studies show that farmers favor the proposed improvements because of time and labor savings. EWUP studies also show that at this time, no definite increase in crop production can be measured. However, savings in time and labor can be reinvested by the farmer in many ancillary areas such as livestock raising, off-farm employment, education of children (who would otherwise be needed to work) and even improved childcare if women are freed from farm labor.

Because the project did not analyze the entire production system, it cannot trace either system benefits or social costs. (For example, improved access by upgrading on-farm roads, as was done in some cases, may benefit the farmers but if it leads to increased urban development, as is possible, it would have a negative economic effect on the agricultural sector itself.)

The project goal, as stated, was to improve the socio-economic condition of Egyptian farmers. However, since neither in its design nor its mid-term evaluation nor its implementation was a specific effort made to measure this systematically, as would be necessary, (and in fact were discouraged in USAID's mid-evaluation), precise evaluation of these benefits now cannot be made.

An open question remains as to what extent efforts should be made in the future to rectify this situation. Some immediate improvement in this regard would occur if the on-farm records included a short narrative of each farm family's overall situation, which would be updated annually. In this regard, it should be noted the divergence between some farm record studies that do include significant qualitative remarks and those which do not. However, as noted elsewhere, the sociolgical team already is over-extended and has not been trained in the type of wider system analysis necessary for this task. One alternative would be to make such analysis part of any project evaluation plan and arrange for it to be carried out over the life or project by a third party institution that had such capability.

XII. UNPLANNED EFFECTS

Apparently this project is rather unique in that it has engineers, economists, sociologists and agronomists all working together toward a common good. The review team has been told that as a result of the EWUP experience, there is a different school of thought regarding irrigation development in the country. The benefits from an interdisciplinary effort are appreciated and consideration is now being given to the social aspects as well as the physical delivery systems.

A world-wide interest in the EWUP project has been shown by the requests for publications coming from several countries and agencies including FAO and USAID.

XIII. LESSONS LEARNED

A. Project Implementation

1) There should be a contract project administrator to care for the logistic needs of the staff, purchases, disbursement, etc. This should not be an obligation of the contractor's technical director. The slow start of the project was at least partially due to the fact that the technical director's time was spent in providing administration and logistic support.

   Projects need closer USAID monitoring to insure that conflicts between project purpose and performance are resolved either through reorientation of contractor scope of work or reworking of the original project's purpose and logframe.

B. Project Evaluation

1) If USAID wishes evaluation reports to follow NE Bureau guides, its specific scopes of work should also be written in that format. Otherwise, difficulties in harmonizing conflicting categories and formats can raise substantial problems for final document preparation.

2) In order to avoid neglect or misjudgement of crucial needs in areas outside the expertise of the evaluators mid-term evaluations should be by a multidisciplinary team reflecting all the major areas of project activities.

C. Project Design

Even though a project has a very specific operational focus, it is important to conceptualize and remain aware of its purpose in terms of longer term development strategies, and to supplement project specific financial analysis with economic analysis of relevance to its contribution to national as well as individual goals.

XIV. SPECIAL COMMENTS

A. General Comments Related to the Review Team Scope of Work

The scope of work for the review team (see Appendix A) outlined items A through F to be documented or assessed as appropriate. Without restating the scope of work items the following comments are viewed as appropriate by the team.

ITEM A.

The EWUP has studied and tested a large array of water management practices assumed to have economic or other benefits including:

1. Water Users' Associations and/or Farmer Organizations for participating in the design, operation and maintenance of the water delivery system.

2. Irrigation system design and improvement including canal lining, improved gates and control structures, water scheduling, measuring devices and *mesqa* improvement.

3. On-farm water systems including irrigation stream size, infiltration measurements, precision land leveling, *marwa* improvement, longer and improved furrows, farm drains, farm roads and water budgets.

4. Drainage including studies of water tables, drainage systems, drainage coefficients and water quality.

5. Farming systems, farm records and economic studies.

These major water studies and tests carried out in an interdisciplinary context produced an on-farm water management package introduced to the farmers for acceptability.
The water management package has five components:

1. Evaluation of the nature and condition of the site specific delivery system.

2. Survey, characterize and classify the soils in order to have a basis for land leveling estimating water holding capacity and fertilizer practices.

3. Develop design and plans for improvement of the delivery system by:
   a) Organizing the farmers of a *mesqa* for design, operation and maintenance of the improved system
   b) Improving the *mesqa* (clean, straighten, line)
   c) Providing gravity water or improve *saqia* or pump
   d) Improving farm turnouts and water control
   e) Adopting water delivery schedules or water budgets.

4. Develop plans to improve the on-farm system by any or all of the following:
   a) Increase stream size for higher efficiencies or time saving
   b) Expand cropping area by combing *mesqas*, installing pipes to replace *mesqas* and eliminating unnecessary farm drain and waste areas.
   c) Precision land leveling
   d) Farm ditch improvement - design, location, lining or provide a road.
   e) Longer furrows or more efficient basins.

5. Provide good crop husbandry by:
   a) Testing the soil to determine the fertilizer needs including the minor elements such as zinc and iron and for the need for soil amendments.
   b) Providing recommendations as to fertilizers needed and amounts, the varieties of crops to grow and when to plant and the means for control of pests.

This water management package is replicable. Some of the practices have more or less impact or applicability due to site specific conditions. At a specific location a given practice may not apply at all, at another location it may produce the major impact. However, the water management package is a focal point for improvement of the irrigated area and is believed to have considerable potential to increase irrigation efficiency and agricultural growth with applicability and replicability. Long term success, however, is dependant upon continued and valuable MOI management of the overall system.

ITEM B

As stated under item A above it is believed that the water management practices and "package" is replicable and applicable to most all of the irrigated areas of Egypt. Some specific practices may be highly cost effective when applied on a large scale, either regionally or nationally. However, the cost effective component within the small scale of the research and the difficulty of application within the research setting did not produce the data to effectively fore-cast. The cultural acceptability was evidenced by the participation of the farmers in water users organizations. The physical appearance of the *mesqas* and farms in those areas gave further evidence of farmer acceptance. When the water management constraints were replaced at the farm level by reducing the time, effort, and energy required to irrigate, together with more efficient water distribution throughout the *mesqa*, farm yields were shown to increase. The elimination of the inequity almost always suffered by those at the "tail end" (both in quantity of water and expense in getting water to the land such as cleaning of the *mesqa*) was a factor in farmer acceptance. At the same time, farmer acceptance is directly related to the level of reliability of assistance provided and might reverse itself if such support is not institutionalized. There is no doubt that the greater the water management constraint, the greater the farmer acceptance and production response when the constraint is removed.

It is evident that high priority is given to the work of WRC and EWUP as evidenced by the following quotation taken from pages 137 - 139 of Strategies for Accelerating Agricultural Development - a report of the Presidential Mission for agricultural development in Egypt GOE-MOA/USAID/IADS-USDA, July 1982.

"Water Management

Constraint: Imperfect water management is a serious constraint. Conveyance losses in on-farm channels are often high because of poor design and low flow-rates from the *saqia* or *mesqa*. Poor land-leveling and low flow-rates

cause uneven field distribution and total water applications that greatly exceed actual crop needs. These imperfections result in reduced yields and restrict crop intensification via more timely seedbed preparation, transplanting, etc. Inadequate on-farm drainage often results from poor maintenance of field drains and/or main drains.

Recommendations: Provide farmers with technical assistance in:

- Rationalizing and improving within-farm conveyance channels;
- Land leveling;
- Basin or furrow design and layout;
- obtaining appropriate flow rates for efficient irrigation, using pumps as needed;
- Forming water-user groups for better regulation of the *mesqa* and conducting field demonstrations of improved water management and conveyance systems operations, (Such demonstrations should show effects on uniformity and yield of crops, reduction in time and cost of tillage and crop production etc.);
- Conducting field studies to develop and test alternative systems of group action by farmers for the off-farm management and maintenance of irrigation and drainage systems.

