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FINAL ADMINISTRATIVE REPORT

EGYPT WATER USE AND MANAGEMENT PROJECT

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TO:

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ABSTRACT

The following report summarizes the objectives and accomplishments of the Egypt Water Use and Management Project during the period of its operation, 1977 to 1984. The project was instigated in 1977 through action of the Egyptian Government's Ministry of Irrigation, its Ministry of Agriculture and the United States Agency for International Development. Operation of the Project was conducted by the Consortium for International Development with Colorado State University as the lead university.

The primary objective of the project was to increase the overall social and economic well-being of the small farmer farming the old alluvial lands within the Nile River Valley and Delta within Egypt. This objective was to be met through the development of an applied program of increased water use and management efficiency that would lead to increases in agricultural yields. The objective was approached through the initiation of surveys to identify problems at the farm level pertaining to the water application, delivery and drainage systems and related agronomic, social and economic conditions. Following this diagnostic analysis phase, solution alternatives were developed and field tested regarding their technical and economic feasibility, and potential acceptance by both farmers and government. The third phase of the project's objectives was the establishment of project trials to verify the utility and acceptance of the most feasible solution alternatives identified in the previous phase. Those solutions which demonstrated success in field trials were then collated into a program applicable to either regional or national projects.

An additional objective of the project was the development and training of Egyptian scientists and technicians to conduct and sustain on-farm water management and delivery system improvements.

The primary objective of the project was divided into six project outputs defined as necessary conditions for the successful completion of the project. The following report documents these required outputs, the accomplishments of the project and the eleven specific technical objectives and accomplishments delineated within the study. An additional summary of the project's technical accomplishments may be found in the Final Technical Report titled, "Improving Egypt's Irrigation System In The Old Lands - Findings of the Egypt Water Use and Management Project." Specific technical recommendations for on-going work are provided in the final chapter of this Administrative Report and also in the Final Technical Report of March 1984.

TABLE OF CONTENTS

	PAGE
Abstract	i
Table of Contents	ii
List of Tables	vi
List of Figures	vi
Acknowledgements	vii
I. BACKGROUND	2
II. GOALS AND OBJECTIVES	3
III. HISTORY OF THE PROJECT	6
IV. PERSONNEL INVOLVED	14
V. PHILOSOPHY AND METHODOLOGY	23
General Guiding Philosophy	23
Research Methodology	24
Formation of Task Groups	24
Advisory, Planning and Coordinating Committees	24
Research Management	28
VI. RESULTS	29
A. General Accomplishments	29
Output #1 Identify the major constraints to improved on-farm water management and optimal water delivery system operation.	29
Accomplishments	29
Output #2 Determine and establish the use of optimal irrigation practices at the farm level in representative pilot areas.	30
Accomplishments	30

TABLE OF CONTENTS (Continued)

PAGE

Output #3 30
Establish improved water control practices for the water delivery and drainage system in the project area.

Accomplishments 31
System Design 31
Hydraulic Structures 31
Water Course Improvement Alternatives . . . 32
Delivery System 32
Management 33

Output #4 34
Develop plans for the organization and implementation of expanded future programs based on the results in the project areas.

Accomplishments 34

Output #5 35
Develop and/or train qualified scientists and technicians for the conduct of project activities.

Accomplishments 35
EWUP Short-Term Training 38
SRP - MOI Irrigation Exchange Program . . . 39
SRP - Executive Training Seminar. 40
EWUP Long-Term Trainees 40
On-Farm Water Management Training Course Participants 41
Irrigation Training Tour Participants 45

Output #6 50
Strengthen the institutional capabilities of the MOI to operate the delivery system in an equitable and efficient manner to obtain and sustain the improvements of on-farm water management.

Accomplishments 50

B. Specific Technical Accomplishments 51

1. On-Farm Water Management 51
Objectives 51
Accomplishments 52

TABLE OF CONTENTS (Continued)

		PAGE
2.	Water Distribution Systems	53
	Objectives	53
	Accomplishments	53
3.	Farmer Organization	55
	Objectives	55
	Accomplishments	56
4.	Irrigation Advisory Service (IAS)	57
	Objectives	57
	Accomplishments	57
5.	Water Budget	58
	Objectives	58
	Accomplishments	58
6.	Land Leveling	59
	Objectives	59
	Accomplishments	59
7.	Soil Fertility	60
	Objectives	60
	Accomplishments	60
8.	Soil Characterization	61
	Objectives	61
	Accomplishments	61
9.	Pest and Disease Control	62
	Objectives	62
	Accomplishments	62
10.	Conjunctive Use of Water	62
	Objectives	62
	Accomplishments	62
11.	Farm Management and Planning	63
	Objectives	63
	Accomplishments	63
C.	National Conference	64
D.	Final Report	65

TABLE OF CONTENTS (Continued)

	PAGE
VII. REPORTS	70
Project Technical Reports	70
Manuals	76
Special Publications	77
Brochures	77
Training Manuals	77
Conference Presentations and Journal Publications	77
Inter-Office Draft Working Papers	82
Fort Collins Inter-Office Staff Papers	90
VII. RECOMMENDATIONS FOR ON-GOING WORK	91
Research Process	91
Farmer Involvement	93
Management	93
Agronomic & Structural Changes	93
Training	94
Irrigation Improvement Program	95
Design and Evaluation for Water Delivery System Improvement	95
Commitment to Project Objectives	96
Training	97
Additional Research	97

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
1	Water Use and Management Project	7

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
1	EWUP Field Sites	8
2	Abyuha Field Site	9
3	El-Mansuriya Field Site Showing Beni Magdul and El-Hammami Regions	11
4	Abu Raya Field Site On The Third Reach Of The Daqalt Canal	12
5	Research Format	25

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The Egypt Water Use and Management Project, although not a Title XII activity of the United States Agency for International Development (USAID), functioned under a participatory management style with close cooperation in project activities by the Consortium for International Development (CID), the Ministries of Irrigation and Agriculture of the Egyptian Government, and the USAID. Dr. Jerry Edwards, Associate Director for Agriculture, USAID/Cairo instigated the close cooperation between the three entities and this concept was fully supported by Mr. Donald Brown, Director of USAID/Cairo, and USAID's Project Managers, Mr. Niel Dimick, Dr. Robert Fulton, Mr. John Foster and Mr. W. J. Carmack. The support of USAID on this participatory cooperative management of the project was fully supported by Mr. Brown even after the Government Auditing Office (GAO) made a derogatory reference to the close working relationship that existed between the Egyptians and the CID personnel. A large measure of the success of the project resulted from participation management and USAID's support of the close working relation between the Egyptians and the Americans on the project.

The project design required that the Egyptians make all decisions. It was their activities and their project. The American staff under the leadership of Dr. Roy Brooks at first, and Dr. M. "Gene" Quenemoen in the latter part of the project, fully supported the fundamental aspects that this was an interdisciplinary project by, for, and of, the Egyptians. Each and everyone of the American staff, who are listed in this report, worked very closely with their Egyptian counterparts and by their actions contributed to the enthusiasm and support of the Egyptians working on the project. The dedicated work of the American staff is gratefully acknowledged.

It was a real pleasure working with the Egyptian staff on this project. Their enthusiasm for grasping and implementing new ideas, their willingness to work long hours in the field and office; their wanting to contribute to the success of this project, but more importantly, to make a contribution to the food security of their country by improved on-farm water management, was readily apparent to the project staff, myself and to any of the visitors who came to observe project activities. It would be impossible to name all of the Egyptians in this acknowledgement, however, they are listed in this report.

The leadership of Dr. Mahmoud Abu-Zeid, first as Project Director, and then when he became Chairman of the Water Research Center of the Ministry of Irrigation, was essential to the success of the project. The Project Advisory Committee consisting of: Dr. Mahmoud Abu-Zeid; Dr. Ali Serry, Director, Water & Land Research Institute, Agricultural Research Center; Dr. Kamel Hindi, Director, Agricultural Economics Research Institute, Agricultural Research Center; Dr. Eng. Ibrahim El-Assuity, Professor of Irrigation, Faculty of Engineering, Cairo University; Dr. Eng. Mohamed Wafai Abdel Salam, Professor of Irrigation, Faculty of Engineering, Ain Shams University; Mr. Niel Dimick, USAID; Mr. Robert Fulton, USAID; and Mr. John Foster, USAID; reviewed project activities and gave excellent counsel and advice. Their efforts are greatly appreciated. The dedicated work of

Dr. Wahby, who became Project Director when Dr. Abu-Zeid assumed the Chairmanship of the Water Research Center and the main office discipline leaders, Dr. Mona El-Kady in Engineering; Dr. S. Sallam and his replacement Mr. M. Naguib in Sociology; Mr. Farouk Abdel-Al in Economics; and Dr. Ahmed Taher in Agronomy greatly contributed to the success of the project. Their leadership was appreciated by both the American and Egyptian professional staff. Each one of the field teams was superbly lead by Eng. A. Raouf at El-Minya, Eng. Dr. Mona El-Kady and then Eng. Wadie Fahim at Mansuriya and by Eng. Kamal El-Din at Kafr El-Sheikh. The support provided by the Egyptian secretaries, mechanics, drivers, administrative assistants, accountants, expeditors and the computer specialists all contributed to the project and their efforts are gratefully acknowledged. Mary Halim, as technical editor, helped all of us in finalizing the reports, keeping track of the revisions and arranging for printing by Egyptian printers. Again, as stated earlier, the Egyptians working on the project are all listed in this report and their superb efforts are gratefully acknowledged. And I hope by singling out the leadership provided in the main office and each of the field offices, I do acknowledge the contributions made by all of the Egyptians working on the project.

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Without the leadership the P & C Committee provided, the excellent field team that the project had and the dedicated work of the Egyptians the project would not have succeeded.

I would further like to acknowledge the help of the Consortium for International Development (CID) organization and of CID's personnel at the main office. The Consortium for International Development by locating resources at other CID universities for the project, overseeing accounting, their willingness and ability to help establish good fiscal management of the L.E. account, and their constant liaison with the Washington/AID office, were all very valuable and contributed to the success of the project. I would like to particularly acknowledge the work of Dr. John Fischer, Mr. Bernard Henrie and Mr. Jim Hedrick in their support of the project and its activities.

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It is extremely difficult to thank everyone who had an impact on the success of the Egypt Water Use and Management Project because of the tremendous number of people involved. I hope that all of those who were involved can have a feeling of pride and personal satisfaction of being a contributor to a successful program. Although I have tried to name as many people as possible whom I feel have contributed to the success of the project, I know that invariably I have overlooked somebody. But everyone listed in the acknowledgement and listed as participating in the project in the report and the many others who are not listed, all by their dedicated work contributed to the success of this project.

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FINAL ADMINISTRATIVE REPORT
EGYPT WATER USE AND MANAGEMENT PROJECT

This final administrative report summarizes; (1) the objectives and accomplishments of the Egypt Water Use and Management Project, (2) the methodology utilized in the project, and, (3) the continuing irrigation water management needs of Egypt. This report is not a detailed technical summary of the project's activities, findings, and recommendations. Rather, the reader is referred to the Final Report titled, "Improving Egypt's Irrigation system in the Old Lands - Findings of the Egypt Water Use and Management Project - Final Report," published in March, 1984 in Cairo, Egypt.

The following report is organized into eight chapters. Chapter I provides brief background information about Egypt and its irrigation system. Chapter II discusses the goals, objectives and anticipated output from the project. Chapter III provides a short history of the project. Chapter IV includes the names of personnel who served the project during its existence. Chapter V discusses project philosophy and research methodology and management. Chapter VI gives the results and accomplishments. Chapter VII summarizes the reports written during the project's existence and Chapter VIII discusses recommendations for future work.

CHAPTER I. BACKGROUND

Egypt is a land of approximately 40 million people. Although the country contains more than one million square kilometers of land, most of the people live in a river valley and delta of 350,000 square kilometers, approximately the size of Connecticut. Deserts surround this valley where rainfall is measured in years per inch instead of inches per year. Consequently, the nation's farmlands are and have been since time immemorial, entirely dependent on irrigation from the River Nile. These farmlands include approximately 6 million feddans (one feddan equals 1.04 acres) of alluvial soil along the Nile and in the Delta, the so-called "Old Lands." Some additional land has been and is being reclaimed from the bordering desert and the tidelands along the northern coast.

A growing population and the urge to modernize spurred Egypt to expand her agricultural production in the 1800's . The limited supply of land and the subtropical climate suggested increasing agricultural production by growing multiple crops in one year. But multiple cropping required a dependable water supply throughout the year, and significantly different irrigation methods.

This last century has witnessed a radical change in Egyptian irrigation methods. The ancient system of basin irrigation and cultivation of one crop per year, which prevailed since the dawn of civilization, has been superceded by perennial irrigation. Due to the construction of many barrages and dams over the last 145 years, culminating in the Aswan High Dam, water is now available for year-round crop cultivation.

Perennial irrigation has provided new opportunities for more intensive crop production, but at the same time, it has generated new problems. The use of more water on a relatively fixed area of land has caused some waterlogging, buildup of salts in the soil and excessively high water tables in various farming areas. Management of the delivery and drainage systems has become more difficult under conditions of year-round irrigation and associated changes in crop patterns. Additionally, the food needs of a population increasing at 2.4 percent per annum generates pressures to further increase agricultural yields and expand acreage. In 1975 it was estimated that the ratio between Egypt's cultivated land and population was only 0.15 acres per person and that food production per acre of land was decreasing. Increased yields and water to expand the cultivated acreage would require improved water management. These agronomic and water management problems are significantly exacerbated by the government controlled market of agricultural products. Fixed pricing, regardless of market demands, often reduces farmer production incentives and results in resource wastage.

In recognition of these problems, the Egypt Water Use and Management Project (EWUP) was created in 1977 through action by the Ministry of Irrigation (MOI), the Ministry of Agriculture (MOA) and the United States Agency for International Development (USAID).

CHAPTER II. GOALS AND OBJECTIVES

As stated in the Project Paper, the goal of EWUP was to improve the social and economic well-being of the small farmer. The mechanisms by which this was to be accomplished was the development and implementation of improved irrigation water management in conjunction with improved agronomic practices which would increase agricultural production, develop efficient water use practices and ameliorate drainage problems. An additional explicit component of these objectives was to strengthen the institutional capacities of the MOI and MOA to develop and implement improved on-farm water management programs.

On-farm water management is the research and development (R&D) process for improved economic use of irrigation water by farmers to increase crop production and thus the social economic well-being of the farmers and of their country. Improved on-farm water management requires research and development of the farm water application and drainage system, associated agronomic practices, the delivery of the inputs (water, seeds, fertilizers, labor, etc.) and marketing. Thus, this research and development effort requires interdisciplinary team work of agronomists, economists, irrigation engineers (agricultural and civil engineers) and sociologists. The research and development processes start at the farm and include the total irrigation and farming system.

Six project outputs were perceived to be necessary if the project was to meet its objective. They were:

Output # 1: Identify the major constraints to improved on-farm water management and optimal water delivery system operation.

Output # 2: Determine and establish the use of optimal irrigation practice at the farm level in the representative pilot areas.

Output # 3: Establish improved water control practice for the water delivery and drainage system in the project area.

Output # 4: Develop plans for the organization and implementation of expanded future programs based on results in the project areas.

Output # 5: Develop and/or train qualified scientists and technicians for the conduct of project activities.

Output # 6: Strengthen through training the institutional capabilities of the MOI to operate the delivery system in an equitable and efficient manner to obtain and sustain the improvements of on-farm water management.

At the conclusion of the project an action program would be developed where technical applicability, farmers acceptability, and organizational replicability had been proven. This program could then be implemented on a regional or national basis.

The general purpose of EWUP activities was to develop an applied program of water use and management that would increase agricultural production. The program was initiated with surveys to determine the major problems at the farm level and in the water delivery and drainage systems. This diagnostic analysis provided the information necessary to identify and quantify the problems. The

second step in the project development was to search for alternative solutions in light of the information obtained in the diagnostic analysis and to determine each alternative solution's technical and economic feasibility, as well as its acceptability to both farmers and government. The third phase of the project activities was the establishment of project trials to verify the utility and acceptance of the most promising solution identified in phase two. Those solutions which demonstrated their success in field trials were then packaged into a program which could be expanded into a regional or national project.

At the conclusion of the mid-project review, the project objectives were reevaluated. In consultation with the MOI and USAID, three amendments to the project objectives were made. First, the scope of the project was expanded by defining explicitly that on-farm water management includes not only the fields but also those parts of the water delivery and drainage system which were not regularly maintained or managed by the MOI. This modification officially recognized what had in practice already occurred. Within a year of the project's start, the impact upon on-farm water management of the poorly maintained and regulated mesqas and smaller distributary canals had been recognized and documented by the project. The improvement of on-farm water management was contingent upon an effective management and maintenance policy for these canals. The implications of the relationship between on-farm water management and delivery system management were recognized by both the MOI and USAID and led to the addition of project Output #6 described above.

The mid-project review suggested that the project dissemination of information should be improved and that a more result oriented approach be enacted. Consequently, after consultation with USAID and the Egyptian MOI, the project contract was amended to request reports in ten specific subjects, including on-farm irrigation, water distribution, farmer organizations, water budget, land leveling and the conjunctive use of water. At that same point, the project adopted a revised management plan whereby the accomplishments of specific tasks within the project workplan were assigned to specific individuals or small groups of individuals. The project management and the project's response to the mid-project review will be discussed in greater detail in later sections of this report.

After the project was evaluated by outside reviewers in November 1980, staff personnel studied the recommendations and developed a list of items to receive priority during the remainder of the project life. This list, as shown below, includes the original objectives from the Project Paper and others which were judged to be important after the experience gained from the earlier years of the project life. Most of these items were subsequently built into the task group and pilot program group assignments.

1. Evaluate and improve on-farm irrigation design and management.

2. Evaluate and improve the design and management of the water distribution system

3. Develop and implement a methodology for organizing farmers into water user associations.

4. Design and develop an Irrigation Advisory Service

5. Develop a ground and surface water budget analyzing both water quality and quantity.

6. Analyze the need, and if necessary, implement a land leveling program.

7. Investigate soil fertility problems and the influence of alternative fertilization and micronutrient applications upon yield and water management.

8. Develop a detailed soil characterization map for the project areas and investigate the influence of general soil properties, and vertisols in particular, upon water management in Egypt.

9. Investigate pest and crop disease problems in Egypt, the influence of these upon water management and the control of these pest and disease problems.

10. Investigate the potential for conjunctive use of water for irrigation from sources such as drains, groundwater and the Nile River in Egypt.

11. Investigate improved farm management and planning and its economic implications.

12. Develop a well trained, motivated and managed host country staff to continue the project activities upon the departure of the expatriate advisors.

13. Provide in-field, hands on training to strengthen the institutional capabilities of the MOI to efficiently and equitably manage an irrigation delivery system.

14 Provide training programs in the U. S. for Egyptian staff.

15. Communicate the project findings to all parties who might put such information to beneficial use.

In summary, EWUP was an applied research program for finding the appropriate echnologies for solving Egypt's farm water management problems and for ncreasing agricultural production. These technologies were then developed into an ction program which was proposed for implementation throughout the "Old Lands" f Egypt.

CHAPTER III. HISTORY OF THE PROJECT

The concept of a USAID funded on-farm water management project in Egypt was proposed in early 1976, and a grant agreement with the Government of Egypt was signed in September 1976. The request for proposal (RFP) #60096 was issued that same year and the Consortium for International Development (CID) submitted its proposal February 11, 1977. On May 20, 1977 a Technical Assistance Contract was signed by USAID and CID with Colorado State University (CSU) specified as the lead university. The selection of project personnel began immediately and the advance team consisting of Dr. E. V. Richardson, the Campus Project Coordinator and two other project personnel flew to Cairo on June 12, 1977. On August 22, of the same year, eight Egyptian team members appointed to the project by the MOI arrived at CSU to begin a three month On-Farm Water Management Training program. The first member of the project field team arrived in Cairo October 1977 with the last member of the team arriving in January 1978.

During the life of the project there were 16 separate amendments to the project contract which included two contract extensions. Amendment #9 in April, 1982 extended the contract an additional two years to June 30, 1984. Amendment #15 in June, 1984 extended the contract 6 months to December 31, 1984. This last extension did not provide any additional funding but allowed unspent project funds to be used to support the on-going project activities in Egypt. The time frame of the major activities is given in Table 1.

As per the original contract, the project headquarters were located in Cairo in the Water Resources Research Institute. This location provided access to both the decision makers in the MOI and the MOA. Locating the project headquarters in Cairo also allowed easy access to USAID personnel and simplified many logistic problems.

Additionally, the contract specified that a field site would be located in each of three geographical regions. These regions were the El-Minya region in Upper Egypt, the Mansuriya region adjacent to the sprawling Cairo suburbs, and the Kafr El-Sheikh region in the North Central Delta. Each site was representative of a particular cropping pattern and unique water management problems. Yet, taken in a group, they represented nearly the entire range of crop, agronomic and water management conditions found in the "Old Lands" of Egypt. These locations are shown in Figure 1.

The El-Minya area in the Upper Nile is typical of areas with loamy soils, fragmented holdings, drainage problems, a gravity-fed irrigation system and cropping pattern centered on sugarcane, cotton, maize, and broadbeans. The Mansuriya area near Cairo typifies both heavy clay loam and lighter sandy alluvial soils near the desert fringe, lesser drainage problems, a lift irrigation system, fragmented holdings and a cropping system largely of citrus fruits and vegetables. The Kafr El-Sheikh area in the north central Delta contains heavy clay loam soils, somewhat larger holdings, major drainage and salinity problems, a lift irrigation system, and major crops of paddy rice, cotton and wheat.

A description of each field site in these three regions follows.

The Abyuha (El-Minya) site, as shown in Figure 2, consisted of approximately 1200 feddans served by the Abyuha (El-Minya) distributary canal, 20 km south of the city of El-Minya. The site was selected to represent upstream areas of Egypt which produce broad beans, cotton, sugarcane and other crops in the Nile River Valley.

TABLE 1. WATER USE AND MANAGEMENT PROJECT
Time-frame for major activities (1977-1984)

	1977 Jan-Dec	1978 Jan-Dec	1979 Jan-Dec	1980 Jan-Dec	1982 Jan-Dec	1983 Jan-Dec	1984 Jan-Dec
1. Project Preparation	———						
2. Field Team Arrives Egypt	——						
3. El-Mansuriya Problem Identification		———					
4. Search For Solutions		———					
5. Pilot Program Testing Of Solutions			———	———	———	———	———
6. Abu Raya Problem Identification		———					
7. Search For Solutions		———					
8. Pilot Program Testing Of Solutions			———	———	———	———	———
9. Abyuha Problem Identification		———					
10. Search For Solutions			———				
11. Pilot Program Testing Of Solutions				———	———	———	———
12. Development Plans For NIIP						———	———
13. Outside Evaluation				———			
14. Formation Of Task Groups & Pilot Program Groups					———		
15. Plan & Implement National Conference & Final Report						———	———

