EGYPT WATER USE AND MANAGEMENT PROJECT

MID-PROJECT REPORT

VOLUME I

PROJECT SUMMARY, CONCLUSIONS AND RECOMMENDED PILOT PROJECTS FOR ON-FARM WATER MANAGEMENT

by Egyptian and American Team

Cairo, ARE
Ft. Collins, Colorado USA

September 1980

Mid Project Report
Volume I

Project Summary, Conclusions and Recommended Pilot Projects for On-Farm Water Management

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PREFACE

The present Technical Project Director, Dr. Royal Brooks, was one of the first project team members to arrive in Egypt and has had the responsibility for the technical direction of the work from October 1977 until October 1980. Dr. Gene Quenemoen has been appointed technical project director to become effective November 1980 and will assume the responsibility for carrying out the work plans for the last two years of the project which primarily involves pilot implementation and evaluation. Dr. Brooks and Dr. Quenemoen have worked closely in bringing this report to a final draft form with Dr. Quenemoen assuming the major responsibility for developing the materials for the Egypt part of the report. Dr. Richardson the Project Coordinator on the CSU campus has taken the responsibility for final editing of the overall report and preparation of that portion dealing with water budget, training and other CSU inputs.

It should be pointed out that the field teams contributed greatly to what is reported herein. However, some editing and modifications have been performed on the plans submitted by the teams to keep the pilot programs confined to obtainable goals and still meet the target goals of the project. Credit goes to Dr. Mahmoud Abu-Zeid who directed the project for the first two years and to Dr. Hassan Wahby who was appointed project director one year ago and presently holds that position. Without their support and direction the project could not have attained its present accomplishments. As noted from the list of personnel assigned to the project by the Government of Egypt, a considerable effort is spent in managing personnel and providing the facilities to carry out the work.

This report has permitted the entire EWUP staff to look back over the past three years and evaluate the progress that has been made. The major problems affecting irrigated agriculture in Egypt have been identified and much research has been accomplished. In retrospect, however, there are still many problems to be quantitatively identified and solutions to problems that need to be researched.

In fact, problem identification and search for solutions is and should be a never-ending task. But, these two are not sufficient by

2\

themselves to meet project objectives. Implementation of meaningful solutions to major problems in order to improve the social-economic conditions of the small farmer is the objective. Major conditions of implementation is farmer acceptability and governmental ability and and willingness to provide the services necessary for implementation. The pilot programs are to further test proposed solutions on a farm system basis over a large enough physical area involving enough farmers to determine the feasibility for implementation. To do this the pilot programs will be carried out on a meska or larger system. A meska is a ditch generally owned by farmers which receives water from the government branch canal. The meska serves 10 to 50 farmers and irrigates 50 to 300 feddans. A feddan is 1.04 acres.

In the preparation of this report, proposed plans for pilot project implementation were carefully reviewed and modified to fulfill two or three objectives in each pilot area. In other words not all problems or solutions to problems will be involved in the pilot areas. Implementation of too many concepts by the farmer or the government at any one time is not possible. The reader should recognize that the pilot plans presented herein are guite general. Specific details have been omitted for the sake of brevity. Detailed plans have been developed by the field teams and are presently being expanded to successfully implement the pilot program development.

The report is in six volumes which in total gives the written record of the project. Volume I summarizes project activities and gives the proposed pilot programs. Volume II contains project technical papers. Volume III contains project staff papers. Volume IV contains the technical papers that have been presented at technical meetings and for publication in technical journals in Egypt or abroad. Volume V contains the training manual and Volume VI "The How to Do It" series used in training. The difference between project technical papers and project staff papers is in degree of review and refinement. Staff papers are preliminary reports that have not been completely reviewed. They are intended to provide a model for staff to get their information, ideas and concepts up for consideration and possible action. From a staff paper, project technical papers may evolve.

Besides the written record of project accomplishment there is the hand-to-document accomplishment of establishing farmer to professional interaction; the creation of a cadre of professionals eager and capable of working with farmers; the establishment in the Ministry of Irrigation of the concept that irrigation at the farm level, on-farm water management and miska level problems are its concern and responsibility; the establishment of improved water management and associated practices in the project areas, and the establishment in the Ministry of Irrigation of the knowledge that improved irrigation requires an interdisciplinary approach using the discipline of agronomy, sociology, and economics in addition to engineering.

CONVERSION FACTORS[1/]

Area		Sq. Meter		Acre		Feddan		Hectare
1 feddan (fed)	=	4,200.8335	=	1.03805	=	1	=	0.42008
1 acre	=	4,046,856	=	1	=	0.96335	=	0.40469
1 hectare (ha)	=	10,000	=	2.47105	=	2.38048	=	1
1 sq kilometer	=	$100x10^4$	=	247.105	=	238.048	=	100
1 sq mile	=	$259x10^6$	=	640	=	616.4	=	259

Water Use:

1 billion m^3 = 810,710 acre-feet
1,000 m^3 = 0.81071 acre-foot = 9.72852 acre-inch
1,000 m^3/feddan = 0.781 acre-foot/acre = 9.372 acre-inch/acre
= 238 mm of rainfall

Commodity Measurements

	Egyptian Unit	Weight in kg	Weight in lbs
Cotton (unginned)	Metric kantar	157.5	346.92
Cotton (lint or ginned)	Metric kantar	50.0	110.13
Sugar, onion, flax straw	Kantar	45.0	99.12
Rice (rough or unmilled)	Dariba	945.0	2081.50
Lentils	Ardeb	160.0	352.42
Clover	Ardeb	157.0	345.81
Broadbeans, fenugreek	Ardeb	155.0	341.41
Wheat, chickpeas, lupine	Ardeb	150.0	330.40
Maize, Sorghum	Ardeb	140.0	308.37
Linseed	Ardeb	122.0	268.72
Barley, cottonseed, sesame	Ardeb	120.0	264.32
Groundnuts (in shells)	Ardeb	75.0	165.20

Other

1 ardeb = 198 liters = 5.62 bushels (U.S.)
1 ardeb/feddan = 5.41 bushels/acre
1 kg/feddan = 2.12 lb/acre

[1/] From Contemporary Egyptian Agriculture, by H. A. Tobgy.

DEFINITIONS

<u>meska</u> - Generally speaking a "meska" is a privately owned tertiary canal serving 30 to more than 200 feddans.

<u>marwa</u> - In traditional Egyptian irrigation systems a "marwa" is a farmer constructed field ditch serving a number of small (say 6 meters x 6 meters) basins.

<u>sakia</u> - A water wheel, generally powered by animals for lifting water from meskas to fields.

<u>tambour</u> - A water lifting device usually powered by human labor also called "Archimedes' screw."

I. INTRODUCTION

The purpose of this report is to present the accomplishments of the Project during the first 3 years and the proposed plans for accomplishing project objectives during the second 2 years. Project objectives are given in the Project paper--"Water Use and Management, Egypt," and they follow in Part IA along with project goals, logical framework and design in Part IB.

According to the "Operational Plan" attached to Contract No. NE-C-1351, Project No. 263-017 between USAID and the Consortium for International Development, a major review is scheduled at the end of 2 1/2 years to "determine the elements and organizational arrangements required for pilot demonstration/production activities to be conducted in the second half of the Project." A request to delay submission of the mid-project report until September 30, 1980 was submitted August 9, 1979 and approved by USAID September 10, 1979. The request and approval were made to give the project 3 complete summer crops of experience. Also, a mid-project evaluation report shall be submitted within 45 days following the end of 2 1/2 years of operation."[1/] This is the mid-project report.

The tangible accomplishments and findings of the Project during the first 3 years are explained and documented in the following chapters,

[1/] See pages 6-7, 14 of the "Contract."

II. Major Problems Identified and Proposed Solutions and III. Other Project Outputs. Also, the appendices of this report contain a collection of professional papers and manuals produced during the past 3 years dealing with Project objectives.

Each field team has prepared plans for conducting one or more Pilot Programs during the next 2 years. The major effort of the entire Project will be oriented to supporting the Pilot Programs. Details of the Pilot Programs are reported in Chapter IV, Plans for Pilot Programs. Other proposed work of the Project is contained in Chapter V, Additional Work Planned for Problem Identification and Search for Solutions. In Chapter VI pictorial anecdotes are given which review in pictures and captions project activities.

The Egypt Water Use and Management Project (EWUP) began operating as an integrated Egyptian-American research effort in October 1977 with the arrival of the first American research scientists. In January 1978 the Project became fully staffed with Egyptian and American personnel as specified in the contract and grant agreement. Project personnel are given in Chapter VII.

I.A. Project Objectives (from the Project Paper, 1977)

The general objective of the Project is to improve the social and economic conditions of the small farmers in Egypt through development and use of improved irrigation water management and associated practices which will increase agricultural production, develop efficient water use practices and decrease drainage problems. Associated with this major objective the Project should increase the institutional capacity of the Ministry of Agriculture and the Ministry of Irrigation to develop and implement improved on-farm water management programs. The final product of the Project should be an action program, tested and proven as to technical applicability, farmer acceptability and organizational replicability, that can be expanded to regional and/or national programs.

I.B. Project Design

I.B.1. Description

During the five-year contract period the Project is expected to conduct an applied research and extension program with small farmers in three representative sites in the governorates of Kafr El Sheikh, Giza, and El Minya.[1/] At these sites the Project is expected to:

1. Identify the major constraints to improved on-farm water management and optimal water delivery methods.
2. Determine and establish the use of optimal irrigation practices at the farm level in representative pilot areas.
3. Establish improved water control practices for the water delivery and drainage systems in the Project areas.
4. Develop plans for organization and implementation of expanded future programs based on the results in the Project areas.
5. Develop and/or train qualified scientists and technicians.

I.B.2. Logical Framework

The Project is designed to contribute critical technological information to the agricultural sector of Egypt and hence provide an input which will increase the productivity of the sector. The Project has two major "internal" objectives: 1) the generation of practical information on the proper use of irrigation water and management of irrigation systems, and 2) the strengthening of institutions which deal with water management research and extension of findings to farmers. The "external" objective of the project is to carry out pilot area operations. This will be done with farmers and irrigation system managers. It will demonstrate to both how to best use the water resource to increase farm production, hence, the project purpose as shown in the Logical Framework Outline, I.B.3.

The Project outputs will be achieved through a series of phased actions which cumulatively lead to the achievement of the purpose. These action elements are:

[1/] In order to avoid confusion about the location of sites the reader should understand that three sites were selected in each of the governorates of Kafr El Sheikh, Giza and El Minya. The Project field office is in the town of Kafr El Sheikh near the Sakha Agricultural Experiment Station. The actual Project field site is near the village of Abu Raia about 20 km from Kafr El Sheikh. In Giza Governorate the Project field office is located by the Mansouria Canal and the field sites are nearby at the villages of Beni Magdoul and Kafr Hakime. In El Minya Governorate the field office is located at the village of Abueha which is 25 km south of the town of El Minya. Some references are made in the first sections of this report to Abu Korkas. This is a town near Abueha that was considered during the planning of this Project as a potential field site.

1. a) Initiation of applied research on questions of a) quantity and timeliness of irrigation water application, b) quantity of water entering and leaving the district system; c) influence of the levelness of fields on yields; and d) agronomic practices as related to irrigation efficiencies.

   b) Carrying out of farmer surveys to ascertain information which will help specify additional research areas and to provide better understanding of the farming and irrigation systems.

2. Performance and analysis of the applied research program and design of the pilot program.

3. Carrying out of the pilot program.

The training of staff and other institutional development efforts are an integral part of project operations. They lead to the "internal" objective of creating the capability to sustain demonstration activities which eventually are to go beyond the pilot areas. The Project will have achieved a measure of success when a revised and practical set of irrigation and water management technologies are prepared and implemented in the pilot areas. The final measure of success will be ascertained in terms of changes in farmers' productivity which can be attributed to the Project.

I.B.3. Logical Framework Outline

NARRATIVE SUMMARY

Program Goal: Improve the social and economic conditions of the small farmer.

Project Purposes:

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

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

Outputs:

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

2. Established optimal water practices available for use at the farm level in Project areas.

3. Improved water control practices for the delivery system in the Project areas established.

4. Plans for organization and implementation for future program expansion.

5. Experienced scientists and technicians in place.

Inputs:

1. USG: TA (Scientists, field party personnel); TDY, equipment, training, studies.
2. GOE: Staff officers, local labor costs, local costs of support of research, local materials and equipment, advisory and evaluatory.

OBJECTIVELY VERIFIABLE INDICATORS

Measures of Goal Achievement: In project areas, farmers' crop production and real income will have increased.

Conditions that will indicate purpose has been achieved:

1.A. Three pilot areas established.

B. Farmers are practicing recommendations derived from the Project.

C. Yields have increased significantly over non-Project areas.

2.A. Government approval exists for program expansion.

B. Farm problem feedback mechanism exists.

C. An evaluation program exists for the research.

D. Interministry and interdisciplinary approach accepted.

E. Farmers' views understood and incorporated in planning.

Magnitude of outputs:

1. A process of listing and selection of research priorities is being carried out.
2. Farmers have available (in a practical form) the results of applied research.
3. Water budgets and other managerial information available to systems operators, program and policy makers.
4. Expansion plans exist and are based upon cost-effective programs, analysis of pilot area results and farmers' views.
5. Improved job knowledge and staff competence reflected in above outputs and project purpose achievement measures.

Implementation Target (Type and quantity):

1. TA staff in GOE 90 days after contract signed.
2. GOE staff on project 90 days after contract signed.
3. Staff officers' equipment and vehicles available 120 days after contract signed.

MEANS OF VERIFICATION

Program Goal:

Comparison of conditions found in initial Project surveys with status found later.

Project Purpose:

1. Project monitoring.
2. Annual report.
3. Sampling of farmers in project areas.

Outputs:

1. Project monitoring.
2. Annual report.
3. Revised work plan at end of first six months of Project.

IMPORTANT ASSUMPTIONS

Assumptions for achieving goal targets:

That there continue to be cost/price relationships at least as favorable as at present.

Assumptions for achieving purpose:

1. Adequate supplies of improved seed, fertilizer and other inputs available, as well as reliable markets for crops produced.
2. Adequate GOE personnel are available.
3. That engineers and agriculturists from the two joined ministries will continue to work together to achieve project purpose and that external assistance contributes to this end.

Assumptions for achieving outputs:

- (Same as for project purpose.)

Assumptions for providing inputs:

1. Inflation within budget estimates.
2. Timely GOE authorization of budget and staff required.
3. Contractor with required expertise will be available.

I.B.4. Summary of Program Design

The focus is on the identification of problems and the testing of solutions with the farmer on the farm. The research is conducted by an interdisciplinary team of U.S. and Egyptian engineers and scientists to develop and test a package of technologies which solve the priority problems of on-farm water management.

There are three basic components in the On-Farm Water Management Research Project. In Component A the present on-farm water management practices will be researched to identify the primary constraints to increased production and efficient use of water. Outlet studies for a season or a year on representative laterals, and a physical and socio-economic survey of farms will form the basis for problem identification.

Component B will initiate village programs of soil testing for fertilizer recommendations and improved irrigation practices in the early months of the Project on farmers' fields. As additional problems are identified from Component A, additional testing of solutions will be attempted in continuing experiments during the Project. Problems requiring further research will be given to Research Institutes to define solutions as part of their on-going programs. In the third year of the Project, pilot programs consisting of solutions to the priority problems will be developed and tested on selected villages within the project areas. The pilot programs will be evaluated and revised during the remainder of the Project and results provided to the Government of Egypt for implementation as a development program within the project area.