Water Management Coordination

Constraint: The physical limitations of the water conveyance system and the human factors influencing its operation, together with the multiple objectives the system serves -- e.g. power generation and irrigation water supply -- lead to a situation that frequently is not compatible with best on-farm water management strategies.

Water is often delivered at the wrong time or at the wrong flow rate, making good water management impossible on the farm. Conversely, the diversion of a large flow upstream to irrigate quickly and efficiently may interfere with water availability downstream.

Recommendation: Good water management calls for "total" water management with careful and explicit integration of components. This constraint is listed to highlight the importance of coordinated system-planning and coordinated system-operation.

As illustrated by the Egyptian Water Use Project (EWUP), effective management starts with the farm unit in planning and implementing physical system improvements (e.g. raising the *mesqa* and leveling the field) and then advances to larger and larger units. Conscientious planning, together with small-scale experience, will thus lead to identification of many desirable improvements, the implementation of which may require substantial capital investment."

It should be noted that this quote represents primarily the view of the report which is not necessarily a GOE priority.

ITEM C

The 1980 evaluation report contained a recommendation that the Project should be continued. It also contained additional recommendations. Most of these were found to be constructive and where appropriate and adequately translated into the 1981 Project paper amendment. Most of the recommendations were followed to completion. Several were of a detailed and specific nature which aided in giving the staff some helpful direction. The following comments are on the degree of compliance for some of the general recommendations.

The review was critical of the distribution of the reports generated and proposed a mailing list be prepared. This was done and the list is included as Appendix B. An editor was employed and the reports have been edited and printed in a professional and attractive form.

At the time of the review there had been a large number of short term consultants and, to the reviewers, the members seemed excessive. The suggestions was made that consultants be brought to Egypt only when the functions were essential and at the initiative of the Project. Only a few have been

utilized since the 1980 review. The use of many of the consultants prior to that time was justifiable in order to provide senior staff for early training and to provide leadership in initiating the complex program.

The reviewers continued that there was a problem of inadequate and inequitable distribution of incentives to staff members at various levels. As nearly as can be decerned this problem persisted to some extent throughout the duration of the project.

The audit report of 1980 contains the following quotation:

> "It is highly doubtful that the purpose of the Water Use and Management Project will be accomplished as planned and required by the Project Paper and the contract.
>
> The overall project purpose is to develop and demonstrate replicable improved irrigation water management and associated practices that increase agricultural production. Yet, the contractor responsible for implementation of the project has concluded that only the process used to obtain the results of the research can be replicated, but not the actual results of the research. Accordingly, the contractor cannot accomplish the project purpose."

These conclusions are representative of the confusion over the proper interpretation of the project purpose. They give literal interpretation and maximum importance to the purpose as stated in the project logical framework. However, none of the realistic purposes stated or implied in the CID contract and on-going project were addressed. The realistic purpose, focused on a package, consists of methods for identifiying the problems in an area to be impacted and then selecting from a group of approved practices those most satisfactory for the solution of the site specific problems and acceptable to the farmer.

ITEM D

The Water Research Center (WRC) was created in 1975 and in the short ten year span has emerged as an organized unit with eleven research institutes. One of these institutes is the Water Distribution Irrigation Systems Research Institute which was the administrative unit for EWUP. On-farm water management problems were given priority for the first time in Egypt under this program. Before the "water management in Egypt was no man's land1/".

In March of 1984 a National Conference was held in Cairo where the results of the seven year EWUP study were presented in Arabic to approximately 200 members of MOI and others. The English version of the final report was translated to Arabic for distribution at the Conference and members of EWUP staff presented their findings and led discussions.

This conference and previous interactions between EWUP staff and the professionals of MOA and especially the Soil and Water Research Center have generated a trend of thinking giving priority to on-farm water management including the total agronomic, economic and social problems in the package. Our interviews with MOA professionals indicate that they have a very favorable reaction and are supportive of EWUP work and its findings. MOA has revised both research and extension activities to improve the flow of appropriate technology to the farmers. However, it is doubtful that a "critical mass" has been generated and institutionalized in either MOI or MOA up to this point. The current five year plan2/ Budgets show L.E. 21,500,000 for the Water Research Center of which L.E. 4,100,000 is for the Water Distribution and Irrigation Systems Research Institute.

It is interesting to note that seven water management projects are now on-going. Two financed by USAID and five by other donors (see table).

1/ Water Management in Egypt: Past, Present and Future Concepts by M. El-Kady and M. M. El-Kady - Unpublished.

2/ Five year plan for Economic and Social Development 1982/83-1986/87

On-Going Water Management Projects

Name*	Oonor	One of the Objectives
El-Minufiya Project	World Bank - MOA MOI	Water Management
El-Fayoum Project	FAO - M.O.A.	Water Management
El-Dakahliya Proj. (El-Mansoura)	Canada - M.O.I.	Water Management
IMS (RIIP)	USAID - M.O.I.	Water Management
Relation bet. Water Manag. & Drainage	Holland - M.O.I.	Water Management
Water Manag.& Ground Water Utilization in El-Minya & Menufiya	Ford Foundation - M.O.I.	Water Management
Farm Machinery	USAID - M.O.A.	Land Leveling for Water Management

* Reference not official name!

ITEM E

Based on our review of the data available, external factors were not an issue in the direct implementation and outcome of EWUP itself. Studies did not include the effect of crop quotas, fixed prices or other agricultural regulations. They were not given major consideration in the project design, the work plan or the project activities. The cost recovery issue for on-farm irrigation system improvements is also very difficult to assess at this time because the small scale experimental sites did not yield any "hard" economic data for large scale expansion. A cost recovery analysis as well as a real analysis of socio-economic benefits and beneficiaries must also include factors beyond the experimental site or farm level, for example the economic and social value of new lands that water savings might make possible, or the decreased cost of drainage that on-farm water management achieves and the reinvestment of time and energy saved. One study showed a water saving of 3292 m^3 per feddan per year and a general lowering of the water table amounting to nearly 30 cm. Achieved by making water available on demand to the farmer (TR #20). The economic and social implications may be far reaching but were not subject to a detailed analysis. Also not looked at was the legal restrictions on water development and related legal or similar constraints.

The role of the water user groups was studied and is considered to be extremely important in expanding on-farm water management to large areas. The organization of water user groups before or at the time improvements are made will involve them so that they have a feeling of being included in the design for their area and a propriety about the project and be willing to take on operation and management responsibilities vital to making the project work i.e. maintain the *mesqa*, observe regulations concerning delivery and use of water. The strong water users groups, besides enforcing the rules and regulations they formulate for their own groups, present a unified voice to officials managing the larger system. This will provide a necessary feedback to MOI to make it more responsive to the needs of the farmer, a forum that is currently lacking or weak.

ITEM F

The team believes that EWUP has produced considerable potential for long range impacts. In Egypt, as in other countries of the world, both water and land for increased agricultural production must come from the existing resource. Lands now out of production due to short water supply, water logging or salinity can be returned to productivity by applying the appropriate practices to such lands. Water for agricultural expansion of some new lands or for a full supply for lands suffering from water shortages can be partially, if not fully, met by effective and efficient water management. Establishing gravity delivery on appropriate canals of the Nile system for example has been demonstrated to be physically feasible and socially acceptable. When the decision is made to replace lift irrigation by gravity delivery to the farm along with the management package required, it will have long range impacts on GOE expenditures for irrigation infrastructure. It will also impact the farmer by eliminating some of the time and energy required for irrigation. It might also have an adverse effect upon the industry built around the manufacture of *saqias*. Gravity delivery increases the opportunity for water waste if the management package is ignored which could impact water logging but should not be allowed to happen. Management and the strong enforcement that can be enhanced through the influence of organized farm groups (water users' organizations) should eliminate the possibility of water waste. The small and variable flow rates produced by the *saqia* are seldom the most efficient, considering the many variables in surface irrigation applications. An efficient manageable and dependable stream size is considered to be another plus for gravity delivery. This has implications for design and implementation within the IMS project or as a new project designed to explore the advantages of gravity delivery on a much larger scale where the canal levels are at or near the required water surface elevations. The Ibrahimiya area canal has been suggested.