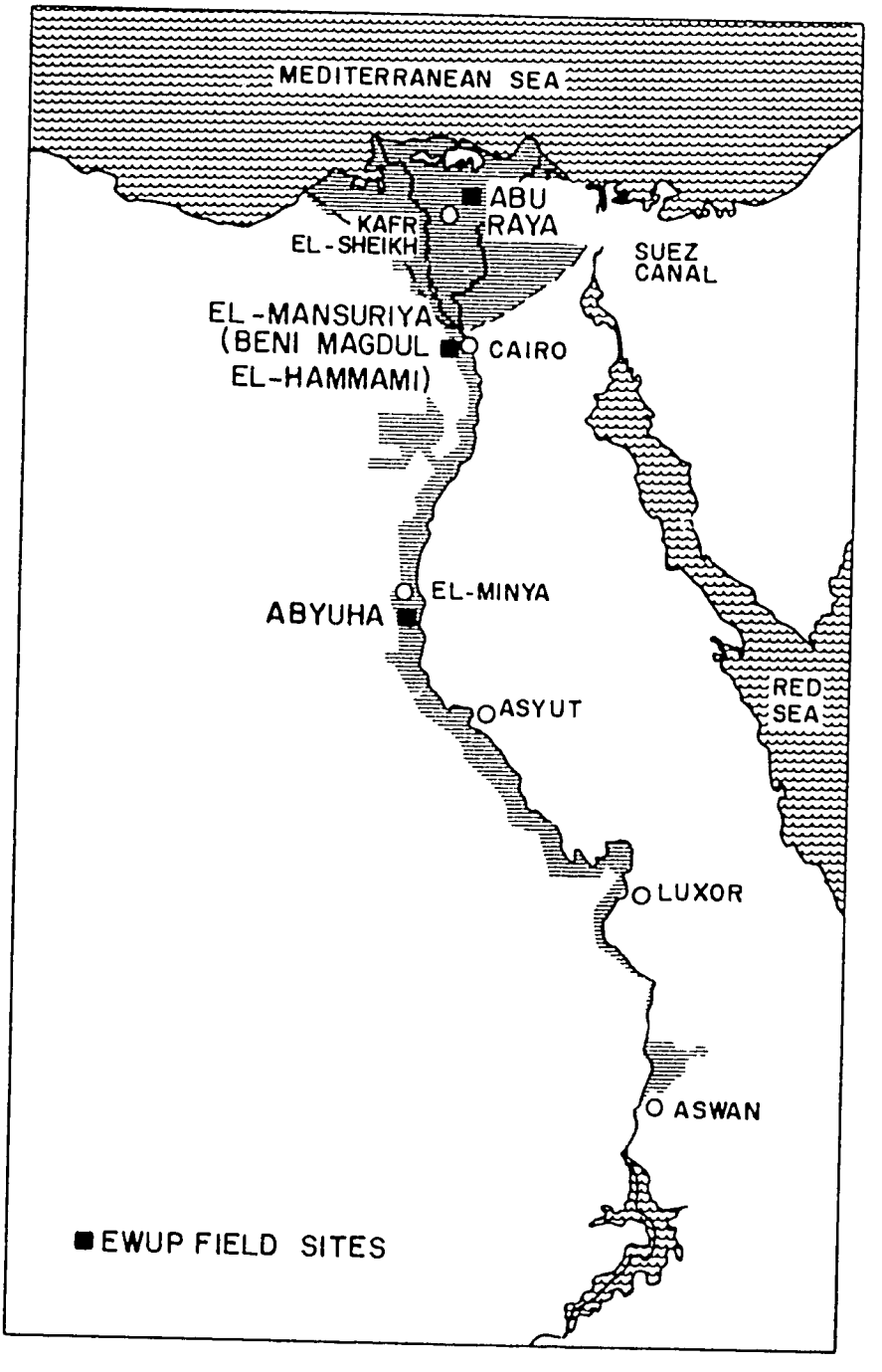

FIGURE 1. EWUP Field Sites

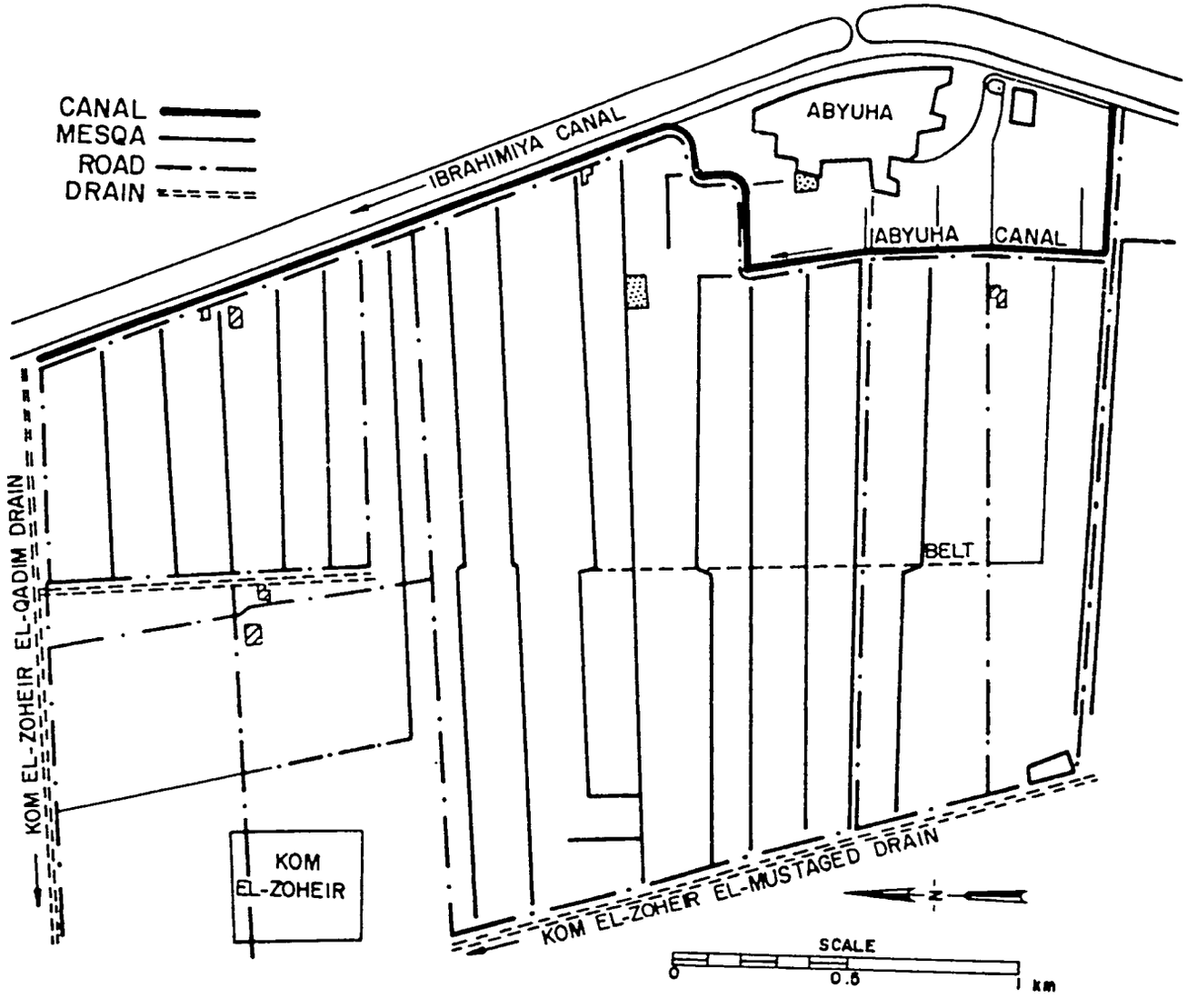

FIGURE 2. Abyuha Field Site

Work emphasized at this site included land leveling, long level furrow and basin irrigation, farmer organization to maintain the mesqas and schedule water use among farmers and renovation of the distribution canal and mesqas (mesqas are privately owned canals which receive water from government canals and carry it to private farms) for improvement of the gravity irrigation system. In 1983 the MOI decided that the area around the Abyuha (El-Minya) site should become part of the National Irrigation Improvement Program. Consequently, a study of the area served by the nearby Serry Canal was conducted by the MOI with assistance of EWUP trained personnel. The Serry Canal command area has subsequently become the first of an ambitious Egyptian program of renovating and improving the Nation's irrigation system.

The El-Mansuriya site, as shown in Figure 3, is located along El-Mansuriya canal in Giza Governorate. The land within the field site is served by Beni Magdul and El-Hammami distributary canals. This site was selected because it represented the vegetable-producing areas serving the Cairo market. The soil of the Beni Magdul command area is predominately alluvial clay while that of El-Hammami area is sandy. The El-Hammami areas is representative of the sandy soils which lie between the alluvial soils of the Nile valley and the desert. Each area covers approximately 800 feddans. The work emphasized at this site included channel lining, elevated mesqas, buried pipeline and continuous-flow water delivery and farmer organization to maintain the mesqas and schedule water use among farmers.

The Abu Raya (Kafr El-Sheikh) site is located along the third reach of Daqalt distributary canal near Abu Raya (Kafr El-Sheikh) village, 35 km northeast of the city of Kafr El-Sheikh. This field site, as shown in Figure 4, was selected to represent the major rice-producing regions. The work concentrated on command areas served by Hamad, Om Sen and Manshiya mesqas which consisted of 219, 235, and 246 feddans, respectively. Land leveling, appropriately designed level furrow and basin irrigation systems and farmer-organized mesqa cleaning were emphasized at this site. In 1983, work at this field site was expanded to include water delivery system improvement for the entire area, approximately 6,300 feddans, served by all three reaches of Daqalt canal.

In each of the pilot areas, project activities were implemented in three overlapping and interrelated components. The first component, titled, "Diagnostic Analysis and Quantification," provided a data base on existing farm production, on farm and delivery system water management practices and on the quantity and quality of water delivered and utilized. This component continued throughout the life of the project as a source of feedback information on the interventions being tested.

The second component of the project activities was titled, "Search for Solutions." Theoretical studies, computer models, and on farm testing were used to develop solutions and then test these solutions to determine not only their technical and economic feasibility but also government and farmer acceptance.

The third component of EWUP's research approach was the testing of solutions through project programs. This component was more than a slightly enlarged field trial. It represented the projects determination to confront the organizational, technical and political problems involved in implementing a water management program on a larger scale.

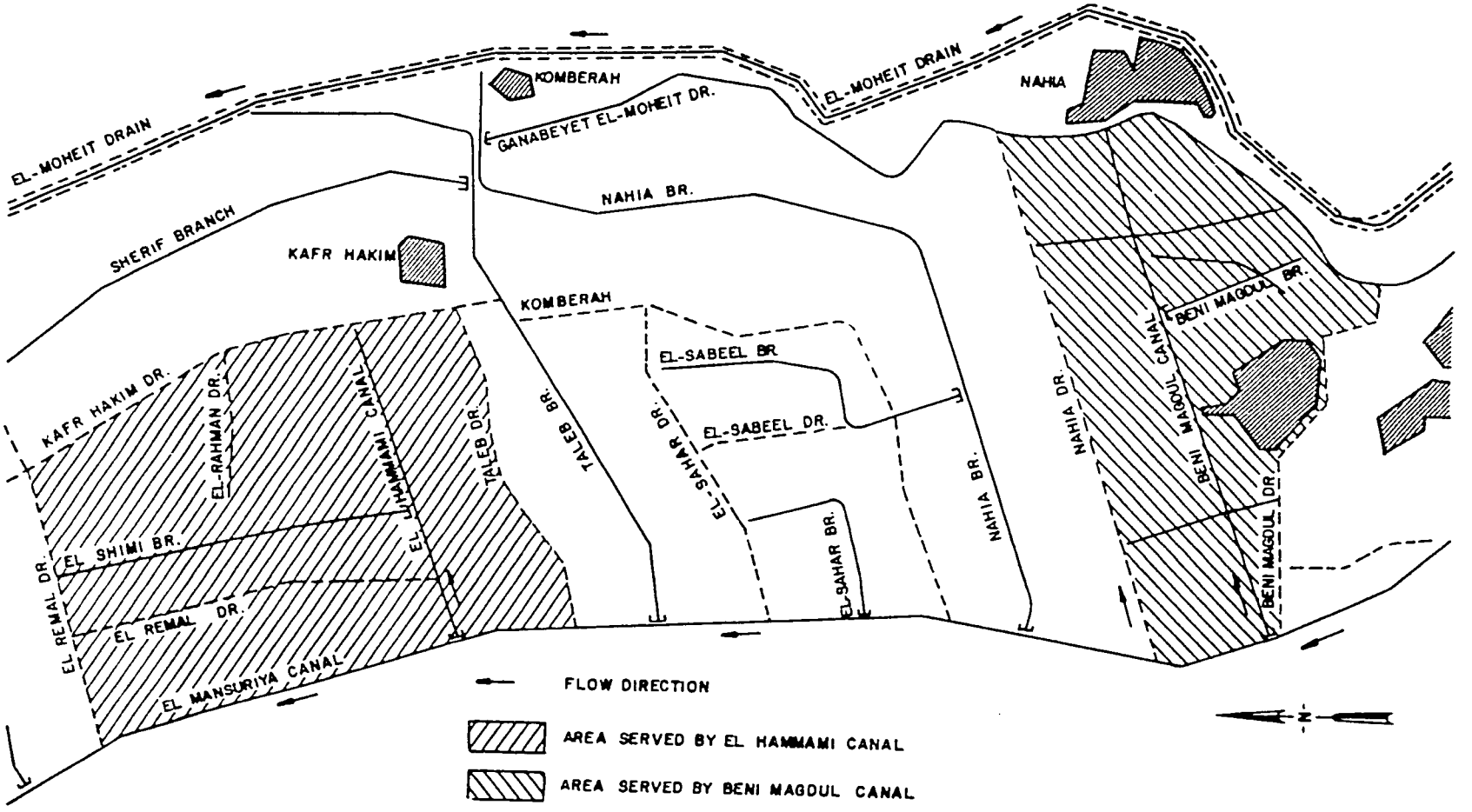

FIGURE 3. El-Mansuriya Field Site Showing Beni Magdul & El-Hammami Regions

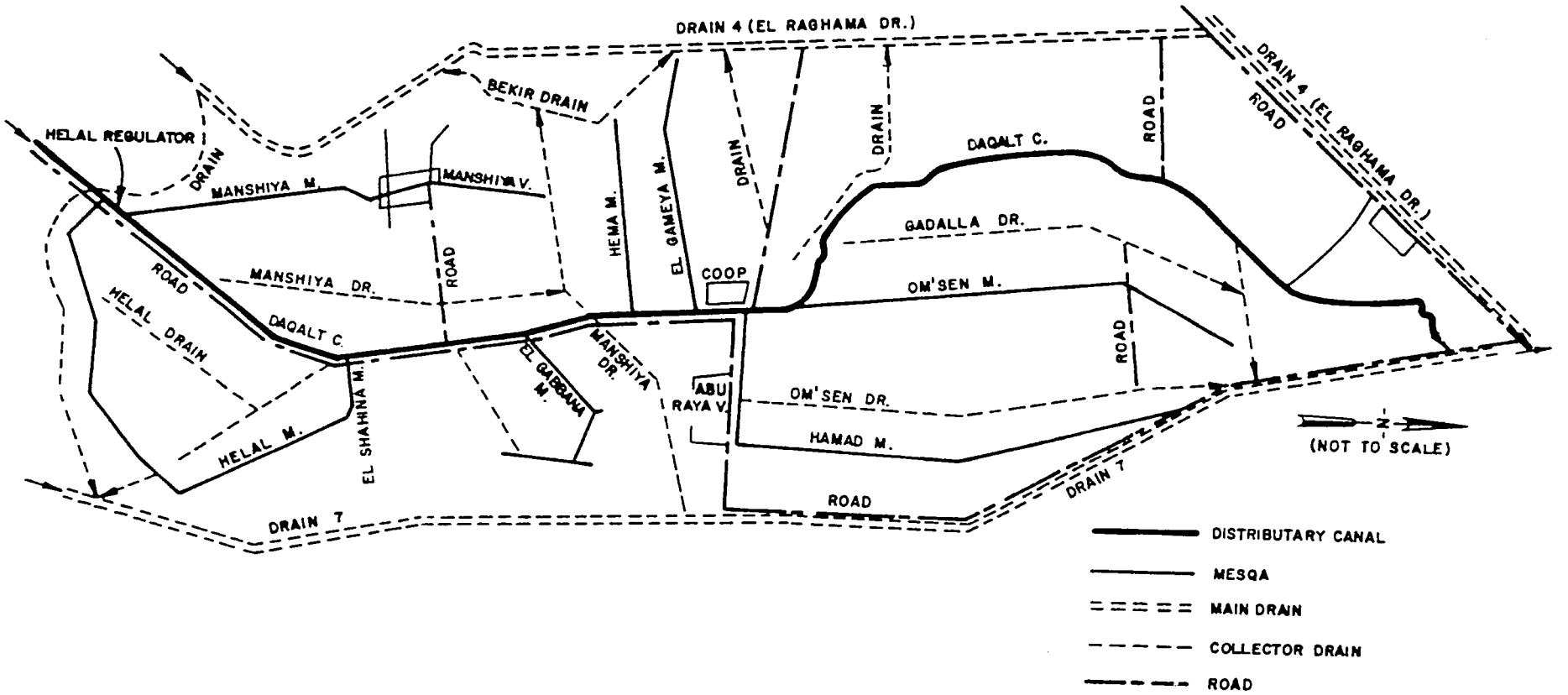

FIGURE 4. Abu Raya Field Site On The Third Reach Of The Daqalt Canal.

The time frame given in Table 1 shows the approximate periods during which major activities were conducted. Although ending times for various activities are shown on the chart there was a tendency for each activity to phase gradually into other activities. For example, problem identification does not stop at a point in time; problems are reformulated as additional information is obtained through the process of searching and testing solutions. The time frame only indicates the period during which activities were given major project emphasis. Also, such activities as training and inside evaluation were continually addressed throughout the life of the project and are not mentioned in the time frame.

Other historical notes worthy of mention:

1. A team of American and Egyptian scientists worked together to implement the project. This was the first time such a team had worked in Egypt in many years.

2. Egypt's MOA and MOI were both involved in planning and implementing the project. This was a unique operation in Egypt and opened new opportunities for future involvement and cooperation of these two ministries in developing a more substantial food supply for the nation.

3. Many senior staff members from Egypt's MOA and MOI attended classes, seminars and tours in the U. S. for joint training and experience in modern systems of irrigated agriculture.

4. Temporary duty (TDY) American staff who participated in the project were provided three days to a week of orientation. Permanent field personnel were provided two to three weeks of orientation and language training. One week of the orientation of permanent field personnel was given by AID in Washington, D.C.

5. A CSU based Planning and Coordinating Committee (P & C) was used to provide technical backstopping and interdisciplinary coordination of project work. The committee consisted of a senior faculty member from each of the five disciplines included (Agronomy, Agricultural Engineering, Civil Engineering, Economics, and Sociology).

CHAPTER IV. PERSONNEL INVOLVED

Twelve Americans were employed fulltime by the project at the height of its activities with nine located in Egypt and three in Fort Collins supporting the project's activities. Again, at the height of the project 109 Egyptian citizens were employed in various capacities ranging from Project Director, engineering to technical and administrative support. During the life of the project 54 American professionals worked in Egypt on temporary duty (TDY).

Over 50 percent of the TDYs were employed for periods in excess of several months duration and made repeated trips. The use of such a high number of TDYs has advantages and disadvantages. Cost savings, reduction of the number of Americans permanently residing in Egypt, the utilization of expertise in specialized areas and the development of a group of experienced professionals for future long term assignments are advantages of a large TDY program. The major disadvantage is the time and expense involved in orienting the TDY personnel to Egypt, his colleagues and the project's needs. In an attempt to minimize time and expense, the majority of the TDY assignments involved personnel with previous TDY or long-term experience in Egypt and assignments were for a duration of two or more months.

The long term expatriate staff at the project headquarters in Cairo consisted of six people including a project technical director, two engineers (agricultural and civil engineer), an agronomist, an economist and a sociologist or extension specialist. In addition, an expatriate agronomist or engineer was assigned to each of the three field sites outside of Cairo.

Americans who served in Egypt as expatriate experts during the project life were:

NAME	TITLE	TERM
<u>Cairo Main Office</u>		
Royal Brooks	Project Technical Director	10/77-11/80
M. E. Quenemoen	Project Technical Director	11/80-06/84
John Wolfe	Irrigation Engineer	01/78-02/81
Timothy Gates	Irrigation Engineer	01/81-06/84
Eldon Hanson	Irrigation Engineer	02/81-06/84
M. E. Quenemoen	Economist	01/78-11/80
David Martella	Economist	02/81-09/83
Edward C. Knop	Sociologist	01/78-01/80
James Layton	Extension Specialist	03/80-06/84
Alex Dotzenko	Agronomist	01/78-01/80
Richard Tinsley	Agronomist	02/80-06/84
<u>Abyuha Field Site</u> (El-Minya)		
Erwin Nielsen	Agricultural Engineer	11/78-07/83

Mansuriya Field Site

Harold Golus	Agronomist	10/77-11/79
William Braunworth	Agronomist	01/80-07/83

Abu Raya Field Site (Kafr El-Sheikh)

Nancy Adams	Agricultural Engineer	11/77-12/79
Thomas Ley	Agricultural Engineer	02/79-05/83
Kenneth Litwiller	Agricultural Engineer	03/82-06/84

A senior Egyptian staff served as counterparts to the American expatriates during the life of the project. Those serving at the time the National Conference was held and the Final Report was presented are as follows:

NAME	TITLE
Egyptian Staff	
Dr. Hassan Wahby	Project Director
Dr. Mona Moustafa El-Kady	Engineering Discipline Leader
Farouk Abdel Al	Economics Discipline Leader
Mohamed Naguib	Sociology Discipline Leader
Ahmed Taher A. Moustafa	Agronomy Discipline Leader
Wadie Fahim	Team Leader - Mansuriya
Kamal Ezz El-Din	Team Leader - Abu Raya (Kafr El-Sheikh)
Abdel Raouf Hassan	Team Leader - Abyuha (El-Minya)

Dr. E. V. Richardson served as Project Coordinator throughout the life of the project. USAID Project Officers included Niel Dimick, Robert Fulton and John Foster.

The project was served at CSU by a Planning and Coordinating Committee (P & C Committee). The function of this committee is explained in Chapter V. Members of the P & C Committee were:

NAME	TITLE	TERM
Dr. E. V. Richardson	Chairman and Project Coordinator - Civil Engineering	77-84
Dr. Wayne Clyma	Vice Chairman and Associate Project Coordinator - Ag Engineering	77-84
Dr. Daniel K. Sunada	Member - Civil Engineering	77-84
Dr. Melvin D. Skold	Member - Economics	79-84
Dr. Willard (Bill) Schmehl	Member - Agronomy	77-84
Dr. Max Lowdermilk	Member - Sociology	77-81
Dr. Edward Sparling	Member - Economics	77-79

An Egyptian based Advisory Committee served EWUP throughout its life. Members were as follows:

NAME	TITLE
Dr. Eng. Mahmoud Abdel Halim Abu-Zeid	Spokesman - Chairman, Water Research Center
Dr. Ali Serry	Director, Water & Land Research Institute, Agricultural Research Center
Dr. Kamel Hindi	Director, Agricultural Economics Research Institute, Agricultural Research Center
Dr. Eng. Ibrahim El-Assuity	Professor of Irrigation, Faculty of Engineering, Caifo University
Dr. Eng. Mohamed Wafai Abdel Salam	Professor of Irrigation, Faculty of Engineering, Ain Shams University
Niel Dimick	USAID
Robert Fulton	USAID
John Foster	USAID

American TDY personnel served EWUP at various times. The names and discipline of TDY personnel are:

NAME	TITLE	INSTITUTION
<u>Agronomists</u>		
Alex Dotzenko	Professor	Colorado State University
Gale Dunn	Professor	Colorado State University
Robert Heil	Professor	Colorado State University
Jeff Jacobsen	Res. Associate	Colorado State University
Larry Nelson	Res. Associate	Colorado State University
David Redgrave	Assoc. Professor	Colorado State University
Willard Schmehl	Professor	Colorado State University
Parvis Soltanpour	Professor	Colorado State University
<u>Business</u>		
Douglas Benton	Professor	Colorado State University
<u>Computer Science</u>		
Michael Moravan	Systems Analyst	Colorado State University

Economists

Mohamed Haider	Ass't. Professor	Colorado State University
Robert King	Professor	Colorado State University
Donald Lybecker	Assoc. Professor	Colorado State University
Leroy D. Luft	Professor	CID/Montana State University
Albert G. Madsen	Professor	Colorado State University
Richard McConnen	Professor	CID/Montana State University
George Radosevich	Professor	Colorado State University
Rex Rehnburg	Professor	Colorado State University
Melvin D. Skold	Professor	Colorado State University
Forrest Walters	Professor	Colorado State University

Engineering

Nancy Adams	Res. Associate	Colorado State University
John Andrew	Assoc. Professor	Colorado State University
Niel Biggs	Res. Associate	Colorado State University
Royal Brooks	Professor	Colorado State University
Wayne Clyma	Professor	Colorado State University
Richard Cuenca	Professor	CID/Oregon State University
Sterling Davis	Professor	Colorado State University
Alan Early	Professor	Colorado State University
Tom Edgar	Res. Associate	Colorado State University
Timothy Gates	Res. Associate	Colorado State University
Wendell Gwinn	Professor	Colorado State University
Eldon Hanson	Professor	Colorado State University
Billy D. Hayes	Professor	Colorado State University
Norman Illsley	Ass't. Professor	Colorado State University
Forrest Izuno	Res. Associate	Colorado State University
Thomas Ley	Res. Associate	Colorado State University
James Loftis	Ass't. Professor	Colorado State University
Albert W. Marsh	Professor	Colorado State University
Ronald Miner	Professor	CID/Oregon State University
David Molden	Res. Associate	Colorado State University
Yack Moseley	Professor	Colorado State University
Terry Podmore	Assoc. Professor	Colorado State University
William O. Ree	Professor	Colorado State University
E. V. Richardson	Professor	Colorado State University
A. R. Robinson	Professor	Colorado State University
James F. Ruff	Assoc. Professor	Colorado State University
Thomas Sanders	Assoc. Professor	Colorado State University
W. Sayre	Professor	University of Iowa
Verne Scott	Professor	Colorado State University
William Shaner	Professor	Colorado State University
G. V. Skogerboe	Professor	Colorado State University
Roger Slack	Res. Associate	Colorado State University
Kern Stutler	Professor	CID/Utah State University
Daniel Sunada	Professor	Colorado State University
Robert Vandenberg	Res. Associate	Colorado State University
Jim Warner	Ass't. Professor	Colorado State University
John Wolfe	Professor	Colorado State University
Robert Young	Professor	Colorado State University

Property Inventory Control

Bob LaRocque	Civil Service	Colorado State University

Psychology

Jacob E. Hautalumoma	Professor	Colorado State University

Sociologists

Edward Knop	Assoc. Professor	Colorado State University
Joyce Ham	Res. Associate	Colorado State University
James Layton	Ass't. Professor	Colorado State University
Max Lowdermilk	Professor	Colorado State University
James Mayfield	Professor	Colorado State University
David M. Rogers	Professor	Colorado State University
Frank Santopolo	Professor	Colorado State University
Louis A. Zurcher	Professor	Colorado State University

Technical Journalism

Daniel Hilleman	Ass't. Professor	Colorado State University
Dan Lattimore	Assoc. Professor	Colorado State University
Elizabeth Sherman	Res. Associate	Colorado State University

Staff Assistant/C. E. Department

Dorothy Rein	Civil Service	Colorado State University

Present and past administrative and clerical staff who served EWUP on the CSU campus are:

NAME	TITLE	TERM
Dorothy Rein	Staff Assistant II	77-84
Judy Cobb	Secretary	77-79
Pamela Hobbs	Secretary	78-84
Jan Wilson	Secretary	79-80
Beverly Jensen	Secretary	80-81
Patsy Smith	Secretary	81-82
Diane Maybon	Secretary	82-84
Cheryl Stevens	Secretary	82-84

In addition, Egyptian professionals worked TDY in the United States at various times.