Measurement of quantities, qualities and rates of water delivered in the project areas and study laterals, in the drainage outflow, and the ground water (shallow and deep) system will also be measured as part of Component C. Results will be used to evaluate the delivery system for improvement, change of the rotation system for more efficient on-farm water management, development of a water budget for the project area and evaluation of the effects of on-farm water management practices on drainage requirements.

The above programs will be initiated in three different project areas at phased 6-month intervals, beginning in the Mansouria Irrigation District.

I.B.4.1. Problem Identification--Component A

The interdisciplinary team will plan to conduct the field surveys as an integrated program. The field surveys will be divided into two phases. The first phase, the preliminary field survey, will consist of tabulation of existing data and information about the project area. The second phase will consist of detailed field surveys combined with seasonal or annual studies of selected outlets.

Preliminary Field Survey

A preliminary survey will be conducted in the field to gain an understanding of how the irrigation delivery system operates and how it governs the use of water by the farmer. The survey will also include an elucidation of agronomic and other farm management practices. Preliminary measurements of delivery losses, irrigation efficiencies and drainage losses will be made. The data will be obtained from a number of laterals in each project and will be used to select laterals for the detailed field survey and possibly for the location of cooperators for on-farm testing. The preliminary survey will be made at Mansouria during the first 6 to 8 weeks of the project, and at succeeding six-month intervals at Sakha and Abu Korkas.

Detailed Field Survey

The detailed field survey will be conducted in all three districts during the spring and summer of the second project year. The on-farm engineering, agronomic and socio-economic components of on-farm water management practices will be researched to identify the primary constraints to increased production and the efficient use of water.

The farm survey will consist of a questionnaire and the measurements of physical factors. The questionnaire will be used to collect four types of data: 1) general information on farm operations, inputs, yields, personal information, etc.; 2) organizational factors such as amount and frequency of water rotations, water costs, relationship to government institutions; 3) farmers' perceptions of problems; and 4) farmers' management and decision making awareness. The physical measurements will include the monitoring of outlet discharge, conveyance efficiency, soil survey, soil testing, and mapping of the entire outlet, and a mapping of cropping patterns, water channels, field branches, etc.

Seasonal Watercourse Evaluation

A watercourse survey will be carried out to determine farmer practices during a complete year so that water management can be related to cropping pattern, stage of plant growth, soil moisture stress, crop water requirements, agronomic practices and the supply of irrigation water. This will supplement the detailed field survey and will be used to identify seasonal on-farm water management problems in Egypt.

This study will include, primarily, physical measurements of the system such as the amount and time of application of water, water losses, soil moisture stress, water table depth, measurement of crop yields, soil tests, etc. Cropping patterns, stage of growth, past drainage, and other data will be recorded.

The study will be initiated in each project area as soon as an outlet can be identified from the preliminary field survey.

Fertility of Village Soils

A village soil testing program will be initiated during the first six weeks of the Project. Approximately 250 fields will be selected from a village in each District. The surface soil will be sampled and analyzed in the Soil Testing Laboratory for available nitrogen, phosphorus and potassium by analytical procedures developed for Egyptian soils. The results will be summarized to give the general fertility for soils in each village, and will serve as a guide to supplement current fertilizer recommendations for the upcoming crops.

In a second phase of the soil testing program, the cultivated and subsurface soil layers will be sampled for all cropped fields in the seasonal studies. The samples will be used for fertility and salinity analyses. The results will assist in determining fertilizer practices for the optimal management study.

Physical Analysis of Soils

Certain soil physical properties may need to be determined in areas where crop yields are poor, yet soil fertility and other management practices appear to be good. Rooting depths will be studied. Possible measurements will include an examination of the soil for deleterious factors such as poor soil structure, the presence of a soil pan caused by cultural operations, chemical deposition or cementation, or by the presence of a high water table. Other physical properties such as bulk density, texture, as well as field capacity and wilting point moisture contents will also be measured on selected fields.

Determination of Agronomic Practices

An intensive survey and analysis of current farmer practices is needed to determine possible agronomic constraints in the effective use of irrigation water on the farm. The same outlet areas will be used for study as for the seasonal watercourse evaluation. The study will include an assessment of all agronomic practices that effect the efficient use of irrigation water by the small Egyptian farmer. The results will be used to identify agronomic factors for study in the optimal systems experiment.

I.B.4.2. On-Farm Testing--Component B

Problems identified in Component A will be tested on the farms of cooperating farmers at the three field sites. Revision of problems will be made as results become available. Some problems may be so obvious that practical solutions will be attempted early in the on-farm studies.

Delivery System Improvement

Since studies by the Irrigation Ministry indicate that in many instances the rotation system of delivering water does not result in optimum use to meet crop water requirements, on-farm experiments with a demand system of water delivery will be initiated. The advantages and disadvantages will be evaluated with emphasis on on-farm water use efficiencies and the effects on crop yields. Another policy of the Irrigation Ministry has been to deliver water to the farmer below the land surface. Studies should be conducted to deliver water, possibly on demand, at elevations for gravity flow and at a rate that is efficient for both delivery and field application of water. Redesign of outlets would be a major component of this program. The water delivery system should also be evaluated.

Application System Improvement

A review of the present system of applying water to fields suggests that current application efficiencies may be low. Studies should be initiated which will develop an optimum combination of flow rate, furrow length or border length and width, infiltration rate of the soil, surface slope, and precision of levelness which results in the most efficient application of water. Other studies will be initiated to develop simple criteria to improve the effectiveness in application of water with existing systems. In conjunction with these studies would be research to determine the exact amount of water required to replenish the soil water deficit and to control soil salinity and waterlogging.

Optimal Management Systems

After the major agronomic constraints to improve on-farm management of water are identified, optimal management systems will be designed and research will be conducted on the farm to determine the feasibility for adoption by the farmer. Management factors will include field cultural practices, fertilizer application, pest control and irrigation methods. Acceptability of the proposed practices by the farmer will have high priority in the identification of improved practices for general recommendations. This research will be initiated during the first year of the Project.

Salinity Balance Experiments

Experiments will be initiated during the second project year in the Kafr El Sheikh District to determine the influence of water quality, water management practices and the presence or absence of drainage, on the salinity balance for rice and cotton cropping systems. Similar research will be initiated during the third year in the other districts. The results will provide guidelines for recommending optimal management in areas where both soils and ground water are saline.

Fertility Experiments and Soil Test Correlations

With preliminary soil test data obtained from the field survey, fertilizer experiments will be designed to study the effect of fertilizer material, fertilizer rate, and method of application on crop growth on farmers' fields. The data will be used to correlate the soil test with crop yields and is the basis for developing a soil testing program for Egypt that will optimize fertilizer inputs for small farmers.

In other phases of the soil fertility research, the recovery of applied fertilizer for selected cropping patterns and nitrogen fertilizer systems will be studied. The results will have direct application to the evaluation of efficient methods of farm irrigation.

Experiment Station Research

Most of the basic data required to outline on-farm adaptive research appears to be available for Egyptian conditions. Where the basic data are not available, experiment station research may be conducted, but it is anticipated that this type of research will be limited to high priority areas.

The Pilot Program

At the end of the initial program of finding solutions to the major problems, a number of high benefit technologies will be defined. With these technologies identified, an integrated package of technologies will be offered as a pilot program on an outlet or lateral basis for adoption by farmers. Such a program would then be initiated on a pilot basis to test its acceptability by farmers and their rate of adoption. In the pilot program phase, the organization and the technical competence of the people required to implement the program would be determined. The pilot program areas would be further studied to obtain costs and benefits before adoption of the program on a project or country basis. As problems develop during the pilot program phase, the research program team would be available to identify and provide solutions to these particular problems.

I.B.4.3. Water Irrigation District Delivery and Drainage--Component C

In each of the three irrigation districts (Mansouria, Sakha, Abu Korkas) the amount and quality of irrigation water entering the district at main canal headworks and also leaving the district by canal will be measured, and the same measurements will be made for all major drain water entering and leaving the district. Similar determinations will be made on the distributories where the on-farm water management research will be conducted. The elevation and quality of the shallow and deep ground water tables will also be determined at 30 or 40 selected points in each district.

These data will provide the information needed to calculate a budget for the hydraulic system, and will be used to determine delivery efficiency of the canal system, water stored in the canal system at any time, the contribution of the main canals and distributaries to the drainage problem, and will supply information needed to design possible changes in water rotation systems.

Component C will be implemented in the Mansouria District as soon as the project begins, and in the Sakha and Abu Korkas Districts in successive six-month intervals.

II. MAJOR PROBLEMS IDENTIFIED AND PROPOSED SOLUTIONS

Problem identification was given primary focus during the first six months of work at each field site. It become apparent that a meaningful definition of a problem required not only quantitative data about the existing situation or condition but also quantitative data about "what could be." The latter requirement phased into "search for solutions." Consequently each field team was asked to address problem identification and search for solutions jointly in preparation for developing pilot programs. This chapter reports the results of this activity. The introduction (II.A) explains how the mid-project assessment was conducted. It is followed by a report of results of this activity for Mansouria, Kafr El Sheikh and Minya, II.B, II.C and II.D, respectively.

II.A. Introduction

The teams were also provided with a tabulation as shown in Table II-1 to help evaluate and select problems relevant for pilot programs.

Meetings were scheduled at each field site for the purpose of bringing together Discipline Leaders and Project Directors from the main office in Cairo to discuss problem identification and pilot programs with the field staff. The meetings were held as follows:

Mansouria	July 28-30, 1980
Kafr El Sheikh	August 3-5, 1980
Minya	August 8-10, 1980

The agenda from Minya is shown to illustrate the nature of the discussions at these meetings. In each case the meetings concluded with the assignment of task groups from the field teams to develop detailed plans for the proposed pilot programs (Table II-2).

The sections which follow in Part II of this report summarize the problems identified and the solutions proposed through the process explained above. To explain the problem and its proposed solutions the format described previously is followed. The socio-economic section combines Economic Implicatons and Social Implications. The reader should understand that problems and solutions which were considered

Table II. Tabulation of stage of activity in proceeding from problem solution research to the pilot study (development).

Problems and causes identified	Potential New Practice or Resource Development	Stage of Research Theory Qualitative Quantitative Verified			Suitability for Development (Consider complexity, visibility, etc.)						General Impace Upon the System (lg/small)	Type and Probability of Implementation			For Pilot Study
		Tech	Econ	Socio	Inst	Econ	Soc	Cons	Tech	Inter-action		Farmer's choice	Farmer coop	GOE	YES/NO

Table II-2. (Proposed) Program for El Minia Seminar
EWUP Mid-Term Report

Presiding -
Secretary -
Timekeeper -
Place -
Facilitator -

Session I. 0800 - 1030, Friday, 8 August 1980

Time		Information	Discussion	Decision	Leader
0800-0801	1. Call to order	x		x	EN
0801-0805	2. Welcome	x			AR
0805-0810	3. Introductions	x			RB
0810-1830	4. Meeting format--house rules, procedures	x			EN
0830-0915	5. Goal statement for entire seminar	x	x		GQ
0915-1945	6. Goal statements for each session	x	x		GQ
0945-1015	7. Preliminary agenda for Session II	x	x		EN
1015-1030	8. Non-report seminar plans	x	x	x	RB
1030	9. Adjourn			x	EN

Session II. 2100 - 2300, Friday, 8 August 1980

Time		Information	Discussion	Decision	Leader
2100-2105	1. Call to order. Summary, Session I	x		x	EN
2105-2110	2. Final action, seminar goal		x	x	EN
2110-2115	3. Final action, Session II goal		x	x	EN
2115-2117	4. Final action, agenda, Session II		x	x	EN
2117-2145	5. Review of preliminary Minia report	x			AR
2145-2200	6. Break				
2200-2230	7. Discussion, preliminary Minia report		x		GQ
2230-2240	8. Revise topic outline of report	x	x		GQ
2240-2245	9. Goal statement for Session III		x		GQ
2245-2250	10. Preliminary agenda, Session III		x		EN
2250-2300	11. Task groups and assignments	x	x		GQ
2300	12. Adjourn				

Session III. 0800 - 1030, Saturday, 9 August 1980

Time		Information	Discussion	Decision	Leader
0800-0805	1. Call to order. Summary, Session III	x		x	EN
0805-1810	2. Final action, Session III goal		x	x	EN
0810-0815	3. Final action, Session III agenda		x	x	EN
0815-1825	4. Final action, topic outline of report		x	x	EN
0825-1830	5. Instructions to task groups	x	x	x	GQ
0830-0845	6. Break. Move to task group locations	x		x	EN
0845-1220	7. Task group meetings		x		GQ
1220-1235	8. Break. Return to general session				
1235-1240	9. Progress report, group "a"	x	x		GQ
1240-1245	10. Progress report, group "b"	x	x		GQ
1245-1250	11. Progress report, group "c"	x	x		GQ
1250-1255	12. Progress report, group "d"	x	x		GQ
1255-1257	13. Goal statement, Session IV		x		GQ
1257-1300	14. Preliminary agenda, Session IV		x		EN
1300	15. Adjourn			x	EN

Session IV. 2100 - 2300, Saturday 9 August 1980

2100-2101	1. Call to order	x		x	EN
2101-2105	2. Final action, Session IV goal		x	x	EN
2108-2107	3. Final action, Session IV agenda		x	x	EN
2107-2120	4. General discussion re: task group work-- progress toward final goal	x	x		GQ
2120-2125	5. Task group instructions	x			GQ
2125-2130	6. Break. Move to task group locations	x		x	EN
2130-2220	7. Task group meetings		x		GQ
2220-2235	8. Break. Return to general session				
2235-2255	9. Reports, all task groups	x	x		GQ
2255-2257	10. Goal statement, Session V		x		GQ
2257-2300	11. Preliminary agenda, Session V		x		GQ
2300	12. Adjourn	x		x	EN

Session V. 0800 - 1200, Sunday, 10 August 1980

(to be determined)

likely to have obvious negative economic and/or social benefits were excluded from consideration. Consequently we shall avoid making redundant statements regarding each problem such as "the solutions are anticipated to have favorable social and economic benefits."

In cases where the solution of a problem requires optimum use of factors of production it is implied that it is optimum from a social and economic point of view. For example optimum irrigation frequency means it must be consistent with the small farmer's social and economic objectives and not simply optimum with respect to maximum output or technical efficiency. It is the role of the economics and sociology disciplines to monitor all project activities to insure that technical solutions are not imposed at the expense of diminishing the social and economic well-being of the small farmer.

It should also be understood that socio-economic problems such as low farm prices and farm incomes, lack of education, poor communications facilities, and inexperience with formal and informal organizations are common to the solution of most technical engineering and biological problems. Therefore they are not singled out as specific problems identified by the project. Such social and economic constraints will, however, effect the process of solving the engineering-biological problems which have been specified.

II.B. Problem Identification/Solution Statements for Mansouria

II.B.1. Frequency, Amount and Uniformity of Irrigation

II.B.1.1 The Problem

Optimum application of water with respect to frequency, amount and uniformity does not occur continuously throughout the year and on all fields of the Mansouria site. Some fields are irrigated with less frequency than required, often due to lack of water, but sometimes lack of knowledge. Water shortages can be caused by weeds in the canals and meskas, users upstream taking more than their share, waiting for a turn to irrigate on the meskas, or waiting for the canal rotation. Conversely, some irrigations are applied too frequently, especially in El Hammami when a field may be irrigated twice in one 4-day "on" period, or in an unlevel field where the high spots may suffer from drought. Some irrigations tend to be excessive, especially the first ones of the season. This, plus the conveyance loss from canals, meskas, marwas contribute to a high water table. The farmer tries to apply less water but then has difficulty getting the field uniformly wet. To get a high spot at the far end of the field wet, he must apply too much at the near end. The result is uneven seed germination and uneven early growth. Along with a level field he needs a larger irrigation stream to spread the water across the field faster. Improvement of this situation, if combined with good agronomic practices, could increase yield and farm income for the individual farmers involved. Indirect benefits would be a lower water table, release of farm labor for alternative industries, savings of water, and greater versatility for controlling soil salinity.