B. Training

One of the primary goals was to "develop and/or train qualified scientists and technicians for the conduct of Project activities." A major achievement has been the assembling of interdisciplinary Egyptian water use research teams which are field oriented and able to work with farmers. They established methodologies for conducting irrigation - agronomic research and transferring the findings to the farmers. There are not enough trained scientists to conduct a large regional project, hence a training component will be required in an expanded program.

The Project provided training opportunities for its staff through a three-point program: (1) developing a special on-farm water management course, (2) sending selected professionals to the United States, and (3) upgrading the English language skills of the Project staff.

A seven-week field-oriented training program was developed which emphasized the two major working principles of the Project: (1) examining on-farm irrigation systems through the research-development process, and (2) working with on-farm irrigation problems in an interdisciplinary manner. The administration of the training program evolved from an American-operated course to an Egyptian managed program over the six years of its development. This course has not only trained all of the EWUP staff, but it also included many officials from both the MOI and MOA who now work throughout the country. In 1983, the administration of On-Farm Water Management Training Program was transferred to the Irrigation Management Systems Project.

Many of the EWUP professionals received advanced technical training in the United States. Two programs were developed for sending personnel to the U.S.A. First, 21 professionals spent one academic year (nine months) at Colorado State University to upgrade their respective academic discipline knowledge. Ten have received advanced degrees from US or Egyptian universities. Twenty-four other individuals enrolled in specific courses at various universities for a period of one to three months. In addition, a total of over

200 have participated in field trips in the U.S. In order for these individuals to study in the U.S.A., many of them had to upgrade their knowledge and ability in English. The Project provided the means for many of the EWUP staff members to enter the AID-sponsored English program. All of the EWUP staff, some technicians and drivers participated. A total of 83 Egyptian staff members received on-the-job practical experience.

C. Possibilities for the Institutionalization of Multidisciplinary Capacity in MOI and for Multidisciplianry Coopertion between MOI & MOA

The MOI has vast responsibilities for management of the nation's water resources, including the granting of permits for the sinking of all agricultural wells other than those using traditional human-or-animal driven lift devices. Considerable discretionary regulatory powers are vested in the hands of the individual irrigation districts which closely parallel but are not synonymous with governorate boundaries (Water Master Plan, Working Paper No. 20). Given such responsibilities, it is doubtful whether on-farm production activities could ever occupy a major part of the Ministry's attention and resources. Thus, major agronomic research or extension on irrigated lands should be performed by the Ministry of Agricutlure.

At the same time, given the scope of MOI's authority over providing a basic resource (water) to the farmer, permanent and well coordinated cooperation between MOI, MOA and the farmer will be required if there is to be increased production in irrigated areas through the introduction of improved water management.

The EWUP project itself did not demonstrate that extensive, sustainable collaboration between MOI and MOA exists. However, water management at the farm level surfaced as a focal point for better cooperation. What actually occurred was that some MOA personnel were detailed to work with MOI in the context of the EWUP project. The collaboration that did

exist during EWUP, such as equipping a major laboratory at the Soil and Water Research Institute, project training of non-MOI personnel and the loan of farm leveling machinery from MOA, does not seem to be continuing (even under IMS). There seems little doubt that both inter-and intra-institutional competition over limited resources is a large part of the problem. When clearly allocated project funds are provided for collaborative tasks, common effort occurs. As soon as outside funding is removed, each Ministry seeks to guard its resources for its own acivities and personnel. The same is true even within Ministries between divisions and professions in matters such as incentive pay or allocation of higher echelon positions. One of the institutionalization of the interdisciplinary approach in the future will be the extent to which a greater mix of technical skills, including agronomy, economy and sociology is reflected in the number and level of permanent staff positions in MOI.

This situation has important implications for future upgrading of irrigation management and irrigated agriculture. It basically says that each Ministry must maintain primary control over resources for activities in its areas of responsibility. Within a properly designed and outside funded project a successful temporary sharing of resources is possible. However, if the intent of the project is to build a permanent institutional capacity to continue such activities, then it probably needs to be assumed that each Ministry must have its own technical resources to do the job and possess the necessary interdisciplinary professionals to achieve their specific responsibilities. Moreover, as a corollary, it can be said that until both MOI and MOA have established within their own organization a minimally adequate number of permanent positions for such interdisciplinary personnel, with equal status and rights (including incentives), it cannot be said that MOI has institionalized an interdisciplinary capacity.

D. Economic Review

The general objective of EWUP as stated in the final report was "To improve the social and economic conditions of Egyptian small farmers through development and use of improved irrigation water management and associated practices which increase agricultural production, promote efficient water use and decrease drainage problems." The final product of the project was to "Provide an action program, tested and proven as to technical applicability, farmer acceptability and organizational replicability, that would be expanded to regional and/or national program." The project purpose as defined above is very broad. The assumption that experiments on a micro level can be automatically translated into a macro plan is economically not valid. It should be admitted that the project is primarily research oriented which means that at this stage and since the project has never looked at on-farm production as a total economic system it is difficult to know with precision the economic benefits and disbenefits accruing to the farmer. However, an attempt will be made to review the economics of EWUP.

Production and Income

EWUP economists state that "Because of differences in the combination of crops grown and a higher crop intensity index, it is not obvious that the more rapid increase in crop productivity per *feddan* during the last two years is associated with the improved irrigation system. (TR # 75, p. ii).

Project's trials show that there is a potential for increase in crop production. However, the main observation is that trials reported increase in production depended primarily on agronomic intervention which was part of the total package and not irrigation practices alone. Economic evaluation of zinc sulphate on wheat at Abyuha shows that both output and farmers' net income can be increased (from 6 ardeb/*feddan* to 15 ardeb/*feddan*) substantially at a fairly low cost (SP # 49). Economic evaluation of corn trials at Abyuha have shown similar results (SP # 10).

Although, efficient water use was intended to be the primary factor behind increase in production, no causal relationship between improved water efficiency and yield was established at the field level. Production economic analysis provides a means to estimate the relative economic contribution of each input in crop production. Yet a water response model still need to be developed to identify the relative contribution of improved irrigation practices. Additionally, at this stage one problem with farm records is that insufficient number of observations are being collected to permit any statistical analyses of economic relationships on farms. The average number of farm records kept through the lifetime of the Project was about 15 for each site.

In general, benefits accruing to the farmer in the form of increased production and income are not well established at the project's level. Yet, the nature of data provided and the scale at which the project has been implmented do not allow for a final assessment of the economic viability of those findings.

Water Savings and Efficiency

While increased farm production is one reason for more efficient water management, water saving and improved efficiency are justifications per se given the increasing demands being made on Egypt's water supply. EWUP activities have shown that substantial water savings and increase in on-farm and water delivery efficiency can be achieved by different irrigation interventions. Improvement of Om-Sen *Mesqa* and Daqalt Canal (in Abu Raya, Kafr El-Sheikh) increased water delivery efficiency from 42.49% to 80%, on-farm efficiency from 58.83% to 73.5% and irrigation efficiency from 25% to 58%. Improvement made possible on-farm water saving of 1695 m^3/*feddan* Assuming annual water requirement/*feddan* is 5000 m^3 realized savings would irrigate 0.339 extra *feddans*. The value of water saved depends on the use to which it is applied and differs from the micro level to the macro. Water saved can be used to reclaim new land, reduce water tables and increase crop production .. etc. In that regard,

a model for water valuation need to be developed so that the value of water saved could be assessed and economic returns calculated. It is also important to examine the possibility of achieving water savings and improving water use efficiency through water charges. In that regard, it should be noted that EWUP has been successful in stimulating some thoughts on the necessity of assessing the value of water and the need for a water charging mechanism to improve the efficiency of the resource use.