PARTICIPANT	DISCIPLINE	MONTHS	DATE
Dr. Mona El Kady	Engineer	1.50	02/79
Dr. Salah El-Din	Engineer	1.00	03/80
Dr. Mohamed Sallam	Sociologist	1.00	03/80
Saad Mansour	Administrative Ass't.	0.50	10/80
Dr. Mona El-Kady	Engineer	1.00	11/80
Dr. Mohamed Sallam	Sociologist	0.50	08/81
Farouk Abdel-Al	Economist	1.00	06/82
M. Wadie	Engineer	1.00	07/83
Dr. Hassan Wahby	Engineer	0.50	05/83
Dr. Mona El-Kady	Engineer	1.50	05/83
Mohamed Naguib	Sociologist	1.25	11/83
Farouk Abdel-Al	Economist	1.00	05/83
Farouk Abdel-Al	Economist	1.00	05/84
Dr. Mona El-Kady	Engineer	1.50	05/84
Dr. Hassan Wahby	Engineer	1.50	05/84
Dr. Mahmoud Abu-Zeid	Engineer	1.50	05/84

Egyptians who served the project in Egypt from 1977 to 1984 are:

NAME	TITLE
<u>Main Office</u>	
Dr. Hassan Wahby	Project Director
Dr. Mona Moustafa El-Kady	Engineer, Discipline Leader
Farouk Abdel Al	Economist, Discipline Leader
Ahmed Taher A. Moustafa	Agronomist, Discipline Leader
Mohamed Naguib	Sociologist, Discipline Leader
Mohamed Helal	Engineer
Azza Nasr	Engineer
Mahmoud Ibrahim	Engineer
Ahmed Bayoumi	Engineer
Nadia Wahby	Engineer
Abdel Hamid Fahim	Engineer
Wadie Ragy	Engineer
Mohamed Nabil Naguib	Engineer
Talaat Helmy	Engineer
Gamal Ayad	Economist
Lotfy Nasr	Economist
Assia El-Falaky	Agronomist
Mohed Semaika	Agronomist
Ikram Al-Anwar	Agronomist
Taha Moustafa	Agronomist
Karima Khallaf	Chemist

Main Office (Continued)

Saad Mansour	Management Ass't. - Fin. & Adm.
Nawal Abdalla	Accountant
Zeinab Abdel Ghany Hassan	Accountant
Mohamed Adly Helmy	Administrative Assistant
Mohamed A. M. Salem	Administrative Assistant
Abdel Aziz El-Kady	Expeditor
Magda M. Mahrous	Executive Secretary
Mervat Hassan	Secretary
Hanan Samuel	Secretary
Hala Mokhtar Awad	Secretary
Salah El-Din M. Salem	Secretary
Ihlas Abdel Ghaffar	Secretary
Mary K. Halim	Technical Editor
Hamdi Ahmed Hamdi	Translator

Mansuriya Field Team

Wadie Fahim	Engineer, Team Leader
Tarif Zeitoun	Engineer
Samir Ibrahim	Engineer
El-Shinnawy Abdel Ati	Economist
Gamal Fawzy	Economist
Hossam El-Din El-Naggar	Economist
Mahmoud Khedr	Agronomist
Talatt Abdel Al	Agronomist
Ahmed Tahoon	Agronomist
Sabah Mahmoud	Agronomist
Farouk Abdel Al	Sociologist
Ahmed El-Said El-Attar	Sociologist

Kafr El-Sheikh Team

Kamal Ezz El-Din	Engineer, Team Leader
Abdel Fattah Metawie	Engineer
Safaa Fahmy	Engineer
Saad Hussein Zaki	Engineer
Ahmed Abdel Monsef	Engineer
Magdy Badawi	Economist
Mohamed Ragy Darwish	Economist
Sobhi Ahmed Elewa	Economist
Magdy Awad	Agronomist
Ahmed Ismail	Agronomist
Mohamed Ibrahim Meleha	Agronomist
Mohmoud Mohamed Said	Agronomist
Sohair Kamal Youssef	Sociologist
Essam Ezz El-Din	Sociologist
Hoda Hussein Abdel Latif	Sociologist

Minya Field Team

Abdel Raouf Hassan	Engineer, Team Leader
Esmat Wafik	Engineer
Ahmed Abdel Naim	Engineer
Elia Sorial	Economist
Nabil Farag	Economist
Mohamed Awad	Agronomist
Farouk Hassanein	Sociologist
Abdalla Saber	Sociologist

Former Egyptian Staff

Main Office

Dr. Mahmoud Abu Zeid	Project Director
Ahmed Maher	Engineer
Mahmoud Seif	Engineer
Farouk Shaheen	Engineer
Abdel Ati Allam	Engineer
Farida Abdel Meguid	Engineer
Bishara Ishac	Engineer
Youssef M. A. Youssef	Economist
Nasr Farag	Economist
Mohamed Nasr Farid	Economist
Mohamed Zanati	Agronomist
Anwar Keleg	Agronomist
Elwy Attalla Allam	Agronomist
Mohamed Abdel Naim	Agronomist
Hamed Saleh	Agronomist
Mohamed Sallam	Sociologist
Yousria Allam	Sociologist
Mohamed Said M. El-Shatter	Expeditor
Mona Ghaleb	Executive Secretary
Samaa Atwa	Executive Secretary
Ingi Abdel Nour	Executive Secretary
Jihan Abdel Nour	Executive Secretary

Mansuriya Field Team

Zaki Abu El-Fetouh	Engineer, Team Leader
Hammam El-Sayed	Engineer
Hanafy Mahmoud	Engineer
Tarik A. Tawfic	Agronomist
Elaine Nasif	Agronomist

Kafr El-Sheikh Field Team

Samir El-Aref	Agronomist, Team Leader
Amany El-Kayal	Engineer
Ahmed Dardir	Engineer
Sanaa Ezz El-Din	Engineer
Nehad Ibrahim	Agronomist
Sayed Abdel Hafez	Agronomist
Abdel Fattah El-Masry	Sociologist

Minya Field Team

Salah Saleh	Agronomist
Abdel Sattar El-Rayes	Agronomist

Former Staff Americans

Main Office

Royal Brooks	Technical Director
John Wolfe	Engineer
David Martella	Economist
Alex Dotzenko	Agronomist
Edward Knop	Sociologist

Mansuriya Field Team

Harold Golus	Agronomist - Ass't. Team Leader
W. S. Braunworth	Agronomist - Ass't. Team Leader

Kafr El-Sheikh Field Team

Nancy Adams	Engineer, Ass't. Team Leader
Thomas W. Ley	Engineer, Ass't. Team Leader

Minya Field Team

Erwin Nielsen	Engineer, Ass't. Team Leader

CHAPTER V. PHILOSOPHY AND METHODOLOGY

General Guiding Philosophy

At the conception of the project it was recognized that the project objectives were multidisciplinary in nature. Water management practices in Egypt were the result of a tangled combination of technical, economic and cultural factors and any attempt to change such practices might have far reaching implications in many areas of rural life and the operation of the delivery system. To better understand the traditional water management practices of the Egyptian farmer and the implications of potential interventions, a multidisciplinary team was organized.

Project plans emphasized that the farmer should be the focus of attention for the interdisciplinary team. It was recognized that farmer involvement is an effective method for gaining information about the dynamics of complex systems. Preliminary information indicated that Egyptian farmers were not typically involved in decisions affecting the irrigation system and that such an approach would encounter resistance. However, experience from irrigation improvement programs in other countries indicated that this was the right approach and that a strong effort should be made to involve farmers.

The Project Paper emphasized improved management of the irrigation system in Egypt as a most significant anticipated output (see the "project purposes" and "outputs" in the logical framework). It was anticipated that this would meet some degree of resistance from host country personnel who are more inclined to think in terms of "hardware" development, i.e. construction of dams, barrages, control structures and canal lining. Again, however, based on experience in other countries with irrigation development projects, it was decided to emphasize improved management even though this approach would likely meet various degrees of resistance. The project was designed to focus on on-farm water management including (a) crop environment, (b) farm management practices, (c) water supply and removal and (d) institutional linkages. The research was to begin in farmer's fields in order to understand and improve the higher levels of the system.

The project was established as an applied research project where all interventions would be judged in the field after considering political, cultural and economic terms. The emphasis on in-field research and development was intended to help insure the replicability of the successful interventions. The project actually used the farmer's fields for the testing of interventions to guarantee a "real world" environment. The inclusion of the farmer within the project provided a touch stone with which to measure the success of an intervention.

The project recognized that the long term replicability of the successful intervention was also dependent upon the creation of a technically sound, motivated, and well managed staff within the MOI and the MOA. The creation of such a staff required and resulted in an institution building program within the ministries and consequently a large training program was authorized. This institution building program grew during the project until it became one of the project's primary missions.

In order to facilitate this institution building program, the expatriate staff acted in only an advisory capacity. Final decisions on all project activities rested with the Egyptian team members. At times this led to some frustrations but this involved the Egyptian staff with the project work on a much more intimate basis and provided valuable hands on experience.

Research Methodology

Diagnostic Analysis

Project workplans followed the general format developed through previous research on irrigation improvement in Pakistan. This included (a) problem identification, (b) diagnostic analysis, (c) development of alternative solutions and (d) testing of solutions. The project implementation was planned to follow steps leading to phased transfer of responsibility to the host country government. An outline of this format follows in Figure 5.

Formation of Task Groups

Upon the completion of the mid-project review, the project team was divided into ten interdisciplinary task groups and later expanded to eleven. Each group was assigned a particular technical objective which they were expected to meet. The objectives were result oriented and the creation of task groups clearly delineated personal responsibilities. The result was an effective research program with a focused agenda and a quantifiable output.

Advisory, Planning and Coordinating Committees

A Project Planning and Coordinating Committee (P & C) was formed which consisted of a senior Colorado State University faculty member with extensive agricultural development experience from each of the five disciplines involved in the project (sociology, agricultural engineering, civil engineering, agronomy, and economics). The duties of the P & C Committee were to advise and help the Project Coordinator in planning project activities, selecting both long term and short term personnel, and in designing and implementing training programs. Members of the P & C Committee also helped design, implement, backstop and review the project's technical research programs, reviewed proposed project technical reports, worked in Egypt and served as communication links between the project and their respective disciplines at CSU.

The P & C Committee was a mechanism by which the project could utilize the extensive experience of a group of developmental experts in planning and guiding the long term activities of the project. Additionally, when a particularly difficult technical problem was encountered the technical expertise of the P & C Committee could be called upon.

The Advisory Committee of the Egypt Water Use and Management Project was established by the Egyptian Minister of Irrigation in Decree No. 2113 in 1976. The committee consisted of representatives of the Ministry of Irrigation (MOI), the Ministry of Agriculture (MOA) and a representative of the United States Agency for International Development (USAID). The purpose of the Advisory Committee was to review on a regular basis the projects execution, follow up the project research results and report back to the MOI and MOA on the project's activities and recommended changes. The Advisory Committee met twice yearly throughout the project.

DIAGNOSTIC ANALYSIS

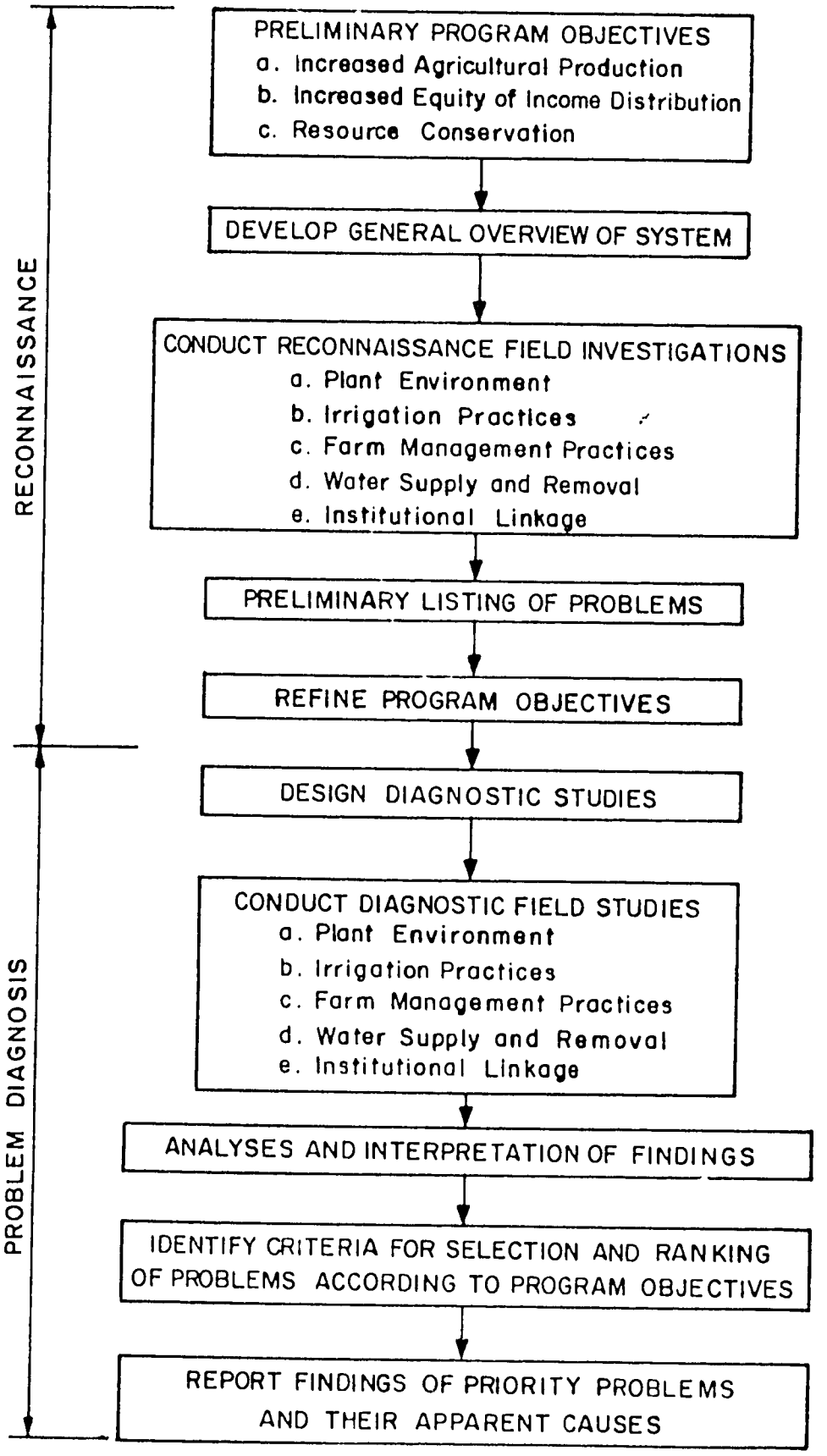

FIGURE 5. Research Format

DEVELOPMENT OF SOLUTIONS

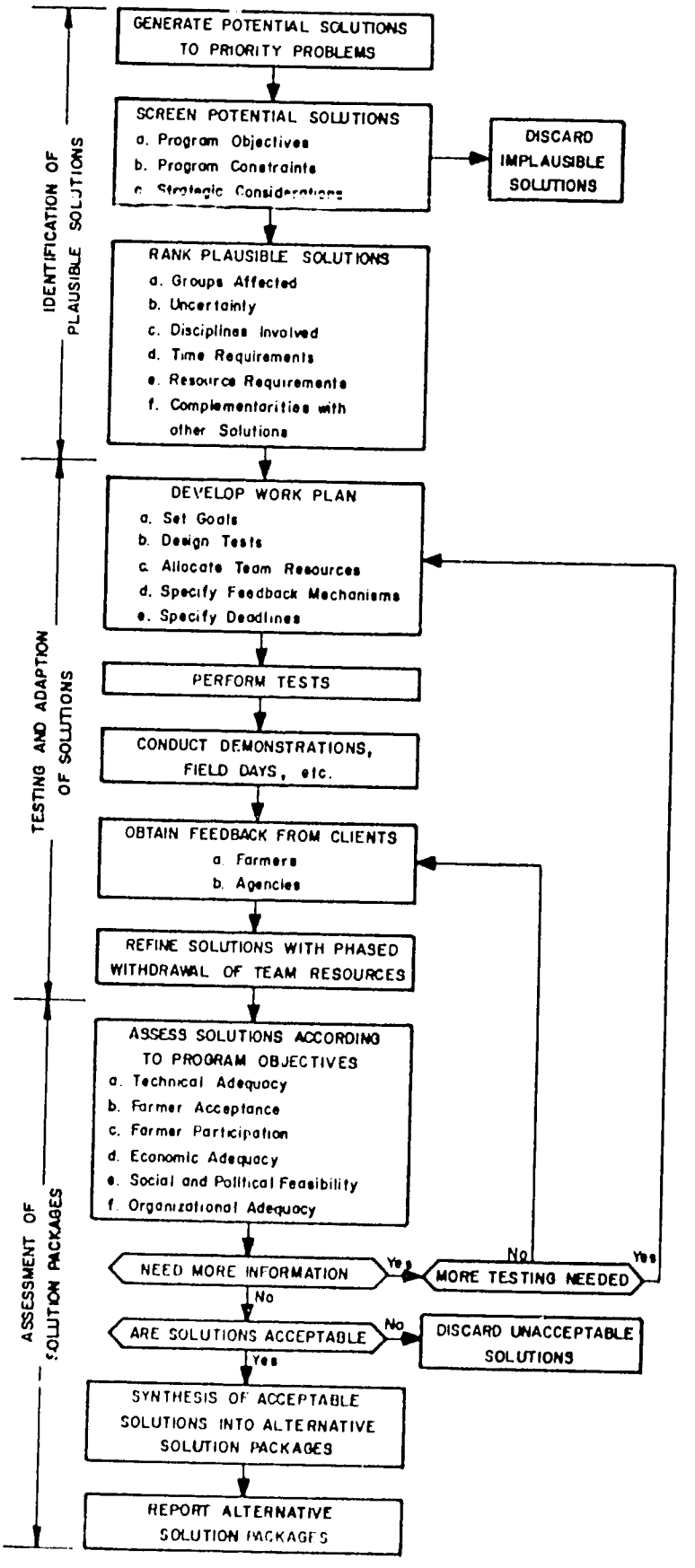

FIGURE 5. Research Format (Continued)

PROJECT IMPLEMENTATION

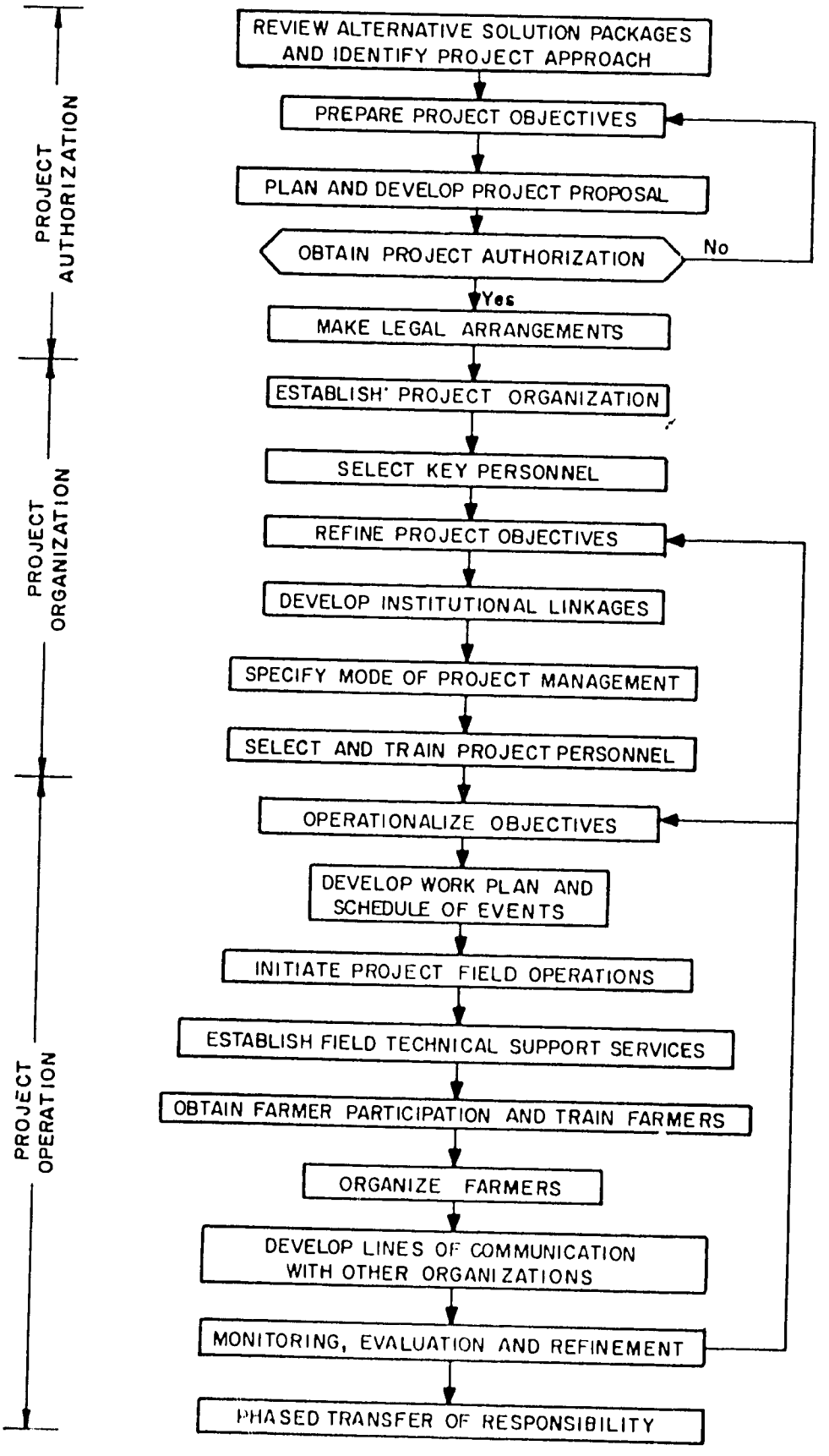

FIGURE 5. Research Format (Continued)

Research Management

Any planned research methodology is subject to modification throughout the project implementation period. It has already been noted that task groups were formed after the mid-project review. At the same time pilot program groups were formed at the three field sites to implement and evaluate proposed solutions in the farmer's fields and in the selected watercourse command areas.

Soon after the field staff arrived in Egypt it became apparent that host country personnel were impatient with the problem identification and diagnostics phase of the research methodology. Most host country professionals expressed the opinion that they knew what the problems were and wanted to press on with finding and implementing solutions. It was apparent, however, that there was no consensus and no real basis for a work plan to search for or test solutions.

The first problem identification work began at the Mansuriya field site. The project managers were successful in delaying the search for, and implementation of, solutions until after the quantification process of the diagnostic analysis was completed. At the Abu Raya (Kafr El-Sheikh) field site, located 80 miles north of Cairo, the field team moved more rapidly into implementation of solutions. The project managers reviewed this as undesirable and made a concerted effort to avoid moving too rapidly into the implementation of solutions phase at the Abyuha (El-Minya) field site. This decision was criticized by the outside reviewers in the mid-project evaluation report. The reviewers tended to agree with the host country staff that problems were obvious and too much time was allowed for problem identification and diagnosis. What the reviewers forgot was that an obvious problem may not have an obvious cause or solution.

Problems that were identified by the project were provided to AID and the Egyptian Government on a timely basis and resulted in other development projects such as the Irrigation Management Systems (IMS) Project. The subsequent failure, or at least lack of satisfactory progress, with certain implementation projects, even where substantial time was allowed for problem identification and diagnosis, seems to indicate that more time for this activity should have been allowed. In irrigated agriculture the diagnostic identification process is very difficult and time consuming because of the many social, economic and technical variables (variables associated with the water application, delivery and removal system, soil variables, social decision variables, etc.); the different sets of interacting personnel with different goals and objectives (these different personnel groups are farmers, landlords, Ministry of Agriculture and Ministry of Irrigation professionals, laborers, private suppliers of goods and services, private purchasers of crops, etc.) and the cropping cycle of land preparation, planting, cultivation, and harvesting which constrains what can be done.

CHAPTER VI. RESULTS

The contractual objective of the EWUP was to improve the social and economic well being of the small farmer in Egypt through the development and implementation of improved irrigation management in conjunction with improved agronomic practices. The internal project objective was to implement the project findings on a regional basis so as to maximize the benefits to the farmer. The contractural objective was met and surpassed; the internal objective is currently being implemented by the Egyptian Government with the help of members of the project staff utilizing the findings of the project.

Six project outputs were defined as necessary conditions for the successful completion of the project. These outputs were listed in Chapter II of this report and will be repeated below. Following the description of each project output will be an explanation of how that particular output was produced. Later in this chapter the specific technical objectives will be discussed.

A. General Accomplishments

Output #1

Identify the major constraints to improved on-farm water management and optimal water delivery system operation.

Accomplishments

The major constraints to improved on-farm water management and optimal water delivery system operation were identified and quantified. It was discovered that the delivery of irrigation water to the farmer was not based upon the entire cropping pattern but upon individual crops (TR 48). Furthermore, water deliveries assumed that irrigation occurred 24 hours of the day. In fact, irrigation occurred primarily from 5 am to noon during the summer (TR 72). The consequence of this erroneous planning assumption and approach was irregular shortages and excesses of water throughout the growing season. This in turn resulted in highly variable flow rates and farmer uncertainty with regard to water delivery. Non-optimal water management practices, inefficient irrigation methods and water wastage resulted.

Additional constraints included non-uniform distribution of water in the major canals because of the poor condition of gates and regulators; poor distribution of water in field distribution ditches because of no water scheduling between farmers and poor condition of the ditches; poor farm application because of small discharges, leakage, seepage, dead storage, unlevel fields and farmers lack of knowledge of the actual soil moisture content. These problems further constrained the introduction of improved on farm water management and optimal delivery system operations.

Although the principal drains were usually clean and well maintained by the Government of Egypt (GOE), the secondary and small drains were more often than not overgrown with weeds and filled with silt. As a result, many fields were poorly drained and water logged. Infiltration studies and measurements of on-farm topography indicated that, due to low infiltration rates and field depressions, surface drainage is required. Hence the poor condition of small drains contributed to poor water management (TR 57).

The GOE has laws which specify the spacing and size of farm turnouts. Project studies indicated that there were considerably more turnouts than prescribed by law (TR 6). As a result, the system did not operate as designed and many farmers suffered from water shortages while others were more than adequately supplied.

Studies of water quality indicated that canal water was very low in salts and presented no problems for irrigation. Salinity and sodicity of shallow ground water is much greater than canal water. It is not generally suited for irrigation. In cases where it enters the drains it diminishes the water quality. However, there is usually enough surface water entering the drains that even the drain water can be used for irrigation under reasonable management (TR 62).

The condition of irrigation canals, except for the main canals, is generally poor. Nearly all canals are unlined and subject to the usual problems of weeds, seepage and unstable cross sections. The condition of mesqas (which has traditionally been the responsibility of the farmers to maintain) was especially bad. Weeds and excessive cross-sections resulted in serious problems of water delivery, especially for those farmers along the tail reaches.