II.B.1.2 Documentation

EWUP Technical Report No. 1. Problem Identification Report for Mansouria Study Area

ASAE Paper No. 79-2566

Data in the Mansouria files showing prolonged intervals between irrigation.

Data in the Mansouria files showing increased yield from improved agronomic practices.

Data from around the world have shown that a field of uniform soil that is uniformly leveled and uniformly irrigated, seeded, fertilized, etc., can have a uniformly good crop over its entire area, not just in sports. Increases in yield may vary from zero to more than double, depending on how level the original ground surface is, and how spotty the present crop growth pattern is.

II.B.1.3 Proposed Solution

Select the area served by at least two meskas in Beni Magdoul and at least one in El Hammami for improvement. Provide educational and adivsory services for land leveling, frequency and amount of irrigation, system design, agronomic practices, irrigation methods and practices, and meska maintenance. Provide for water to be supplied continuously on demand with reduced conveyance loss. For at least two of these areas, supply the water in a pipeline or elevated meska to permit and test irrigation by gravity methods.

Engineers will plan the water supply system and will assist with land leveling and system design. They will monitor the groundwater level and assist with irrigation practices, irrigation scheduling, and salinity monitoring.

Agronomists will assist farmers with pest control, seed selection, plant population, fertilizer practices, cultural practices, irrigation scheduling, and salinity monitoring.

Economists will assist cooperating farmers to develop farm plans and keep records of costs and production. They will evaluate the economic returns from better water management and associated practices. They will collect baseline data from the pilot area at the beginning of the project for long-range evaluation of the program. They will assist the farmers in the pilot area to establish better markets and marketing practices.

Sociologists will collect baseline data and will help create a user organization for equal water distribution and meska maintenance. They will conduct educational programs for meska maintenance. They will assist the economists with marketing mechanisms.

II.B.1.4 Socio-Economic Implications

The synergistic effects of the activities proposed above are expected to increase incomes of farmers. It is expected that labor requirements, especially for irrigating but also in total, will diminish and that farmers will become more involved in social action aimed at water scheduling, cooperative use of machines, cooperative marketing, educational programs and the like. It will take close monitoring by project staff to determine if these activities, on-balance, are beneficial to the small farmer's well-being. It should also be noted that solutions to this problem involve introduction of technologies other than alternative irrigation methods.

II.B.2 Inadequate Water Supply for El Hammami Canal

II.B.2.1 The Problem

Land served by the El Hammami Canal receives less than half as much water per feddan as the average land served by the entire Mansourai Canal, and the El Shimi Branch even less, due to conveyance losses, to greater withdrawals further upstream, and to weeds in the canal. While some land lies idle for lack of water, other fields receive too much water, at least momentarily, when two irrigations are applied during one 4-day, on-period of the canal rotation. These short intervals between irrigations result from anxiety about crops suffering from the 8-day off-period. The frequent irrigations cause temporary rises in the water table in parts of the area, which greatly limits rooting depth, and possibly yield as well. Conveyance losses from canals and meskas help to keep the water table high.

If adequate water could be supplied on a continuous, or demand basis, the crop yields could be increased. It is estimated that water management could increase maize yield up to 23 percent. The land now idle could be brought into full production. Reducing the conveyance losses and eliminating the need for short intervals between irrigations could lower the water table and increase yield still further.

II.B.2.2 Documentation

EWUP Technical Report No. 1. Problem Identification Report for Mansouria Study Area

ASAE Paper No. 79-2566

Farm Management records in the main office file

Staff Paper # 11, Economic Costs of Water Shortages along Branch Canals

Notes from a workshop conducted by Eldon Hanson, June 24-26, 1980 (Hanson's TDY report, Quarterly report April to June 1980).

II.B.2.3 Proposed Solution

Engineers design and construct a pipeline to replace the El Hammami Canal and the El Shimi Branch. Supply water to it every day under low pressure by pumps.

Economists and engineers analyze the feasibility of replacing canals with pipelines under the following alternative choices:

a. Leave the meskas as they are, thus requiring the farmers to continue lifting.

b. Replace meskas by pipelines. No more lifting required.

c. Replace meskas by elevated ditches. No more lifting required.

d. Consider concrete pipe instead of asbestos cement.

Sociologists arrange whatever farmer organization is necessary to provide equitable distribution of water to all meskas, to get cooperation from the irrigation district for operation and maintenance, and to promote improvement of the meskas to permit irrigation by gravity methods.

II.B.2.4 Socio-Economic Implications

A system of equitable distribution of optimal quantities of water will increase yields on farms not presently receiving an adequate amount, reduce investment cost for wells and pumps and increase yields generally from lower water tables. Whether the net effect of the solution is economically and socially feasible depends on the development of cost effective delivery systems and socially acceptable organizations and institutions for controlling the new system. This has not been tested adequately since the concept of developing an alternative delivery system is not amenable to experimentation on a single farm basis. Testing will require the use of an irrigation canal command area which involves a number of small faremrs and, as in the case of other types of development change in Egyptian agriculture with its many small-scale farm producers, the task of social organization and communications will be difficult. It will require time and substantial project resources.

II.B.3 Insect Control

II.B.3.1 The Problem

Although insect control for cotton is supervised carefully by the Government of Egypt, most other crops receive little attention. At the Mansouria field site it has been observed that maize, tomatoes, and other vegetable crops are very responsive to chemical treatment for control of corn borers, white flies, spider mites and several species of leaf worms. Yields of tomatoes, for example, can be increased from the present average production of 6 tonnes per feddan to more than 20 tonnes by controlling the white fly, a vector spreading leaf curl virus. Yields of late planted maize can be increased from 10 ardabs per feddan to at least 14 by appropriate chemical control of corn borers. Farmers have only rudimentary knowledge of insect control and safe use of chemicals.

II.B.3.2 Documentation

Contemporary Egyptian Agriculture by H. S. Tobgy, 1976

Report on Insect Control at Mansouria, Internal Staff Paper No. 22 by Dr. Elwy, 1980

II.B.3.3 Proposed Solution

The white fly, a vector in spreading leaf curl virus in tomatoes should be controlled on an area basis rather than on a single farm basis. An irrigation canal command area of 50 or more feddans should be selected. All tomato growers should reach agreement to control the white fly through chemical application. This would require close cooperation between agronomists and sociologists to teach farmers appropriate technology, to obtain assistance through the Village Cooperative for chemicals and application equipment and to achieve necessary group action of farmers.

The control of insects in maize and vegetables could be done on a single farm basis. It would be more efficient, however, to work with groups of farmers through the Village Cooperatives and Extension Service.

II.B.3.4 Socio-Economic Implications

Appropriate use of chemicals for insect control on maize and vegetables appears to have a very high economic return. The results are highly visible to farmers. Insect control methods could be used to encourage the application of technology with less visible results, such as improved irrigation efficiency. Certain types of control, e.g., the white fly which affects tomatoes, are best done on an area basis. This will require establishment of complex social organization and commitment among small-scale tomato producers. Given the present social structure in rural areas and poor communications facilities this will not be an easy task.

II.B.4 Rate and Timing of Fertilizer Application

II.B.4.1 The Problem

Chemical fertilizers are widely used by farmers at the Mansouria site. The Village Cooperative distributes the fertilizers, at subsidized prices, on a crop quota basis. Fertilizers are also available on the free market at about twice the government price. It has been observed that large variation exists among farmers in amount and timing of application. Through experimentation we have knowledge of the optimum amounts and timing of fertilizer application and therefore must conclude that the highly variable practices of farmers indicates a need for improvement. Optimum use of fertilizer, based on calculations including production functions, price of fertilizer and value of crops produced, will maximize farmers' returns from using fertilizer. Deviations from optimum will result in foregoing the highest potential returns.

II.B.4.2 Documentation

The Use of Chemical Fertilizers in Mansouria Location, Internal Staff Paper No. 34, by M. Zanati, Mohamed Lotfy and Gamal Ayad

Farm Management in Africa by Martin Upton

II.B.4.3 Proposed Solution

Establish a fertilizer advisory service, in cooperation with the Village Banks, Village Cooperatives and Extension Service, to work with farmers on amount and timing of fertilizer application.

Conduct field demonstrations to show farmers the results of optimum amount and timing of fertilizer application compared to sub-optimum application.

The economists and agronomists should work together closely on the field demonstrations. Sociologists can assist with establishing communications and cooperation between EWUP, the farmers and the Village Banks, Village Cooperatives and Extension Service.

II.B.4.4 Socio-Economic Implications

A study of Mansouria site farm records indicates the annual expenditure per feddan for chemical fertilizer in 1979 ranged from L.E. 36 to L.E. 89. This is supported by the study by Zanati, Lotfy and Gamal which indicates high variability in application rates. This implies that a program to achieve optimum application would have some economic significance to farmers. However if farmers had to pay international prices for fertilizer they would have even more incentive to use it optimally. The subsidized price, about 50 percent of international price, takes away much of that incentive.

II.C Problem Identification/Solution Statements for Kafr el Sheikh

One of the more serious problems observed and measured in the Kafr el Sheikh field area is the unequal and poor distribution of water by the Dakalt Branch Canal which serves the EWUP study area. This problem will not be listed with others in this section with proposed solutions because it does not seem likely that the project has the resources to implement solutions to this problem. However, it should be recognized that the problem has an affect upon the other problems mentioned with some degree of severity. For example, over-excavation of the canal during cleaning or removal of soil for making bricks tends to lower the head available for private meskas and causes apparent water shortages.

Another aspect of this problem has to do with untimeliness and inappropriate allocation of water. The irrigation water is usually enough for the crop throughout the agriculture year except during two critical periods: 1) after winter closure (moderately critical), 2) during submergence of rice fields for transplanting (usually the month of June). Data from Dekalt Regulator, which serves most of Kafr el Sheikh area (including Abu Raya), show peak deliveries in March and in July. The peak requirements, according to water application measurements and water requirements data, actually occur in late February, in June and in November during planting of winter crops. If the winter closure could be made in late December/early January as it was 15 years ago, (1 month earlier) and if peak deliveries could be moved forward in time by approximately 1 month, the critical water shortages would be eliminated. This would be expected to even solve the problem when there is more than 50 percent rice on any one canal or meska (according to MOI Decision No. 14038, 1979, the rice area cultivated on the main canal is limited to 50 percent) as in the case on Dakalt Canal and the branches it serves.

Other factors causing inequal and poor distribution of water along the main distributor canal are discussed in the Kafr el Sheika problem identification report (see Appendix A).

The problems listed below with their proposed solutions are those that will have the greatest impact upon water managment for the area and will produce the greatest affect upon the income of the small Egyptian farmer.

II.C.1 The Problems of Water Delivery in Private Canals (meskas)

II.C.1.1 Problem Statement

Poor conditions of the meska (cross section, slope, embankments) cause flooding at some points and shortage of water at other points. There is presently no suitable maintenance procedures on the meskas. Farmer use of the soil from the bed and banks of the meskas for making bricks contributes to the problem. Poor maintenance causes water shortage at the ends (particularly during critical periods) because the farmers near the head of the meska have better control of the water and use it without regard to what happens downstream. All meskas should also receive the fair allocation according to the irrigation departments authorizations. This is presently not the case. Improved maintenance of meskas will improve the distribution along the meska. With fair distribution of water to each meska and cooperation of farmers along a meska in scheduling of irrigations, water shortages during critical periods could be eliminated, possible reductions in over-irrigation on meskas receiving too much water and possible overall increases in crop production could be realized.

II.C.1.2 Documentation of the Problem

Data files of Kafr el Sheikh show cross section and longitudinal surveys and documentation statements regarding water shortages and private canal maintenance.

II.C.1.3 Proposed Solutions

The farmers should be educated regarding essential criteria (that they can control) for an adequate water delivery system. This requires extension type training meetings using special visual aids that have been prepared as well as videotapes.

A formal organization among farmers along the meska must be established for maintenance and scheduling of water use. This will require infrastructure support from the Ministry of Irrigation to provide engineering data on cross section and grade of meskas for proper delivery of water.

II.C.1.4 Socio-Economic Implications

Water delivered in clean and well-maintained meskas will produce increased trust toward government officials and promote on-farm irrigation efficiency. This will have the effect of increased production for the farmer and water savings for the country in an area where water has no opportunity for reuse downstream.

II.C.2 Seepage and Conveyance Losses from On-Farm Ditches (Marwas)

II.C.2.1 Problem Statement

The poor conditions of on-farm distribution ditches (marwas) results in poor irrigation efficiencies due to considerable conveyance losses between sakia and field. This also contributed to high water table conditions near the marwa. Conveyance loss measurements show losses may be as high as 40 percent in a 100 m reach (marwas up to 240 m in length have been measured). A large amount of water (0.3 m^3/m on site 3-20 where the marwa is near 200 m) may also be lost as dead storage due to the depth of the marwa below the surrounding ground surface. This condition also contributes to high water table problems surrounding the marwa. Improved marwa conditions would eliminate high water table problems near marwas and associate yield reductions. Irrigation efficiencies would increase. Water would be saved; less water lifting required.

II.C.2.2 Documentation of the Problem

a. Observations of leakage, i.e., 2 strips on site 3-12 were irrigated by marwa leakage all season (1979-80) with no outlets
b. Omda field trial data (site 3-05, summer 1979)
c. Cotton P.I. draft report (by Adams et al.)
d. 1979-1980 yield reduction near marwa due to higher water table (site 3-02)
e. 1979-1980 marwa survey site 3-02
f. Summer 1980 training data
g. Kafr el Sheikh Problem Identification Report (Appendix)

11.C.2.3 Proposed Solution

Extension education of farmers on proper layout and design of field ditches will be an important step in the solution of this problem. Schemes will be proposed for reducing seepage and losses such as low cost materials to reduce stream bed permeability. Such materials may include plastic, compacted clay, and bentonite.

II.C.2.4 Socio-Economic Implications

Obviously where loss of water along a marwa is reduced or eliminated, the time and amount of money required for lifting water will be reduced. Water tables adjacent to the marwas will be lowered and soil-water conditions will be greatly improved with a resulting increase in crop yield for the fields. Such an investment by the farmer into his irrigation system will bring about an increase in his net income.

The solution of this problem will necessitate attention to the entire on-farm irrigation methods and should bring about a change in attitude of the farmer toward irrigation. Such change in attitudes could improve on-farm irrigation efficiency.

II.C.3 Over-Irrigation of Major Crops

II.C.3.1 Problem Statement

During the problem identification period we have found that most of the farmers over-irrigate their crops. Comparing the amount of water used with the requirements given by Serry et al. (1980) in a draft report on water requirements and by the water requirements department in the Institute[1/] we have found that the percentage of excess water reaches 100 percent (including the leaching requirement).

The farmers over-irrigate due to the following reasons:

a. The farmers believe that with more water applied they can increase the yield.

b. Poor land leveling requires the farmers to apply more water to cover the high spots. While irrigated as level basins, elevation varies (after plowing and disking) as much as -6 cm to +8 cm of the mean basin elevation.

c. The pre-irrigation represents about 30-50 percent of the amount of water applied in some cases due to the poor land preparation.

d. The bad condition of the field boundaries leads to high runoff losses.

e. High conveyance losses between sakia and the field.

f. Poor irrigation basin layout and design.