Water Productivity

Water savings realized at the three sites meant that water productivity, defined as crop output per unit of water, has increased. Assuming that site crop production has remained constant, the decline in the amount of water used will increase output to water ratio has increased.

However, it was difficult to estimate with precisions water productivity on a field-by-field basis for each of the participating farmers due to difficulties in collecting water data for each field. "The amount of irrigation water applied was measured on a sample of fields. The average amount of water on the sample field as then projected to apply to all fields on which the same crop was grown." (TR # 76 p. 24-28). Output productivity varied from one crop to another over years. For Example, cotton water productivity declined over the 5-year period while that of maize has increased. It is important to note that at this stage the statistical significance of the results is questionable, due to insufficient number of observations and the fact that the sample might not have been "representative". Future activities must concentrate on estimating the impact of improved practices on water productivity on a crop by crop basis.

Equity in Water Distribution

"One of the problems identified by EWUP is that of water shortages at the tail end of some branch canals. EWUP staff

observed that there was substantial water shortages in the summer at the lower end of El-Shemi Canal in El-Mansuriya site." (Economic Costs of Water Shortages Along Branch Canals, TR #5 P.1). El-Mansuriya farmers at the lower ends expected lower yields of maize compared to upper end (6.7 ardeb/*fed.* against 10.6 ardeb/*fed.*). Farmers' reaction to the availability of water will vary. He might leave his land idle, crop yields might be poor, less than optimal crops might be planted to endue water shortage, additional costs might be incurred to supply water..... EWUP reports that farmers suffering most from water shortage will incur up to L.E. 250 output losses per *feddan* per year (Idib, p. 15).

Not all of EWUP interventions seem to have succeeded in achieving the objective of more equitable water distribution. For example, EWUP managed to clean *Mesqa* # 3 with the result that farmers at the tail received on equal and appropriate share of water (TR # 20, p. 14). On the other hand, although the objective of raising *Mesqa* # 10 at El-Mansuriya was to, among other things, provide equal and adequate amounts of water at proper times, poor planning and shortage of water in the main canal meant that the objective has not been realized (TR # 63, p. 47-51).

Future activities must concentrate on determining farmers economic benefits accruing to them from an equitable water distribution. At this stage, actual estimates have not been culculated to assess returns against costs incurred.

Data Collection, Training

A good point of EWUP is data collection. Data collected and analyzed has been an improvement over data previously collected in Egypt. Information gathered provide real insight to activities on the farms and to the actual operating conditions of the irrigation system. The fact that EWUP has been operating at the micro level is considered a substantial advance for Egypt. Farm records and surveys provide a framework for data collection. Future activities ought to build up on EWUP's model giving more emphasis to the improvement in the quality of data collected. Additionally, it is important to emphasize the importance of developing techniques for the analysis of data collected.

Training of economists has been a positive experience for all participants. Future training could be enhanced by more field oriented problem solving exercises. Analytical capabilities should be enhanced and less emphasis ought to be given to academic and theortical training.

Cost Reductions

EWUP activities show that there are potentials for cost reduction particularly in labor and time required for operation and maintenance processes. On the other hand, for example, economic analysis of *Mesqa* # 26, at Abyuha, which was elevated and served by "a single point pumping station" show that supply of water was adequate and farmers were able to irrigate by gravity with no difficulty. Additionally, farmers have benefited from reduced labor costs. The value of labor saved in irrigation and maintenance due to *mesqa* improvement is of the magnitude L.E. 2600/yr. based on EWUP calculations of the value of labor. (L.E. 2.5/laborer/day). Cost analysis of canal lining have shown potential reductions in maintenance opertional and management costs. Savings vary according to the size of the canal and type of lining. On the other hand, analysis of *Mesqa* # 10 at Beni Magdul, which was converted to a lined elevated *mesqa* served by "a single point pump," show that farmers have not yet gotten major benefits out of it. Although pre-feasibility analysis estimated labor savings in both irrigation and maintenance operation. Farm records show that no actual savings have been achieved (TR # 63, P. 49).

It is important to note that although, a decrease in the extremely burdensome labor requirements of traditional agricutlure is considered a significant social benefit per se, it is difficult at this stage to assess the macro benefit accruing from time and labor savings. Additionally, the net cost profile both on small and large scales should be assessed and measured against potential returns. Attention should be given to the impact that poor planning might have on costs which could limit potentials for net cost savings and reduce benefits accuring to the farmer. (e.g. El-Hammami pipeline & *Mesqa* # 10).

Cost-Recovery

EWUP has tested alternative means to improve the design and management of water delivery systems and on-farm water practices. EWUP irrigation interventions include lining canals, elevating *mesqas*, and constructing buried pipelines. (Precision land leveling is the primary on-farm intervention.) "The total annual cost (1983) for 2,500 meters of size 1 channel varied from L.E. 1.05/m^2 for bricks with concrete lining to L.E. 4.44/m^2 for rubber lining. For size 2 total annual costs for 10,000 meters of channels varied from L.E. 0.93/m^2 for cast in place concrete to L.kE. 3.53/m^2 for rubber lining. For size 3 total annual cost for 5,000 meters of channel varied from L.E. 1.02/m^2 for soil cement to L.E. 3.41/m^2 for rubber membrane (TR # 56). The cost of elevating and improving *Mesqa* 10 stood at L.E. 12932 to serve 54 *feddans* while that for *Mesqa #* 26 stood at L.E. 5500 to serve 40 *feddans*. The highest cost incurred was for the construction of El-Hammami pipeline which absorbed L.E. 1 million.

The project has not developed a mechanism for cost recovery for on-farm irrigation system improvements. Apart from one technical report "Allocative Efficiency and Equity of Alternative Methods of Charging for Irrigation Water; A Case study of Egypt", by R. Bowen & R.A. Young," EWUP has not engaged nor pursued studies on water pricing (and cost recovery). However, it is worth mentioning that the project's findings were important inputs to studies undertaken by other agencies. For example, the supreme council of universities engaged in a study on "Design and Management of Irrigation - Drainage Systems in Egypt" which include reports on water pricing. Additionally, one of EWUP economists has completed his M.A. Dissertation on Water Pricing.

In that regard, it is important to note that the burden of changing a policy that has been in effect for years cannot fall on a single project particularly with the recognized difficulty in old lands. The development of water users association can become an instrumental vehicle for cost recovery. In fact EWUP staff reports that under WUA farmers were

willing to cooperate, to maintain and to operate the new facility particulary in El-Hammami a vegetable growing area where farmers are not subject to direct price controls.

Future activities must concentrate on exploring the possibility of setting water charges to improve the efficiency of resource use and permit cost-recovery of improved irrigation system particularly in new lands where metering of water is both feasible and desirable.

Replicability

Internal Factors

The final product of EWUP was to "Provide an action program, tested and proven as to technical applicability, farmer acceptability and organizational replicability, that would be expanded to regional and/or national program." Unfortunately, the project's economists were unable to concentrate on the objective of replicating the findings on basic or sound economic analysis. According to George Radosevich, a TDY economist, "The project has concentrated heavily upon the technical and social design of improved practices." (Internal memo, June 1983). More attention should have been directed to the design and formulation of a program for economic replication of the project's findings. EWUP economists should have put themselves in the greater political picture and studied the foreseable implications of a potential replication of the findings. J. R. McConnen, a TDY economist, notes that "An educational effort internal to the project on policy issues needed to be developed."