Pilot programs addressed these constraints through lining canals and mesqas, reconstructing earth banks of canals and mesqas to design grade and cross section, establishing a buried pipeline, precision land leveling and working with irrigation district supervisors to improve the quantity and timeliness of water delivery. This work included one distribution canal command area of at least 800 acres at each field site.

Output # 2

Determine and establish the use of optimal irrigation practices at the farm level in representative pilot areas.

Accomplishments

Optimal irrigation practices were developed and successfully introduced to the farmers in each of the pilot areas. The practices included improved crop management, irrigation scheduling, the design of improved basin irrigation and the introduction of border and furrow irrigation and precision land leveling. In order to address this question the project had to perform numerous analyses of available flow rates, surface roughness and infiltration studies.

The results of these project studies helped to improve yields and labor savings. These farmer benefits were documented by EWUP and were published in Technical Report #'s 38 and 41. Additional benefits include the potential for mechanization, application efficiencies as high as 75 percent, reduced saqia to field conveyance channel length and consequential water savings, decreased need for surface drainage and improved soil conditions.

Output #3

Establish improved water control practices for the water delivery and drainage system in the project area.

Accomplishments

Improved water control practices for the water delivery and drainage system were formulated and tested. Four subject areas where improvement was most needed were identified. These areas were 1) system design methodologies and specifications 2) the design, installation and maintenance of hydraulic structures 3) water course improvement alternatives and 4) alternative management schemes and organizations.

System Design

A set of design and evaluation procedures were developed. A case study was published as Technical Report # 22, titled, "The Hydraulic Design of Mesqa 10, An Egyptian Irrigation Canal," and a draft technical paper was written describing in detail the general design and evaluation methodology. A final version of this report was not completed at the close of the project. However, a mathematical system model for the hydraulic design and analysis of a gravity flow irrigation system was completed and published in Technical Report #46 titled, "Hydraulic Design of a Canal System for Gravity Irrigation." The importance of this model is that it philosophically and mathematically ties the design of the delivery system to the design of the on farm irrigation system. Should a new project be funded, the first project task will be to complete and publish the design and evaluation procedures manual.

Hydraulic Structures

Analysis of the delivery system headgates in the project areas showed that 30 percent to 45 percent of the inflow water volume was being lost due to the poorly designed and maintained headgates. New gates were designed, manufactured and installed which led to improved, yet still unsatisfactory, regulation. Technical and practical manufacturing and installation aids will be required to improve the effectiveness of future headgates. Specifically, training in reading blue prints, metal forming and quality control will be required.

Five types of field turnouts were tested in the field. All turnouts tested had advantages and disadvantages. As a rule those turnouts that operated most effectively were either too expensive, cumbersome, or required relatively high operating heads.

A variety of small flow measuring structures were tested. Because there is little available head and high submergence conditions are often encountered, measuring devices such as the cutthroat or trapezoidal flume are most appropriate. Manual #1 titled, "Trapezoidal Flumes for Water Management," was written which described the manufacturing specifications for a trapezoidal flume and its installation.

A turnout that functioned as a water measuring device was also designed and tested. Laboratory and field tests indicate that this turnout is a reliable flow measuring device but too expensive to be used solely as a farm turnout. It can be used as a mesqa turnout.

Water Course Improvement Alternatives

Mesqa and canal lining alternatives were field tested from a technical, economic and social perspective. Cast in place and pre-cast concrete, butyl rubber membrane, plastic membrane, plastic membrane covered with cement tiles and asphalt linings were tested. A comprehensive analysis of the economic costs of the different lining types was published in Technical Report # 56 titled, "Egyptian Canal Lining Techniques and Economic Analysis." The analysis indicated that the economically preferred lining alternative varied with the size of canal or watercourse being lined. However, if a nation-wide lining program were to be initiated, cast in place concrete utilizing slipform construction techniques would be the preferred alternative due to the anticipated life span, ease of maintenance and comparative cost advantage.

Potential benefits of lining canals were also estimated in Technical Report #56. Many benefits such as the improved control of schistosomiasis were intangible and difficult, if not impossible, to express in monetary terms. The tangible benefits considered included water savings, maintenance cost reduction, land area savings, operational and management cost reductions and on-farm distribution benefits. Some of these benefits could not be quantified due to a lack of data. Other benefits were calculated utilizing best estimates. Consequently, the benefits calculated can only be considered preliminary at best. The attempt to quantify these benefits highlighted how site specific many of these benefits may be due to the varying soil characteristics throughout Egypt.

Delivery System

Two alternative water delivery systems were built and tested while a third system, a low pressure buried pipeline, was never completed.

Two mesqas were elevated above the level of the surrounding fields and pumps were installed at the head of each mesqa to lift water from the distribution canal to the mesqa. The need for each farmer to lift water was eliminated, and the increased head supplied at the farm turnouts resulted in significant reduction in the irrigation time. The benefits of this system were primarily reduced farmer costs, the conservation of water by controlling the inflow into the mesqa and the elimination of flow to the drains. These benefits, and the problems incurred, are quantified in Technical Report #63 titled, "Watercourse Improvement Evaluation (Mesqa 26 and Mesqa 10)." Problems incurred included initial farmer problems with the increased flow rates, farmer hesitancy to assume group responsibility for the pump management and an inadequate supply of water in the distribution canal at the mesqa pump inlet. These problems underscored the importance of studying the entire system with a multidisciplinary perspective before attempting to alter any part of the system.

The second water delivery system alternative that was built was designed to provide above grade gravity irrigation to 1200 acres at the Abyuha (El-Minya) field site. This system is currently under construction and will include reconstruction of the main distributary canal and all mesqas, installation of hydraulic control structures, construction of farm and perimeter roads and elimination of several of the original mesqas. Approximately 80% of the construction was completed prior to the end of this project.

Reduced channel cross-section and elimination of several of the mesqas will result in net land savings of 10 to 15 acres after roads have been installed. Though the project is incomplete, observations to date on the completed portions of the system indicate that the farmers have adjusted to the higher flow rates this new system provides and irrigation labor and irrigation time has been reduced. The cost of the contract for this system was $190 per acre.

Problems experienced with constructing this new system were the contractors inability to follow design specifications and implementation schedules. Lack of coordination between the MOA and MOI in scheduling work. The MOA was to do the precision land leveling (PLL) to provide the soil for the improved mesqa construction. This had to be done before the MOI contractor could reconstruct the mesqas. The MOA field PLL team would or could not maintain a schedule. This is not much different than in the United States when two independent contractors are on a job. Lack of proper construction equipment and experience by the contractor, lack of construction supervisory skills by MOI and MOA professionals and, last but not least, the short time between crops when construction can occur. These types of problems were encountered repeatedly throughout the project. Generally most contractors have little experience with the types of construction required for irrigation system improvement at the mesqa and farm level.

A low pressure buried pipeline was designed as a third alternative for water delivery system to be field tested by the project. The system was to be installed at the Mansuriya field site to improve the equity and quantity of water available while increasing the cultivatable land area through the elimination of open distribution canals. The soil in the area is very sandy with large conveyance losses due to unlined ditches.

The construction contract for the irrigation pipeline was awarded to a major pipeline contractor. The contractor was unable to complete the job due to his inability to handle the high water tables encountered when excavating the pipeline trench. The contractor's previous experience had been with the installation of desert pipelines. In the future, projects such as EWUP must be prepared to provide contractors with technical expertise if the facilities are to be built to specification and on schedule.

Management

The project work on the management aspects of the delivery system can be broken down into two general areas. Changes in the actual operation of the system and institutional changes.

The operation of the delivery system is usually based upon a standardized rotation system. Several alternative rotation schedules were studied. Technical Report # 43, titled, "Planning Irrigation Improvements in Egypt: The Impact of Policies and Prices on Farm Income and Resource Use," presented an alternative rotation schedule for the Daqalt Canal in Abu Raya (Kafr El-Sheikh). This rotation schedule based upon project collected water records and on farm irrigation demands would reduce the number of on days by 20 and could significantly reduce water losses.

An alternative water delivery schedule tested by the project was continuous flow schedule in the distribution canal at Beni Magdul. Technical Report #47, titled, "Water Budgets for Irrigation Regions in Egypt," discusses the high irrigation efficiencies that occurred under the continuous flow system.

A third type of water delivery schedule has been designed for the above grade gravity irrigation system in Abyuha (El-Minya) mentioned previously. This system will operate on a continuous flow system at the distribution canal level with a scheduled rotation of the mesqas. This operation system was designed for the specific site and represents the best compromise between water supply availability, system sizing, crop, farmer and MOI needs.

The institutional component of EWUP's management program was the creation of a Water Users' Association in the project sites. The associations consisted of groups of farmers served by a common source of water. The purpose of the associations was to allocate, distribute and manage the water at the distributary canal and mesqa level where the MOI did not have trained personnel. The farmer associations were also to improve mesqa maintenance which is the responsibility of the individual farmers.

The Water User's Association in the Abyuha (El-Minya) area has progressed most rapidly with the farmers cooperating amongst themselves in scheduling irrigation times and mesqa maintenance. The result is improved water management, decreased irrigation time and labor and water savings.

Technical Report #65, titled, "Experiences in Developing Water User's Associations" describes the techniques utilized and the preliminary results of the attempt to develop their Water User's Associations.

Egypt Water Use and Management Project's efforts in the formation of Water User's Associations can only be viewed as preliminary in nature. For the Water User's Association to become a wide-spread and effective tool, it must be formally, legally, and administratively linked to the MOI. Power and responsibility over the distributary canals and mesqas must be formally transferred to the Water User's Association if this new institution is to flourish. Without a Water User's Association the MOI will be unable to extend effective water management to the smaller reaches of the system.

Output #4

Develop plans for the organization and implementation of expanded future programs based on the results in the project areas.

Accomplishments

The organization of an implementation program based on the results obtained from the project areas was studied extensively by EWUP. The underlying question that was examined is, "How do you introduce the farmer to new farming and water management practices?"

EWUP's approach to solving this problem was to find identifying characteristics common to Egyptian farmers when they were the receiver of advice, equipment or aid. Technical Report #66, titled, "The Irrigation Advisory Service: A Proposed Organization for Improving On-Farm Irrigation Management in Egypt," details these characteristics of the Egyptian farmer.

Having developed a character sketch of the farmer, alternative methods of introducing ideas and practices were formulated and tested. Demonstration projects, "expert" opinion and negotiations were, in their respective order, the most successful mechanisms for introducing change. Demonstration projects were

important and where a demonstration project failed to yield the expected benefits, farmer opposition to change could not be swayed. The least successful method of introducing new practices was coercion.

The agent of change was the proposed Irrigation Advisory Service which 1) would advise farmers about ways to improve their irrigation practices, and 2) help organize farmers and the proposed Water User's Association to operate and maintain the small watercourses (mesqas).

EWUP successfully established an Irrigation Advisory Service in the project areas. The usefulness of such a service was proven to the farmers. However, questions about who would administer such an organization have not yet been resolved. EWUP has developed the metholodolgy for the research, development, and implementation of proposed solutions. Furthermore, an understanding has been developed of the institutional, cultural and economic constraints to the implementation of the project findings on a regional basis. Technical reports such as #69, "The Administrative and Social Environment of the Farmers in an Egyptian Village," and #19, "Rural Development and Effective Extension Strategies: Farmers and Officials' Views," and #27, "Alternative Approaches in Extension and Rural Development Work: An Analysis of Differing Perspectives," provide insight into the institutional constraints the farmer and the MOI work within. The cultural constraints upon the implementation of a regional program are addressed in several of the reports mentioned above and in Technical Report #67, titled, "Sociological Evaluation of the On-Farm Irrigation Practices Introduced in Kafr El-Sheikh."

Finally, the economic/financial constraints which would infringe on the success of an implementation project are discussed in Technical Report #43, "Planning Irrigation Improvements in Egypt: The Impact of Policies and Prices on Farm Income and Resource Use."

Output #5

Develop and/or train qualified scientists and technicians for the conduct of project activities.

Accomplishments

EWUP 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) on-the-job training of upgrading the skills and knowledge of project staff.

The development of qualified personnel was primarily on an individual basis and usually included non-degree academic training, short term specialized training and work experience. Twenty-one Egyptian personnel were provided one year (two semesters) of academic training in the United States. Each of these individuals worked closely with a member of the Project Planning and Coordinating Committee who acted as an advisor and mentor. With one exception, every trainee completed his academic training program. The level of difficulty of each individual's course work varied considerably according to previous educational experience. In several cases an intensive English short course prior to the commencement of the academic year would have resulted in a more rewarding experience. Nonetheless, ten academic trainees completed the requirements and received graduate degrees in their respective disciplines.

The short term training consisted of a total of 73.25 man months of from one to four months training programs for 40 project members. Their programs consisted of both short technical courses at Universities in the United States and specialized group and individual study programs proposed by the project staff, and the Planning and Coordinating Committee in Fort Collins. Examples of short term training programs would be the four month On-Farm Water Management Seminar conducted at Colorado State University in 1977 for eight of the project Egyptian staff, the Water Conservation and Management course at Utah State University in Logan, Utah and the Executive Training Seminar at the Salt River Project in Phoenix, Arizona.

The on-the-job training component for the project's Egyptian staff was the most important part of the project staff development program. Working side by side with American long term and temporary duty staff, the Egyptian staff participated in and directed an in-field research program. The validity of a practical in-field research project, the commitment of engineers and other professionals to help the farmer, and the responsibilities and techniques of effective project management can best be learned through work experience. The work experience actualized the potential that formal classroom training had created, validated the research and organizational techniques used and justified the efforts the project's Egyptian staff were called upon to make.

EWUP developed a seven-week field-oriented training program 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 the project. This course has not only trained all of the EWUP staff, but it also trained many officials from both the MOI and MOA who now work throughout the country. In 1983, the administration of the On-Farm Water Management Training Program was transferred from EWUP to the Irrigation Management Systems Project. The course content and the training staff remain, as established by EWUP.

Another aspect of the on farm water management project training activities was an annual tour of irrigated agriculture in the Southwestern United States. The tour participants consisted of those individuals successfully completing the on-farm water management short course taught in Egypt and a number of high officials of the MOI and MOA.

The objective of the tour was to initiate critical thinking about irrigated farming systems. Topics discussed included: (1) state of the art technology - its limitations and infrastructure requirements, (2) alternative water delivery management systems - the roles and responsibilities of farmers and system managers, (3) on-farm water management advisory service - how to provide it and its benefits, (4) salinity control and salt tolerant crops - state of the art and in place programs, and (5) alternative application systems.

The response to the tour has been very favorable. It serves as an excellent incentive for the trainees enrolled in the on-farm water management field course and aids the participants ability to critically evaluate their own farm and system water management needs.

The 1984 tour was organized by CSU at the request of the Training Institute of the Water Research Center, Ministry of Irrigation. This request came through the United States Department of Agriculture.

The tour varied from 3 to 4 weeks in length and was designed to provide a mix of lectures and field visits. Stops were made at private irrigation systems in the Fort Collins area, the Colorado River Salinity Project in Grand Valley, Colorado, Glen Canyon Dam in Arizona, the USDA Water Conservation Lab and the Salt River Project in the Phoenix, Arizona area, the Wellton Mohawk Irrigation District near Yuma, Arizona and the USDA Salinity Lab at Riverside, California. Additional visits with irrigation districts in the Imperial valley and a variety of irrigation equipment manufacturers were also included.

The second component of the EWUP training activities was non-degree advanced technical training in the U.S.A.

Two programs were developed for sending personnel to the U.S.A. First, 21 professionals spent one academic year or more (nine months) at CSU to upgrade their respective discipline knowledge. Forty other individuals enrolled in specific courses at various universities for a period of one to three months. In order for these individuals to attend university classes 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. Through the training opportunities in the U.S.A., ten individuals were supported in their pursuance of graduate degrees. EWUP felt that training its professional staff was an important and necessary aspect of the project work. Many individuals improved their skills by participating in the various training activities. EWUP found that these individuals could effectively use these improved skills to benefit Egypt in terms of improved irrigation management.

An exchange program was also carried out between Egypt's MOI and the Salt River Project (SRP) in Arizona. The exchange program provided hands on experience for MOI professionals in the operations, maintenance and management of American irrigation systems. These MOI professionals were experienced engineers with many years of service in the Egyptian MOI and had extensive knowledge in operation, management and maintenance of Egypt's irrigation network. However, after a series of visits by Senior MOI officials to the Salt River Project, it was concluded that MOI professionals would have their skills and knowledge increased if they could work with professionals from the SRP. Therefore, an exchange program was developed and executed, whereby two-man teams of Egyptians would observe and work for two months on the SRP in Arizona, and two-man teams from the Salt River Project would work in Egypt with MOI professionals. In all, sixteen Egyptians and eight Americans took part in the exchange.

The objective of the MOI/SRP exchange program was to increase the capabilities of MOI professionals in operation, maintenance, management and modernization of Egypt's irrigation delivery system and the design of irrigation structures. The costs of transportation, per diem, training materials and medical insurance was paid by the USAID through EWUP. The MOI paid the salaries of its personnel and some direct and indirect costs associated with the Americans visiting Egypt. The SRP paid the salaries of its personnel and some direct and indirect costs of the Egyptians visiting Arizona.

The exchange program was evaluated yearly by Senior MOI and SRP officials alternating the location yearly from Arizona to Egypt. These evaluations concluded that the exchange program was providing valuable knowledge and experience for the MOI officials and that the MOI was benefiting from the exchange.

In the evaluation carried out in Egypt, in the spring of 1983, it was recommended that the exchange program be extended for a 2nd phase. It was further recommended; that the 2nd phase be for 4 years, (June 1984 to June 1988); that it should be more oriented to specific problem issues facing the MOI; that CID/CSU administer it; that the ratio of American to Egyptian exchangees be one to two; that tours range from 6 to 12 weeks with teams from 2 to 4 persons, and that exchangees give at least one seminar at the host institution. Follow-up tours by team members who have taken part in the previous tours would be acceptable for special issues and a minimum of one evaluation should be conducted each year.

The exchange program for the Egyptian participants began with a one week orientation program at CSU and concluded with a one week tour of irrigation projects in the Southwestern United States. The program at the Salt River Project began immediately following the CSU orientation. The first week of the SRP program consisted of a management seminar which included an overview of the water operations at SRP, water resources and services, civil engineering topics, and water facilities continuation and maintenance. The next five weeks were spent on specialized topics which included:

1. Data Communication
   a. design
   b. maintenance

2. Water Measurement and Record Keeping

3. Water Operation and Water Conveyance Construction and Maintenance

4. Design of Irrigation Structures

5. Conjunctive Use of Surface and Groundwater

6. Project Management, Management Reporting, and Management and Decision Making Processes.

Each of these specialized subject programs were designed to last for 3 weeks allowing each participant to take two programs during his stay at SRP.

Short Term Training Participants

PARTICIPANT	LENGTH OF TIME MONTHS	DATE
Dr. Mona Mostafa El-Kady	4.00	08/77
Nadia Mohamed Abdel	4.00	08/77
Moneim Wahby	4.00	08/77
Farouk Abdel Nahman Shahin	4.00	08/77
Mohamed Zaki Abdel Fatouh Farag	4.00	08/77
Mohamoud Ibrahim Saif Issa	4.00	08/77
Mohamed Shafie Sallam	4.00	08/77
Mohamed Ragib El Zanati	4.00	08/77
Anwar Mohamed Keleg	4.00	08/77
A. W. Selim	1.50	11/79
Mohamed Helal El-Sherif	1.25	09/79
Ahmed Taher	0.50	08/79

Short Term Training Participants (Continued)

Meleha	0.50	08/79
Mohamed Ragib El Zanati	0.50	08/79
Anwar Mohamed Keleg	0.50	08/79
M. Saleh	0.50	04/80
A. Fahim	1.00	05/81
Mohamed Naguib	1.50	09/81
Abdel Fattah Metawie	1.50	09/81
Ahmed Taher	1.00	08/81
Abdel Raouf	1.00	08/81
Mohamed Helal	3.00	06/81
Mohamed Zanati	1.25	06/81
Abdel Shinnawi Ati	1.25	06/81
Farouk Abdel Al	1.25	07/81
Elia Sorial	1.00	06/82
Ahmed Ismail	1.00	06/82
Ahmed Maher	1.50	06/82
Amany El-Kayal	2.00	06/82
Dr. Mona El-Kady	1.50	06/82
Assia El-Falaky	1.00	11/82
Nadia Wahby	1.00	11/82
Safaa Fahmy	2.00	07/83
Abdel Raouf	2.00	06/83
Sohair Kamal	1.50	06/83
Lotfy Nasr	1.75	09/83
Abdel F. Metawie	4.00	09/83
Abdel Aty Shinnawi	1.25	01/84
Moheb Semaika	1.25	04/84
Ahmed Bayoumi	1.00	05/84

Salt River Project - Ministry of Irrigation Exchange Program

MOI PARTICIPANTS	LENGTH OF TIME MONTHS	DATE
Esam El Din Fawzi Bakarat	2.00	03/82
Abdel Hushem Saleh	2.00	03/82
Mahmoud Sayed	2.00	07/82
Ahmed Ahmed	2.00	07/82
Abdel R. Mohamed Shalaby	2.00	10/82
Salam A. Fafter Moussa	2.00	10/82
Ibrahim Ismail Mohammed Gad	2.00	02/83
Essam Menotie Sheikh	2.00	02/83
Ramsis Pakoum Lotfy	2.00	06/83
Hassan El Attafie	2.00	06/83

Salt River Project - Ministry of Irrigation Exchange Program (Continued)

Mohamed F. Saoudi	2.00	09/83
Ahmed Darwish	2.00	09/83
Kamal Zaky	2.00	02/84
Fathi El-Shaer	2.00	02/84
A. El-Kashef	2.00	05/84
F. Saweres	2.00	05/84

SRP PARTICIPANTS	LENGTH OF TIME MONTHS	DATE
Ed Kirdar	0.50	10/81
Alvin Risinger	0.50	10/81
Alex Richards	2.00	04/82
Don Davis	2.00	04/82
Jim McDade	1.75	10/82
Ron Merkeley	1.75	10/82
Don Womack	1.75	02/83
Sid Friar	1.75	02/83

Salt River Project - Executive Training Seminar

PARTICIPANT	LENGTH OF TIME MONTHS	DATE
Dr. Mahmoud Abu Zeid	0.25	06/84
Dr. Hassan Wahby	0.25	06/84
Dr. Mona El-Kady	0.25	06/84
Dr. Omnia El-Hakim	0.25	06/84
Mohamed Abdelsalom	0.25	06/84
Rashwan Ibrahim	0.25	06/84

Long Term Trainees

PARTICIPANT	LENGTH OF TIME MONTHS	DATE
Abdel Fattah Metawie	9.00	01/80
Farouk Abdel Al	6.00	01/80
Mohamed Naguib	5.00	01/80
Tarek Tawfic	6.00	01/80
Wadie Fahim	9.00	09/80
Lofty Nasr	9.00	09/80
Moheb Semaika	9.00	09/80
Abdellah Saber Aly	9.00	09/80

Long Term Trainees (Continued)

Ahmed Esmat	12.00	09/81
Elia Sorial	11.00	09/81
Ahmed Ismail	11.00	09/81
Azza Nasr	16.00	09/81
Magdi Awad	9.00	09/82
Mohamed Awad	9.00	09/82
Gamal Fawzy	9.00	09/82
Kamal El Din	9.00	09/82
Ahmed El Attar	9.00	09/82
Ragy Darwish	9.00	09/83
Farouk Abdel Al Omar	9.00	09/83
Sabeh El-Sayed	9.00	09/83
Tarif A. Zaitoun	7.00	09/83

ON-FARM WATER MANAGEMENT TRAINING COURSE

June 23, 1978 to August 3, 1978

PARTICIPANT	TITLE
Mahrous Amin Emara	Mechanical Engineer
Abdel Aty Allam Hassan	Irrigation Engineer
Kamel Abdel Fattah Helmy	Irrigation Engineer
Ahmed Farouk Mohamed Abdel-Al	Economist
Mohamed Samir Abdel Aziz	Horticulturist
Ahmed Hussein Bayoumi	Engineer
Magdy Mohamed M. Awad	Agronomist
Wadie Fahim Mankarous	Irrigation Engineer
Mohamed Naguib Mahmoud Naguib	Sociologist
Mohamed Lotfy Youssef Nasr	Economist
Moheb Ramzy Semaika	Agronomist

June 15, 1979 to August 9, 1979

PARTICIPANT	TITLE
Mohamed Zaki	EWUP Training Officer
Sayed Abdel Hafez	Agronomist
Abdel Sattar El Rayes	Agronomist
Tarek Tewfik	Agronomist
Mohamed Hamed	Agronomist
El-Shinnawa Abdel Aty	Economist
Ragy Darwish	Economist
Elia Sorial	Economist
Youssef Ali Youssef	Economist
Fouad Moussa Ramadan	Engineer
Fatma Attia	Engineer

On-Farm Water Management Training Course (Continued)

June 15, 1979 to August 9, 1979

PARTICIPANT	TITLE
Mohamed Helal El Sherif	Engineer
Salah Abu El Ela	Engineer
Abdel Fattah Metawie	Engineer
Amany El Kayal	Engineer
Abdel Raouf Hassan	Engineer
Abdel Fattah El Masry	Sociologist
Taha Hussein	Lab. Technician

May 18, 1980 to July 15, 1980

PARTICIPANT	TITLE
Dr. Mohamed Safie Sallam	EWUP, Training Officer
Sabah Mahmoud El Sayed	Agronomist
Mohamed Refaat Farag	Agronomist
Salah El Din Mahmoud	Agronomist
Nehad Mohamed Ibrahim	Agronomist
Ahmed Tahoon	Agronomist
Mohamed Mahmoud Awad	Agronomist
Mohamed Meleha	Agronomist
Mahmoud Saied	Agronomist
Gamal Fawzi	Economist
Mohamed Gabaly	Economist
Azza Nasr	Engineer
Esmat Wafik Ahmed	Engineer
Ahmed A. Dardir	Engineer
Kamal Ezz El Dinn Khalil	Engineer
Farouk Ahmed Abdel Al	Sociologist
Ahmed El Attar	Sociologist
Abdallah Saber Aly	Sociologist