[1/] Water Management and Irrigation Technologies Research Institute, Ministry of Agriculture

II.C.3.2 Documentation of Problem

1. Water applied for each crop and the water recommended and the leaching requirement (P.I. draft report, cotton draft report, unpublished data in files)
2. Daily water table from some observation wells (unpublished data in files)
3. Some data from the field trials for the amount of water applied and the yield (P.I. data and field trial data 1979-1980 winter season)
   a. Data from 1979-1980 winter field trials
   b. P.I. report (see Appendix A)
   c. Data in files on irrigation water application
4. Distribution curves: Problem Identification Report
5. 1979-1980 field trial data, (a) vs. (b) management, showing reduced irrigation times and increased application efficiencies.

II.C.3.3 Proposed Solutions

Solutions to this problem are complex and will require some significant changes in technology as well as attitudinal changes of the farmer. It may not be possible for all the technological changes required for improved on-farm irrigation efficiency to be implemented. However, if one or more of the proposed changes listed below can be implemented, significant progress will have been achieved.

1. Help to establish equipment and expertise within the area so that proper land leveling can be achieved by the farmer. This is the most difficult part of the proposed solution to achieve. Expertise adeequipment is not presently available in the Cooperative. The task may best be accomplished by some government company or private contractor rather than through the Cooperative. At any event, the service must be available if land preparation for improved irrigation is to be achieved.
2. Through extension education and demonstration, educate the farmer in the use of a different farm layout for distribution of water. The layout and design of the field must be considered before land leveling can occur.

3. Through extension education and demonstration teach the farmer to irrigate by growth stage of the plants. Irrigation should not necessarily occur at every rotation period.

II.C.3.4 Social and Economic Implications

Modifying the farmers present practices will be difficult expecially since there are no obvious incentives to use less water. As with the successful implementation of the solutions to other problems mentioned above, one expects greater crop production because of the increased control on the soil-water system. Again water savings for use elsewhere in Egypt is a significant economic implication.

Infrastructure support is essential for the continuation of implementation and requires great emphasis on extension work and acceptance by the farmer. Such changes made by the farmer will no doubt produce the kind of effect the project was designed to achieve, i.e., "improve his economic and social well-being."

II.C.4 Ineffective Field Drains

II.C.4.1 Problem Statement

Small in-field (field drains) in the Abu Raya area presently do not operate as drains because they are poorly maintained. Depth and spacing are not according to design. It is likely that farmers do not maintain their field drains because the collector drains and secondary drains are poorly maintained as well. Unless these drains are maintained to specifications their usefulness is severely limited and they take up space which could be devoted to cropland.

The 1979-1980 winter field trials, where field drains were eliminated, show that under improved water management, water table building through the season was not a problem. Data analysis showing the soil salinity conditions at the beginning and end of the season is not yet complete. If favorable, then field drains could be eliminated and good water management used as a tool for water table level control and maintenance of favorable salinity conditions while bringing more land (10-15 percent) into production. If field drain elimination is not feasible (in terms of salinity) then the entire drainage system from field to main drains must be well maintained to be effective as a means of controlling salinity and water table levels.

II.C.4.2 Documentation of the Problem

a. The Kafr el Sheikh problem identification report presents some data on the area consumed by field drains.

b. Memo Eng./038-80 by J. Wolfe.

c. 1979-1980 winter field trials on elimination of field drains.

II.C.4.3 Proposed Solution

The field drains were initially designed and constructed to lower the water table and promote land reclamation. Over time due to poor maintenance the drains have been ineffective. The proposed solution is conditional:

1. If reclamation is still an essential on-going process as evidenced by soil salinity measurements, a program should be developed with the farmers to promote the cleaning and maintaining of drains or the drains could be replaced by subsurface covered drains. Covered drains may be under the authority of the Ministry of Land Reclamation, or the Tile Drainage Authority of the Ministry of Irrigation.
2. If reclamation is reasonably complete, drains could be eliminated and by implementation of water management practices already mentioned above, salinity and water table may be controlled within safe limits.

II.C.4.4 Socio-Economic Implications

Elimination of ineffective drains will bring from 10-15 percent of additional land into production. Such an addition will increase farm income in excess of 10-15 percent due to side benefits of water management. Fewer drains to maintain will decrease the farm labor requirements.

The farmer may be reluctant to eliminate these drains because he often uses them to drain off excess surface water applied to his fields. In this case extension education is needed to help the farmer improve on-farm water management. Traditional thinking and customs with respect to implementation of the above solutions will be difficult to change except by demonstration.

II.C.5 Low Plant Populations of Cotton

II.C.5.1 Problem Statement

Cotton is considered as the main cash crop in Egypt. It occupies 40 percent of the land of Abu Raya location during summer. The optimum cotton population recommended by the Ministry of Agriculture is 70,000 plants/fed (35,000 hills/fed). Many irrigation and agronomy practices followed by the farmers affect plant population density.

The results obtained through the soil fertility survey work (45 sites in Abu Raya location) revealed that cotton plant density ranged from 18,750 to 49,500 plants/fed whereas seed cotton yield lies in a range of 2.15 to 10.24 kentar/fed. A significant correlation exists between plant population and seed cotton yield. Obviously if the farmers could obtain the recommended plant populations, yields of seed cotton could be increased.

II.C.5.2. Documentation of Problem

a. The soil fertility survey for the cotton areas recorded plant population and yield of cotton on 45 selected sites at the Abu Raya location.

b. Kafr el Sheikh problem identification report.

c. Sakha Experiment Station reports.

d. Cotton Research Institute Publications.

II.C.5.3 Proposed Solutions

The reason for the low population of cotton plants is not clear. Plantings are made by hand with 10-15 seeds placed in each hill. The hills are later thinned to two or three plants. Field demonstrations could convince farmers that higher yields may be obtained by planting more seeds.

Salinity and water table conditions must also be improved on the field by proper water management so that seedlings will mature into high yielding plants. Irrigations according to stage and maturity of the crop will be necessary also.

II.C.5.4 Socio-Economic Implications

Optimum plant populations are necessary for maximizing returns to the farmer. Water management with the agronomic practices could increase farm income due to increases in cotton yields.

Increases in the yield of cotton also has a considerable national impact due to the fact that it is an important export commodity which earns a substantial amount of Egypt's foreign exchange.

However, farmers recognize that the prices they receive for cotton are well below world market prices and the incentive for increasing yields is not particularly high. If the price paid to the farmers were tied to increases in yield, i.e., higher yields being higher prices, perhaps both the balance of payment and farmer income would be improved.

II.C.6 Minor Soil Element Deficiencies

II.C.6.1 Problem Statement

Next to nitrogen and phosphorus deficiencies, minor element deficiencies are important nutritional factors limiting the growth of many important Egyptian crops such as rice, cotton, flax and wheat. Deficiencies in these minor elements, particularly zinc, at times are not visible but they do restrict crop growth by not allowing plants to give maximum response to macro-nutrients such as nitrogen and phosphorus.

For example, in EWUP field trials conducted at Abu Raya, the addition of zinc sulphate prior to transplanting of rice increased yields by 28 percent compared to those fields not treated with zinc. Similar responses were found with cotton and wheat. The soil fertility survey shows that most soils in Aba Raya are deficient in zinc.

II.C.6.2 Documentation of Problem

a. Kafr el Sheikh problem identification report, Project Paper 6.
b. "Response of Rice, Wheat and Flax to Zinc Application on the Soils of the Nile Delta," by Dotzenko et al., Staff Paper 38.
c. Zanati et al., 1979. "Micronutrient Status in Irrigated Soil of Egypt 1979," ASA Annual meeting in Fort Collins, Colorado.
d. IRRI publications on Zn-deficiency under the calcareous soils and high pH.

II.C.6.3 Proposed Solutions

Since zinc is the most common minor element that is deficient in the Kafr el Sheikh soils, success in solving the above problem depends largely upon availability of zinc and its price. Farmers can be educated as to its use and benefits, but if it is not available on the market or cooperative, the training will be of little use. Infrastructure support in this problem is essential in order to make materials available as they are needed.

A soil fertility testing procedure will be essential in implementing use of minor elements when needed. Farmers may be able to learn how to recognize plant symptoms in the field, but a more logical solution is to develop a soil testing capability so that farmers can submit samples for analysis.

II.C.6.4 Socio-Economic Implications

Obviously infrastructure support is essential to the successful solution to this problem. Such supporting infrastructure will bring about increased yields and net farm income. By demonstration and education the project can bring about an awareness of the farmer on the use of minor elements to boost yields, but availability of materials and testing facilities will be the responsibility of the GOW. In terms of their priorities in the use of resources, the infrastructure support may or may not be forthcoming. If support is received, use of deficient minor elements could represent a significant increase in farm income.

II.C.7 Shortage and High Cost of Labor in Rice Production

II.C.7.1 Problem Statement

Rice constitutes 50 percent of the summer crop in Kafr el Sheikh Governorate. Transplanting rice is a major labor consuming operation that exhausts the available supply of labor. This results in delay of rice establishment from early June to mid-July. Faster transplanting should make rice production cheaper and increase yield.

II.C.7.2 Documentation of Problem

a. EWUP economics study shows labor cost increasing during time of transplanting, Kafr el Sheikh problem identification report No. 6.
b. EWUP economic study shows possibility of cost reduction in transplanting may be achieved by mechanical planting, Staff Paper 7.
c. EWUP Enterprise budget studies for rice.

II.C.7.3 Proposed Solution

Introduce mechanical rice transplanter that will save time and labor. Transplanters are available in various designs. Sufficient field trials have not been completed to determine what is most suitable. If costs can be kept small, this offers the farmer a chance to increase net farm income. Other solutions lie in direct broadcasting of seeds and perhaps changing from paddy rice to upland rice. Solutions are not firm at this point in time and additional field trials may be necessary.

II.C.7.4 Socio-Economic Implications

Costs of mechanized transplanters present a serious limitation to using mechanization. Larger farm operators may find it economical. Questions remain as to the acceptability of such machines by the farmers even if costs are reasonable. However, farmers may be more willing to accept mechanization than to change to upland form of rice, if an alternative were given to them.

Of course reduced cost of inputs into rice culture will bring about an economic advantage to the farmer. It does not seem likely that socio-aspects will be a constraint in changing to a mechanized transplanter. The effects of eliminating large quantities of hand labor, however, have not been evaluated. The consequences of such a change should be looked at carefully.

II.D Problem Identification/Solution Statements for Minya

The last of the three field sites to phase into the project was Minya. Since the formal problem identification report for this site has not been presented some introductory remarks about the problem identification process are in order. After making preliminary observations and a base survey the following tentative problems were identified:

1. The Abueha Canal (commanding an area of approximately 1150 feddans) is designed for gravity irrigation. However, many farmers do not consistently receive water with 25 cm of head (the minimum head considered adequate for reasonable field irrigation efficiency). The apparent reasons for this are:

   a. there are no controls at the inlet and the outlet of meskas,

b. farmers near the intake of meskas take more than their share leaving farmers at the tail with shortages,

c. weeds and silt restrict the flows, and

d. seepage from meskas reduce the flows at the tails.

2. Fields are not properly leveled. This makes farmers use more water than needed in order to cover the high spots.
3. Excess water entering the area overloads the drains.
4. The use of mud dams and the use of meskas as animal wallows makes control of siltation in the meskas difficult.
5. Lands adjacent to the meskas and drains may have high water table, poor soil aeration and excessive leaching due to seepage.
6. Canals and drains are not cleaned frequently enough to maintain designed water flows.
7. Land preparation for seeding is inadequate.
8. Weed and insect control is inadequate.
9. Plant stand populations are often less than optimum.
10. Fertilizer application is not consistent with recommendations.
11. Plants show micro-nutrient deficiency. Farmers do not apply micro-nutrients to crops.
12. Irrigation scheduling is on a rotation basis and not according to crop needs.
13. Planting cotton and maize is often delayed past the recommended dates.
14. The extension service does not provide adequate support to farmers.

In order to address these problems special study farms and meskas were selected and work plans during the first year emphasized the following points.

1. Develop a water budget for the area (1150 feddans).
2. Install a cutthroat flume on Abueha canal before meska 5 for measuring the discharge entering the area.
3. Install weirs on the two drains for measuring the discharge at these locations.
4. Install staff gauges on the canal and on the drains to show the water level.

5. Make cross section and longitudinal section measurements of the meskas and the elevation of the land adjacent to their banks to compare water level with land elevation.
6. Install observation wells in the area and at the boundary to show the fluctuation of the water table.
7. Measure the area commanded by each meska and the size of farms and land holdings.
8. Make surveys for the selected farms on meska 22 to evaluate their topography related to meska water level.
9. Measure the water applied to these selected farms every irrigation.
10. Measure the discharge into Abueha canal.
11. Conduct soil fertility and soil characterization surveys.
12. Record application of organic fertilizer to selected farms.
13. Measure soil moisture on study farms before and after irrigation and quantity of water applied to determine field irrigation efficiency.
14. Measure plant population density.
15. Establish system of farm planning and record keeping to determine income to farmers, amounts of fertilizer used, labor for weeding, and labor for controlling insects. Records also show planting dates, harvesting dates, and irrigation methods.
16. Conduct field trials on application of micro-nutrients.
17. Conduct sociological interviews.
18. Develop crop enterprise cost reports for major crops produced in the area.

At mid-1980, after 18 months of problem identification and search for solution activities, six problems were selected for consideration in pilot programs. Each problem is discussed and evaluated in the following section II.D.1 through II.D.6.

II.D.1 Application of Excessive Water

II.D.1.1 The Problem

Water applied to fields is more than consumptive use. The excess infiltrates to the water table which tends to leach nutrients from the soil and overload the drainage system. Where water is lifted so, using an excessive amount also increases the labor required for irrigation.

II.D.1.2 Documentation

Field studies during the first year indicated the field irrigation efficiency ranged from 46 percent to 88 percent. The studies also indicated that farmers achieve high field irrigation efficiency during growth stages when plants are especially susceptible to lack of soil aeration from water-logged soils. For example, irrigation of wheat at tillering time achieved 88 percent field irrigation efficiency and broadbeans at blossom stage achieved 82 percent. Farmers seem to know that overirrigation at these critical growth stages retards tillering of wheat and causes blossoms to drop from broadbeans.

II.D.1.3 Proposed Solutions

Based on these results it was determined that plans to improve field irrigation efficiency should be delayed until nutrient leaching, labor savings and drainage overloading can be further studied. An exception might be to assist farmers determine soil moisture conditions in order to irrigate according to crop water requirements which is generally a good management practice. This may increase efficiency of all irrigations rather than only those associated with critical plant growth stages. Suggested solutions include:

1. Establish system of meskas which delivers water of not less than 25 cm head to all farmers.
2. Assist farmers with measurements which will enable them to apply water according to consumptive use of crops.
3. Assist farmers with land leveling and improved field irrigation systems.

II.D.1.4 Socio-Economic Implications

It is anticipated improved irrigation efficiency will save labor and possibly increase production. The magnitude of the economic impact is not known.

II.D.2 Improved Gravity Irrigation Delivery System for Abueha Canal

II.D.2.1 The Problem

The Abueha canal was originally designed to deliver water by gravity to all farms in the command area. At the present time it fails to achieve this design objective. Consequently some farmers do not receive adequate water by gravity and are forced to lift water with tambours or mechanical pumps.

II.D.2.2 Documentation

EWUP measurements indicate that minimum water levels in the main supply canal (Ibrahimya Canal) is 41.0 meters above sea level. The minimum water levels in the Abueha Canal during the "on" period are 40.85 at the inlet and 40.40 at the tail escape. Some field elevations in the command area are 40.60 meters which of course exceeds the water level in the Abueha Canal at certain times of minimum flow. Consequently, about one-third of the area requires intermittent lifting of water. If the water level was raised to 40.70 at the tail escape of the Abueha Canal the system of meskas could be designed to provide each farmer with 25 cm of head at his field intake.