Additionally, it would have been extremely beneficial if financial analysis was supplemented by economic analysis. For instance, an obvious and fairly easy task to do was to analyze the impact of a hypothetical governmental program to increase prices of agricultural output and inputs up to their economic level. For example, the impact of abolishing energy subsides on present irrigation by lift practice. Some of

the staff papers started to pursue that line, yet the practice was neither continued nor incorporated into the project's technical reports. R. J. McConnen notes that "A dissatisfaction is associated with the fact that there are so many worthwhile things that were not started and too many that received too little attention."

Future attention should be directed to the development of comparative cost effectiveness of different packages. The cost and benefit structure of larger scale implementation of the project's findings, so that it can be undertaken at a regional/national level, should also be assessed.

External Factors

Egyptian agricultural sector has been subjected to different socio-economic policies in the last three decades. Small farmers are subjected to pricing and marketing policies which limited their financial capacity and ability to accumulate reserves. Net income transfer from the Egyptian farmer to other sectors of the economy stimated by W. Cuhiby stood at L.E. 1.2 billion. The Egyptian government exercise control over the farmer through:

1. Assessment of crop production area and marketing quotas.

2. Establishment of fixed prices for the main crops. (Mohamed Haider, "The Impact of Egyptian Agricultural Policies On-farm Income and Resource Use").

EWUP goals were to improve the conditions of the Egyptian farmer through improving on-farm water use efficiency. Farmers' ability and willingness to adopt new and perhaps costly technology is a function of the economic and institutional constraints under which they operate. Small farmers in areas subject to fixed prices, procurement quotas and imposed crop rotations suffer from an artificial depression in their income which limits their capability to acquire new techniques. To adopt improved technologies, the farmer

requires short term and long term capital outlays, current policies limit the ability of the small farmer to accumulate reserves required for investments. Therefore, any large scale project should be supported by an efficient credit system.

Technical adoption of new practices is also limited by factors beyond farmers' control. The Egyptian farmer will adopt practices which are financially attainable, however, the availability and supply of a new technology may be beyond his control. For instance, "land leveling was seen as extremely beneficial by the farmers. They stated that they would continue the practice if the equipment were available" in fact EWUP staff reports shortages of equipment. They also report that "the introduction of new agronomic inputs was made more difficult because many of these items were unavailable at the cooperative." This raises the question of the role and efficiency of the current extension program which, if operating optimally, provide the farmer with necessary technical information on new practices. If extension work is weak, adoption and dissemination of EWUP techniques is questionable. Farmers are believed to maximize their return within existing constraints.

From a macro perspective, one has also to question the priority which the government attaches to on-farm water management programs. Irrigation programs, which receives about 4% of total investments in the current five-year plan, concentrate on rehabilitation, completion and expansion in the main delivery system. However, there are people who believe that EWUP will have a say in changing government irrigation priorities in favor of on-farm water management packages. Yet it all depends on government action to provide incentives to embrace the required changes.

E. Water User Associations

Outputs

Project activities surrounding the organization and use of irrigation or water user associations (WUAs) represents perhaps the single most important aspect of EWUP's sociological interventions and reflects, simultaneously, one of the project's most promising innovations and yet unfilled opportunity. To understand the full implications of such associations to better irrigation management they must be seen in both their worldwide and Egypt specific contexts.

It should be understood that water user associations are as integral a part of multiple user irrigation systems as lift devices and flow gates. Any technology that requires cooperation implicitly demands that people organize to exploit it. What varies worldwide is the nature of such organizations, which ranges from highly opportunistic informal arrangements to rigid mandatory associations. This variation is largely determined by the existing technical, socio-political and economic constraints.

The history of the EWUP Project attests to the above. The project began with numerous expressions of the lack of cooperative associations among farmers. For example, Staff Paper # 1, p.4, states that "the lack of social organization among farmers, formal or voluntary, causes communication problems and does not promote cooperation among the farmers with respect to water use." In contrast, by the end of EWUP, it had been recognized that not only are there traditional farm organizations that control shared access to and use of the *saqia* but that these were of direct relevance to project activities. (e.g. Draft Working Paper #98, Beni Magdul Canal, notes that "the organization [of water users] had as its foundation the eight *saqia* sites from which eight outlets from the new *mesqa* would be constructed.") (The best description of these associations is in the ACU/SRP report for the Ford Foundation to which EWUP findings contributed.)

What EWUP really demonstrated is not that farmers need a project to organize themselves for themselves so much as needing it to organize themselves in order to interface with MOI representatives. The Project accomplished this by establishing, largely through the efforts of the sociological teams, water users' association and councils which met with EWUP personnel, (again mainly the sociologists) to established on-site procedures to regulate the distribution of water among farmers along project improved canals (*mesqas*). As such, EWUP has demonstrated that such associations can be formed and are a valuable, and probably crucial, mechanism to better water management. EWUP has also demonstrated (as supported by worldwide experience) that the way to organize such association is around the demands of a new technology crucial to their farming operations. Such are the notable successes to date.

What EWUP has not done, however, is create a completely replicable process for the organization of local water user associations and their interface with MOI for extension to an entire region or the nation. The present model is not immediately applicable for several reasons. First, it is based on the input of quantities of concentrated efforts by trained personnel that would reach astronomical numbers if required for all future activites. Second, there still exists limited willingness on the part of many engineering and agronomic technicians to share decisions with farmers. The willingness of EWUP technicians to restrict their own decision making prerogatives was only developed over time and within the context of this very special project; third, as constituted, the associations still do not directly speak to those who control the water (the engineers), but largely depend on the guardianship, goodwill and often personal sacrifice of EWUP sociological team members to act as intermediaries for them.

These problems are recognized in several internal EWUP documents. For example, F. Santopolo's memo 7/28/82 notes: "Two major questions need to be answered concerning farmer organizations. One concerns the legal structure of these organizations ..... Without some legal recognition these

organizations will not be functional." George Radosevich, a recognized expert on water user associations and a consultant to EWUP, summed up the situation (memo 11/17/82) as follows: "With irrigation, the sheer numbers of water users is too great for one-on-one contact between the governmental agency and irrigators; some organizational structure needs to be established in which the program components can be allocated and channels of communication, cooperation and coordination set." (p.3). Dr. Radosevich goes on to describe various experiences in Sri Lanka, the Philippines and India on how official-legal definition has been given to such associations and the nature of their role vis-a-vis their respective Ministries of Agriculture and Irrigation.

TR # 65 provides very good information on the structuring of such associations and TR # 66 deals with the question of water user associations but largely from a theoretical perspective that focuses on the internal dynamics of such organizations. As with much of the Project's findings, however, a leap is made from Project specific experiences to general theorems leaving behind a question as to what precisely is the next necesary operational step to convert successful pilot activities to a viable regional or national program. TR # 66 does present a definite proposal for an Irrigation Advisory Service in MOI but such an outreach service from MOI, though perhaps warranted, is not the same as a new official role for the water users themselves in MOI structure as would be the case with official WUA's.

A variety of explanations have been provided as to why this is the case as specifically regards officially operationalizing water user associations. One is that the success of the informal process demonstrates that it suffices without an official legal/administrative structure. Another is that such associations will arise on their own as people see the advantages gained; a third is the fear of raising premature and unfulfillable expectations; a fourth is that formal organizations would lead to undesirable politicization of the associations. In addition to these expressed beliefs, apparently present are several underlying factors such as a general negative attitude to the legal process, (seeing it as more a mechanism to raise conflicts than to settle them);

a disinclination to nationally politicize the question by seeking a law that might involve other high authorities; and the desire to keep the process under the control of MOI technicians and not create a new forum which might become a troublesome source of pressure on MOI performance. [In regards to this, it should be noted that MOI already has very extensive regulatory powers for water management. The need for official definition of the role of WUAs is to insure that local MOI agents use their powers in positive collaboration with the on-farm water users.]