May 23, 1981 to July 13, 1981

PARTICIPANT	TITLE
Ahmed Tahoon	Agronomist
Ahem Sayed Ismail	Agronomist
Hanafy Mahmoud Hanafy	Agronomist
Mahmoud Khedr Afifi	Agronomist
Salah Saleh Abdel Samie	Agronomist
Abdel Sattar Shineshan	Economist
Ahmed Mohamed El-Shater	Economist
Sobhi Ahmed Elewa	Economist
Abdel Razek Ismail Hashim	Engineer
Adel Mohamed El-Kholy	Engineer
Ahmed Abdel Naiem Abdel Ghany	Engineer
El Quaqua Mossad Megahed	Engineer
El Sayed Mohamed Ahmed Hassan	Engineer
Essam Menoufy Mohamed El-Sayed	Engineer

On-Farm Water Management Training Course (Continued)

May 23, 1981 to July 1, 1981

PARTICIPANT	TITLE
Fathi Aly Soliman	Engineer
Kadry Ahmed Osman	Engineer
Mohamed Abdel Moniem El-Etefi	Engineer
Mahamed Salama El-Shafee	Engineer
Mohamed Shebl Abdel Aziz	Engineer
Mostafa Abdel Ghany Sakr	Engineer
Saad Shehata Abdel Al	Engineer
Tarief Fahmy Abdel Rahman	Engineer
Wadie Ragy Kelada	Engineer
Ahmed Gamal El-Din	Sociologist
Saber El-Sabbagh	Sociologist

July 31, 1982 to September 16, 1982

PARTICIPANT	TITLE
Refaat Fahmy Fanous Soliman	Agronomist
Anahar Saleh Mohamed Rifaat	Ag. Engineer
Abdallah Mohamed Hussein Mostafa	Economist
Nabil Kamal Farag	Economist
Magdy Mohamed Badawy Helal	Economist
Farida Abdel Meguid El Hssy	Engineer
Nabil Mohamed Soliman	Engineer
Samir Abbas Saad	Engineer
Maamoun Mohamed Aou-Zaid	Irrigation Englneer
Maher Sobhi Salama	Irrigation Engineer
Abd El Aliem Mohamed Okasha	Irrigation Engineer
Saad Hussein Zaki	Irrigation Engineer
Mahmoud Ibrahim Ali	Irrigation Engineer
Ahmed Ibrahim Ghoniem	Irrigation Engineer
Talat Helmy Youwkiem	Irrigation Engineer
Safaa Fahim Risho	Irrigation Engineer

July 23, 1983 to September 8, 1983

PARTICIPANT	TITLE
Ahmed Hussein Abdel Halim El Garnousy	Economist
Aly Moursi Mohamed Batt	Engineer
Abou Zeid Ahmed Abouzeid	Engineer
Ahmed Senousy Sayed	Engineer
Ahmed Abd El Monsef Ibrahim El Wahab Mohamed	Engineer
Abdel Hak Hassan Khatter	Engineer
Galas Ahmed Mahmoud Beda	Engineer
Hani Galal Sadek Sayed	Engineer
Ibrahim Ahmed Mohamed Lashen	Ag. Engineer
Lotfy Mohamed El Taher Hassan	Engineer
Mohamed Abd El Hakim Omar Hassan	Engineer
Magdy Mohamed Abdel Nabbi Said	Ag. Engineer

On-Farm Water Management Training Course (Continued)

July 23, 1983 to September 8, 1983

PARTICIPANT	TITLE
Magdy Ali Mohamed Ragab	Ag. Engineer
Youness Abbas Hassan Tomborok	Engineer
Mohamed Rashed Ali	Ag. Engineer
Nabil El Said Ibrahim El Desouky	Ag. Engineer
Hossam Mohamed Ahmed El Nagar	Ag. Economist
Hoda Hussein Dweeb	Sociologist
Khairy Mohamed Mohamed El Basiry	Agronomist

July 1, 1984 to August 23, 1984

PARTICIPANT	TITLE
Mohamed Hassan El Sayed Gewedh	Ag. Engineer
Nabil Fathi El Sayed Kandil	Ag. Engineer
Abdalla El Saied Abo El Azem	Ag. Engineer
Mohamed Amin Mohamed Rashed	Ag. Engineer
Fayez Ali Monsour	Ag. Engineer
Abdel Sattar El Saied Zween	Ass't. Dir. Irr. Dept.
Magdi Jacoub Youssef	Ass't. Dir. Irr. Dept.
Moustafa Kamal H. Abo Kerecha	Ass't. Dir. Irr. Dept.
Mohamed Abdel Kawy Seliem	Ass't. Dir. Irr. Dept.
Mohamed Abdel Samieh Mohamed	Ass't. Dir. Irr. Dept.
Samir Ibrahim Ahmed	Demonstrator - Water Research Center
Mahmoud Saif Issa	Engineer
Mohamed Nabil N. Ali Salem	Engineer
Ezz El Arab Badry Mohamed	Engineer
El Sayed Abdel Azim Koutb	Engineer
Safwat Abdel Karim Abdel Maged	Engineer
Abdel Hamed Ibrahim Fahim	Engineer
George Ibrahim Meleka	Gen. Manager - Irr. Dept.
Abdel Raouf Abdel Hamid Mohamed	Gen. Dir. Irr. Dist.
Ibrahim Mohamed Abdo Abu Zeid	Irrigation Engineer
Mohamed Khalil El Toukhly	Irrigation Engineer
Farag Saed Metwally Ragab	Irrigation Engineer
Fathi Ibrahim Moursi	Research Engineer
Nadia Mohamed Wahby	Research Engineer
Nabil Nassif Bushara	Tech. Dir. Irr. Dept.

IRRIGATION TRAINING TOUR PARTICIPANTS

August 4, 1978 to August 23, 1978

PARTICIPANT	TITLE
Mahrous Amin Emara	Mechanical Engineer
Abdel Aty Allam Hassan	Irrigation Engineer
Kamel Abdel Fattah Helmy	Irrigation Engineer
Ahmed Farouk Mohamed Abdel-Al	Economist
Mohamed Samir Abdel Aziz	Horticulturist
Ahmed Hussein Bayoumi	Engineer
Magdy Mohamed M. Awad	Agronomist
Wadie Fahim Mankarous	Irr. Engineer
Mohamed Naguib Mahmoud Naguib	Sociologist
Mohamed Lotfy Youssef Nasr	Economist
Moheb Ramzy Semaika	Agronomist

Senior Officials

OFFICIAL	TITLE
Aly Zaytoon	Under Sec. of State - Min. of Irrigation - Assyout
Samah El-Sayed Yassin	Gen. Dir. - Minya Irrigation
Mokhtar Abdel Halim	Off. Dir. of H. E. the Minister
Ezzat Mohamed El-Far	Gen. Dir. of Sharkia Irrigation
Mahmoud Abu Zied	EWUP Project Director
Bashara Isshak Yussef	Staff of Water Distribution & Methods of Irrigation Research Institute

August 4, 1979 to August 22, 1979

PARTICIPANT	TITLE
Mohamed Zaki	EWUP Training Officer
Sayed Abdel Hafez	Agronomist
Abdel Sattar El Rayes	Agronomist
Tarek Tewfik	Agronomist
Mohamed Hamed	Agronomist
El-Shinnawa Abdel Aty	Economist
Ragy Darwish	Economist
Elia Sorial	Economist
Youssef Ali Youssef	Economist
Fouad Moussa Ramadan	Engineer
Fatma Attia	Engineer
Mohamed Helal El Sherif	Engineer
Salah Abu El Ela	Engineer
Abdel Fattah Metawie	Engineer
Amany El Kayal	Engineer
Abdel Raouf Hassan	Engineer
Abdel Fattah El Masry	Sociologist
Taha Hussein	Lab. Technician

Irrigation Training Tour Participants (Continued)

August 10, 1979 to August 23 1979

Senior Officials

OFFICIAL	TITLE
Aly Ezzat Mokhtar	Under-Sec. of State - Ministry of Irrig., Giza
Aly El Deeb	Under-Sec. of State - Ministry of Irrig., Minya
Jean Kamel	Dir. of Weed Control -Research Institute
Abdel Rahman Shalaby	General Dir. - Ministry of Irrig., Tech. Office
Ahmed Shawky	General Dir. - Kafr El Sheikh Irrigation Dist.
Elwy A. Meky	General Dir. - Sen. Under-Sec. of State, Tech. Office

August 19, 1980 to September 10, 1980

PARTICIPANT	TITLE
Dr. Mohamed Safie Sallam	EWUP, Training Officer
Sabah Mahmoud El Sayed	Agronomist
Mohamed Refaat Farag	Agronomist
Salah El Din Mahmoud	Agronomist
Nehad Mohamed Ibrahim	Agronomist
Ahmed Tahoon	Agronomist
Mohamed Mahmoud Awad	Agronomist
Mohamed Meleha	Agronomist
Mahmoud Saied	Agronomist
Gamal Fawzi	Agronomist
Mohamed Gabaly	Economist
Azza Nasr	Economist
Esmat Wafik Ahmed	Engineer
Ahmed A. Dardir	Engineer
Kamal Ezz El Dinn Khalil	Engineer
Farouk Ahmed Abdel Al	Engineer
Ahmed El Attar	Sociologist
Abdallah Saber Aly	Sociologist
	Sociologist

Senior Officials

OFFICIAL	TITLE
Saad Hanafy	Vice Minister of Planning
Ismail Badawy	Vice Minister Finance & Economy
Fawzy Farag Helwa	Under-Sec. - High Dam Authority
Wahid Moustafa Ismail	Dir. - General Irrigation Co.
Yehya Attia Abdel Khalek	Under-Sec. of State - MOI - El-Gharbia
Ezat Abdel Raouf Fayed	Under-Sec. of State - MOI Kaloubia & Ismailia

Irrigation Training Tour Participants (Continued)

August 19, 1980 to September 10, 1980

Senior Officials

OFFICIAL	TITLE
Saad Abdel Latif Al Samalify	Under-Sec. of State - MOI Skarkia
Mohamed Gamal El Din	General Dir. - Tech. Office Vice MOI
Ahmed Bahgat	
Naguib Hamdy	Team Leader - Wheat & Barley Program Sakha Station, Major Cereals Proj.
Naibl Khamis	Team Leader - Maize & Sorghum Program El Guimeza Station Major Cereals Proj.
Hamed Ghanem	Team Leader - Wheat & Barley Program Sids Station, Major Cereals Project
Ahmed Aly Hassan	Team Leader - Maize & Sorghum Program Shandawil Station Major Cereals Project
Dr. Ali El Bassel	Dean of Agric. College Univ. at Fayoum (Not EWUP)

July 28, 1981 to August 18, 1981

PARTICIPANT	TITLE
Ahmed Tahoon	Agronomist
Ahem Sayed Ismail	Agronomist
Hanafy Mahmoud Hanafy	Agronomist
Mahmoud Khedr Afifi	Agronomist
Salah Saleh Abdel Samie	Agronomist
Abdel Sattar Shineshan	Economist
Ahmed Mohamed El-Shater	Economist
Sobhi Ahmed Elewa	Economist
Abdel Razek Ismail Hashim	Engineer
Adel Mohamed El-Kholy	Engineer
Ahmed Abdel Naiem Abdel Ghany	Engineer
El Quaqua Mossad Megahed	Engineer
El Sayed Mohamed Ahmed Hassan	Engineer
Essam Menoufy Mohamed El-Sayed	Engineer
Fathi Aly Soliman	Engineer
Kadry Ahmed Osman	Engineer
Mohamed Abdel Moniem El-Etefi	Engineer
Mahamed Salama El-Shafee	Engineer
Mohamed Shebl Abdel Aziz	Engineer
Mostafa Abdel Ghany Sakr	Engineer
Saad Shehata Abdel Al	Engineer
Tarief Fahmy Abdel Rahman	Engineer
Wadie Ragy Kelada	Engineer
Ahmed Gamal El-Din	Sociologist
Saber El-Sabbagh	Sociologist

Irrigation Training Tour Participants (Continued)

August 2, 1981 to August 17, 1981

Senior Officials

OFFICIAL	TITLE
Atia Omar Atia	Under-Sec. of State MOI - Assuit
Fathy Abdel Haliem	Under-Sec. of State MOI - El-Minya
Salah El Din Hassan	Under-Sec. of State MOI - Beni Suef & Fayoum
Dr. Baligh Shindi Zikri	Dir., Soil & Water Research Institute
Dr. Elwy A. R. Atalla	Dir., Plant Protection Research Institute
Mohamed A. El Zeftawy	Dir. General of Irrig. - Gharbia
Mohamed Mahmoud El Malkh	Irrig. Inspector Ministry of Irrig., Cairo

September 23, 1982 to October 15, 1982

PARTICIPANT	TITLE
Refaat Fahmy Fanous Soliman	Agronomist
Anahar Saleh Mohamed Rifaat	Ag. Engineer
Abdallah Mohamed Hussein Mostafa	Economist
Nabil Kamal Farag	Economist
Magdy Mohamed Badawy Helal	Economist
Farida Abdel Meguid El Hssy	Engineer
Nabil Mohamed Soliman	Engineer
Samir Abbas Saad	Engineer
Maamoun Mohamed Aou-Zaid	Irrigation Engineer
Maher Sobhi Salama	Irrigation Engineer
Abd El Aliem Mohamed Okasha	Irrigation Engineer
Saad Hussein Zaki	Irrigation Engineer
Mahmoud Ibrahim Ali	Irrigation Engineer
Ahmed Ibrahim Ghoniem	Irrigation Engineer
Talat Helmy Youwkiem	Irrigation Engineer
Safaa Fahim Risho	Irrigation Engineer
Mahamed Farouk Ali Abu Hindia	Irrigation Engineer
Yousria Ahmed Allam	Irrigation Engineer
Farouk Ibrahim Hassanien	Research Associate
Sohair Kamal Youssef	Sociologist
	Sociologist

Senior Officials

OFFICIAL	TITLE
Abdel Aziz Amin Soliman	Dep. Min. of Water Distribution
Ali Abdel Raham Ali	Dep. Min. of Sharkiya Governorate
Atfy Mohamed Aly	Dep. Min. of Fayoum Governorate
Aly Rafie Ahmed Aly	Gen. Dir. Monofiya Dist.
Talaat Eshag Tadros	Gen. Dir. Sharkiya Dist.
Abdel Meguid Abdel Wehab Badran	Gen. Dir. Dakahliya Dist.
Mahmoud Ibrahim Issa	Gen. Sec. Water Res. Center
Mohamed Abd El Naim Ahmed	Agron. Discipline Leader - EWUP

Irrigation Training Tour Participants (Continued)

November 16, 1983 to December 7, 1983

PARTICIPANT	TITLE
Ahmed Hussein Abdel Halim El Garnousy	Economist
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Abou Zeid Ahmed Abouzeid	Engineer
Ahmed Senousy Sayed	Engineer
Ahmed Abd El Monsef Ibrahim El Wahab Mohamed	Engineer
Abdel Hak Hassan Khatter	Engineer
Galas Ahmed Mahmoud Beda	Engineer
Hani Galal Sadek Sayed	Engineer
Ibrahim Ahmed Mohamed Lashen	Ag. Engineer
Lotfy Mohamed El Taher Hassan	Engineer
Mohamed Abd El Hakim Omar Hassan	Engineer
Magdy Mohamed Abdel Nabbi Said	Ag. Engineer
Magdy Ali Mohamed Ragab	Ag. Engineer
Youness Abbas Hassan Tomborok	Engineer
Mohamed Rashed Ali	Ag. Engineer
Nabil El Said Ibrahim El Desouky	Ag. Engineer
Hossam Mohamed Ahmed El Nagar	Ag. Economist
Hoda Hussein Dweeb	Sociologist
Khairy Mohamed Mohamed El Basiry	Agronomist

Senior Officials

OFFICIAL	TITLE
Mohamed Hassan Hassanien	Under-Sec. Admin. - MOI - Beni Suef
Mohamed Abdel Haleem Abdel Megead	Under-Sec. Admin. - MOI - Kaliub, Ismailia & Port Said Governorates
Fares Gorgi Mikhail	Dir. Gen. Admin. - MOI - Minya
Abdel Gamil Abdel Galil Ali El Hag	Gen. Dir. Admin. - MOI East Dakahlia
Sobhy Hassan Nada	Dep. Dir. Des. & Implem. Drain. - MOI
Abdel Hamid Ibrahim	Dep. Dir. Water Res. Institute
Hussein Ahmed Abdel Halim Lasheen	Gen. Dir. Admin. - MOI - Dev. & Oper. Proj
Abdel Hamed El Sadik Hassan	Dep. Dir. Admin. Ass't. - Gen. Dir. - Esna
Abdel Galil Sabir Ahmed	Dep. Dir. Admin. MOI - Kom Ombo
Abd El Raheem Abd	Ass't. Dir. of Irr. Admin. Off. MOI - Assiut
Mohamed Hassan Abd El Karim	Ass't. Dir. MOI - Sohag District
Mohey El Din Fathi El Hawal	Ass't. Dir. Admin. Off. - MOI-Kafr El-Sheikh
Shehata Kamel Shehata	Ass't. Dir. - MOI - Kalyoubia

September 10, 1984 to October 13, 1984

PARTICIPANT	TITLE
Mohamed Hassan El Sayed Gewedh	Ag. Engineer
Nabil Fathi El Sayed Kandil	Ag. Engineer
Abdalla El Saied Abo El Azem	Ag. Engineer
Mohamed Amin Mohamed Rashed	Ag. Engineer

Irrigation Training Tour Participants (Continued)

September 10, 1984 to October 13, 1984

PARTICIPANT	TITLE
Fayez Ali Monsour	Ag. Engineer
Abdel Sattar El Saied Zween	Ass't. Dir. Irr. Dept.
Magdi Jacoub Youssef	Ass't. Dir. Irr. Dept.
Moustafa Kamal H. Abo Kerecha	Ass't. Dir. Irr. Dept.
Mohamed Abdel Kawy Seliem	Ass't. Dir. Irr. Dept.
Mohamed Abdel Samieh Mohamed	Ass't. Dir. Irr. Dept.
Samir Ibrahim Ahmed	Demonstrator - Water Research Center
Mahmoud Saif Issa	Engineer
Mohamed Nabil N. Ali Salem	Engineer
Ezz El Arab Badry Mohamed	Engineer
El Sayed Abdel Azim Koutb	Engineer
Safwat Abdel Karim Abdel Maged	Engineer
Abdel Hamed Ibrahim Fahim	Engineer
George Ibrahim Meleka	Gen. Manager - Irr. Dept.
Abdel Raouf Abdel Hamid Mohamed	Gen. Dir. Irr. Dist.
Ibrahim Mohamed Abdo Abu Zeid	Irrigation Engineer
Mohamed Khalil El Toukhly	Irrigation Engineer
Farag Saed Metwally Ragab	Irrigation Engineer
Fathi Ibrahim Moursi	Research Engineer
Nadia Mohamed Wahby	Research Engineer
Nabil Nassif Bushara	Tech. Dir. Irr. Dept.

Senior Officials

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Sohair Ahmed Mokhtar Arif	Ass't. Dir. Admin. Off. Dept. - Suttanity Drainage Project
Halmy Mohmoud Ibrahim	Under-Sec. of State - Irrigation Dept.
Isis Aziz Bishay	Dir. of Works - Irrigation Project Dept.
Hassan Hussein Shouman	Ass't. Dir. Admin. Affairs

Output #6

Strengthen the institutional capabilities of the Ministry of Irrigation (MOI) to operate the delivery system in an equitable and efficient manner to obtain and sustain the improvements of On-Farm Water Management.

Accomplishments

The accomplishment related to building institutional capabilities are difficult to measure but highly significant as a major project output. The first evidence that the project was successfully producing results came from the outside consultants hired by USAID in 1980 to review project work. These consultants wrote:

> "The chief achievements of the project to date have been (a) creation of a well trained motivated, truly interdisciplinary Egyptian water use research team which is field-oriented and has excellent rapport with the farmers, and (b) establishment of the methodology of doing bona fide agro-irrigation research on the farmers' fields and with their cooperation. The evaluation team considers that these institutional achievements far outweigh the short falls in meeting project external objectives, noted below."

Since the mid-project review in 1980 the MOI has received authority and funding from the Peoples Assembly of Egypt to undertake a National Irrigation Improvement Program (NIIP) to extend the work initiated by EWUP. USAID has shown interest in assisting with a Regional Irrigation Improvement Program (RIIP) which will provide valuable experience for NIIP. This undertaking is moving forward in three regions of Egypt and is perhaps the best testimony available as to the success of EWUP in institution building.

Both technical and management expertise had to be developed to ensure the continued existence of the project. The Americans and Egyptians who worked on this project grew in their understanding of the management requirements for conducting such a project of complex objectives utilizing an interdisciplinary team. The MOI learned the advantages of using disciplines other than engineering to accomplish its objectives.

B. Specific Technical Accomplishments

As indicated in Chapter II the project established ten, later expanded to eleven, task groups following the mid-project review. All technical objectives of the project were assigned to one of these task groups for analysis and evaluation. The actual field work was done by pilot program groups made up of American and Egyptian staff members at each of the three field sites. The task groups and pilot program groups were made up of people representing at least several disciplines and in some cases a representative of each project discipline, viz., engineering, sociology, economics and agronomy.

This section of Chapter VI briefly describes the reports of accomplishments for each of the eleven task groups. Reports from these task groups were specifically required in the contract amendment which extended the life of the project following the mid-project review. The technical objectives included in the task group assignments were reviewed and approved by the Egyptian based Project Advisory Committee. A more detailed summary of the project findings is presented in the project Final Technical Report entitled, "Improving Egypt's Irrigation System in the Old Lands, Findings of the Egypt Water Use and Management Project."

1. On-Farm Water Management

Objectives

- Development of criteria for the proper frequency and amount of irrigation and development of an acceptable procedure for implementing these criteria in the pilot areas.

- Evaluate the impact of various on-farm water management practices on soil properties, water table, and crop production.

- Determine the cost and benefits associated with the changes in delivery systems for selected sites.

- Determine the sociological changes brought about by changes in on-farm water management practices.

- Compare and evaluate the on-farm water management practice of long furrows and/or borders as compared to conventional basins.

Accomplishments

A four part program was initiated to evaluate and improve on-farm irrigation design and management. At the project's inception a review of the state of the art of on-farm irrigation design and management was initiated and, where needed, new design standards were established. At the same time a large study of current Egyptian irrigation practices was initiated. These studies were both macro and micro scopic in design and examined both overall irrigation patterns within the farming system and individual irrigation events. Additionally, irrigation water pumping studies and studies to determine the Egyptian soil characteristics relevant to irrigation design were initiated. The third component of the on-farm irrigation design and management program was the synthesis of the results of the first two components into a set of design practices tailored to the Egyptian farming system. Finally, these practices were implemented on a trial basis and carefully evaluated to ensure that they met the needs of Egyptian farmers, resulted in improved water management, did not adversely impact other parts of the farming system and were culturally and politically acceptable to both Egyptian farmers and the Ministries of Irrigation and Agriculture. The evaluations of the design trials, in conjunction with continuing refinement of our knowledge of the technical parameters encountered in Egypt, led to revisions and improvements in the suggested design practices.

The results of the project studies indicate that the United States Department of Agriculture's Soil Conservation Service design methods for level furrows and level borders are most appropriate. A series of micro-computer and programmable calculator programs were written which proved to be extremely useful aids when designing new level basin and furrow irrigation systems. The systems were designed for the flow rates encountered in the fields. These rates ranged from 20 to 35 liters per second where saqias (water wheels) were used to lift water into unimproved conveyance channels. Test results indicate that desirable irrigation efficiency can be obtained when flow rates exceed 2.5 liters per second for 100 sq. meters of water area. Studies of surface roughness for furrow and border irrigation methods indicated that under well tilled soil conditions, Manning's roughness coefficient values of .04 for furrow irrigation or .15 for border irrigation were appropriate for small grain crops. Additional details on surface roughness studies, infiltration characteristics, field layouts and irrigation management studies can be found in a variety of technical reports including report #35, titled, "Farm Irrigation Systems Design, Kafr El-Sheikh, Egypt," report # 41, titled, "Influence of Farm Irrigation System Design and Precision Land Leveling on Irrigation Efficiency and Irrigation Water Management," and report #57, titled, "Infiltration Studies on Egyptian Vertisols."

Irrigation scheduling played a large part in the project's attempts to improve on-farm irrigation management. Irrigation scheduling must be designed to not only provide the proper crop soil water balance, but also must meet cultural, delivery system, and cultivating practice constraints. Consequently, EWUP initiated a study to try to understand the constraints that would have to be considered in designing an irrigation scheduling program and the feasibility of implementing such a program. Technical report #54, titled, "Criteria for Determining Desirable Irrigation Frequencies and Requirements and Comparisons with Conventional Frequencies and Amounts Measured in EWUP," details the constraints encountered in implementing an irrigation scheduling program and proposes a program that would minimize the impact of these constraints. Technical report #35, titled, "Farm Irrigation System Design, Kafr El-Sheikh, Egypt," and technical report #57, titled, "Infiltration Studies on Egyptian Vertisols," provide additional insight into irrigation scheduling in Egypt.

Specifically, the EWUP study showed that irrigation should take place at a soil water depletion of 40 to 50 percent of the available water in the effective root depth. This was equivalent to a soil water deficit of about 7 cm. Applying less water than the 7 cm soil water deficit was considered impossible with prevailing surface irrigation application methods and soil infiltration characteristics. Farmers actually deviated in water application from the typical 7 cm deficit value due to water availability in the distributary canal. Unexpected and anticipated water shortages caused these variations. Additionally, the farmers tailored their irrigation practices to aid in the ease of removal of cotton stocks, to aid in seed bed preparation and in anticipation of prearranged harvesting dates. Reliable water delivery and appropriate delivery scheduling was essential for implementing an on-farm irrigation schedule. Irrigation and water delivery had to be responsive to the on-farm water demand.

2. Water Distribution Systems

Objectives

- Develop procedures for designing gravity distribution systems for canals and mesqas.

- Organize and evaluate operating and scheduling procedures.

- Evaluate mesqa maintenance and lining with respect to delivery efficiency.