II.D.2.3 Proposed Solution

Raise the banks of the Abueha Canal to a level 50 cm higher than at present. Install a new headgate control and a new gate at the tail escape. Clean the canal of trees and other obstructions and establish a system of cleaning frequently enough to maintain designed flow. Meskas would also be raised with headgates at each farm intake. Farmers would be organized to distribute the water equitably and according to consumptive use of crops.

II.D.2.4 Socio-Economic Implications

It is estimated that 5000 hours of labor could be saved each year in the command area by establishing a better delivery system. Anticipated improved irrigation efficiency could save water, relieve load on drains and improve crop yields. The new system would require cooperation of farmers through group action. This could be difficult to achieve but such group organization could have secondary benefits for other community development projects.

II.D.3 Excessive Through-Flow in Abueha Canal

II.D.3.1 The Problem

According to EWUP water budget records as much as 90 percent of the water entering the area flows through and into the drains at certain periods. Specifically the data on a daily basis indicate that water applied to the area as a percentage of water entering the area ranges from 77 percent to 90 percent during the on-period and 24 percent to 67 percent during the off-period. The average for both periods ranges from 71 percent to 88 percent. This situation overloads the drainage system and returns water to the Nile River.

II.D.3.2 Documentation

The data shown above can be verified from EWUP water budget records.

II.D.3.3 Proposed Solution

Starting at the intake from the Ibrahamia Canal an improved system of gates and control structures could be installed. Irrigation would be permitted only during "on" periods. Canals and drains would be cleaned frequently to permit them to carry designed flows of water.

II.D.3.4 Socio-Economic Implications

Currently farmers irrigate during the "off" period. The gate at the Ibrahamia Canal leaks and flows can be adjusted by special arrangement with the gatekeeper. Farmers of influence and power in the village use the "off" period water by lifting it with diesel pumps. They would probably resist modification which restricted "off" period use. They too may resist modifications. The economic consequences of saving water from passing through the Abueha Canal system are not clear. Further evaluation should be done on this issue.

II.D.4 Land Leveling

II.D.4.1 The Problem

Topogography measurements indicate 17 cm range in elevation on fields designed for level border irrigation. A reduction of this variance would permit more efficient irrigation which would save water, labor, soil nutrients and result in increased yields.

II.D.4.2 Documentation

EWUP topography data from selected study farms confirms the assertion that fields are not level. Field trials may be needed to confirm the anticipated results from leveling fields and to test equipment and accessibility of fields to mechanized equipment.

II.D.4.3 Proposed Solution

Conduct pilot project work and field trials using EWUP equipment to level and shape fields for improved irrigation management. Compare field irrigation efficiency, labor requirements and yields between trial fields and other fields under traditional but well-managed basin irrigation systems.

II.D.4.4 Socio-Economic Implications

The socio-economic implications of land leveling and improved systems of irrigation at the Abueha Canal need to be further tested.

II.D.5 Low Plant Stand Density in Row Crops

II.D.5.1 The Problem

Surveys indicate that farmers generally have lower plant stand densities than recommended by the Ministry of Agriculture.

II.D.5.2 Documentation

Data from records and surveys by EWUP are available in project files. Ministry of Agriculture recommendations are available through the Village Cooperative.

II.D.5.3 Proposed Solution

Farmers could be encouraged to plant more seeds, use closer spacing, reduce the number of plants thinned and practice insect control.

II.D.5.4 Socio-Economic Implications

It is not known exactly why farmers produce crops with lower stand density than recommended by the Ministry of Agriculture. Also the economic effect of low density at the Abueha field site is not known but evidence from other studies indicates that yields could be increased by achieving optimum plant density.

II.D.6 Micro-Nutrient Deficiency

II.D.6.1 The Problem

The soils in the Abueha area are deficient in zinc. Farmers do not generally correct this deficiency by soil or foliar application of appropriate chemicals. Yields of grain can be increased at least 10 percent for maize and nearly doubled for wheat by foliar application of zinc.

II.D.6.2 Documentation

Soil fertility surveys indicate of lack of available zinc in soil of the Abueha area. Field trials have shown increases in maize grain from 16.1 ardebs per feddan on control areas to 18.28 ardebs with foliar application of zinc. Wheat grain yields increase from 9.34 ardebs to 18.16 ardebs.

II.D.6.3 Proposed Solution

Additional field demonstrations will be required to fully convince all farmers in the Abueha area of the advantages of foliar spraying of zinc on maize and wheat. The use of an extension or advisory service will be necessary to help conduct demonstrations and disseminate information. The Village Cooperative should be encouraged to supply zinc and sprayers for application of chemicals.

II.D.6.4 Socio-Economic Implications

Economic evaluations of zinc application on wheat indicate annual returns per feddan can be increased from L.E. 79 to L.E. 201. This is a relatively simple practice requiring only individual action for adoption. It is not anticipated there would be any special social complications associated with solving this problem. Since results are simple and direct it may be that this practice can be combined with a package of other technologies which are now subtle and difficult to introduce.

III. OTHER PROJECT OUTPUTS

III.A. Introduction

As explained in the introduction, the Project Paper discribed other project activities that were to be accomplished. These activities at the time of the preparation of the Project Paper and even now were considered as essential elements in support of the major goal of improved on-farm water management. These activities were:

1. village soil fertility survey,
2. soil characterization surveys,
3. water budget surveys, and
4. training.

In addition, during problem identification it became apparent that pest control was a major problem affecting the economic conditions of the small farmer. Dr. Elwy Atalla, Entomology Division, Ministry of Agriculture, agreed to help in this area by working with project staff and project farmers. This resulted in another project activity on pest control. These activities are described in this section.

III.B. Soil Fertility Survey

In order to determine reasonable ways of fertilizer applications to meet the nutrient requirements of the crops in different areas, the project conducted a soil fertility survey. The specific objectives of this survey were to:

- Index the present level of both macro and micro plant nutrients in each project area.
- Determine the variability of the nutrient levels within and between farms and/or basins.
- Examine the relationship of soil fertility to cropping patterns and crop productivity.
- Establish a data base for evaluating the feasibility of a national soil testing program.
- Examine the current use of fertilizer by farmers and how this corresponds to fertility needs.

Procedures

Soil sampling for fertility analysis was done by selecting 1 feddan in 10, and sampling all individual parcels within the selected feddan. The exception was Minya where the sampling density was increased to 1 feddan in 5. This change was done because there had been no previous soil fertility surveys in Upper Egypt. Samples were collected at soil depths of 0-20 cm, 20-40 cm and 40-60 cm, with the two lower depths not being sampled each time. The sampling was done before winter crops in 1978 in Mansouria; before cotton or rice depending on the rotation in spring 1979 in Kafr El Sheikh; and before both winter and summer crops in 1979 and 1980 in Minya. After being collected, the samples were brought to Cairo for analysis at the Soil and Water Research Institute of the Ministry of Agriculture. Ten individual determinations were made on each sample. These included:

- pH,
- electrical conductivity,
- water soluble cations and anions,
- P,
- K, and
- micro-nutrients (Zn, Cu, Mn, Fe)

The results of the analysis were tabulated and statistically summarized to show the percentage of samples that fell within different critical index criteria of deficiency or sufficiency. The farmers use of fertilizer was determined by reviewing farm records of applied fertilizer and comparing this with recommended rates.

Accomplishments

Mansouria: The survey work with all analysis have been completed and a written report prepared. The results showed an ample supply of both P and K even in the sandy soil areas. However, there was some potential for Zn deficiency and high pH values in El Hammami. Also the farm record summary has been completed showing some very inconsistent use of fertilizers including rates of N well in excess of recommended rates.

Kafr El Sheikh: The analysis is essentially complete except for a few samples and reruns. The results indicate an ample supply of K throughout the area, but a good possibility of P deficiency and the Zn index was consistently zero. The results also showed that the basins were a good sampling unit, because the variability within basins was considerably less than the variability between basins.

Minya: A representative sub-sample of the analysis has been completed sufficiently for some general trends to be identified. This shows a general absence of available Zn, but adequate amounts of Cu and Mn. The pH is generally high and becomes high at lower depths, but salinity is low.

Evaluation of Effort

Reviewing the 3 surveys at this present stage of completion the most important determination appears to be pH, electrical conductivity, Zn, and P. The major constraint in conducting the fertility survey has been the number of samples and number of determinations per sample. The work requirement greatly overloaded the available laboratory facilities. This resulted in an 8 to 12 month data turn out time. Much of this was due to equipment delays. However, it does indicate a need to strengthen the laboratory facilities including stabilizing the laboratory technician benefits and/or upgrading the equipment. Also, it may be necessary to adjust the sample number and analysis required.

Future Work

Future EWUP effort in soil fertility should include:

- Completing the current analysis for each location, and examining possible correlation between some of the nutrient indexes, particularly the micro-nutrient indexes, with more general soil chemical parameters such as pH.
- Continue to provide routine support analysis as field requirements warrant.
- Determine the feasibility of implementing a soil testing program and how this can be organized to best serve small farmers.

Papers and Reports

- Zanati, M., et al. 1979. Soil Fertility Status of Some Irrigated Soils in Egypt. American Society of Agronomy Annual Meeting, Fort Collins, Colorado, August 1979.

- 1977. Problem Identification Report for Mansouria Study Area. Project Technical Report No. 1.

- Dotzenko, A. D., et al. 1979. Preliminary Soil Survey Report for the Beni Maydoul and El Hammami Areas. EWUP Technical Report No. 2.

- Zanati, M., N. Lotfy and G. Ayad. 1980. Use of Chemical Fertilizer in Mansouria Location. EWUP Staff Paper No. 34.

- Soltanpour, P. N. 1980. Soil Fertility Survey of Kafr El Sheikh Phosphrus. Staff Paper No. 43.

III.C. Soil Characterization and Classification Survey

In an effort to accurately understand the physical and chemical environment of each project area, a soil characterization survey was made by the project. Specific objectives of this survey were:

- To determine the physical and chemical reference parameters for which information could be related.

- To evaluate how suitable other results were for use in the project areas.

- To evaluate how useful project results are for other areas.

These objectives recognize the sensitivity of many agronomic factors to local environmental parameters, which can substantially affect crop production.

Production

The soil survey program was done by EWUP in cooperation with the Soil Survey Division, Land and Water Research Institute, Ministry of Agriculture. The procedure was to sample profiles on a 10 or 15 feddan grid to working from cadustral maps of scale 1:2500 a depth of 150 cm, or the occurance of a water table. Once open, the profiles were described according to the procedures of the Soil Survey Manual. This included noting any horizon development, the general soil texture, soil color and variation in soil color such as mottles, depth to the water table, presence of cracks, slickenslides, etc. After describing each profile, soil samples were taken from each layer for laboratory analysis. The laboratory analysis included particle size distribution, pH, organic matter, electrical conductivity, water soluble cation and anions, cation exchange capacity, free $Ca\ Co_3$, $Ca\ So_4$, calculation of sodium adsorption ratio, etc.

The results of the profile description and laboratory analysis was a grouping of all soil profiles with similar characteristics, and plotting the similar profiles on final maps at a scale of 1:10,000 (Kafr El Sheikh) or 1:25,000 (Mansouria). At the same time the different mapping units were classified according to an early edition of Soil Taxonomy.

Accomplishments

Mansouria: The soil survey has been completed and reported in EWUP Technical Report #2. This report recognizes three soil series in Beni Magdoul and one series with two phases in El Hammami. The biggest difference between the areas was in soil texture. In both areas high water table was a major problem with only isolated patches of alkalinity or salinity.

Kafr El Sheikh: The work in Kafr El Sheikh has also been completed and a manuscript prepared. This has been recently forwarded to CSU for final editing and publication as another EWUP Technical Report. The report lists three soil series of which one was subdivided into four phases and another into three phases. This made a total of eight mapping units.

El Minya: The field work has been completed as well as most of the laboratory analysis. The soil profile descriptions have also been completed. It is expected the manuscript preparation will begin shortly. The survey has shown the Minya area to be very homogenous with only one soil series and one mapping unit for the entire area. The area does not have a water table problem but does have a general problem with alkalinity.

Evaluation

Reviewing all three surveys as a whole, most of the managerial interpretations revolve around the criteria of:

- soil texture,
- depth to water table,
- salinity,
- alkalinity, and
- gypsum.

Except for texture and gypsum, the classification system used did not recognize these criteria and they had to be handled in the reports and mapped as phases of different soil series. This is largely because the Soil Taxonomy classification system puts heavy emphasis on natural climate, while in Egypt, mans irrigation, flood control, and climate modifications are an essential feature of the entire agricultural effort. Because of this there may be a need to make some national modifications of the system that will improve the interpretations of soil survey results when applied to Egypt. An example might be, to note the soils in Minya, Beni Magdoul, and Kafr El Sheikh are all classified as Typic Torrerts. This describes a soil with heavy texture, shrinking and swelling mineralogy in a dry climate. The last problem one would expect would be a wetness problem due to high water table. Yet in two of the three areas this is a major constraint. One way to resolve this could be to replace Typic with Anthydric (Anth from Antheric, meaning man induced, and hydric for wet) for Beni Magdoul and Kafr El Sheikh sites. This would then seperate this major problem when it occurs.

Future Work

During the remainder of the project the following soil survey related tasks are anticipated to be completed.

- Finish the two outstanding reports of project areas.
- Review surveying procedures to look at the possibility of increasing the efficiency and reducing the actual number of profiles sampled.
- Review soil classification terminalogy to see if some simple modification of Soil Taxonomy would allow more precise interpretation here in Egypt, or if some other classification system is better.
- Examine the possibility of defining "Irrigation Management Units" that could be used to extrapolate project results to other parts of Egypt.
- Evaluate the prospects of using LANDSAT imagery or other remote sensing methods to locate the map the "Irrigation Management Units." This work would be preliminary to developing an independent project for actually doing this.

EWUP's accomplishing these tasks will continue to be on a TDY basis, using approximately 18 man-months from the Soil Survey Division of the Soil and Water Research Institute, and 2 or 3 1-month TDY's from CSU Agronomy Department.

Project Reports

- Dotzenko, Zanati, Abdel-Wahed and Keleg. 1979. Preliminary Soil Survey Report for the Beni Magdoul and El Hammami Areas. EWUP Technical Report #2.
- Preliminary Soil Survey Report for Abo Raia Area. In Press.
- Heil, R. D. 1979. Soil and Land Classification. Staff Paper No. 44.

III.D Water Budget

The results from the water budget studies can be used to predict the effects that changes in water management will have on water losses, drainage problems and salinity buildup. The budget information will be needed to determine consumptive use and in any effort to change the management of the delivery system and method of scheduling delivery to the farmers (rotation to demand for example). Water budget results from three project areas will represent anticipated results from other irrigated areas throughout Egypt.

Accomplishments and Future Work

Mansouria: The Beni Magdoul Study area is in the Southern portion of the Mansouria Irrigation District and consists of approximately 750 feddans under irrigation. The study area (see Figure III.C-1) is a well defined hydrologic unit. The entire area is bounded by drains and water is supplied by the Beni Magdoul Canal. The surface soils of this area consist primarily of sandy clay, sandy clay loam and sandy loam. The log of the well installed for the deep aquifer test located at the intersection of the Beni Magdoul Canal and the branch canal SE quadrant is given in Table III.C-1. The clay layer in the upper seven meters was encountered in the drilling of the domestic water supply well for Beni Magdoul village and a preliminary exploration hole drilled approximately 300 meters north of the Beni Magdoul Canal along the Nahic Drain. This clay layer would effectively limit deep vertical seepage of irrigation water and is in effect an impermeable subsurface boundary for the area.