While the matter remains debatable, EWUP findings and experience itself would seem to support the opinions of its internal suggestions rather than its official position. The tremendous and admirable effort made by the Project's sociological team to organize the water users is attestation of the high costs of this methodology. The continued need for the mediation of the sociological team shows that the informal organizations are not yet permanent self-sustainable institutions vis-a-vis MOI. Analysis of project activities, (such as the differences of opinions between MOI technicians and farmers over responsibility for the fact that during the summer insufficient water reaches *Mesqa* #10), indicates that while most technicians are willing to use the sociolo-gists and the WUAs to help convince the farmer of his responsibilities, few tehnicians are prepared to informally or voluntarily accept ta legitimate role of WUAs as a mechanism for feedback regarding their own responsibilities.

While concern for politicization of WUAs is certainly justified, EWUP's own surveys show that those people most respected among the farmers are not those most influential and powerful in the present political/cooperative structure. To organize the WUA's in an equitable fashion is a challenge but as EWUP has demonstrated, it can be done. In contrast, if MOI does not formalize a process to assure this, the spontaneous informal WUA organizations that spring up when people see benefits to be gained will most likely, really become troublesome pressure groups who will vie against each other based on local political influence rather than actual

needs. (Moreover, if one waits for such groups to informally organize in response to improvements rather than as an official pre-requisite, there will be a much greater probability that they will see continued operation and maintenance also as the governments job, and their job as pressuring the MOI to do so). Lastly, EWUP's success with organizing WUAs and integrating them into its operations in its pilot areas demonstrates that MOI can create and integrate WUAs within its own structure if it wishes.

For example, MOI could create a specific division of water user associations, which, following ministerial guidelines, would officially organize and register WUAs in conjunction with the upgrading of areas to new technological and managerial practices. Official recognition would include the application of new procedures that clearly define the rights and obligations of both the water users and the local MOI officials vis-a-vis each other. Under such a schemata, the job of the WUA division sociologists would be to prepare both the WUAs and local MOI technicians for their new roles vis-a-vis each other. The ultimate goal would be to establish a direct working relation between WUAs and engineers, with sociologists incorporating themselves into the system only on special occasions such as for original organization, training, evaluation or social problem resolution.

While suggestions can be made, the actual resolution of the status of WUAs in a new system of water management remains an open question. However, it is a question that should be specifically dealt with and resolved before one can say replicable systems for improved integrated water system management have actually been developed.

F. Gravity Delivery

One activity observed by the team at El-Minya and also at Abu Raya was the upgrading of the *mesqa* to provide gravity flow along with other associated water management and cultural practices. It appears that the possibility of receiving the right amount of water by gravity was sufficient inducement for the farmers to agree to organize for

proper maintenance of the *mesqa* and adopt water delivery schedules. EWUP engineers were to insure water management and guarantee water delivery to the farm in the right amount at the right time and the right place (the high point of his field). With this inducement (gravity) the farmers were also willing to try, and also accept, other recommended practices in the water management package such as land leveling, longer irrigation furrows, plant populations, pest control, fertilizers and improved varieties.

The lift irrigation system now practiced in Egypt is seen as a substitute for controlled water management at the farm level. It works because water on the farm is not received without a considerable expenditure of energy on the part of the farmer. Moreover, there is a major capital cost involved. We have seen estimates that from 400000 to 500000 *saqias* are now in daily use on the farm *mesqas* of Egypt and that the cost averages L.E. 500 per *saqia* installed totaling L.E. 200,000,000 to 250,000,000. If the replacement of these irrigation structures (*saqias*) were included in the SR project, the annual requirement would be L.E. 13,000,000 to 17,000,000 based on a 15 year average life. It should be noted that many farmers are now substituting diesel pumps for *saqias* with the associated costs.

The EWUP research at the sites visited by the team substantiates the fact that good management of a gravity system can replace the "lift system" and the *saqia* and actually save water and assure equity between water users at the same time. With confidence in the reliability of the water supply and the appreciation for savings in time and energy the farmers can and will organize to control the water according to carefully made schedules, clean and operate the *mesqa* to prevent water losses and observe other water saving practices made possible by the scientific operations of the on-farm system.

The new dimension of gravity irrigation is seen as a betterment program that should be carefully considered and integrated with the SR program within the IMS project wherever possible. To simply replace a major structure with

a like structure at the same level and same place may produce a foregone opportunity for gravity delivery to the farm. Whereas, minor changes in design or location would make gravity delivery along with its associated advantages and water saving a viable opportunity. Often minor changes in the operating levels of the delivery canals will make gravity delivery possible, as with lateral 26 at El-Minya. Of course, changing to a gravity delivery program must be coupled with the organization of the farmers to insure that the tight control of water management at the farm level is achieved.

G. *Mesqa* 10, Beni Magdul Canal

Draft Working Paper No. 98, entitled (Summary of the Farmers' Organization and On-Farm Water Management Data for *Mesqa* 10, Beni Magdul Canal, Mansuriya District, Egypt), By A. Tahoun, Farouk Abdel Al and W. S. Braunworth is a very well written, well thought out and pertinent document. If it were put together with information in other EWUP documentation and yet unwritten team experience on *Mesqa* # 10, it would be a most valuable case study of the conditions, promises and problems that can be encountered in the upgrading of *mesqas*.

As understood, the problems surrounding *Mesqa* 10 involved a combination of factors including poor initial planning, and inadequate consideration of the entire water delivery system, including supportive services such as electricity to run the pump. As a result, project completion was delayed and, in fact has still not been completed, and during the summer months, adequate water still does not always reach the *mesqa*. These problems have apparently been a source of extensive dialogue between project technicians and the local water users association. At one point, the WUA apparently paid to clean out the canal area leading to the *mesqa* (normally a government responsibility) because (as did not prove the case) this was thought to be the explanation for the insufficient flow. In fact, present problem seemingly stems from insufficient flow into the Beni Magdul canal itself. All in all, project experience on *Mesqa* # 10

demonstrates the complex nature of upgrading water delivery to the farmer and the need for both an initial systemic approach and on-going readjustments and fine tuning of engineering and operational design.

Work is still going on to resolve the problems and people are waiting for a successful ending. While a successful final resolution is to be hoped for, in experimentation as much is learned from initial failures as from final success. Moreover, as regards the value of WUA's, many people who appreicate them as ways of avoiding problems fail to appreicate them as mechanisms of addressing and arbitrating problems, which are inherent in any water management system. In this sense, the process of dialogue and response that has occurred between technicians and users around *Mesqa #* 10 is itself a project success.

It is highly recommended that DWP No. 98 be updated and made an official technical report so that the valuable lesson learned while working on *Mesqa #* 10 can be saved.

APPENDIX A

Scope of Work

A. Document achievements at the project's purpose level (as defined in the PP amendment). (To What extent has this project contributed to the research, development and demonstration of replicable water management practices? To what extent could the water management practices developed contribute to the efficiency of the Egyptian irrigation system, agricultural yields, and production? What are the "institutional" effects of the project, i.e., will the water research center be a self-sustaining, permanent and productive institution? Is it/will it be integrated into the broader work of the MOI)?

B. Assess the replicability of the project's efforts. (Are the results of research, development and demonstration cost effective on a regional/national scale? Are they culturally acceptable? What are the implications of the project's research for agricultural production and productivity in on/coordinated with the WRC's work?)

C. Document the changes in project implementation since the 1980 project evaluation. (Were the recommendations made in 1980 necessary and sufficient to improve project performance? Were the recommendations translated adequately into the 1981 PP amendment? Have the recommendations been carried out appropriately? If so, how has this affected achievement of the project purpose as discussed in No. 1 above? If recommendations have not been implemented, why not? And how has it affected project progress?)