Accomplishments

Improved on-farm water management requires that the delivery system provide to each farmer a reliable and appropriate quantity of water. In recognition of this fact and the inability of the Egyptian irrigation delivery system to meet these requirements, the project initiated an extensive program evaluating and improving the design and management of water distribution systems. As detailed in the description of the project accomplishments of Output #3, on page 30, an evaluation of the delivery system identified four specific areas where improvement was most needed. These areas were:

1. System design methodologies and specifications.

2. The design, installation and maintenance of hydraulic structures.

3. Water course improvement alternatives.

4. Alternative management schemes and organizations.

General procedures in computer programs were developed and tested for designing and evaluating alternative schemes for system renovation. Technical report #22, titled, "The Hydraulic Design of Mesqa 10, an Egyptian Irrigation Canal," and technical report #46, titled, "Hydraulic Design of a Canal System for Gravity Irrigation," describe the methodologies, design philosophy and computer programs written to aid in the design and evaluation of water delivery systems. A considerable amount of effort was expended evaluating the hydraulic structures, gates and turnouts currently installed in the water delivery systems in the project areas. Project water budget studies indicated that water losses to the drains were as high as 45 percent of the inflow. Poor distribution of water throughout branches of the canal and poor irrigation efficiency could be traced back to problems with structures and turnouts in the delivery system. Repeated attempts were made to design headgates, turnouts and measurement structures that could be easily constructed and installed using technology used in the local project areas. The project did not succeed in these attempts as continuing problems with manufacturing, and installation of these structures were never resolved. The designs were repeatedly simplified, but continued to require materials and technology in the manufacturing process that local contractors were unwilling or unable to consistently provide.

The project's designs and efforts in this area are inadequately reported. Technical report #51, titled, "Structural Specifications in Construction of a Canal System for Gravity Irrigation," provides some information on the proposed mesqa headgate design. The project's experimentation with measurement structures was more successful and is reported in technical report #47, titled, "Water Budgets for Irrigated Regions in Egypt." The project concluded that the high submergence conditions frequently encountered in Egypt necessitated the use of a cutthroat or trapezoidal flume. A manual describing manufacturing specifications and instructions for the installation of trapezoidal flumes was prepared and is titled, "Trapezoidal Flumes for the Egypt Water Use and Management Project." However, again the project was unsuccessful in obtaining locally manufactured trapezoidal flumes that met the minimum required specifications.

Several water course improvement alternatives were designed, built and evaluated by the project. During this procedure a methodology and evaluation procedure was developed to aid in future evaluation of alternative water course improvements throughout Egypt. Cast in place and pre-cast concrete lining, butyl rubber membrane, plastic membrane covered with cement tiles and asphalt were tested in field and initial benefit cost ratios were developed. These ratios were found to be very site specific and highly dependent upon costs and benefits that could not be accurately predicted without additional research and pilot implementation studies. Technical Report #56 summarizes lining methods and costs of materials in Egypt.

Two elevated mesqas were built and evaluated to test the effects of increased head at the field turnouts and single point lifting for a large number of farmers. Farmer response and an economic analysis presented in technical report #63, indicated that the primary benefit of the evaluated mesqas was to reduce irrigation time and consequently reduced labor costs. Significant water savings did occur due to the elimination of flow to drains and the control of inflow water through the regulation of the pump. Optimum operation of one of the elevated mesqas was never obtained because of an inadequate water supply in the distributary canal at the mesqa inlet. This experience underscores the importance of carefully studying the entire delivery system from the distributary canal to the farm before attempting to alter any part of the system.

An above grade gravity irrigation system was designed for a 1200 feddan area at the Abyuha (El-Minya) field site. The implementation of the design had not been completed at the project's conclusion. The evaluation of those parts completed indicates that the design improves the distribution and timing of the irrigation water, eliminates the need to lift water, increases cultivatable land by 1.3 percent, and improves the field access of mechanized equipment. The higher flow rates now available to the farmers have reduced irrigation labor requirements and irrigation time.

Construction problems were encountered during the renovation of this irrigation system. The local contractors hired did not have the equipment nor experience needed to complete the project on schedule or according to specifications. Additionally, the contractors lacked the managerial and organizational skills required to coordinate the construction work between breaks in the crop and irrigation rotations and within the limited right of way.

A low pressure buried pipeline system was designed to improve the equity and adequacy of water distribution in the El-Hammami project area. Construction began in 1981 but has never been completed. Several Egyptian contractors have in turn been unable to complete the construction of the pipeline to specification due to the high water table conditions encountered. Tests of completed portions of the system have repeatedly failed due to improper installation of the pipe. Construction has been discontinued but the Egyptian Ministry of Irrigation continues to attempt to resolve the contractor problems and complete construction.

3. Farmer Organization

Objectives

- To define the purpose and nature of a farmer organization.
- To examine the existing organizational capabilities of Egyptian farmers.
- To develop and analyze strategies for implementation of farmer organizations.
- To analyze the procedures and administrative structure encompassing the farmer organizations at the specific field site.

Accomplishments

EWUP accomplishments relative to these objectives include (1) developing and sustaining farmer organizations at field sites, (2) the documentation of this process and (3) studies and documentation of the social environment affecting the process of organizing and sustaining farmer organizations.

Technical Report #65, titled, "Experiences in Developing Water Users Associations," documents work at field sites. The farmers at Abu Raya (Kafr El-Sheikh) were effectively organized to provide labor for cleaning mesqas. The farmers had, for a long time, recognized the problem but leadership from EWUP staff was required to initiate the necessary organization and coordination. The farmers continued to carry out the mesqa cleaning function after the original organization had been established.

Farmers at Mansuriya field site were organized on mesqa #10 of Beni Magdul Canal to manage the water distribution from the raised mesqa. Because of problems mentioned previously about the failure of Beni Magdul Canal to deliver a dependable supply of water to the pump on Mesqa #10, the organization did not function as well as expected. It became apparent from this experience that better upstream management, also involving water user's associations, would be required before the organization of farmers on Mesqa #10 would be very effective. Egyptian farmers behaved similarly to farmers elsewhere in the world; they were only willing to give their time and accept the frustrations and inconveniences associated with cooperative action if the rewards were adequate. Given the conditions of uncertain water delivery under the new system, they did not perceive advantages attractive enough to warrant their full support of an organization.

The greatest accomplishment with establishing a farmers' water users association was at the Abyuha (El-Minya) field site. At this site a project was initiated for raising the level of water in the entire delivery system serving 1200 acres. The organization established some thirty mesqa leaders to unlock the gates and control the water to the farmers. This experience also demonstrated that farmers were willing to overcome the cost and frustration of cooperative action if the benefits were large enough.

A major accomplishment of this work was to demonstrate to MOI personnel the advantages of allocating time, effort and resources to organizing farmers. Although well established in other countries, this is new to Egypt. The experience clearly demonstrated the need for establishing the legitimacy of any system improvement with farmers. System improvements were short lived, in one case actually destroyed by farmers, when EWUP staff failed to get farmers' support.

Many persons from the MOI visited the field site and talked to cooperating farmers. MOI officials were made aware of the need for linking farmer organizations to the MOI in order to sustain the farmers' organization and in order to maximize opportunity provided by an organization for better irrigation system management. Only time will tell if enough high level MOI personnel were convinced of this need to establish the required support to institutionalize the linkage.

EWUP failures at organizing farmers were associated with failures to successfully implement proposed irrigation system development plans. One case has already been discussed relative to Mesqa #10 on Beni Magdul Canal. Another relates to the proposed pump and underground pipeline system for El-Hammami Canal. Because of contractor failures with construction, previously reported, the efforts to organize the farmers were stymied. The construction failure caused some hardship among farmers and destroyed project credibility. It underscores the importance of integrated management of interdisciplinary projects. Overall project success depends on effective implementation of each part of the project plan.

In spite of some failures, the overall reaction to farmer organization was positive. For political reasons the Egyptian reference to farmer organizations will probably be "water users associations" or its equivalent translation into Arabic. Many persons now in the MOI recognize the importance of such organizations in improving irrigation water management.

4. Irrigation Advisory Service (IAS)

Objectives

- Provide technical advice and assistance to farmers and farmer organizations in the pilot areas.

- Cooperate in providing service to farmers with existing extension service, village cooperatives and farmers organizations.

- Develop criteria and procedures for establishing a countrywide Irrigation Advisory Service (IAS) including integration of such a service into the existing institutional structure of the local communities and the nation.

Accomplishments

EWUP experience during its first two years of operation led project managers to the conclusion that educational programs on irrigation management were not likely to come out of the existing institutional structure. The extension service is administered by the MOA which has many priorities ranking ahead of irrigation management. Therefore, it seems unlikely the MOA will allocate its scarce resources to water management related research and extension. Efforts of EWUP during the first two years, as well as later, to develop an adequate IAS to serve pilot areas through existing agencies met with failure. After the mid-project review in 1981 the project managers decided to emphasize establishing an IAS within the project which could serve as a prototype.

The results of this work demonstrated not only the value of establishing such a service in Egypt but also provided insights into how new irrigation techniques may be diffused at the on-farm and mesqa levels of operation. Farmers responded readily to advice on better irrigation methods, especially when they were involved in planning the implementation of the techniques to be demonstrated. Farmers from outside the pilot program areas saw the work and heard about the results. They have requested assistance with modifying and improving irrigations systems on their own farms.

Technical Report #66 titled, "The Irrigation Advisory Service: A Proposed Organization for Improving On-Farm Irrigation in Egypt," presents a plan for initiating an IAS, including administrative requirements. There will undoubtedly be much debate concerning the specific role of such an organization, how it will be administered and who will control it.

During the final year of the EWUP contract the Government of Egypt was beginning the implementation of a National Irrigation Improvement Program (NIIP). The initial areas designated for improvement were contiguous to the EWUP pilot program areas. EWUP staff who had been involved with the extension aspects of irrigation improvement were providing leadership to the new program. EWUP has provided a model. Past experience with EWUP should have also provided the necessary personal confidence for the managers of NIIP to work toward resolving the questions of role and administration for an IAS.

5. Water Budget

Objectives

- To collect data on surface inflow and outflow, precipitation, weather station evaporation and evapotranspiration, water table elevations, hydraulic conductivity and water quality at each of the field sites.

- To conduct regular periodic analyses of water budget data for each site with subsequent reports of results.

- To produce a final comprehensive report of the water budget work.

Accomplishments

A water budget is an accounting of water supply and use for a specified area. When monitored through time, it provides information about distribution and irrigation efficiencies, water table levels and other hydrological dynamics which is useful in planning and managing irrigation systems. the major accomplishment of this work in EWUP was to establish a computer assisted data collection and processing unit within the Institute and the Water Research Center of the MOI. Technical Report #47 titled, "Water Budgets for Irrigated Regions in Egypt," summarizes the water budget work at the field sites during the project life. It provides a format and computer programs which can be used effectively for future water budget work.

An example of how this work is used has been reported previously under "Water Distribution Systems." The fact that as much as 45 percent of water flowing into some areas passed through to the drains suggested modifications in the irrigation system which led to the pilot program work on Abyuha (El-Minya) Canal. The water budget work also indicated that there is substantial water table contribution to consumptive use in certain areas which should be considered when determining the quantity of water to allocate into delivery canals. The reduction in the amount of water passing through delivery canals and drains can reduce (1) problems of waterlogged soils, (2) maintenance of canals and drains, and (3) pumping costs since many of the drains are pumped in order to return drainage water to the Nile River or the sea.

The Egyptian staff is now well trained in collecting water budget data. Egyptian engineers have also participated in writing computer programs, useful for this work, as reported in Technical Report #47 and Manual #2 titled, "Programs for the Hewlett-Packard Computer Model 9825 for EWUP Operations."

Water quality data, mentioned in the objectives above, is reported later under "Conjunctive Use of Water."

6. Land Leveling

Objectives

- To collect and analyze EWUP data regarding land leveling.
- To determine costs and benefits from precision land leveling.
- To assess the impact of land leveling on water management.
- To provide training for farmers and technicians in order to improve their skills related to precision land leveling.

Accomplishments

The most general traditional method of irrigation in Egypt is to flood small level basins. This is highly labor intensive (approximately 41 man hours per acre just to prepare the borders) and as basins are not precisely level, it results in low field application efficiency of irrigation. EWUP staff found that 90 percent of farmers' fields exceeded the acceptable standard (± 0.015 m from mean field elevation) for levelness by at least three times (TR# 36 titled, "Precision Land Leveling on Abu Raya (Kafr El-Sheikh) Farms"). This situation could be corrected, on the average, by moving 60 m^3 of soil per acre at a cost of approximately LE25 per acre. How long the precision leveling would last before needing maintenance was not determined but it was observed that farmers understood the value of level fields and were careful to maintain them in that condition.

EWUP was successful in introducing precision land leveling to Egypt. In 1983 another project (Egyptian Agricultural Mechanization Project) in the MOA initiated a major effort in land leveling and brought in at least fifty tractors and a smaller number of laser controlled scrapers. EWUP staff had already had experience with laser leveling equipment provided by an in-country machinery company. Consequently the EWUP staff was able to provide considerable training assistance directly and through publications (see Manual 8 titled, "Thirty Steps to Precision Land Leveling").

The EWUP cooperation with the MOA project resulted in the use of the tractors and laser equipment at the Abyuha (El-Minya) Canal pilot area where 1200 acres were in the final stages of being leveled at the end of the EWUP contract.

Although EWUP was successful in introducing precision land leveling to Egypt, many problems remain. Farmers now recognize the need for better leveling. However, their fields are small and it is difficult to have them clear of crops in large enough blocks to permit the efficient use of big tractors and

equipment. Also, the management of big equipment is mostly in the control of government agencies rather than private operators. Farmers complain that government tractor drivers and machinery managers are not responsive enough to the farmers' needs. It will take time to resolve these problems so that Egyptian farmers will have access to equipment needed for precision land leveling.

7. Soil Fertility

Objectives

- Conduct soil fertility surveys and indentify primary agronomic constraints to increased production and efficient water use.

- Evaluate alternative solutions and disseminate findings to farmers in pilot program areas.

Accomplishments

A comprehensive soil fertility survey was completed for each of the three project field sites. At least 10 percent of the farms in each area, selected at random, were sampled. The soils were all analyzed for pH, EC and available P. At the Mansuriya site potassium content was measured. All field sites were spot checked for N, Zn, Fe, Cu and Mn. Technical Report #10 titled, "Soil Fertility of Kafr El-Sheikh, El Mansuriya and El Minya Sites," summarizes the results of this study. The report indicates some areas have serious salinity problems, and the soils at the three sites showed high variance in the availability of nutrients measured. Most soils were low in available nitrogen and phosphorous but specific site testing would be valuable before making recommendations regarding application rates. Potassium is needed in some of the more sandy soils especially for crops which have high K requirements. Some areas are very low in zinc and iron and should be supplied for crops which are highly dependent on these elements. Field trials showed exceptional response to zinc application for rice and wheat.

EWUP staff agronomists were successful in getting information to farmers in the pilot project areas at each field site. Many farmers who had previously been selling their allotment of fertilizer were persuaded to apply it to their crops. In some cases excessive use of fertilizer was observed and experimental data were used to convince farmers that they could save money by applying less fertilizer.

The distribution of commercial fertilizer and micro-nutrients is under the control of the MOA. The MOA personnel in general, jealously guard this prerogative and were reluctant to consult with EWUP concerning fertilizer and micro-nutrient questions.

A major accomplishment of EWUP was to emphasize testing of plant food materials in farmers' fields rather than in experiment station plots. The farmers learned from watching the EWUP test plots and have encouraged other agencies to also participate more widely in field testing.

8. Soil Characterization

Objectives

- To determine best soil and water management techniques based on soil characteristics.

Accomplishments

Soil surveys were conducted at each field site and Technical Reports #2, #33 and #34 summarized the findings. The purpose of these surveys and reports was to supply basic information about soil characteristics in order to improve the soil and water management in the three field sites. Soil classes, salinity, SAR levels and water table levels were mapped.

Special irrigation problems in the Nile Valley and Delta were found to be generally associated with low infiltration rates of clay soils and their instability due to cracking and swelling during the wetting and drying cycles. Profiles of the clay soils at field sites were almost homogeneous to a depth of 150 cm. The combination of soil type and water table conditions restricted the root zone to the upper 30 to 40 cm of soil profile. This resulted in an available soil moisture capacity of from 50 to 7 cm. The infiltration rate of these soils changed rapidly during an irrigation. Typically the initial rate was 750 mm/hr. and then decreased to about 7 mm after two hours (see TR #57, titled, "Infiltration Studies on Egyptian Vertisols). In many cases the infiltration rate after two hours was nearly zero and this resulted in ponds remaining in field depressions. These ponds were, of course, detrimental to plant survival and farmers generally provided surface drainage systems to remove them quickly after irrigation. This situation calls attention to the need for precision land leveling to eliminate field depressions and careful control of the amount of water applied to fields. These methods can eliminate the need for field drains and thus save land for crop production. The relatively shallow root depth and low permeability of soils create a difficult irrigation management problem. As pointed out elsewhere in this report, EWUP's solution to the problem is precision land leveling and carefully controlled application of water by pump or gravity flow. Technical Report # 64 titled, "Influence of Soil Properties on Irrigation Management In Egypt," summarizes project findings and recommendations.

EWUP initiated studies of Vertisol soils which characteristically swell and then crack with wetting and drying cycles. This process affects earthen ditch banks as well as fields, and results in high seepage losses through the cracks in the banks. A review of literature revealed that this problem is shared with several other areas of the world. Technical Report #73 titled, "Consideration of Various Soil Properties for the Irrigation Management of Vertisols," summarizes the work done on this problem in Egypt and provides a bibliography of literature. Further attention needs to be given to this issue in Egypt.

9. Pest and Disease Control

Objectives

- Identify pest and disease problems which are affected or can be controlled by irrigation management

- Test control methods in pilot program areas.

Accomplishments

A senior level entomologist was provided by the MOA to provide assistance in meeting these objectives. EWUP agronomists had reasonably good training in identifying and controlling plant diseases but needed assistance with pest control.

It was hypothesized that pest and disease control would have some important interrelationships with irrigation management. The first step in identifying these linkages was to provide training in disease and pest management for the staff at EWUP field sites. This was done at each field site in 1980-81. Out of this work Technical Report #24 titled, "Agricultural Pests and Their Control" was developed. The field staff then held educational meetings and demonstrations for farmers to teach them control methods at each of the pilot program areas.

The major linkages discovered between irrigation management and pest control was associated with crickets that destroyed cotton seedlings. It was found that pre-planting irrigation tended to control these crickets. The entomologist from the MOA initiated studies in the MOA to provide information on this subject. Questions need to be answered regarding the degree of control provided by pre-planting irrigation; extent of damage caused by the crickets, the extent of crop reduction from the winter crop caused by the pre-planting irrigation or the reduction from the cotton crop caused by delayed planting of cotton, and the costs to the farmer for the pre-planting irrigation. The issue is complex and is undergoing further study before sound recommendations can be made.

10. Conjunctive Use of Water

Objectives

- Collect and classify water samples from canals, wells and drains at each of the three field sites.

- Evaluate management problems, including leaching requirements, for using irrigation water of various qualities under Egyptian conditions.

Accomplishments

Water samples were collected and analyzed routinely throughout the life of the project. A summary of the data collected is provided in Technical Report #62. An evaluation of problems and potentials is provided in Technical Report #44 titled, "Conjunctive Water Use - The State of the Art and Potential for Egypt."

The water in the Nile River is very low in salt content and the quality of water for irrigation in the canals was good throughout the year. Drainage water at field sites fluctuated in quality according to seasons. During the winter, when little surface runoff or canal water reached the drains, the water quality in the drains diminished. This is because most of the water reaching the drains in the winter had percolated through the soil profile, thereby picking up saline and sodic compounds. For example, the sodicity of the drain water at Beni Magdul, as measured by adjusted SAR, varied annually from 2.46 to 18.69. Soil permeability is severely affected by water testing above an adjusted SAR value of 9. This illustrates that there are potential problems associated with conjunctive water use in Egypt. However, there is still an abundant supply of good quality canal water which could be mixed with lower quality drain water to extend the total supply.

Although it was outside the scope of EWUP to do field testing of conjunctive use alternatives, the project provided valuable data for future use as water becomes more limited and as it becomes necessary to expand supplies through utilization of drainage and underground water sources. Additionally, a water testing laboratory and a trained staff was developed which is now a part of the Water Research Center. This laboratory and staff is continuing the process of collecting and analyzing water samples and adding to the data base.

II. Farm Management and Planning

Objectives

- Evaluate alternative farming systems for Egyptian agriculture.
- Evaluate recommended agronomic and irrigation practices.
- Evaluate the farmers' ability to implement improved practices.

Accomplishments

Perhaps the major accomplishment of EWUP, relative to these objectives, was the establishment of a comprehensive farm management and planning data base within the Institute and the Water Research Center. During the first year of the project a representative sample of fifteen farmers was selected at each field site. These farmers were visited weekly by EWUP staff for purposes of farm planning and record keeping. At the end of each year the records were summarized. An additional use of the farm plans and record books was to prepare enterprise data sheets for each crop. The combined record summaries and enterprise data sheets provided the data base for economic evaluations referred to in the objectives stated above.

The process of analyzing and storing data was computerized, first using the Hewlett Packard Model 9825A and later IBM Personal Computers. Programs and reports of data are included in Technical Reports #11, #23, #30, #31, #45, #75,. #76, #77, and #78. These reports comprise a comprehensive source of data for farm income, expenses and capital investments of small farms in Egypt during the period 1978 through 1983.

Technical Reports #49 and #50 describe and evaluate alternative farming systems used in Egypt. These reports include models which can be used to evaluate alternative systems when changes in technical and price coefficients occur.

Technical Report #12 explains the use of feasibility studies for selecting alternative water distribution systems. It also illustrates the use of the method for several project field sites. This publication is expected to be widely used by the Project Preparation Unit now being established in Egypt through the Irrigation Management Systems Project.

The ability of farmers to implement improved practices often depends on the use and availability of credit. Technical Report #12 describes credit arrangements which are available through Village Bank loans.

Examples of using the data base to evaluate improved practices includes Technical Report #28 titled, "Economic Evaluation of Wheat Trials," #37 titled, "Allocative Efficiency and Equity of Alternative Methods of Charging for Irrigation Water," #63 titled "Watercourse Improvement Evaluation," and #5 titled, "Economic Costs of Water Shortages Along Branch Canals."

An economic publication which received, and is still receiving much attention in Egypt is Technical Report #7 titled, "A Procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt." MOI policy requires that water should be delivered one-half meter below the surface of the farmers' fields. The reason usually given for this policy is that it saves water. However, with reduced labor availability in rural areas many farmers are purchasing low lift pumps powered by diesel or gasoline engines. Thus it is becoming increasingly costly to save water by this method (if in fact it really saves water) and many leaders in agriculture and irrigation are questioning the wisdom of this policy. Consequently, Technical Report #7 has contributed significantly to the on-going policy debate and may be instrumental in eventually shifting to systems which deliver water to farmers' fields with enough head for gravity application.

C. National Conference

The National Conference titled, "Improving Egypt's Irrigation System in the Old Lands," represented a milestone in the project activities. The conference was held in Cairo, March 18th through the 20th, 1984. During the conference, the findings of the project and recommendations for improving the irrigation system at the farm and distributary level were presented by the Egyptian project members. The conference, held in Arabic, represented an extensive effort to publicize the project findings and present these findings to the meeting of over 200 specialists and policy makers representing the highest level in the Ministry of Irrigation, Ministry of Agriculture, and the Egyptian Universities. Additionally, members of USAID, FAO, the World Bank and several other national and multi-national organizations attended the conference. Questions and discussions about the project findings, recommendations and the implications of the project research continued throughout the three day conference.

The Undersecretary of State for Irrigation, who will be in charge of the Regional Irrigation Improvement Project (RIIP), played an active role in the conference discussion.

The results of the conference may not be fully felt immediately. The dissemination of research results is only one aspect of such a conference. Perhaps, more importantly, the conference initiated communication between scientists and policymakers. It presented a research methodology for continuing research needs and presented irrigated agricultural improvements as part of an agricultural system which will require cooperative and coordinated efforts of many different agencies.

D. Final Technical Report

The Final Technical Report of the Egypt Water Use and Management Project was first distributed at the National Conference described previously. This report titled, "Improving Egypt's Irrigation System in the Old Lands. Findings of the Egypt Water Use and Management Project," is a technical summary of the EWUP's activities, its findings and recommendations. The report briefly introduces EWUP, its history, its goals and its research methodology. The report summarizes the characteristics of Egyptian farming, water delivery and groundwater systems and then describes the interventions tested at each of the three field sites. These interventions were classified according to their impact on on-farm water management, the water delivery system, and the irrigation advisory system.

The work on an irrigation advisory service served two purposes. In human terms it coordinated the on-farm and delivery system interventions so that the full beneficial impacts of these interventions could be realized. The creation of the Irrigation Advisory Service at EWUP field sites was a response to the truth that delivery system management and on-farm irrigation management significantly impact one another. The Irrigation Advisory Service also served as a test bed whereby methodologies for introducing ideas related to organizing farmers could be developed. The Irrigation Advisory Service is the foundation upon which the RIIP implementation plans were developed.

The recommendations of the technical final report were grouped in the following subject areas:

1. Research process.
2. Irrigation parameters.
3. Farmer involvement.
4. Management.
5. Agronomic and structural changes.
6. Training.

The recommendations in the Technical Final Report are summarized from over 70 published project technical reports. The reader is urged to read the Technical Final Report and to refer to the other EWUP technical reports for more specific recommendations.