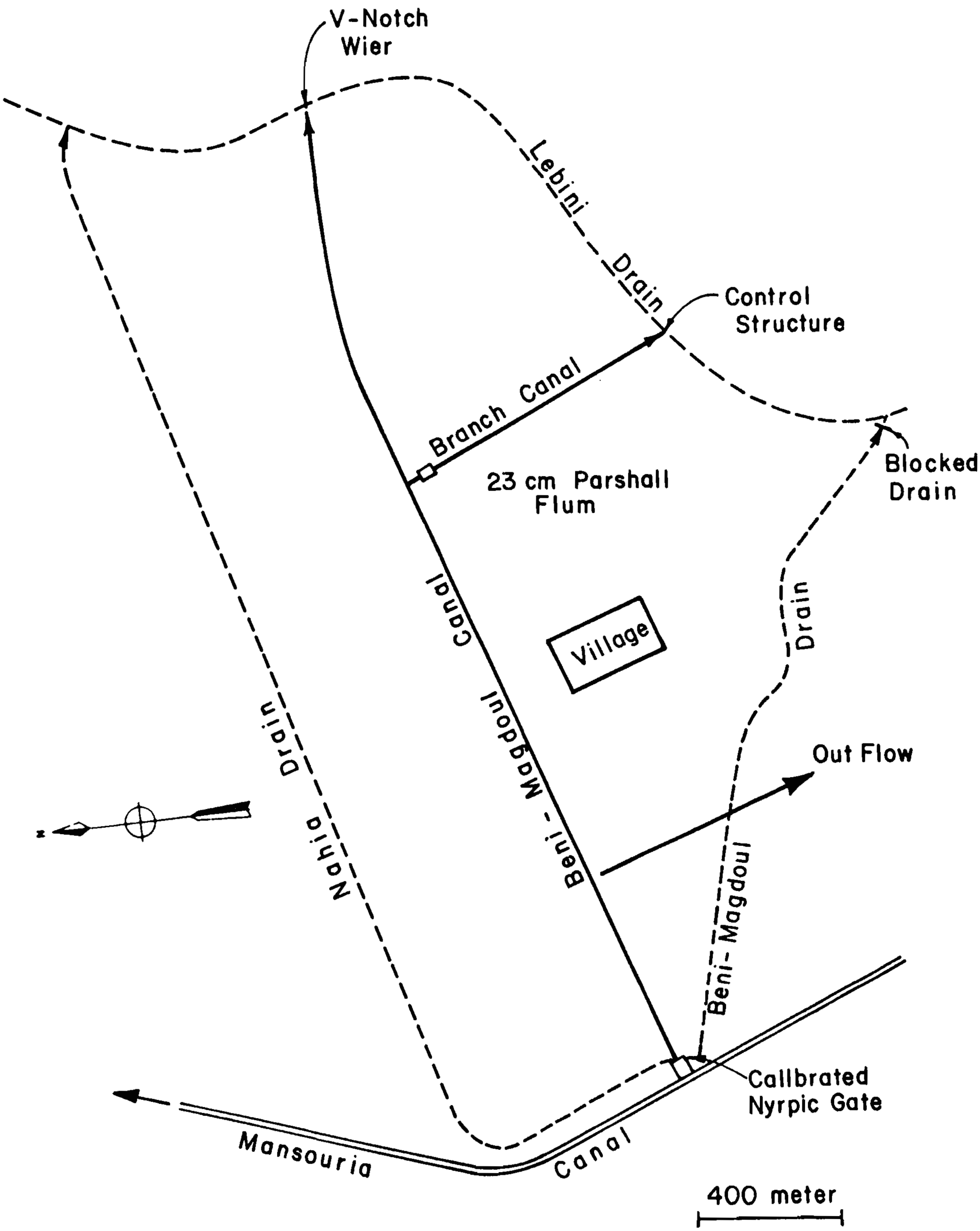


Figure III.C-1. Beni Magdoul Study Area

Table III.C-1. Soil Classification of Deep Well

Depth Meter	Classification
0-7	Clay
7-11	Fine sand
11-14	Clay with sand
14-15	Fine sand
15-20	Medium sand
20-26	Sand with gravel
26-27	Coarse sand, big gravel
27-34	Coarse sand
34-40	Fine sand

The results of the aquifer test conducted in Beni Magdoul showed that the clay layer is an effective vertical barrier between the deep aquifer and the shallow aquifer. The water table in the shallow aquifer responds directly to surface application of water and is the aquifer of prime concern in the water budget analysis.

The general concept for water balance for an area during a selected period of time is, "inflow less outflow equals change in storage for the area." The primary inflow to Beni-Magdoul site is controlled by a calibrated head gate at the junction of Mansouria canal and the Beni Magdoul canal. Other sources of water due to precipitation, deep wells, and interflow between adjacent areas have been determined to be relatively small and account for about 5 percent of the total inflow to the study site.

Consumptive use has been determined to be the most significant outflow from the area and more effort needs to be concentrated in more accurate consumptive use determinations.

Berseem is one of the biggest winter crops (578 feddan) for Beni Magdoul. Other winter crops grown are wheat (42 feddan), onion (18 feddan), flax (31 feddan), cabbage (2 feddan), carrots (51 feddan) and onions (25 feddan) for a total cropped area of 747 feddans. A complete yearly inventory of crops grown by area will be completed.

For this area, subsurface outflow is very small but can be increased by installing drains if salinity becomes a more serious problem. Surface outflow was very small, controlled by proper management of surface inflows at the headgate.

The change in groundwater storage was determined to be small over a one year period and changes in volume of water stored beneath ground surface was small.

The two largest variables are inflow from the Beni Magdoul canal and outflow due to consumptive use. These two flows account for approximately 94 percent of the total volume balance.

There is very little subsurface outflow which would indicate that salinity buildup within the area could be a more serious problem in the future unless the subsurface outflow is increased. Periodic salinity measurements of all waters including soil paste extracts should be made in order to evaluate the potential salinity problem. Some areas already show high saline soil conditions (EWUP Technical Report No. 3).

Since subsurface outflow is small, a critical balance between inflow and consumptive use must be established to control water table elevations at desired levels. Presently, water table levels (within 140 cm of ground surface) are at what is probably the highest level that can be maintained and still obtain a reasonable crop yield.

The high water table coupled with low subsurface outflow and salinity buildup would indicate that the subsurface outflow for this area should be increased. For the period January 1979 through December 1979, the inflow to the area through the headgate was approximately 5,400,000 m^3 and consumptive use was computed to be 5,600,000 m^3. Inflow from other sources was 330,000 m^3. Data for 1980 are being collected and have been evaluated through April. The evaluation of this partial data support the results of 1979.

Kafr El Sheikh: A water budget for Kafr El Sheikh study site will be well on its way to completion by January 1981. A well network to evaluate change in groundwater storage has been completed as well as surface inflow measurements. A preliminary hydrologic evaluation indicates that unlike Beni Magdoul, Kafr El Sheikh may have significant surface outflow through the surface drains. A complete set of flumes will be installed to monitor the volumes of water leaving the area.

Preliminary data suggest that volumes of water from surface inflows and consumptive use will be highly significant with surface outflow being secondary and all other hydrologic being small. A complete water budget will provide an evaluation of each component of inflow and outflow for this site.

El Minya: A study area for water budget has been selected. Measuring structures such as flumes and observation wells are being installed on schedule. Measurements for water budget evaluations are being taken and will be evaluated by December 1981.

Reports

- Helal, M. 1980. Cutthroat Flow Metric Equations. Staff Paper No. 6.
- Shinnawi, M. D. Skold, and M. L. Nasr. 1980. Economic Costs of Water Shortages along Branch Canals. Staff Paper No. 11.
- Wadir, F. 1979. Water Budget for Beni Magdoul Area in 1979. Staff paper No. 14.
- Ree, W. O., D. Sonada, J. Ruff. 1980. The Beni Magdoul Water Budget, January 1980 to April 1980. Staff Paper No. 27.

III.E. Training

Introduction

Training activities are a vital part of the EWUP Project. Training is important to supporting project activities to assist in the achievement of the project goals, and as a long term contribution to the Egyptian Government to increase the availability of staff who have capabilities in on-farm water management.

The training activities of the project can be subdivided into the following functional areas.

1. On-farm Water Management Short Course
2. Academic Training
3. Specialized Training
4. On-The-Job Training
5. Field Study Activities

6. Future Training Plans
7. Additional Activities

Each of the above areas will be presented separately.

1. ON-FARM WATER MANAGEMENT SHORT COURSE

A special course was developed to train project personnel in field activities and techniques used in the evaluation and analysis of on-farm water management. This course has been presented twice at CSU and once in Egypt.

The basic approach of the course is to provide hands-on training in the individual disciplinary skills required to analyze irrigated agricultural systems on an interdisciplinary basis. Specific skills are taught to the appropriate discipline members, and in addition, members of other disciplines are taught the basics of those skills. The method used is to divide the trainees into small teams with representation from the engineering, agronomy, economics, and sociology disciplines on each team. A field study site is assigned to each team for practice analysis. This analysis, in conjunction with lectures and demonstrations, provides the team with a realistic core activity, direct application of discipline skills, and an opportunity to work as a team. Each discipline learns the theoretical and the applicational aspects of their own discipline as well as the similar aspects of all the other disciplines. This multi-discipline teaching is augmented by team application of field and office skills within a framework of planning, coordination, and information analysis and exchange. Thus the end result is an interdisciplinary team whose members are not only enhanced in their own disciplinary skills, but are fully aware of their contributions to other disciplines and the value of information from other disciplines to their own work. A cooperative approach to data interpretation, report writing, and preparation of realistic recommendations is also stressed.

An adjunct to the training course is the two volume manual that has been developed. VOLUME ONE provides background information for each discipline and explains how the disciplines are interrelated. The emphasis is upon on-farm investigations of irrigation agricultural systems. VOLUME TWO provides specific skills information via a series of HOW-TO-DO-IT sections that give specific information about individual discipline skills and activities for on-farm water management investigation. VOLUME ONE is applicable to all disciplines in its entirety and forms the basis for an interdiciplinary understanding. VOLUME TWO is very specific and each section is primarily applicable to the relevant discipline.

As previously mentioned, the course has been presented three times--twice at CSU and once in Egypt. Plans call for the course to be offered twice more eith both activities in Egypt.

In addition to the formal training portions, a field study tour is part of the course. This study tour provides the trainees with the opportunity for first hand observation of irrigation activities in the United States. Visits are made to agricultural research stations, water development operations, irrigation projects, farmer cooperatives, and both private and public sector operations that form part of this infrastructure supporting irrigated agriculture in the United States.

A summary of the participants and staff for each of the three training programs is presented below:

A. 1978 Training Program

Summary

Discipline	Participants	Staff	Assistants	Special Lectures
Engineering	5	3	2	3
Agronomy	3	1	1	-
Sociology	1	1	1	1
Economics	2	1	1	
Admin.		1 (admin. committee)		
Additional Tour Participants	5			
Totals	16	7	5	4
Man-Months (Training 6 weeks) (Study tour 4 weeks)	22			

Trainees

Mr. Kamel Abdel Fattah Helmy	Engineer
Mr. Abdel Aty Allam	Engineer
Mr. Wadie Faheem Mankarous	Engineer
Mr. Moheb Ramzy Semaika	Agronomist
Mr. Magdy Mohamed Awad	Agronomist
Mr. Mohamed Naguib Youssef	Sociologist
Mr. Mohamed Lotfy Nasr	Economist
Mr. Ahmed Farouk Abdel Al	Economist
Mr. Mahrous Amin Emera	Mechanical Engineer
Mr. Ahmed Hussein Bayoumi	Agricultural Engineer (Farm Machinery)
Mr. Mohmed Samir Abd El Aziz	Agronomist - Project leader Kr El Sheikh

Additional Study Tour Participants

Engineer Aly Zaytoon	Under Secretary of State, Irrig. Ministry, Assyout
Engineer Samah El-Sayed Yassin	General Director of Minya Irrigation
Engineer Mokhtar Abdel Halim	Office Director of H. E. the Minister
Engineer Ezzat Mohamed El-Far	General Director of Sharkia Irrigation
Engineer Beshara Isshak Yussef	Staff of Water Distri. & Methods of Irrig. Research Institute

Staff

Dr. Wayne Clyma	Agricultural Engineering
Dr. Bill Hart	
Tom Ley	
Dr. Willard Schmehl	Agronomy
Dr. David Redgrave	
Dr. Dan Sunada	Civil Engineering
Dr. Jim Ruff	
Dr. E. V. Richardson	
Tom Edgar	
Dr. Ed Sparling	Economics
J. Warren Smith	
Dr. Erwin E. Nielsen	Industrial Sciences

Dr. Max Lowdermilk	Sociology
Dr. Frank Santopolo	
Dr. Jim Layton	

B. 1979 Training Program

Summary

Discipline	Participants	Staff	Assistants	Special Lecturers
Engineering	6	5	4	1
Agronomy	6	1	1	2
Sociology	1	2	2	1
Economics	4	1	1	
Admin.		1	4	
Additional Tour Participants	7			
Totals	24	10	12	4
Man-Months (Training 6 weeks) (Study tour 4 weeks)	33			

Trainees

Sayed Abdel Hafez	Agronomist
Abdel Sattar El Rayes	
Mohamed Said	
Tarek Tewfik	
Mohamed H. Abdel Sallam	
El-Shinnawy Abdel Atty	Economist
Ragui Darwish	
Elya Sorial	
Yusif Yusif	
Abdel Fattah Metawie	Irrigation Engineer
Amany El Kayal	
Salah Abo El Ela	
Abdel Fattah El Masry	Sociologist
Taha Hussein	Laboratory Technicial
Mohamed Helal El Sherif	Electrical Engineer

Fouad Moussa Ramadan	Drainage Engineer
Fatma A. Attia	Groundwater Engineer

Additional Study Tour Participants

Abdel Rahman Mohamaed Shalaby	Technical Director, Minister's Office Ministry of Irrigation
Ahmed Shawky Makrum	Director General for Irrigation Kafr El Sheikh (Ministry of Irrigation)
Jean Kamel Abdel Sayed	Director of Aquatic Weeds Institute Under-Secretary of State, Ministry of Irrigation
Elwy Aly Mahmoud Makky	First Under Secretary and Technical Director, Ministry of Irrigation
Aly Aly El Deeb	Under-Secretary of State, Ministry of Irrigation, Minya Governorate
Aly Ezzat Mokhtar	Under Secretary of State for Irrigation Ministry of Irrigation, Egypt
Dr. Mohamed Samra El Guindy	Drainage Institute

Staff

Dr. E. V. Richardson	Administration
Dr. Wayne Clyma	Engineering
Dr. Max Lowdermilk	Sociology
Dr. Al Madsen	Economics
Dr. Yack Moseley	Agricultural Engineering
Dr. David Redgrave	Agronomy
Dr. Dan Sunada	Drainage Engineering

Part-time

Dr. Mel Skold	Economics
Dr. Bill Schmehl	Agronomy
Dr. Robert Heil	Agronomy
Dr. Jim Ruff	Engineering
Dr. Frank Santopolo	Sociology
Dr. Parviz Soltanpour	Soil Testing

C. 1980 Training Program

Summary

Discipline	Participants	Staff	Assistants
Engineering	7	2	2
Agronomy	6	1	1
Sociology	3	1	1
Economics	2	1	1
Admin.		2	1
Additional Tour Participants	10		
Totals	28	7	6
Man-Months (Training 6 weeks) (Study tour 4 weeks)	55		

Trainees

Esmat Wafik Ahmed	Engineer
Azza Nasr	
Ahmed A. Dardir	
Kamal Ez El Din Khalil	
Mohamed Refat Farag	
Salah El Din Mahmoud	
Ahmed Abo Ellial	
Gamal Fawzi	Economics
Mohamed Gabaly	
Farouk Ahmed Abdel Al	Sociology
Ahmed El Attar	
Abdallah Saber Aly	
Nehad Mohamed Ibrahim	Agronomy
Ahmed Tahoon	
Mohamed Mahmoud Awad	
Mohamed Meleha	
Sabah Mahmoud El Sayed	
Mahmoud Saied	

Additional Study Tour Participants

Fawzy Farag Helwa	Under-Secretary for High Dam Authority
Wahid Moustafa Ismail	Director of the General Irrigation Company for Mechanical Excavation
Yehya Attia Abdel Khalek	Under-Secretary of State for Ministry of Irrigation, El Gharbia
Ezat Abdel Raouf Fayed	Under-Secretary of State for Ministry of Irrigation, Kaloubia & Ism
Saad Abdel Latif Al Samalihy	Under-Secretary of State for Ministry of Irrigation, Sharkia
Mohamed Gamal El Din Ahmed Bahgat	General Director of Technical Office for the Vice-Ministry of Irrigation
Naguib Hamdy	Team Leader, Wheat & Barley Program, Skaha Station, MCP
Nabil Khamis	Team Leader, Maize & Sorgum Program, El Guimeza Station, MCP
Hamed Ghanem	Team Leader, Wheat & Barley Program, Sids Station, MCP
Ahmed Aly Hassan	Team Leader, Maize & Sorgum Program, Shandawil Station, MCP

Staff

Dr. Mohamed Sallam	EWUP Training Officer
Salah El Din	Assistant Training Officer
Dr. David Redgrave	Training Program Coordinator
Dr. Yack Moseley	Engineer--Trainer (Irrigation)
Nancy Adams	Engineer--Assistant Trainer (Irrigation)
Thomas Edgar	Engineer--Trainer (Drainage)
Roger Slack	Engineer--Assistant Trainer (Drainage)
Dr. Larry Nelson	Agronomy Trainer
Gale Dunn	Agronomy Assistant Trainer
Dr. Al Madsen	Economics Trainer (First half)
Mohamed Haiden	Economics Assistant Trainer (Later Economics Trainer)
Ragi Darwish	Economiscs Assistant Trainer
Dr. James Layton	Sociology Trainer
Joyce Ham	Sociology Assistant Trainer

2. ACADEMIC TRAINING

Training opportunities have been provided to the project staff with an emphasis upon both improvement of dicipline skills and to provide a better understanding of the project goals and operations.