D. Comment on the work (both to date and future) of the WRC vis-a-vis that of other agriculture-related research institutions (e.g., the Water Distribution Research Institute, the Agriculture Research Institute, the Soil and Water Research Institute) and of other donor activities in Egypt. What will the impact be on training, employment, and staffing as a result of the integration of the Water Research Center with the Irrigation Management Systems project? As crop management is an

essential element in realizing the benefits of on-farm irrigation system improvements, how has the Ministry of Agriculture (MOA) reacted to EWUP findings? Is the MOA prepared to mount actions in crop management that are supportive of EWUP findings?

E. If/where appropriate, comment on the relevant external factors potentially affecting the achievement of this project's objectives. (For example, is replicability affected by crop quotas, fixed prices or other agricultural regulations that inhibit national distribution of agricultural resources?) What experience was gained on cost recovery for on-farm irrigation system improvements and what lessons can be learned for future programming efforts? Discuss the role of water user groups as potential vehicles for implementing a cost recovery program. Review project studies and data collection activities for information pertinent to the cost recovery issue.

F. Within the time available, consider the potential long-range impacts of the project, e.g., on GOE expenditures for irrigation infrastructure (tile drainage, etc.) on cropping patterns and intensities, on soil quality and quantity (water logging, salinity, reclamation,) on farmer income, and on rural spread effects (e.g., local manufacture of pumps). Are flow rates a constraint to on-farm irrigation improvements and, if so, what are the implications for design and implementation of the Regional Irrigation Improvement Program?

APPENDIX B

Technical Report Distribution

	No. of copies
1. Ministry of Irrigation	
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9.	Engineering Research Center, CSU	6
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14.	FAO Rome	3
15.	For distribution upon request: (Cairo, 22 El-Galaa St., Bulaq)	100
	Ft. Collins, Colorado, USA	100

APPENDIX C

List of EWUP Technical Reports and Manuals

TR 1. "Problem Identification Report for Mansuriya Study Area, October 1977 to October 1978," Egyptian & American Field Team. EWUP, 1979.

TR 2. "Preliminary Soil Survey Report for the Beni Magdul and El-Hammami Areas," A. D. Dotzenko, M. Zanati, A. A. Selim & A. M. Keleg. EWUP, 1979.

TR 3. "Preliminary Evaluation of Mansuriya Canal System, Giza Governorate, Egypt," Egyptian & American Field Team. EWUP, 1979.

TR 4. "On-farm Irrigation Practices in Mansuriya District, Egypt," M. El-Kady, W. Clyma & M. Abu-Zeid. EWUP, 1979.

TR 5. "Economic Costs of Water Shortages Along Branch Canals," S. A. El-Shinnawi, M. Skold & M. L. Nasr. EWUP, 1980.

TR 6. "Problem Identification Report for Kafr El-Sheikh Study Area," Egyptian & American Field Team. EWUP, 1980.

TR 7. "A Procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt," H. Wahby, G. Quenemoen & M. Helal. EWUP, 1981.

TR 8. "Farm Record Summary and Analysis for Study Cases at Abu Raya and Mansuriya Sites, 1978/1979," F. Abdel Al & M. Skold. EWUP, 1981.

TR 9. "Irrigation and Production of Rice in Abu Raya, Kafr El-Sheikh Governorate," Kafr El-Sheikh Team as Compiled by T. W. Ley & R. L. Tinsley. EWUP, 1983.

TR 10. "Soil Fertility Survey of Kafr El-Sheikh, El-Mansuriya and El-Minya Sites," M. Zanati, P. N. Soltanpour, A. T. A. Moustafa & A. Keleg. EWUP, 1982.

TR = Technical Report

TR 11. "Kafr El-Sheikh Farm Management Survey, Crop Enterprise Budgets and Profitability Analysis," M. Haider & F. Abdel Al. EWUP, 1982.

TR 12. "Feasibility Studies and Evaluation of Irrigation Projects: Procedures for Analysing Alternative Water Distribution System in Egypt," R. J. McConnen, F. Abdel Al, M. Skold, G. Ayad & E. Sorial. EWUP, 1982.

TR 13. "The Role of Rural Sociologists in an Interdisciplinary Action-Oriented Project: An Egyptian Case Study," J. Layton & M. S. Sallam. EWUP, 1982.

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Note: *M= Manual, M 4, 6, 7 are cancelled.

*In addition to the TR and Manual there were 115 Staff Reports and Draft Working Papers.

APPENDIX D

Recommendations From EWUP Final Report

EWUP has worked to improve several important components of agricultural production, giving special attention to water delivery and on-farm water management. Recommendations have been developed based on this experience. Implementation of these recommendations can strengthen and build the various components so they will make appropriate contribution to future agricultural production.

The following recommendations have grown out of six years of EWUP's experience and research. They are not listed in order of priority, recognizing that each can make an important contribution to improving the nation's system of irrigated agriculture. The recommendations are grouped into categories.

Research Process

1. Each water delivery system has site-specific problems and opportunities which should be subjected to appraisal, feasibility analysis and planning before implementing any remedial measures. This should be carried out by a trained interdisciplinary irrigation improvement team of engineers, sociologists, agronomists and economists.

   Various interventions for improving water delivery systems have been planned and tested at Project sites. Determining the interventions most appropriate for a given site is a complex process requiring a broad system approach. A system renovation scheme that is very beneficial at one site may be less effective when transferred to another. Many physical and socio-economic factors must be considered in the analysis.

   A systematic set of procedures has been developed by the Project to provide guidance to professionals responsible for developing plans for water delivery system renovation. These procedures can facilitate design and evaluate alternative plans for system improvement at the

distributary canal system level. Several computer Programs were developed as tools to expedite the implementation of the procedures. These procedures should be applied by interdisciplinary teams working throughout Egypt.

2. Although adequate knowledge is available now to begin a National Irrigation Improvement Program, the future viability of such a program will require adequately funded applied research. It will be necessary to monitor and evaluate on-going programs and develop solutions to new problems as they arise. For example, research is needed to determine the quantity of water supplied to meet crop demands under high water table conditions and potential salinity problems. The impacts of irrigation improvements are complex, continued research is important and improvement alternatives are numerous. Socially responsible analyses, under such circumstances, require an on-going program of in-service training for research personnel. The present EWUP organization serves as a model.

3. Continued training of irrigation improvement teams should include project management, team-building and integrated planning as well as technical subject matter. Training should be given very high priority.

Irrigation Parameters

4. Package programs, including improvement of the water delivery system, on-farm water management and associated agronomic practices are essential and should be encouraged. EWUP experience indicates that farmers are enthusiastic about such approaches because they improve irrigation, save labor, increase yields, accomodate mechanization and generate higher net incomes.

5. The development and maintenance of proper drainage systems should continue where it is desired to lower the water table. At EWUP field sites, it has been learned that very little vertical drainage occurs from the water table aquifer. It is not practical with the traditional

surface irrigation methods to achieve high enough irrigation efficiencies to avoid contributing to the water table. Consequently, good irrigation management alone cannot be expected to eliminate excessively high water tables.

6. Water allocations should be based on the total needs of the farming system. Water demand diminishes during the time between shifts to different crops and it increases at special times, such as for the first irrigation after harvest and when rice paddy-land is puddled. EWUP experience has demonstrated opportunities for saving substantial quantities of water by coordinating delivery with the total farming system needs.

7. The water table contribution to consumptive use should be considered when determining the amount of water to allocate to delivery canals. Smaller allocations would save water and reduce the pressure on drains. Although this issue is complex and needs further study, EWUP experience indicates that the water table makes a significant contribution to consumptive use.

8. Well managed, gravity water delivery systems should be encouraged at the distributary canal and *mesqa* level. EWUP has demonstrated that farmers can manage such systems without wasting water. The saving in energy and farm labor is significant. This development should proceed slowly in areas where upstream head is adequate to serve the distributary canals and *mesqas*. Farmers must be involved to ensure that gravity systems are well maintained and managed.