The following reports are contractually required report subjects:

1. On-Farm Irrigation report or reports with recommendations.

   a. PTR 16a Irrigation System Improvement by Simulation and Optimization: 1. Theory

   b. PTR 16b Irrigation System Improvement by Simulation and Optimization: 1. Application

   c. PTR 17 Optimal Design of Border Irrigation Systems

   d. PTR 29 Irrigation Practices Reported by EWUP Farm Record Keepers

   e. PTR 35 Farm Irrigation System Design

   f. PTR 36 Discharge and Mechanical Efficiency of Egyptian Water-Lifting Wheels

   g. PTR 40 A Procedure for Evaluating Crop Growth Environments for Optimal Drain Design

   h. PTR 41 The Influence of Farm Irrigation System Design and Precision Land Leveling on Irrigation Efficiency and Irrigation Water Management

   i. PTR 45 Irrigation Practices of EWUP Study Cases-Abyuha and Abu Raya Sites for 1979-1980, 1980-1981 and 1981-1982

   j. PTR 54 Criteria for Determining Desirable Irrigation Frequencies & Requirements and Comparisons with Conventional Frequencies and Amounts Measured in EWUP

   k. PTR 57 Infiltration Studies on Egyptian Vertisols

   l. PTR 61 The Effect of Irrigation Water Management on High Water Tables in Egypt

   m. PTR 67 Sociological Evaluation of the On-Farm Irrigation Practices Introduced in Kafr El Sheikh

   n. PTR 71 Impact of Turnout Size and Condition on Water Management on Farms

2. Water Distribution system report or reports with recommendations

   a. PTR 20 The Rotation Water Distribution System vs. The Continual Flow Water Distribution System

   b. PTR 22 The Hydraulic Design of Mesqa 10, An Egyptian Irrigation Canal

c. PTR 46 Hydraulic Design of a Canal System For Gravity Irrigation

d. PTR 48 A Method For Evaluating and Revising Irrigation Rotations

e. PTR 51 Structural Specifications and Construction of a Canal System For Gravity Irrigation

f. PTR 56 Economic Analysis for Canal Linings in Egypt

g. PTR 72 Baseline Data For Improving of A Distributary Canal System

3. Farmer Organizations report or reports with recommendations

a. PTR 26 Social Dimensions of Egyptian Irrigation Patterns

b. PTR 65 Experiences in Developing Water Users' Associations

c. PTR 68 Developing Local Farmer Organizations: A Theoretical Procedure

d. PTR 69 The Administrative and Social Environment of the Farmers in an Egyptian Village

4. Irrigation Advisory Service/Farm Management and Planning report or reports with recommendations

a. PTR 13 The Role of Rural Sociologists in An Interdisciplinary, Action-Oriented Project: An Egyptian Case Study

b. PTR 19 Effective Extension for Egyptian Rural Development: Farmers' and Officials' Views on Alternative Strategies

c. PTR 27 Alternative Approaches in Extension and Rural Development Work: An Analysis of Differing Perspective in Egypt

d. PTR 66 The Irrigation Advisory Service: A Proposed Organization for Improving On-Farm Irrigation Management in Egypt

5. Water Budget report for each area

a. PTR 47 Water Budgets For Irrigated Regions in Egypt

b. PTR 60 Hydraulic Conductivity and Vertical Leakage in the Clay-Silt Layer of the Nile Alluvium in Egypt

6. Land Leveling reports with recommendations

   a. PTR 38 Precision Land leveling on Abu Raya Farms, Kafr El-Sheikh Governorate, Egypt

   b. Manual 5 Precision Land Leveling Data Analysis Program for HP 9825 Desktop Calculator

   c. Manual 8 Thirty Steps to Precision Land Leveling

7. Soil Fertility reports with recommendations

   a. PTR 10 Soil Fertility Survey in Kafr El-Sheikh, El Mansuriya and El-Minya Pilot Projects

   b. PTR 52 Status of Zinc in the Soils of Project Sites

8. Soil Characterization reports with recommendations

   a. PTR 2 Preliminary Soil Survey Report for the Beni Magdul and El-Hammami Areas

   b. PTR 33 Soil Survey Report for Abyuha Area, Minya Governorate.

   c. PTR 34 Soil Survey Report for Abu Raya, Kafr El-Sheikh Governorate

   d. PTR 57 Infiltration Studies on Egyptian Vertisols.

   e. PTR 64 Influence of Soil Properties on Irrigation Management in Egypt

   f. PTR 73 Consideration of Various Soil Properties for the Irrigation Management of Vertisols.

9. Pest and Disease Control reports with recommendations

   a. PTR 24 Agricultural Pests and Their Control

10. Conjunctive Use of Water reports with recommendations

   a. PTR 44 Conjunctive Water Use - The State of the Art and Potential for Egypt

   b. PTR 62 On the Water Quality of Irrigation Canals, Drains and Groundwater in Mansuriya, Kafr El Sheikh, & El-Minya Project Sites

11. Farm Management and Planning reports with recommendations

   a. PTR 11 Kafr El-Sheikh Farm Management Survey Crop Enterprise Budgets and Profitability Analysis.

   b. PTR 12 Use of Feasibility Studies in the Selection and Evaluation of Pilot Studies for Alternative Methods of Water Distribution in Egypt

c. PTR 15 Village Bank Loans to Egyptian Farmers

d. PTR 23 Farm Record Summary and Analysis for Study Cases at Abyuha, Mansuriya and Abu Raya Sites, 1979-1980

e. PTR 28 Economic Evaluation of Wheat Trials at Abyuha, El-Minya Governorate - Winter 1979-1980 - 1980-1981

f. PTR 30 The Role of Farm Records in the Egypt Water Use and Management Project

g. PTR 31 Analysis of Farm Management Data From Abyuha Project Site

h. PTR 37 Allocative Efficiency and Equity of Alternative Methods of Charging for Irrigation Water

i. PTR 43 Planning Irrigation Improvements in Egypt: The Impact of Policies and Prices on Farm Income and Resource Use

j. PTR 49 Farming System of Egypt: With Special Reference To EWUP Project Sites

k. PTR 50 Farming System Economic Analysis of EWUP Study Cases

l. PTR 63 Watercourse Improvement Evaluation (Mesqa #26 & Mesqa #10)

CHAPTER VII. REPORTS

The activities and accomplishments of the project are documented in its reports. There were four types of reports: (1) Project Technical Reports (PTR) which were distributed widely; (2) Manuals, also distributed widely; (3) Draft Working Papers (DWP) which were internal documents with limited distribution, and (4) Conference presentations and Journal publications. In addition, there is this report and the Final Report. This latter report was the basis of the National Irrigation Conference and was also widely distributed. Also, there were two brochures and training manuals published.

Project Technical Reports and Manuals were technically reviewed by project personnel and represent a final product. The difference between the two is that a Manual described a procedure for doing something, whereas Project Technical Reports give project findings. Draft Working Papers were the preliminary reports prepared by project personnel either as the result of personal initiative or collectively as a report documenting a project output. Many of the Draft Working Papers became Project Technical Reports. Although Draft Working Papers were not circulated widely they were furnished to the Government of Egypt, AID, World Bank, FAO and other officials who would have a need for the information on a timely preliminary basis. The following is a list of the reports of the project.

PROJECT TECHNICAL REPORTS

NO.	TITLE	AUTHOR
PTR#1	Problem Identification Report for Mansuriya Study Area, 10/77 to 10/78	Egyptian & American Field Teams
PTR#2	Preliminary Soil Survey Report for the Beni Magdul and El-Hammami Areas	A. D. Dotzenko, M. Zanati, A. A. Abdel Wahed, & A. M. Keleg
PTR#3	Preliminary Evaluation of Mansuriya Canal System, Giza Governorate, Egypt	Egyptian & American Field Teams
PTR#4	On-farm Irrigation Practices in Mansuriya District, Egypt	M. El-Kady, W. Clyma & M. Abu-Zeid
PTR#5	Economic Costs of Water Shortage Along Branch Canals	A. El Shinnawi M. Skold & M. Nasr
PTR#6	Problem Identification Report For Kafr El-Sheikh Study Area.	Egyptian & American Field Teams.
PTR#7	A Procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt	H. Wahby, M.E. Quenemoen & M. Helal

PTR#8	Farm Record Summary and Analysis for Study Cases at Abu Raya and Mansuriya Sites, 1978/1979	F. Abdel Al & M. Skold
PTR#9	Irrigation & Production of Rice in Abu Raya, Kafr El-Sheikh Governorate	Kafr El-Sheikh Team as Compiled by T. W. Ley & R. L. Tinsley
PTR#10	Soil Fertility Survey in Kafr El-Sheikh, El Mansuriya and El-Minya Sites	M. Zanati, P. N. Soltanpour, A. Mostafa, & A. Keleg
PTR#11	Kafr El-Sheikh Farm Management Survey Crop Enterprise Budgets and Profitability Analysis	M. Haider & F. Abdel Al
PTR#12	Use of Feasibility Studies and Evaluation of Irrigation Projects: Procedures for Analyzing Alternative Water Distribution System in Egypt	R. J. McConnen, F. Abdel Al, M. Skold, G. Ayad & E. Sorial
PTR#13	The Role of Rural Sociologists in an Interdisciplinary, Action-Oriented Project: An Egyptian Case Study	J. Layton & M. Sallam
PTR#14	Administering an Interdisciplinary Project: Some Fundamental Assumptions Upon Which to Build	J. B. Mayfield & M. Naguib
PTR#15	Village Bank Loans to Egyptian Farmers	G. Ayad, M. Skold, & M.E. Quenemoen
PTR#16A	Irrigation System Improvement By Simulation and Optimization: 1. Theory	J. Mohan Reddy & W. Clyma
PTR#16B	Irrigation System Improvement By Simulation and Optimization: 1. Application	J. Mohan Reddy & W. Clyma
PTR#17	Optimal Design of Border Irrigation System	J. Mohan Reddy & W. Clyma
PTR#18	Population Growth and Development in Egypt: Farmers' and Rural Development Officials' Perspectives	M. Sallam, E.C. Knop, & S.A. Knop
PTR#19	Rural Development and Effective Extension Strategies: Farmers' and Officials' Views	M. S. Sallam, E. C. Knop, & S. A. Knop

PTR#20	The Rotation Water Distribution System vs. The Continual Flow Water Distribution System	M. El-Kady, J. Wolfe, & H. Wahby
PTR#21	El-Hammami Pipeline Design	Fort Collins Staff Team
PTR#22	The Hydraulic Design of Mesqa 10, An Egyptian Irrigation Canal	W.O. Ree, M. El-Kady, J. Wolfe, & W. Fahim
PTR#23	Farm Record Summary and Analysis for Study Cases at Abyuha, Mansuriya and Abu Raya Sites, 79/80	F. Abdel Al, & M. Skold
PTR#24	Agricultural Pests and Their Control: General Concepts	E. Attalla
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PTR#28	Economic Evaluation of Wheat Trials at Abyuha, El-Minya Governorate 79/80-80/81	N. K. Farag, E. Sorial, & M. Awad
PTR#29	Irrigation Practices Reported by EWUP Farm Record Keepers	F. Abdel Al, M. Skold & D. Martella
PTR#30	The Role of Farm Records in the EWUP Project	F. Abdel Al & D. Martella.
PTR#31	Analysis of Farm Management Data From Abyuha Project Site	E. Sorial, M. Skold, R. Rehnberg & F. Abdel Al
PTR#32	Accessibility of EWUP Pilot Sites (Draft Working Paper - Cairo)	A. El-Kayal, S. Saleh, A. Bayoumi & R. L. Tinsley
PTR#33	Soil Survey Report for Abyuha Area Minya Governorate	A. A. Selim, M. A. El-Nahal, & M. H. Assal

PTR#34	Soil Survey Report for Abu Raya Area, Kafr El-Sheikh Governorate	A. A. Selim, M. A. El-Nahal, M. A. Assal & F. Hawela.
PTR#35	Farm Irrigation System Design, Kafr El-Sheikh, Egypt	Kafr El-Sheikh Team as compiled by T. W. Ley
PTR#36	Discharge and Mechanical Efficiency of Egyptian Water-Lifting Wheels	R. Slack, H. Wahby, W. Clyma, & D. K. Sunada
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PTR#38	Precision Land Leveling On Abu Raya Farms, Kafr El-Sheikh Governorate, Egypt	Kafr El-Sheikh Team as compiled by T. W. Ley
PTR#39	On-Farm Irrigation Practices for Winter Crops at Abu Raya (Draft - Cairo)	A. F. Metawie, N. L. Adams, & T. A. Tawfic
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PTR#47	Water Budgets for Irrigated Regions in Egypt	M. Helal, A Nasr, M. Ibrahim, T. K. Gates, W. O. Ree & M. Semaika

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PTR#50	Farming System Economic Analysis of EWUP Study Cases	F. Abdel Al, D. Martella, & D. W. Lybecker
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PTR#63	Watercourse Improvement Evaluation (Mesqa #26 and Mesqa #10)	R. McConnen, E. Sorial, & G. Fawzy
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PTR#73	Considerations of Various Soil Properties For The Irrigation Management of Vertisols	C. W. Honeycutt, & R. D.Heil
PTR#74	Farmer's Irrigation Practices in El-Hammami Sands	T. A. Tawfic, & R. J. Tinsley
PTR#75	Abyuha Farm Record Summary 1979-1983	EWUP Field Team
PTR#76	Kafr El Sheikh Farm Record Summary	EWUP Field Team

PTR#77	El Hammami Farm Record Summary & Analysis	M. Haider & M. Skold
PTR#78	Beni Magdul Farm Record Summary	EWUP Field Team
PTR#79	Analysis of Low Lift Irrigation Pumping	H. R. Horsey, E. V. Richardson M. Skold & D. K. Sunada

MANUALS

NO.	TITLE	AUTHOR
MAN.#1	Trapezoidal Flumes for the Egypt Water Use Project	A. R. Robinson
MAN.#2	Programs for the HP Computer Model 9825 for EWUP Operations	M. Hélal, D. Sunada, J. Loftis, M. Quenemoen, W. Ree, R. McConnen, R. King, A. Nazr & R. Stalford
MAN.#3 (DWP#39)	Evaluation of Furrow Irrigation Systems	T. W. Ley & W. Clyma
MAN.#4 (DWP#40)	Evaluation of Graded Border Irrigation	T. W. Ley & W. Clyma
MAN.#5	Precision Land Leveling Data Analysis Program for HP9825 Desktop Calculator	T. W. Ley
MAN.#6 (DWP#30)	Program for Calculators HP-67 and HP-97	G. Ayad
MAN.#7 (DWP#37)	A Systematic Framework for Development of Solutions	M. Lowdermilk
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MAN.#9	Alphabetical List of Some Crops and Plants with Their English, Egyptian, Botanical & Arabic Names and Vocabulary of Agricultural and other Terms Commonly Used.	G. Ayad
MAN.#10	EWUP Farm Record System	Farouk Abdel Al, David R. Martella, & Gamal Ayad

SPECIAL PUBLICATIONS

TITLE	AUTHOR
Improving Egypt's Irrigation System In The Old Lands, Findings of the Egypt Water Use and Management Project - Final Report Presented at the EWUP National Conference - Spring 1984.	EWUP Staff
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BROCHURES

TITLE	AUTHOR
Egypt Water Use and Management Project	H. Wahby, M. E. Quenemoen, E. V. Richardson, N. Dimick, D. Lattimore & E. Sherman
The Irrigation Association	H. Wahby M. E. Quenemoen, E. V. Richardson, N. Dimick, D. Lattimore, M. Sallam & J. Layton.

TRAINING MANUALS

VOL.	TITLE
Volume I	How-To-Do-It-Series
Volume II	On-Farm Analysis of Irrigation Systems

CONFERENCE PRESENTATIONS AND JOURNAL PUBLICATIONS

TITLE	AUTHOR
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"The Agricultural Economics Profession in Egypt - Current Status and Special Needs," presented to the American Agricultural Economics Association, March 1979.	M. E. Quenemoen & J. Fitch
"Egyptian Farmer's Perception of Alternative Extension Strategies and Tactics in Irrigated Agricultural Development," presented at the European Congress of Rural Sociology, Cordoba, Spain, April 1979.	M. Sallam, E. Knop & S. Knop
"Price Policy Implications for Small Farms in Kafr El Sheikh Governorate," presented at the FAO Workshop on Improved Farming Systems for the Nile Valley, Cairo, Egypt, May 1979.	M. E. Quenemoen
"Farm Water Management in the Nile Valley," presented at the Conference on Water Resource Planning, Cairo, Egypt, June 1979.	E. V. Richardson & R. H. Brooks
"An Economic Analysis of Water Lifting with a Diesel Pump For a Farm at El Hammami," presented at the Middle Eastern Water Management Training Seminar sponsored by the Research Institute for Water Management and Irrigation Technology, Egyptian Ministry of Irrigation, November 1979.	M. E. Quenemoen & E. Shinnawi
"A Data Management System for Interdisciplinary Research in Agricultural Water Use," Presented at the ASAE Meeting, New Orleans, Louisiana, December 1979.	J. C. Loftis & W. Clyma
"On-Farm Irrigation Practices in Mansuriya District, Egypt," presented at the ASAE Meeting, New Orleans, Louisiana, December 1979.	M. El-Kady, W. Clyma, & M. Abu-Zeid
"Soil Moisture Characteristic of Some Irrigated Soils in Egypt," presented at 1979 Agronomy Meetings, Fort Collins, Colorado, 1979.	A. Moustafa, M. Zanati & A. Dotzenko
"Soil Fertility of Some Irrigated Soils in Egypt," presented at 1979 Agronomy Meetings in Fort Collins, Colorado, 1979.	R. Zanati, M. El-Hussanini, A. Moustafa & A.D. Dotzenko
"The Effect Of Zinc Sulphate on Rice Production in the Nile Delta," presented at 1979 Agronomy Meetings in Fort Collins, Colorado, 1979.	A. Keleg, S. A. Hafez, & A. D. Dotzenko

"Irrigation System Improvement Concepts," presented at the ASAE Regional Meeting, Las Cruces, New Mexico, March 1980.	W. Clyma & T. Ley
"On-Farm Water Management Programs in Egypt," presented at the FOA Expert Consultation Meeting, On-Farm Water Management, Beltsville, Maryland, May 1980.	M. Abu-Zeid
"Bureaucracy and Development: Insight from Egypt," prepared for the Journal of Applied Social Sciences, Special Issue: Bureaucratic Change. July 1980.	E. Knop & S. Knop
"Farm Systems Management," presented at the Farm Systems Conference, Las Cruces, New Mexico, August 1980.	H. Wahby
"Social Dimensions of Egyptian Irrigation Patterns," presented at the 5th World Congress for Rural Sociology, Mexico City, Mexico, August 1980.	E. Knop, M. S. Sallam, S. Knop & M. El-Kady
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"Systems Analysis for Improvement of Surface Irrigation," Presented to the ASAE Summer Meeting, Orlando, Florida, June 1981.	T. Gates, W. Clyma, & T. Ley
"An Agricultural Development Model for Egypt," presented at 1981 Summer Meeting ASAE, Sheraton-Twin Towers, Orlando, Florida, June 1981.	W. Clyma, M. Lowdermilk, E. V. Richardson, W. Schmehl, M. Skold, & D. K. Sunada
"Small Farm Rice Irrigation In Egypt," presented at the ASAE Meeting, Chicago, Illinois, December 1981.	A. F. Metawie, T. Ley, & R. Tinsley
"Problems in Irrigating Vertisols in Egypt," presented at 1981 ASA National Meetings, Atlanta, Georgia, 1981.	A. Taher, A. S. Abdel-Wahed, & R. Tinsley
"Rice Related Studies of the Egypt Water Use and Management Project: Irrigation, Micronutrients, Fertility and Mechanization," presented at the National Rice Conference, 1981.	T. Ley & R. Tinsley

"Analysis of Basin Irrigation Performance with Variable Inflow Rate," published in Agricultural Water Management, 5 (1982): 295-308.	J. M. Reddy & W. Clyma
"Drainage: An Incremental Net Benefit Approach for Optimal Design," presented at the Proceedings of the Fourth National Drainage Symposium, ASAE, St. Joseph, MI., 1982.	D. S. Durnford, T. H. Podmore, & E. V. Richardson
"Drainage Design Incorporating Cost," presented at ASCE Irrigation and Drainage Division, 1982.	D. S. Durnford T.H. Podmore & E.V. Richardson
"Characterization and Water Management of Alluvial Vertisols in Egypt," presented at workshop on Vertisols and Aridsoils, Khartoum, Sudan, November 1982.	H. Hamdy, R. Tinsley, & A. Moustafa
"Border-Ditch Irrigation In Colorado," published in the Transactions of the ASAE, 25 (6): 1612-1616, 1621, 1983.	F. Izuno, W. Clyma & T. H. Podmore
"Valuing Irrigation Water in Egypt's Northern Delta Region," presented at Annual Conference, Western Regional Science Association, Honolulu, Hawaii, February 1983.	R. L. Bowen & R. A. Young
"Choosing Optimal Design Depth for Surface Irrigation Systems," published in Agricultural Water Management, 6 (1983) 335-349 Elsevier Science Publishers B.V., Amsterdam, The Netherlands.	J. M. Reddy & W. Clyma
"Hydraulic Design of a Canal System for Gravity Irrigation," published in ASAE Paper No. 83-2167, for presentation at the 1983 Summer Meeting, Montana State University, Bozeman, Montana, June 1983.	T. Gates, W. Ree, & M. Helal
"Egypt's High Aswan Dam: Progress or Retrogradation," presented at 1979 National Committee of ICID, Annual Meeting, September 1983.	E. V. Richardson & W. Clyma
"Irrigation Water Distribution Along Branch Canals in Egypt: Economic Effects," seminar presented at Wye College, University of London, October, 1983 and at Oxford University, November, 1983.	M. Skold
"Farm Irrigation System Improvement, Abu Raya, Egypt," presented at the 1983 Winter Meeting, ASAE, Hyatt Regency, Chicago, Illinois, December 1983.	T. Ley, K. Litwiller, & A. F. Metawie

"Evaluation of Irrigation System Performance Economics," paper presented at workshop sponsored by Water Resources Development and Management Service, Land and Water Development Division, FAO, United Nations Rome, Italy, December 1983.	M. Skold & I. Carruthers
"Infiltration Studies On Egyptian Vertisols", presented at the Poster Session of the National Conference on Advances in Infiltration, Hyatt Regency Illinois Center, Chicago, Illinois, December 1983.	K. Litwiller, R. Tinsley, H. Deweeb, & T. Ley
"Furrow Irrigation Practices in Northern Colorado," published in the Transactions of the ASAE, 1984, 24(3):610-616, 623.	T. Ley & W. Clyma
"Economic Costs of Water Shortages Along Branch Canals in Egypt," published in EDCC (Economic Development and Cultural Change), January 1984.	M. Skőld
"Probability Based Design Evapotranspiration," presented at ASAE Conference, Knoxville, Tennessee, June 1984.	S. Sritharan, W. Clyma, & E. V. Richardson
"Application System Design and Long-Term Watertable Build-Up In Irrigated Areas," presented at the ASCE Specialty Conference Flagstaff, Arizona, July 1984.	S. Sritharan, W. Clyma, E. V. Richardson & D. K. Sunada
"On-Farm Application System Design and Project Scale Water Management," presented at the ASCE Specialty Conference, Flagstaff, Arizona, July, 1984	S. Sritharan, W. Clyma & E. V. Richardson
"Optimal Turnout Areas in Irrigation Projects," Submitted to Water Resources Research, 1984	S. Sritharan, W. Clyma & E. V. Richardson
"Farming Systems Contributions To Improving Small Farm Irrigation," presented at 1984 Symposium on Farming Systems, Manhattan, Kansas, 1984.	R. Tinsley, & M. Meleha
"Evaluating Distributary Canals with Water Level Records," presented at African Regional Symposium on Small Holder Irrigation, Harare, Zimbabwe, September 1984.	M. El-Kady, H. Wahby, & R. Tinsley
"Use of Farm Records in Irrigation Planning for Small Holder Irrigation Schemes," presented at African Regional Symposium on Small Holder Irrigation, Harare, Zimbabwe, September 1984.	F. Abdel-Al, & R. L. Tinsley

"Improvement of Irrigation Outlets," presented at ASCE meeting, Phoenix, Arizona, Summer, 1984.	R. Ibrahim, M. El-Kady, J. Ruff & R. Robinson
"Analysis of Low Lift Irrigation Pumping," presented at ASCE meeting, Phoenix, Arizona, Summer, 1984.	H. Horsey, E. V. Richardson, M. Skold & D. K. Sunada
"On Farm & Delivery System Water Management," presented at ASCE meeting, Phoenix, Arizona, Summer, 1984.	E. V. Richardson, H. Horsey & J. Andrew
"Border Irrigation Performance Parameter Functions by Dimensional Analysis," presented at ASCE meeting, Phoenix, Arizona, Summer, 1984.	O. El-Hakim, W. Clyma & E. V. Richardson
"Developing Farm Level Information for Improved Irrigation Water Management in Developing Countries," presented at 1984 ISARD Invitied Seminar Series, Colorado State University, December, 1984.	D. Lybécker & M. Skold

INTER-OFFICE DRAFT WORKING PAPERS

NO.	TITLE	AUTHOR
DWP#1	Summary Of EWUP With Its Accomplishments	R. Brooks & H. Wahby
DWP#2	A Preliminary Comparison of Two Cropping Schemes at Abyuha, Minya Governorate. Broad Beans-Fenugreek-Cotton, vs. Berseem and Cotton	E. Sorial & M. E. Quenemoen
DWP#3	Corn Insects	E. Attalla
DWP#4	Rice Insects	E. Attalla
DWP#5	Major Field Crop Insects And Their Control	E. Attalla
DWP#6	Cutthroat Flume Metric Equations.	M. Helal.
DWP#7	Progress Report of Rice Planting Trials at Abu Raya, Kafr El-Sheikh Govenorate in 1979	M. E. Quenemoen, E. Sorial & R. Darwish
DWP#8	Calculations of Machinery Costs for Egyptian Conditions	R. J. McConnen, M. Helal, G. Ayad, A. Bayoumi, J. Loftis, & M. E. Quenemoen