The finest training group was composed of senior project staff and key staff from cooperating institutes. The emphasis was in the following areas:

A. on-farm water management,
B. project goals, operations, and activities,
C. specific course work to increase individual discipline skills,
D. two week project management seminar,
E. local field tours of on-farm irrigation operations, origanizations, and water delivery systems,
F. review of achievements and applicability of data from Pakistan Project, and
G. participation in a special course--Interdisciplinary Agricultural Development.

This training took place from October through December of 1977, and involved the following participants:

<u>Trainees</u>

Dr. Mona Mostafa El-Kady	Irrigation Engineer, Water District and Irrigation Methods Institute
Mr. Mohamed Zaki Abdel-Fatouh Farag	Project Leader, Water District and Irrigation Methods Institute
Dr. Anwar Mohamed Keleg	First Researcher, Soil and Water Institute
Mr. Farouk Abdel Rahman Shahin	Deputy Director, Water District and Irrigation Methods Institute
Dr. Mohamed Ragib El-Zanat	Researcher, Soil and Water Institute
Mr. Mohmoud Ibrahim Saif Issa	Director of Works, Water District and Irrigation Methods Institute
Dr. Mohamed Shafic Sallam	Head Agricultural Extension and Rural Development Research Institute
Mrs. Nadia Mohamed Abdel Moneim Wahby	Assistant Director of Works, Water District and Irrigation Methods Institute

Staff

Dr. Wayne Clyma

Dr. Ed Sparling

Dr. Willard Schmehl

Dr. James Ruff

Dr. Max Lowdermilk

Dr. Dan Sunada

Ms. Nancy Adams

Dr. Ed Knop

Dr. E. V. Richardson

The second group was composed of four people drawn from the field locations. They concentrated upon discipline course work, worked on the collation and interpretation of project data, prepared project papers, and had close contact with CSU staff who were involved in project operations.

This group arrived in January 1980 and stayed until August 1980.

Trainees

Farouk Abdel Al	Economics
Mohamed Naguib Youssef	Sociology
Abdel Fattah Metawie	Engineering
Tarek Tewfik	Agronomy

Staff

Dr. Wayne Clyma	Engineering
Dr. Dan Sunada	Engineering
Dr. Max Lowdermilk	Sociology
Dr. Ed Knop	Sociology
Dr. Mel Skold	Economics
Dr. Al Madson	Economics
Dr. Bill Schmehl	Agronomy
Dr. David Redgrave	Agronomy
Dr. E. V. Richardson	Engineering

The third group started in September 1980 and will continue until the spring of 1981. They will be involved in discipline course work, interdisciplinary course work and seminars and will work on project data and reports.

Trainees	
Wadie Faheem Mankarous	Engineering
Moheb Ramzy Semaika	Agronomy
Abdallah Saber Aly	Sociology
Mohamed Lotfy Nasr	Economics

Staff	
Dr. Wayne Clyma	Engineering
Dr. Dan Sunada	Engineering
Dr. Max Lowdermilk	Sociology
Dr. Ed Knop	Sociology
Dr. Mel Skold	Economics
Dr. Al Madsen	Economics
Dr. Bill Schmehl	Agronomy
Dr. David Redgrave	Agronomy
Dr. E. V. Richardson	Engineering

A fourth group will arrive at CSU in the late summer of 1981

Academic Training Summary

Group	Trainees	Time		Man-months
One	8	3 months		24
Two	4	8 months		32
Three	4	8 months		32 (in progress)
Four	(in planning stage)			
			Total	88

3. SPECIALIZED TRAINING

Training has been provided on special subjects as needed. This activity has taken place at CSU at the Project Office in Cairo, and at the field sites. This training is specially designed for a particular individual or small group, is short-term, and involves intensive instructor/student contact.

a. Specialized instruction in H.P. programming and computer use

Helal Elsherif	September 1979
Azza Nasr	September 1980

b. Selected offerings from CSU Surge Program have been presented to participants at CSU and have been sent to Egypt for presentation to field and main office staff.

c. Training Program Design and Management

Mohammed Sallam	February 1980
Sallah El Din	February 1980

d. Design of pressure pipelines for irrigation systems

Mostaffa Saleh	April 1980

e. Intensive Sociology Instruction prior to on-farm water management short course (2 weeks)

Farouk Abdel Al	May 1980
Ahmed El Attar	May 1980
Abdallah Saber	May 1980
Abdel Fattal El Masay	May 1980

f. Soil testing procedures, laboratory operations, and data interpretation (two weeks each)

Tahir Moustafa	May 1978
	August 1979

g. Organization and operation of a soil testing laboratory (two weeks)

Taha Hussein	July 1979

h. Special three-day management techniques workshop presented by Dr. Benton and Hautalora to staff at each field site and the main office, December 1978. Total of 17 participants.

i. Special workshop on crop water requirements presented to field and senior staff by Dr. Eldon Hanson, June 1980. Total of 12 participants.

j. Special seminar in agronomy, soil testing, data interpretation, and fertilizer recommendations. Presented to senior staff by Dr. Parviz Soltanpour.

4. ON-THE-JOB TRAINING

A standard feature of project activities is that each senior staff member provides close support to the field staff. Thus each visit by a staff member to a field site provides opportunity for individual training under actual working conditions. An additional aspect is that these experts who work on a T.D.V. basis also follow the individual training emphasis in addition to presenting special topics workshops to field staff as needed and seminars about their activities to the senior staff.

Examples of the topics that have been presented follow.

a. Team management techniques
b. Soil-plant-water relationships
c. Soil testing and data interpretation
d. Project goals and operations
e. Preparation and use of crop budgets
f. Establishing field trial sites
g. Field soil survey techniques
h. Soil sampling and sample handling
i. Installation and use of flumes
j. measuring soil moisture
k. measuring water table depth and flow nets
l. Preparation of base survey maps
m. Construction of sociological surveys
n. Farmer interview techniques
o. Water budget field data collection
p. Land leveling techniques and calculations

5. FIELD STUDY ACTIVITIES

This training has been conducted both as the second segment of the On-Farm Water Management course and as a special activity for individual participation as required.

<u>Locations Visited</u>

A. Colorado State University

Contact and discussion with staff and faculty from the Departments of Sociology, Economics, Civil Engineering, Agricultural Engineering, and Agronomy. Visits to the Soil Testing Laboratory, Engineering Research Center, and the Agronomy Field research sites.

B. Big Thompson Irrigation Project (Colorado)

Tour of storage reservoirs, pumping station and remote control facilities, and water conveyance system.

C. North Poudre Irrigation District (Colorado)

Inspect irrigation water delivery network and discuss operation of system with District Manager and selected farmers.

D. Bureau of Reclamation, Denver Regional Office

Tour of facilities and discussion about water management operation and development projects in the western region.

E. Grand Valley Irrigation and Salt Management Project (Colorado)

Field research sites, canal lining equipment and salt control activities. Discussions with researchers, contractors and farmers.

F. Orchard Mesa Research Facilities (Colorado)

Research activities in tree crop production, irrigation methods, salt control, and water conservation.

G. Glen Canyon Dam and Power Plant (Arizona)

Tour of dam and power plant. Overview of Colorado River development activities and regional water distribution facilities and operations.

H. Salt River Project (Arizona)

Tour of irrigated farms, water storage and delivery system, and Automatic Flow Control Center. Operation and organization of a demand type irrigation system with short water supplies.

I. U.S.D.A. Water Conservation Laboratory (Arizona)

Research activities in water flow methods, irrigation efficiency, water delivery methods, irrigation practices, and land farming techniques.

J. Wellton-Mohawk Irrigation Project (Arizona)

Cooperative development project involving federal, state and local government, universities, private organizations and farmer cooperatives. Level basin irrigation operations.

K. Irrigated Areas in Arizona and the Imperial Valley and Coachella Valley in California

General tour of irrigated farms to observe field operations and irrigation methods. Sunface, sprinkler, and drop irrigation.

L. U.S.D.A. Salinity Laboratory (California)

Tour of facilities and activities in water-soil-salt management in irrigated agriculture. Water quality and salt leaching research and extension.

M. Steep Land Irrigation (California)

Tour of drip irrigated upland orchards on steep lands. Irrigation with high cost water. Pressurized water delivery system of irrigation district.

N. Drip Irrigation--Vegetables (California)

Tour of research, demonstrations and commercial operations concerned with small scale farmers, vegetable crops, high value water, and urban development.

Participants

A full list of participants, area of specialization, and parent organizations can be found in the listing of participants in the on-farm water management course.

Participants have come from:

a. project staff,
b. Ministry of Irrigation,
c. Ministry of Agriculture,
d. Faiyum University,
e. Zagzig University,

f. High Dam Authority,

g. Mechanical Excavation Authority, and

h. various cooperating institutes and projects.

Individual Study Tours

Special study tours have also been conducted. These tours have been arranged to meet specific needs of individuals and give them an opportunity to study irrigation methods, research, organizations, and other infrastructures so as to provide them with ideas and approaches in the overall planning activities for water management in Egypt.

Three tours have been conducted for project staff and visiting officials.

a. Dr. Mahmoud Abr Zeid, Director, Water Management Research Institute

b. Dr. Hassan Whaby, Director, Water Management Project

c. Dr. Abdel Hady Samaha, Minister of Irrigation

Assistance has also been provided to other organizations and projects in the determination of study locations and tour arrangements.

6. FUTURE TRAINING PLANS

A. On-Farm Water Management Short Course

This course will be presented two additional times. Participants will come from project staff, cooperating institutes, and from the Ministry of Irrigation, Ministry of Agriculture, various universities and other organizations involved in irrigation water management.

B. Surge Courses

The course offerings will be expanded by adding video material to the project training library. These courses will also be made available to the field site teams on a rotational basis. Extensive video equipment has been provided for course presentation and preparation of new material.

C. Seminars and Short Courses

Seminars and short courses will be continued in response to needs and specific requests.

D. Academic training opportunities will include a new group to arrive at CSU in the summer of 1981.

E. Project staff will participate as assistant instructors in the next offering of the on-farm water management course. This involvement of Egyptian staff will increase with the eventual goal of the course being totally taken over by Egyptian personnel. Discipline training, instructional methods training, and mamagement seminars will be required to successfully achieve this transfer.

7. ADDITIONAL ACTIVITIES

On-farm water management short courses.

a. Training Center Developed at Kafr El Sheihk

b. Mobile Testing Laboratory for Training Support Installed at the Training Center

Staff involved in preparation of the training manual:

Dr. Wayne Clyma	Engineering
Dr. Dan Sunada	
Dr. E. V. Richardson	
Dr. Willard Schmehl	Agronomy
Dr. Parviz Soltanpour	
Dr. David Redgrave	
Dr. Larry Nelson	
Dr. Max Lowdermilk	Sociology
Dr. Frank Santopolo	
Dr. James Layton	
Dr. Al Madsen	Economics
Dr. Melvin Skold	

III.F. Pest Control Study

During the problem identification work the project realized that insect damage was a major crop production problem. It is estimated Egypt's annual loss from insects is L.E. 6,000,000. For this reason the project undertook a study of insect damage to crops and insect control in each project area. The specific objectives of this study were:

- To determine the insects infecting the crops in the study area.

- To obtain information on recommended control procedures for the major insects.
- To demonstrate the recommended control procedure to the farmers.
- To educate the farmers on insect problems and their control, including the safe use of insecticides.

Procedures and Accomplishments

The pest control study was conducted in collaboration with the Plant Protection Institute, Agricultural Research Center, Ministry of Agriculture, through the institute director, Dr. Elwy Atalla. The biggest effort in the study was a systematic survey of insects in Mansouria. This involved weekly sampling for one year of all field crops. Random plants were selected and examined in the laboratory for the actual presence of the insects and/or the diagnostic damage done by the insects. The results were tabulated in a staff paper. The tabulation included the insect, its major host, the symptoms of infestation, and control procedures. In addition to the formal survey of Mansouria, less formal survey visits were made to both Kafr El Sheikh and El Minya. In addition to the survey report a series of four reports on the important insects affecting the major crops of each project area, plus a lead paper on the general concepts of integrated insect management. Finally field trials on chemical control of the major insects of vegetables and maize were designed for the Mansouria team to conduct. These trials effectively demonstrated to the farmer the importance of insect control in crop production, which they readily accepted as judged by their request for additional assistance. This is further supported by highly favorable economic returns from chemical control.

Future Work

The collaborative pest control work with the Plant Protection Institute is expected to continue. The additional work includes:

- Quantifying the insect survey to determine the population density and economic thresholds of the various insects.
- Make more complete surveys of Kafr El Sheikh and El Minya project areas.

- Additional demonstrations on effective insect control procedures.

- Consolidate all results into a Technical Paper on Insect Control.

Project Reports

- Atalla, E. Corn Insects. Staff Paper #3.

- Atalla, E. Rice Insects. Staff Paper #4.

- Atalla, E. Major Field Crop Insects and Their Control, Cotton, Wheat, Barley and Sugarcane. Staff Paper #5.

- Nasr, L. M. An Economic Analysis for Squash Trial at El Hammami. Staff Paper #15.

- Nasr, L. M. An Economic Analysis for Tomato Trials in El Hammami. Staff Paper #16.

- Semaika, M. and H. Golus. The Effect of Soil and Pest Management on Farm Production, Squash. Staff Paper #17.

- Semiaka, M. Report on Tomato - Farm No. 1 in El Hammami, Winter 1979-1980. Staff Paper #17.

- Atalla, E. Survey of Pest Infesting Mansouria Vegetables and Crops (Beni Magdoul and El Hammami Areas). Staff Paper #22.