9. Conjunctive use of water from canals and drains should be given consideration in the future development of the nation's irrigation system. EWUP studies indicate that water from drains at field sites is of adequate quality, at certain times of the year, to extend irrigation opportunities when mixed with canal water. This alternative should be studied in each water delivery system selected for improvement.

10. Precision land leveling and appropriately designed long level furrow and basin irrigation should be encouraged in order to increase irrigation efficiency, save irrigation time and labor, and accommodate increased agricultural mechanization. Controlled application of water, under such methods of irrigation, requires proper balancing of advance and recession times with an appropriate rate of flow onto the land. This balance must consider field slopes and soil infiltration characteristics. As in all irrigated areas of the world, farmers in Egypt need technical help to effectively achieve this balance.

Farmer Involvement

11. Farmers should be involved whenever any proposed water delivery system improvement is considered. The legitimacy of such improvements must be established with local farmers to help ensure efficient operation, routine maintenance, and long life.

12. Farmers should be encouraged to become involved in the management of water delivery at the *mesqa* level. This will require active professional assistance to help farmers organize and to help MOI officials identify leaders and utilize these valuable resources. Farmer involvement is necessary for efficient PLL, distributary canal and *mesqa* renovation, water scheduling, *mesqa* maintenance and implementing recommended changes to long level basin or furrow irrigation.

Management

13. Contractors, who are expected to implement improvements of water delivery systems, should be provided training. EWUP has experienced repeated failures on the part of contractors to assemble necessary resources, follow specifications and complete work according to schedule. Improvement of contractor capability is vital to programs on national irrigation improvement.

14. Consideration should be given to modifying the present rules regarding the specified turnout sizes at the heads of *mesqas*. This is a complex issue. As a general rule, the specified turnout sizes deliver an adequate total amount of water if irrigation is practiced 24 hours per day. One problem is that most farmers irrigate during daylight hours only. This overtaxes the capacity of the delivery system during daylight hours and many farmers are unable to consistently get sufficiently large stream flow rates to achieve high water application efficiency. Unless night irrigation is enforced, it may be better to use larger turnouts with turnout control gates and a system of delivery scheduling. However, implementation would require coordination with or modification of water rotation schedules.

15. An irrigation advisory service should be established. EWUP experience has shown that farmers will adopt new irrigation technology. This could save water. It could also help coordinate water delivery with the actual needs of crops which would increase crop production.

16. Cooperation and planning among agencies and authorities concerned with cropping sequences should take place on a timely basis to match crop water needs with water deliveries. Water scheduling for Egyptian agriculture originates at the High Aswan Dam and cannot be altered without allowing for time lags. It is therefore necessary that agricultural and irrigation systems should be carefully coordinated for efficient use of water in achieving high levels of production.

Agronomic and Structural Changes

17. Crop management and soil technology should be emphasized in order to maximize returns from irrigation improvement programs. Soil surveys permit mapping of soil types which have special irrigation requirements and limitations. Soil fertility improvement will permit better crop management and higher returns.

18. Cost studies indicate that cast-in-place concrete lining, for all potential canal sizes, has a lower annual cost than other forms of lining. However, other lining types should be considered where rigid-boundary canal linings are not physically or economically justified due to special conditions. For example, areas with highly expansive clays may prove to be too unstable, thereby causing rapid deterioration of rigid-boundary linings.

19. Gates, calibrated for water measurement, should be installed and carefully regulated at the head of distributary canals. It has been clearly demonstrated at Beni Magdul canal that this permits regulation of water according to crop needs and the irrigation practices of farmers, thereby saving water.

20. The relocation and construction of farm roads should be considered at the time water delivery systems are improved and modified. Where it is possible to close *mesqas* they can be replaced with roads if farmers agree. Farm roads are popular with farmers because roads improve marketing efficiency and access for machines.

21. Given the present plans to mechanize agriculture in Egypt, action should be taken to further introduce long furrow and long basin systems of on-farm irrigation. This will require precision land leveling. Attention must be given to the development of appropriate technology for precision land leveling which is compatable with small holdings and limited periods of fallow land. Also, training is needed for technicians and machine operators and capital is needed to finance machines and equipment.

22. Adequate sized inlets (vents) to *mesqas* should be installed in areas where mechanization with long furrow and long basin irrigation will be introduced. This is due to the fact that flow rates from existing designed vents are often too small to permit practical scheduling and efficient application for long furrow and long basin irrigation.

23. Single-point lift systems should be considered, especially for areas with reliable sources of water. Farmers along a *mesqa* can join together to lift from one point at the head of a *mesqa* with an appropriate pump size. Lifting water with *tambours*, *saqias* and small pumps is expensive and wastes labor and energy. Single-point lift systems on *mesqas* can conserve these valuable resources and at the same time contribute to strengthening social ties among farmers.

Training

24. Training for MOI professionals, technicians, and farmers, should be provided in water management, soil-water-plant relationships, water control, water measurement, on-farm irrigation methods, interpersonal relations and communications, PLL, water scheduling, crop management practices, construction management, computer-assisted design and record keeping. This training could be provided by special short courses, on-the-job training, demonstrations, academic courses and field days.

APPENDIX E

List of Agencies and Key Individuals Interviewed

1) EWUP/WRC Central Staff

Dr. Mahmoud Abu Zeid	Chairman, WRC
Dr. Hassan Wahby	EWUP Director
Dr. Mona El-Kady	EWUP Deputy Director
Dr. Ahmed Taher	Agronomist (Disc. Leader)
Mohamed Naguib	Sociologist (Disc. Leader)
Farouk Abdel Al	Economist (Disc. Leader)
Gamal Ayad	Economist
Lotfy Nasr	Economist

2) EWUP Mansuriya Team

Wadie Fahim	Team Leader
Samir Ibrahim	Engineer
Ahmed Tahoun	Agronomist
Ahmed Talaat	Agronomist
Farouk Abdel Al	Sociolgist
Sohair Kamal	Sociolgist
Tarif Zeiton	Engineer
Gamal Fawzy	Economist
Hossam El-Naggar	Economist

3) EWUP Kafr El-Sheikh Team

Abdel Fattah Metawie	Engineer (Acting Team Leader)
Saad Hussien Zaki	Engineer
Ahmed Ismail	Agronomist
Ragy Darwish	Economist
Magdy Badawi	Economist
Essam Ezz El-Din	Sociologist

4) EWUP Minya Team

Esmat Wafik	Team Leader
Elia Sorial	Economist
Ahmed Abdel Naim	Engineer
Abdalla Saber	Sociologist
Mohamed Awad	Agronomist

4) Other MOI & MOA Personnel

Artin Hanna	Undersecretary MOI, Minya
Abdel Raouf Abu El-Nour	General Director of Irrigation, Dept. for West Minya
Fares	General Director of Irrigation, East Minya
Abdel Raouf El-Salahi	Head of RIIP, Minya
Dr. Zidry	MOI/Soil & Water Research Inst.
Mohamed Sallam	MOI/Sociology & Extension Inst.
Sarwat Fahmy	Senior Undersecretary of State for MOI and Supervisor of Water Master Plan

APPENDIX F

Appreviations

EOPS - End of Project Status
EWUP - Egypt Water Use & Management Project
GOE - Government of Egypt
MOA - Ministry of Agriculture
MOI - Ministry of Irrigation
WRC - Water Research Center
PLL - Precision Land Leveling
PP - Project Paper
PID - Project Identification Document
SP - Staff Paper
SR - Structure Replacement
TR - Technical Report
M - Manual

Arabic Terms

Marwa Farm ditch within the farmer's property

Mesqa Watercourse (a lateral supplying water from the last MOI-maintained canal to a group of farmers

Saqia Water wheel

Tambour Archimedes' screw