DWP#9	Honey Production At Kafr El-Sheikh Governorate	Y. Youssef
DWP#10	An Economic Evaluation of Corn Trials At Abyuha.	E. Sorial, Sattar, & M. Awad
DWP#11 (PTR#5)	Economic Costs of Water Shortages Along Branch Canals.	Shinnawi, M. Skold & M. L. Nasr
DWP#12	Cost of Production of Irrigated Soybeans and Comparison with Cotton in Egypt	M. E. Quenemoen, G. Ayad & R. McConnen
DWP#13	Sociological Survey for Beni Magdul Area	F. Abdel Al
DWP#14	Water Budget for Beni Magdul Area In 1979	W. Fahim
DWP#15	An Economic Analysis for Squash Trials At El-Hammami	M. L. Nasr
DWP#16	An Economic Analysis for Tomato Trials at El-Hammami	M. L. Nasr
DWP#17	The Effect of Soil and Pest Management of Farm Production: I. Squash, II. Cabbage, III. Tomato	M. Semaika & H. Golus
DWP#18 (PTR20)	Rotation System or Continuous Flow System for Irrigation Canals in Egypt	M. El-Kady, J. Wolfe & H. Wahby
DWP#19	An Economic Analysis of Cabbage Trials at El-Hammami for One Feddan	M. L. Nasr & F. Gamal
DWP#20	An Economic Analysis for Wheat Trials At Beni Magdul	M. L. Nasr
DWP#21	Water Lifting by Sakia: the Incremental Cost of Cow Power	F. Walters
DWP#22	Survey of Pests Infesting Mansuriya Vegetables and Crops (Beni Magdul and El-Hammami Areas) and Their Control	E. Attalla
DWP#23 (PTR7)	A procedure for Evaluating the Cost of Lifting Water for Irrigation in Egypt	H. Wahby, M. E. Quenemoen & M. Helal
DWP#24 (PTR19)	Effective Extension for Egyptian Rural Development: Farmers' and Officials' Views on Alternative Strategies	M. S. Sallam, E. Knop & S. Knop
DWP#25 (PTR18)	Population Growth and Development in Egypt: Farmers' and Rural Development Officials' Perspectives	M. S. Sallam, E. Knop & & S. Knop

DWP#26 (PTR8)	Farm Record Summary and Analysis for Abu Raya and Mansuriya Sites 1978-1979	F. Abdel Al & M. Skold
DWP#27	The Beni Magdul Water Budget, January1979 to April 1980	W. Ree, D. Sunada & J. Ruff
DWP#28	Roller Bed Shaper for Basin Furrow Irrigation	N. Illsley & A. Cheema
DWP#29	Economic Feasibility of Concrete Lining for the Beni Magdul Canal and Branch Canal	G. Ayad, G. N. Farid & M. E. Quenemoen
DWP#30 (Man.6)	Programs for Calculators HP-67 and HP-97	G. A. Ayad.
DWP#31	On-Farm Water Management Investigations in Mansuriya District, 1979-1980	J. Wolfe
DWP#32	Sociological Data of the Project Sites: Some Criteria for Understanding the Implementation Process	EWUP Sociology Team
DWP#33	Analysis of Soil Water Data Collected from Four Winter Crops In El-Minya, 1979-1980	A. Sattar, A. Taher & R. Tinsley
DWP#34	Use of Chemical Fertilizers in Mansuriya Location	M. Zanati, M. L. Nasr & G. Ayad
DWP#35 (PTR24)	Agricultural Pests and Their Control: General Concepts	E. Attalla
DWP#36	Conveyance Losses in Canals	F. Shahin, M. S. Issa, B. Issac & W. Fahim
DWP#37 (Man.7)	A Systematic Framework for Development of Solutions	M. Lowdermilk
DWP#38	Response Of Rice, Wheat And Flax To Zinc Applications On The Soils Of The Nile Delta	A. D. Dotzenko, M. Zanati, A. Keleg, A. Hafez, A. Mostafa & A. Serry
DWP#39 (Man.3)	Evaluation of Furrow Irrigation Systems	T. Ley & W. Clyma.
DWP#40 (Man.4)	Evaluation of Graded Border Irrigation Systems	T. Ley & W. Clyma.
DWP#41	The Cost of Delivery of Irrigation Water	R. Anderson

DWP#42	Agrometerological Stations for Crop Water Requirements	R. Cuenca
DWP#43	Soil Fertility Survey of Kafr El-Sheikh: I. Phosphorus	P. Soltanpour
DWP#44	Soil and Land Classification	R. D. Heil
DWP#45 (PTR17)	Optimal Design of Border Irrigation Systems	J. M. Reddy & W. Clyma
DWP#46A (PTR#16A)	Irrigation System Improvement by Simulation and Optimization: I. Theory	J. M. Reddy & & W. Clyma
DWP#46B (PTR#16B)	Irrigation System Improvement by Simulation And Optimization: 2. Application	J. M. Reddy & & W. Clyma
DWP#47	Status Report on the Water Management Alternatives Study	R. King
DWP#48	Economic Evaluation of Zinc Sulphate Application on Wheat at Abyuha	E. Sorial, M. Awad & S. Saleh, A. Rayes, M. Awad, & S. Salah
DWP#49	Response of Wheat to Zinc Foliar Spray With Respect to Time of Application	A. Keleg, A. El-Rases, M. Awad, & S. Salah
DWP#50a	Challenge of Implementing an Irrigation Program in an Egyptian Village	J. Mayfield, & M. Naguib
DWP#50b	Survey of Outlets on Dakalt Canal Downstream of Helal Regulator, Abu Raya, Kafr El-Sheikh	K. E. El Din, A. Dardir, Kafr El-Sheikh Team
DWP#51 (PTR12)	Benefits and Costs of the Pipeline System Proposed for the El-Hammami Canal	F. Abdel Al & M. Skold
DWP#52	Index of Root Penetration as Related to Water Tables (A Preliminary Study)	R. Tinsley & M. Zanati
DWP#53 (PTR15)	Village Bank Loans to Egyptian Farmers	G. Ayad, M. E. Quenemoen & M. Skold
DWP#54	Sociological Evaluation of EWUP Farm Practices in Kafr El-Sheikh, Summer, 1980	A. F. Masry & A. Attar

DWP#55	Sweet Corn as a New Crop in the Cairo Mansuriya Area	Shinnawi, Sabah, Naguib, Semaika, & W. Braunworth
DWP#56 (PTR14)	The Challenge of Implementing an Irrigation Program in an Egyptian Village (Organization, Development and Leadership Training Needs in the EWUP)	J. B. Mayfield, & M. Naguib
DWP#57	1979/1980 Winter Season Field Trails Wheat Crop, Kafr El-Sheikh	Kafr El-Sheikh Team
DWP#58	Soil Fertility Status of Some Irrigated Soils in Egypt	M. Zanati, M. Hussini, A. Mostafa, & A. D. Dotzenko
DWP#59	Response of Rice to Application of Zinc	A.M. Keleg, S. Abdel Hafez, M. Meleha & A. D. Dotzenko
DWP#60	Soil Moisture Characteristics of Irrigated Soils in Egypt	A. Mostafa, M. R. Zanati & A. D. Dotzenko.
DWP#61	Mid-season Progress Report of Pilot Programs, Winter Season 1980/1981, Kafr El-Sheikh	Kafr El-Sheikh Team
DWP#62 (PTR13)	The Role of Rural Sociologists in an Interdisciplinary Action-Oriented Project: An Egyptian Case Study	J. Layton & M. S. Sallam
DWP#63 (PTR9)	Rice Related Studies of EWUP: Irrigation, Micronutrients, Fertility and Mechanization	EWUP Team
DWP#64 (PTR12)	The Use of Feasibility Studies in the Selection and Evaluation of Pilot Studies for Alternative Methods of Water Distribution in Egypt	R. McConnen, A. Farouk, M. Skold, G. Ayad & E. Sorial
DWP#65	1980-1981 Farm Plans Summary-Study Cases: Abyuha, El-Hammami and Beni Magdul	A. Farouk, E. Sorial, Shinnawi & G. Fawzy
DWP#66	Improvement of Egyptian Irrigation Outlets	M. El-Kady, & A. R. Robinson
DWP#67	Introduction to the Cooperation in Kafr El-Sheikh	A. Fattah, El Masry & A. El Attar

DWP#68	The Livestock Enterprise on Study Farms in Abu Raya, Kafr El-Sheikh Selected Indirect Effects of Water Distribution in Field Management	F. Walters
DWP#69	LEFT BLANK TO INDICATE BEGINNING OF STAFF PAPERS INTO DRAFT WORKING PAPERS (DWP).	
DWP#70 (PTR8)	Farm Record Summary and Analysis For Study Cases at Abyuha, Mansuriya and Abu Raya Sites	F. Abdel Al & M. Skold
DWP#71 (PTR12)	Pre-Feasibility Study - Economic Evaluaction of Elevating Mesqa 10 at Beni Magdul	F. Abdel Al, G. Ayad & G. Fawzy
DWP#72	Maize Production on Mesqa 6 at Beni Magdul, 1980	M. Khidir, S. Mahmoud, H. Mahmoud, G. Fawzy, F. Abdel Al & W. Braunworth
DWP#73 (PTR27)	Alternative Approaches in Extension and Rural Development Work: An Analysis of Differing Perspectives in Egypt	M. Sallam & E. Knop
DWP#74	Cotton Field Trials - Summer 1980, Abu Raya Area	M. Awad, A. El-Kayal & T. Ley
DWP#75	Final Report - 1980-81 Winter Season On-Farm Pilot Program, Kafr El-Sheikh	Kafr El-Sheikh Team
DWP#76 (Man.#1)	Trapezoidal Flumes for the EWUP	A. R. Robinson
DWP#77 (PTR#10)	Soil Fertility Survey in Kafr El-Sheikh El-Mansuriya and El-Minya Pilot Projects	M. Zanati, P. Soltanpour, M. Mostafa & A. Keleg
DWP#78 (PTR#11)	Kafr El-Sheikh Farm Management Survey-Crop Enterprise Budgets and Profitability Analysis	M. Haider & F. Abdel Al
DWP#79	Root Penetration Index For Winter Crops, 1981	R. Tinsley, Bayoumi, Meleha & Salah
DWP#80	Data Base Book for Abyuha Canal and Mesqa 26	R. Rehnberg, F. Abdel Al, & G. Ayad

DWP#81	On-Farm Water Management Trails at Abyuha, Winter Season 1980-1981 and Tensiometer Readings During the 1979-1980 Season	E. Wafik, M. Awad, A. Abdel Naim, S. Saleh, A. Sattar, & J. Wolfe
DWP#82	On-Farm Irrigation Practices for Winter Crops at Abu Raya, Kafr El-Sheikh, (Flax, Wheat and Berseem) 1978-1979	A. Metawie, N. Adams, T. Tawfik, & S. El Din
DWP#83	On-Farm Water Management Trials at Abyuha, Summer Season 1980-1981	M. Awad, A. Abdel Naim, S. Saleh, A. Sattar, & J. Wolfe
DWP#84	Economic Evaluation of Wheat Trials at Abyuha, El-Minya Government Winter 1979-80	N. K. Farag, E. Sorial, & M. Awad
DWP#85	Hydraulic Conductivity Tests Using the Auger-Hole Method, Kafr El-Sheikh	T. Ley & M. Awad
DWP#86	Kafr El-Sheikh On-Farm Pilot Program 1981 Summer Season	Kafr El-Sheikh Team
DWP#87	Wheat Irrigation and Variety Performance on Mesqa 6, Beni Magdul Canal, El Mansuriya District, Egypt, 1980-81	S. Mahmoud, M. Khedr, G. Fawzy, W. Braunworth & J. Wolfe
DWP#88	Irrigation Schedules from Farm Record Data, Abyuha and Abu Raya Sites, 1979-1980 / 1980-1981	F. Abdel Al & M. Skold
DWP#89	Progress Report: On-Farm Conveyance Losses on Abu Raya Farms, Kafr El-Sheikh Spring, 1982	Kafr El-Sheikh Team
DWP#90	Conjunctive Use of Water	A. El Falaky
DWP#91	Maize Irrigation and Variety Perfor- on Mesqa 6, Beni Magdul Canal, Mansuriya District, Egypt 1981	S. Mahmoud, M. Khedr, G. Fawzy & W. Braunworth
DWP#92	Evaluation of Root Penetration for Summer Crops, 1981	R. Tinsley, Saleh, Meleha, & Bayoumi
DWP#93	Crop Calendar Ror El-Hammami, 1980-1981	S. Mahmoud & El-Shinnawi
DWP#94	Accessibility of Farmlands on EWUP Pilot Sites	A. El-Khayal & S. Saleh

DWP#95	Design of Level Furrows and Borders by Programmable Calculator	K. Ezz El-Din, K. Litwiller & Kafr El-Sheikh Team
DWP#96	Farm Record Summary and Analysis for Study Cases at Abyuha, Mansuriya and Abu Raya Sites, 1980-1981	EWUP Economics Team
DWP#97	Status of Zinc in the Soils of Project Sites	M.Abdel Naim
DWP#98	Summary of the Farmers' Organization and On-Farm Water Management Data for Mesqa 10, Beni Magdul Canal, Mansuriya District, Egypt	A. Tahoun, F. Abdel Al & W. Braunworth
DWP#99	Sociological Survey and Engineering Experiences on Mesqa 6, Beni Magdul Canal, Mansuriya District, Egypt	M. El-Kady, F. Abdel Al & W. Braunworth
DWP#100	Crop Management Trials by EWUP	M. Abdel Naim
DWP#101	On the Sugar Beet yield and Soil Salinity Changes Under Long and Short Furrow Irrigation Systems	A. Ahmed-El-Falaky
DWP#102	Farm Record Summary and Analysis for Study Cases at Abyuha, Mansuriya and Abu Raya Sites, 1981-82 Economics Team.	EWUP Team
DWP#106	Beni Magdul Crop Calendar 1980-81	S. Mahmoud & G. Fawzy
DWP#107	Root Penetration Evaluation of 1982 Winter Crops in Abu Raya, Kafr El-Sheikh Governorate	M. Meleha
DWP#108	Day/Night Irrigation Timing Preference of Om Sen Farmers, Kafr El-Sheikh Governorate, Summer 1981	A. Metawie & K. Litwiller
DWP#110	Kafr El-Sheikh On-Farm Pilot Program (1981/82 Winter Season)	Kafr El-Sheikh Team
DWP#112	A Comparison Of The Cost Of Picking Cotton To The Value Of Cotton	S. Elewa, R. Darwish
DWP#115	Effect of Land Leveling On The Time and Depth of Irrigation, Application Efficiency and Water Use Efficiency of Wheat	A. El-Falaky

FORT COLLINS INTER-OFFICE STAFF PAPERS

NO.	TITLE	AUTHOR
FC-1 (MN #1)	Trapazoidal Flumes for Egyptian Water Use Project	A. R. Robinson
FC-2	A Systematic Framework for Development of Solutions	M. Lowdermilk
FC-3	Computer Programs for the Simulation of On-Farm Water Management Alternatives	R. King, J. Loftis, & A. Nasr
FC-4 (PTR #10)	Soil Fertility Survey in Kafr El-Sheikh, El Mansuriya and El-Minya Pilot Areas	M. Zanati, P. Soltanpour, A. Mostafa, & A. Keleg
FC-5 (PTR#11)	Kafr El-Sheikh Farm Management Survey, Crop Enterprise Budgets and Profitability Analysis	M. Haider & F. Abdel Al

There were 79 Project Technical Reports. However, three of these Project Technical Reports (#'s 49, 55 and 59) are available only in draft form from the Fort Collins Office. Also, three Project Technical Reports (39, 48, and 54) are available only in draft form from the Cairo, Egypt Office. Project Technical Reports (32, 42, 58 and 70) were designated as Draft Working Papers and are available only in the Cairo, Egypt Office.

CHAPTER VIII. RECOMMENDATIONS FOR ON-GOING WORK

The technical recommendations of EWUP are provided on pages 55-58 of the Final Report titled, "Improving Egypt's Irrigation System in The Old Lands, Findings of the Egypt Water Use and Management Project, March 1984." There are 24 recommendations dealing with: (1) the research process; (2) farmer involvement; (3) management; (4) agronomic and structural changes; and (5) training. These recommendations are:

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 trained interdisciplinary irrigation improvement teams 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 systems 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 renovations. 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.

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, accommodate 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 total quantity of water to allocate to delivery canals. The reduction of periods of excessive flow through the system 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, especially where it is near the ground surface, 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 on-farm 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, flow 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 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 compatible 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.

Irrigation Improvement Program

During the final months of the EWUP contract the Government of Egypt approved and began implementation of a National Irrigation Improvement Program (NIIP). At the same time USAID was discussing the possibility of assisting the MOI with a Regional Irrigation Improvement Program (RIIP). The difference in name only reflects USAID's reservation about getting committed to a program which is "national" in scope. These programs are vital to the improvement of Egypt's on-farm irrigation system. They reflect, for the first time in many years, a commitment to improving Egypt's irrigation systems at the farm level. This is significant and of utmost importance if Egypt is to build up its food production system so as to keep pace with a rapidly expanding population. Egypt currently imports more than half of its food. It is seeking a way to improve domestic production. The removal of the constraints imposed by an outmoded irrigation system is an important step in that direction.

The success of the NIIP is highly dependent on cooperation between the MOA and the MOI. Improvement of the delivery system will largely be a waste of time without simultaneous improvement in on-farm water management. This latter includes precision land leveling which, according to recent discussions among GOE officials, seems to be the responsibility of the MOA.

In the improvement of mesqas and farm water application, both the responsibility of the MOI, there will be the need for precision land leveling. Soil needed for mesqa improvement will come from the adjacent land and can only be obtained, without disrupting the total farm, by removing 1 or 2 cm of soil in the process of leveling the land. Scheduling this work with the farm operations will require a single entity, not two. Thus, the MOI should have the responsibility for the initial land leveling as part of mesqa reconstruction with the MOA responsible for all follow-on precision land leveling.

The joint efforts of these two ministries should be provided with expatriate technical and managerial assistance. This is necessary because neither the MOA nor the MOI have enough trained and experienced personnel to manage a complex, integrated project as envisioned in NIIP. The only source of personnel with such training is the former EWUP employees who are mostly in the MOI. But there are not enough to provide sufficient core staff to NIIP.

Design and Evaluation for Water Delivery System Improvement

One of the most promising outputs of EWUP was not quite mature and consequently not reported in the final form at the project's contract termination. A draft publication titled, "Design and Evaluation for Water Delivery System Improvement," was tentatively assigned the number of Technical Report #55, but is presently available only in draft form. It is recommended that work should be continued on this report under any continuing technical assistance project. It is estimated that four man months of TDY time from a qualified engineer and two man months of TDY time from a qualified economist could bring this report into publishable form. Travel to Egypt should be included for the final check of data and procedure with the Egyptian staff.

Completion of this report would greatly facilitate the implementation of the NIIP Program. It would as well provide a basis for future training for design and evaluation of improved water delivery systems.

Commitment To Project Objectives

EWUP was initiated when the Egyptian side was controlled by a single Minister of Agriculture and Irrigation. The project was designed with objectives which fit an interdisciplinary team approach. Colleagues on the Egyptian side were available from the Ministry of Agriculture and Irrigation.

Shortly before the project was implemented the Ministry was separated into two ministries, i.e. the MOA and the MOI. Project personnel came from each ministry. The Minister who signed the Grant Agreement with USAID in 1977 became the Minister of Irrigation so the project was administratively tied to that Ministry.

As a result of these events the project encountered difficulties over jurisdictional responsibility throughout its life. New personnel in both MOI and MOA, who were not a party to the initial agreement, were never fully committed to the project objectives. There was a tendency for the MOI to want to rewrite the objectives to make them more consistent with the responsibilities of the Ministry. At the same time MOA administrators could not understand why EWUP addressed problems which typically were a function of the MOA.

This situation caused a degree of uneasiness on the part of Egyptian project managers and Egyptian staff assigned to EWUP. MOI engineers felt a sense of betrayal to their parent Ministry when they concerned themselves with what many perceived to be MOA problems. MOA personnel had similar feelings regarding loyalty to the MOA and they were sometimes criticized by MOI personnel for not emphasizing "water" aspects of irrigation. Expatriate staff members were usually caught in the middle of this cross-fire.

Several specific examples can be used to illustrate the problem. The question of irrigation management of Vertisol soils was determined by project scientists to be of substantial interest and its study was consistent with project objectives. Yet this line of investigation was continually hampered by those who perceived it to be an MOA concern. Another example was the work on disease and pest control. A senior person assigned to EWUP from MOA would not work through the EWUP administrative structure because some persons in that structure had less seniority. Then he finally left the project to take the research he started in EWUP back to his research institute in the MOA where it "belonged."

By mentioning these problems it is not intended to imply that they were major issues. But in terms of recommendations it is well, in the future, to recognize such potential problems at the time contracts and grant agreements are being negotiated. USAID and the contractor should insist that the host country government willingly accepts the objectives of the project and agrees to assign persons who will be loyal to the project and work toward the objectives which have been mutually established.

Training

Training remains both a major accomplishment of the project and the largest portion of incomplete project activities. There remains a significant need for additional technical and managerial training of the GOE personnel.

As pointed out in the preceding paragraphs of Chapter VII, there is a serious shortage of personnel with training and experience to manage and implement NIIP. That the GOE has taken steps to establish such a program is commendable. Donor agencies could contribute significantly to its potential success by providing additional technical and managerial training.

In addition to providing the skills necessary to achieve the objectives of NIIP, additional training programs would contribute to high morale. Salaries are low for Egyptian staff. Training opportunities represent a strong motivating factor for high professional performance. It gives the staff something to work for other than the inadequate government salaries.

EWUP training primarily emphasized non-degree programs even though, as mentioned before, the EWUP training programs assisted ten Egyptian staff members to earn advanced degrees. Advancement in the Egyptian government is highly dependent on training, especially when supported with official certificates of university graduate level degrees. Therefore it is recommended that training should provide degree oriented programs especially for young staff members who are adequately qualified and motivated to undertake the work. Non-degree training should be provided for senior and mid-career employees who may not wish to become engaged in degree programs.

Additional Research

It has been reported that the irrigation district at Fayoum, an area of about 300,000 acres of cropland, successfully operates a system whereby water is delivered to the farm headgates with enough hydraulic head for gravity distribution of the water. The farmers do not have to lift water to their fields. This system is in contrast to the rest of Egypt where water is typically delivered to the farm headgate at least one half meter below the surface of the farmers' fields. It is proposed that the Fayoum system should be carefully studied to determine how it works.

This is an important issue because lifting water is expensive and the GOE policy continues to favor delivery below the surface levels of fields. EWUP was successful at the Abyuha (El-Minya) field site, in demonstrating how farmers could assist in managing the delivery of water to their fields with sufficient head to eliminate the need for lifting. The farmers accepted this responsibility and recognized the cost savings associated with eliminating the water lifting operation. However, many GOE officials are still skeptical. Additional information should be obtained from Fayoum including the role of the irrigation district, the role of the farmers, how they are organized and any special problems encountered.

The so called "old new-lands" represent another topic for additional research. The GOE strategy for increasing food production relies heavily on increasing output from these lands which were reclaimed during the 1960's and early 1970's. For the most part these lands are unproductive and in need of revised irrigation - drainage systems. They probably also require modified settlement and management systems. An interdisciplinary team approach seems most appropriate.

Recommended research on some specific technical areas, in some cases alluded to earlier in this report, are summarized below.

Vertisols have been identified as problem soils because of the characteristic swelling and shrinking. Additional information about these soils could improve crop cultural practices and also help establish better water delivery systems with less leakage and subsequent drainage problems.

Conjunctive use of water from canals, drains and wells promise to expand the effective supply of water available for irrigation. While water supplies for irrigation are not severely limiting now, this situation is sure to change as development in agriculture and industry puts greater demands on the total supply.

Irrigation practices in Egypt are still primitive. More research is necessary to find the combination of factors that will encourage farmers to adopt long-level-furrow and long-level-basin systems of applying water to their fields. It has been demonstrated that these systems increase crop production and save labor but the complete "farming system" must be changed if widespread improvements are to occur in irrigation practices.

The sugar cane producing areas of Egypt are operated by many small land owners. In order to improve irrigation and related management practices it is necessary to organize fields into large blocks. Attempts to do this have more often than not been failures. Concentrated research and extension should be applied to the important sugar cane producing areas to find suitable solutions.

Renovation of canals and mesqas is necessary for improving the irrigation water delivery system. Lining of canals and buried pipelines are being tried but they are expensive. Less expensive alternatives involving reshaping earthen canals may provide at least short run improvements. Alternative methods of doing this mechanically should be tested since labor for hand renovation is becoming scare and expensive. There are various machines available throughout the world that could be appropriate for Egyptian conditions but a concerted effort for their implementation has never been made. Such a research program should be very focused and comprehensive. Each machine or sequence of mechanical operations should be tested in the heavy clay, high water table conditions of the delta as well as in the lighter, better drained soils in the Nile River Valley. The work at each site and with each machinery alternative should be carefully documented. An interdisciplinary team should be involved to fully evaluate engineering, agronomic, economic and social aspects.

Water lifting, traditionally done with human and animal labor, typically adds $20 to $60 per acre to the annual cost of producing crops in Egypt. Many farmers are shifting to diesel and gasoline driven centrifugal pumps. Assuming the GOE continues to encourage lifting water from canals to farmers fields, as opposed to delivering it by canal above the surface level of fields, it would be advisable to introduce more efficient pumps. Axial flow pumps, developed in the Philippines and Thailand, have been tried in Egypt but have not been widely adopted. These pumps are more fuel efficient and more economical to operate for the typical low lift requirements in Egypt. A research-extension program specifically to achieve adoption of such pumps should have a high payoff. The major reservation concerns the policy of requiring a lift system. However, even if the policy were reversed it would take years before canal banks could be raised, control structures installed and management schedules changed. In the meantime, substantial savings could be achieved by using more economical lifting devices.

Farmer-government interaction and communications needs to be encouraged in order to achieve more efficient use of irrigation water. There is little tradition or precedent for this in Egypt. Many Egyptians with EWUP training and experience recognize the advantages to be gained through such interaction but there is not yet a "critical mass" of such individuals necessary to bring about necessary change. Continued inputs, from donor nations, should be addressed to this problem. The potential payoff is substantial.

The economic evaluation of irrigation improvements was initiated in the MOI under EWUP. This work and the associated training of Egyptian staff has been recognized favorably by international organizations as well as by Egyptian officials. An excellent data base has been established within the Institute and the Water Research Center. Analysis of farm records and enterprise reports are done annually to keep this data base current. The use of computers for this work is being developed at resource economics departments of leading American universities. Donor assistance for Egyptian staff interaction and training at such universities would be very helpful in order to keep this work progressing and the data base viable.