- Atalla, E. General Concepts of Agricultural Pest and Their Control. Staff Paper #35.

IV. PILOT PROGRAMS, SEPTEMBER 1980 TO DECEMBER 1982

This chapter defines the concept of pilot programs and compares it with the concept of field trials (IV.A.). Then three pilot program plans are presented for Mansouria (IV.B.1., IV.B.2., IV.B.3.), one for Minya (IV.B.4.) and one for Kafr El Sheikh (IV.B.5.).

One Mansouria pilot program includes improved irrigation and agronomic practices along a typical unimproved tertiary distribution canal serving about twenty-five farmers. A second includes the same practices but modifies the canal by elevating it above field level and includes plans to initiate gravity delivery of water to form outlets. The third combines improved irrigation and agronomic practices with a buried low pressure pipeline.

The Minya pilot program features the improvement of a gravity flow delivery system, improved irrigation management and application of micro-nutrients to wheat and maize.

The Kafr El Sheikh pilot program features improved farmer controlled delivery system on tertiary canals, improved on-farm water management, and improved agronomic practices.

Each team developed its own plan following a general outline of planning components. It is intended that the plans should be refined and modified through discussion and agreement by Project personnel and farmers as they progress through the next two years.

IV.A. Definition and Purposes

According to the Contract page 6, "the second stage of the on-farm research program will be the design and implementation of pilot programs in each of three areas, incorporating high benefit technologies developed in the first stage."

This report now turns attention to this assignment.

At the mid-project field team seminars held in July and August, 1980, the EWUP staff held discussions on the definitions and purposes of pilot programs in order to clarify the thinking of personnel regarding this effort. Some confusion existed between the concept of field trials and the concept of pilot programs. The following statement of the two concepts emerged.

An <u>on-farm field trial</u> is a verification of physical and/or biological response of farm management practices which have already been tested and proven in a laboratory or experiment station. Major emphasis is on physical and biological responses but social and economic attributes should also be monitored during the field trial.

A <u>pilot program</u> is a procedure of introducing pretested farm management practices into a farming <u>system</u> on a limited scale. The purposes of a pilot program are:

1. Program development. This involves creation of extension type administrative approaches and evaluation of the social, economic, physical and biological impacts of specified changes on a broader basis than a field trial. In program development specific changes in on-farm water management and irrigation practices, delivery system operation, farmer advisory services, agronomic practices and farmer organization will be evaluated on a miska area basis.
2. Farmer involvement. Determine farmers willingness to accept specified changes. Also determine the extent to which farmers are individually capable of implementing specified changes.
3. Infrastructure support. Determine the extent to which the infrastructure limits implementation of the specified changes. Examples of possible constraints are inability of the infrastructure to provide timely agricultural inputs such as labor, seed, power, and irrigation water. The evaluation of infrastructure support will likely lead to examination of all institutions serving farmers such as markets, village banks, farmer organizations, cooperatives, extension service, communications, etc. Special attention may need to be given to formal and informal farmer organizations which are responsible for efficient and equitable water distribution. If the infrastructure limits adoption of proven technology by farmers than it will be necessary to consider steps to develop the needed support.

These statements are consistent with the Project Paper, the Contract and the Grant Agreement. They provide the basis for the development of specific pilot program plans at each Project site.

The specific proposals for pilot programs which follow each include a geographical unit of not less than the command area served by one meska. Most areas are in excess of 50 feddans and include at least 25 farmers.

IV.B. Specific Proposals

IV.B.1. Mansouria, Meska #6, Beni Magdoul

I. Description and Essential Features

A. The geographical area will include all of the land irrigated by Meska #6.

B. Technical changes to be introduced.

1. Improve on-farm irrigation by helping farmers determine when to irrigate.
2. Implementation of an irrigation schedule controlled by the farmers.
3. Establish meska cleaning frequently enough to maintain adequate flows of water.
4. Establish an insect control program among all the farmers served by Meska #6.

C. Objectives to be reached by December 1982.

1. All farmers will be irrigating according to crop requirements rather than a fixed rotation.
2. A farmer organization will exist to supervise meska cleaning and water scheduling.
3. Farmers will possess adequate knowledge, chemicals and sprayers through ownership or leasing to adequately control insect pests on Meska #6.

II. Implementation

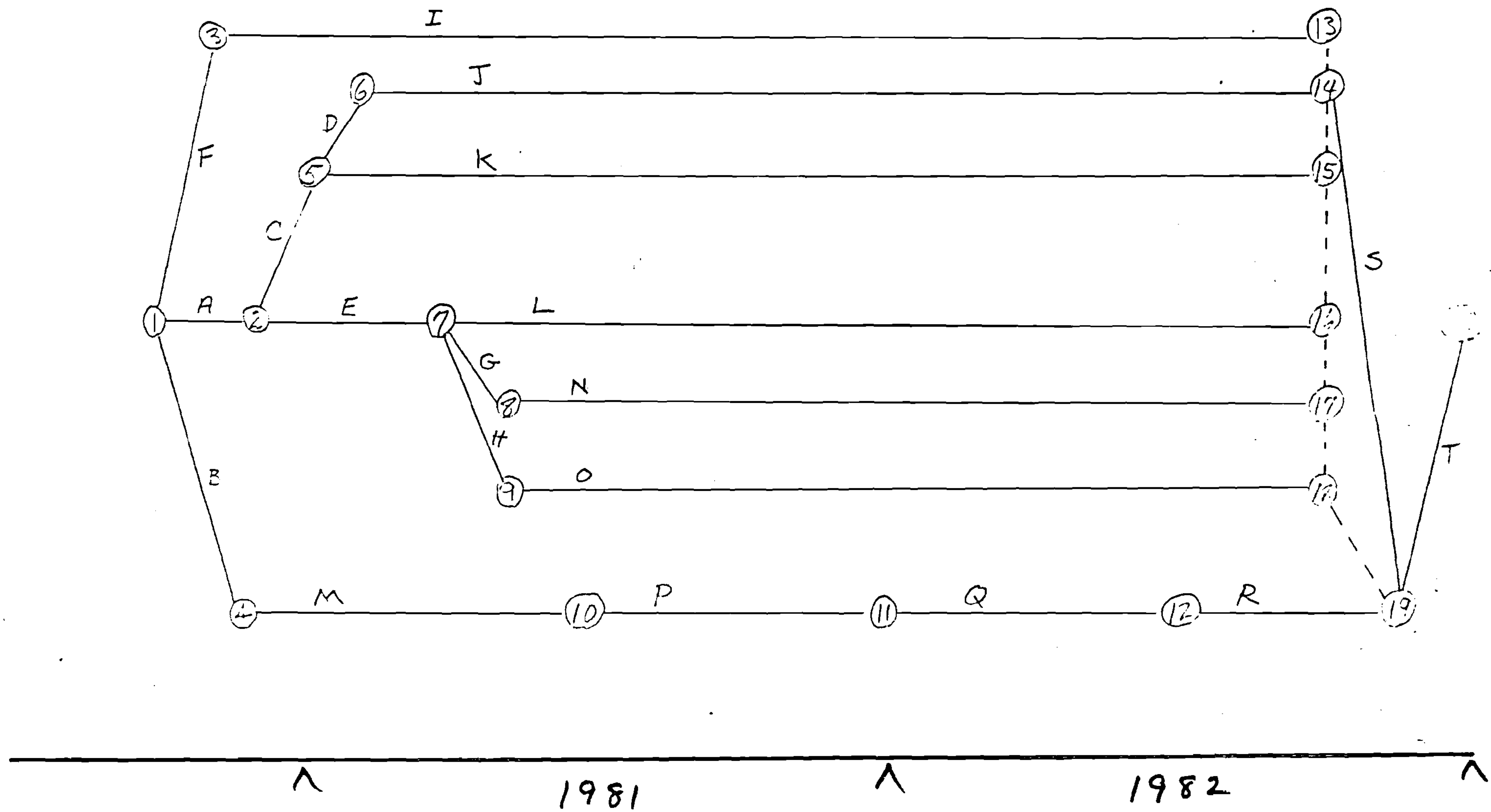
A. Responsibility for coordination and implementation. The Pilot Program Coordinator will be Agronomist Mahmoud. He will be assisted by Engineer Salah, Sociologist Farouk, Engineer Hanafi, and Economist Gamal, all members of the Mansouria team. Activities, events and a PERT network chart of the pilot program plan follow.

B. Procedures and Strategies for Implementing Change

	Activities	Responsible Person
a.	Prepare maps including land ownership	Farouk
b.	Gather data and write report for base line survey	Gamal
c.	Select farms and plan on-farm water management	Salah
d.	Prepare farm plans and set up record books	Gamal
e.	Plan meeting and communication program with farmers	Farouk
f.	Plan insect control program	Mahmoud
g.	Plan system of meska cleaning with farmers	Farouk
h.	Plan system of water scheduling with farmers	Mahmoud
i.	Conduct insect control program	Mahmoud
j.	Continue process of farm plans, records and analysis	Gamal
k.	Conduct program of on-farm water management with selected farms	Hanafi
l.	Conduct program of meetings and planning with farmers	Farouk
m.	Monitor progress and write reports	Mahmoud
n.	Assist farmers with regular meska cleaning	Farouk
o.	Assist farmers with water scheduling	Mahmoud
p.	Monitor progress and write report	Mahmoud
q.	Monitor progress and write report	Mahmoud
r.	Gather data for final evaluation report	Gamal
s.	Analyze farm record data	Gamal
t.	Write final evaluation reports and conduct field day for farmers to present the pilot program results to other farmers and government officials.	Mona, Bill

	Events	Date
1.	Start	Oct. 80
2.	Land use maps completed	Dec. 80
3.	Insect control plan completed	Dec. 80
4.	Base line survey report completed	Dec. 80
5.	Farms are selected for on-farm water management	Feb. 81
6.	Initial farm plans completed	Mar. 81

PERT Network for Meska #6, Beni-Magdoul



	Events	Date
7.	General meeting with farmers	Mar. 81
8.	Plans complete for Meska cleaning	Apr. 81
9.	Plans complete for water scheduling	Apr. 81
10.	Progress report due	June 81
11.	Progress report due	Dec. 81
12.	Progress report due	June 82
13, 14, 15, 16, 17, 18.	End program	Oct. 82
19.	Data collected for final report	Nov. 82
20.	Final report due	Dec. 82

C. Equipment required:
- 2 sprayers, mist-blowing type
- brick, sand and cement for flumes
- 20 sakia counters
- 1 survey level with 2 rods
- insecticides as needed

D. Cooperation planned with other organizations. Cooperation is planned with the village co-op and village banks. Personnel will be informed and a role will be defined for on-farm irrigation advisors. Personnel will be trained in the activities and recommended practices of EWUP. Special attention will be given to training and education of these personnel in regard to recommended agronomy and on-farm irrigation practices. Village co-ops will be encouraged to provide better varieties for planting.

III. Evaluation Plan

A. Methods of Evaluation

1. Economists will constantly monitor the economic impact of all technical changes. Their data collection will focus on farms where more concentrated technical changes are made. The economic effects of the technical changes will be compared to the base economic data for similar farms in the immediate area.

2. Technical evaluations will be made as activities are conducted. It will be important to evaluate the success of each change in the farm system in order to make further recommendations.
3. Sociologists must evaluate their success in developing the farmer organizations. Further the sociologists should evaluate the implementability of all technical changes. This implementability evaluation should consider the farmers' attitudes toward the technical changes, the farmers' resources for implementation and the degree to which the farmers actually make the proposed technical changes. Constraints to technical changes must be carefully documented including all aspects of infrastructure support.

B. Responsibility for evaluation is assigned to the pilot program coordinator, the economist and the Mansouria team leaders.

C. Responsibility for reporting progress will be that of the coordinator of the pilot program.

IV. The team leaders are responsible for the final report and for the field day. The final report should summarize evaluations of each aspect of the pilot program. The field day should provide cooperating farmers with an opportunity to tell other farmers and government officials about the results of the pilot program.

IV.B.2. Mansouria, Meska #10, Beni Magdoul

I. Description of Essential Features

A. The geographic area will be the irrigated land served by meska 10, approximately 57 feddans.

B. Technical changes to be introduced.

1. Construct an elevated meska, beside the existing one, providing farmers with the ability to irrigate by gravity-fed water. A pump at the head of the meska will provide water at the required level.

2. Establish a farmer organization for achieving good water management and scheduling of irrigations along the entire meska. This group will also coordinate a regular maintenance program.
3. Make recommendations and assist farmers with better on-farm irrigation systems.
4. Provide good crop production recommendations and use demonstration plots as needed to reinforce these recommendations. These recommendations will center primarily around improved irrigation methods and good variety selections and effective insect control.

C. Objectives to be reached by December 1982

1. All farmers will be irrigating by the gravity system according to a schedule promoting efficient water use. This will be operated by a farmer user organization.
2. Farmers will be implementing better on-farm irrigation practices as recommended by EWUP.
3. Farmers will practice effective insect control and use the best suited varieties.

II. Implementation

A. Responsibility for coordination and implementation. The pilot program coordinator will be Engineer Salah, assisted by Agronomists Tahoon and Tarik, Economist Gamal and Sociologists Naguib and Farouk, plus all the other members of the Mansouria team. Activities, events and a PERT network chart of the pilot program plan follows:

B. Procedures and Strategies for Implementing Change

	Activities	Responsible Person
a.	Prepare land ownership maps and conduct farmer equipment survey. Document present status of water table.	Naguib, Salah
b.	Survey farmers to establish their understanding and reasoning supporting their various agronomic practices.	Naguib
c.	Establish good relationships with farmers by making agronomic recommendations as requested by farmers.	Tahoon, Tarik

	Activities	Responsible Person
d.	Introduce and develop farmer interest and understanding of the elevated meska.	Farouk
e.	Make continuous observations on the pre-selected farms for irrigation practices and farm records.	Salah Gamal
f.	Promote equipment sharing and leasing among the farmers.	Farouk
g.	Construct elevated meska.	Salah
h.	Conduct economic analysis of the elevated meska.	Gamal
i.	Hold discussions with farmers to facilitate development of a farmer organization for irrigation scheduling with the elevated meska including a maintenance program.	Farouk, Naguib
j.	Promote good on-farm irrigation practices by recommendations with demonstrations on the previously selected farms.	Salah
k, l, m.	Monitor progress and write report.	Salah
n.	Make all necessary evaluation surveys.	Naguib
o.	Analyze and summarize all farm record data, engineering, sociology, and agronomy data. Conduct farmer field day for reporting results to other farmers and government officials.	Mona, Bill
p.	Prepare farm records, prepare irrigation practice information and water table levels.	Gamal

	Events	Date
1.	Start	Sep. 80
2.	Ownership maps and initial surveys completed	Nov. 80
3.	Farmers, in increasing numbers, will be following improved agronomic practices and using equipment more efficiently among themselves.	Feb. 81
4.	Select several farms for base economic data collection and future on-farm irrigation development.	Nov. 80
5.	Begin farm records, irrigation practice information, and water table position.	Nov. 80
6.	Base line report completed	Dec. 80
7.	Design elevated meska	Jan. 81
8.	Complete construction of meska	June 81
9.	A functioning farmer organization for good irrigation scheduling along the entire meska	Sep. 81
10.	Good on-farm irrigation practices followed especially on the pre-selected farms.	June 82

	Events	Date
11.	Economic analysis of the elevated meska, preliminary report.	Aug. 81
12.	Progress report due.	June 81
13.	Progress report due.	Jan. 82
14.	Progress report due.	June 82
15, 16, 17, 18.	End program.	Dec. 82
19.	Make final report and conduct field day.	Dec. 82

III. Evaluation Plan

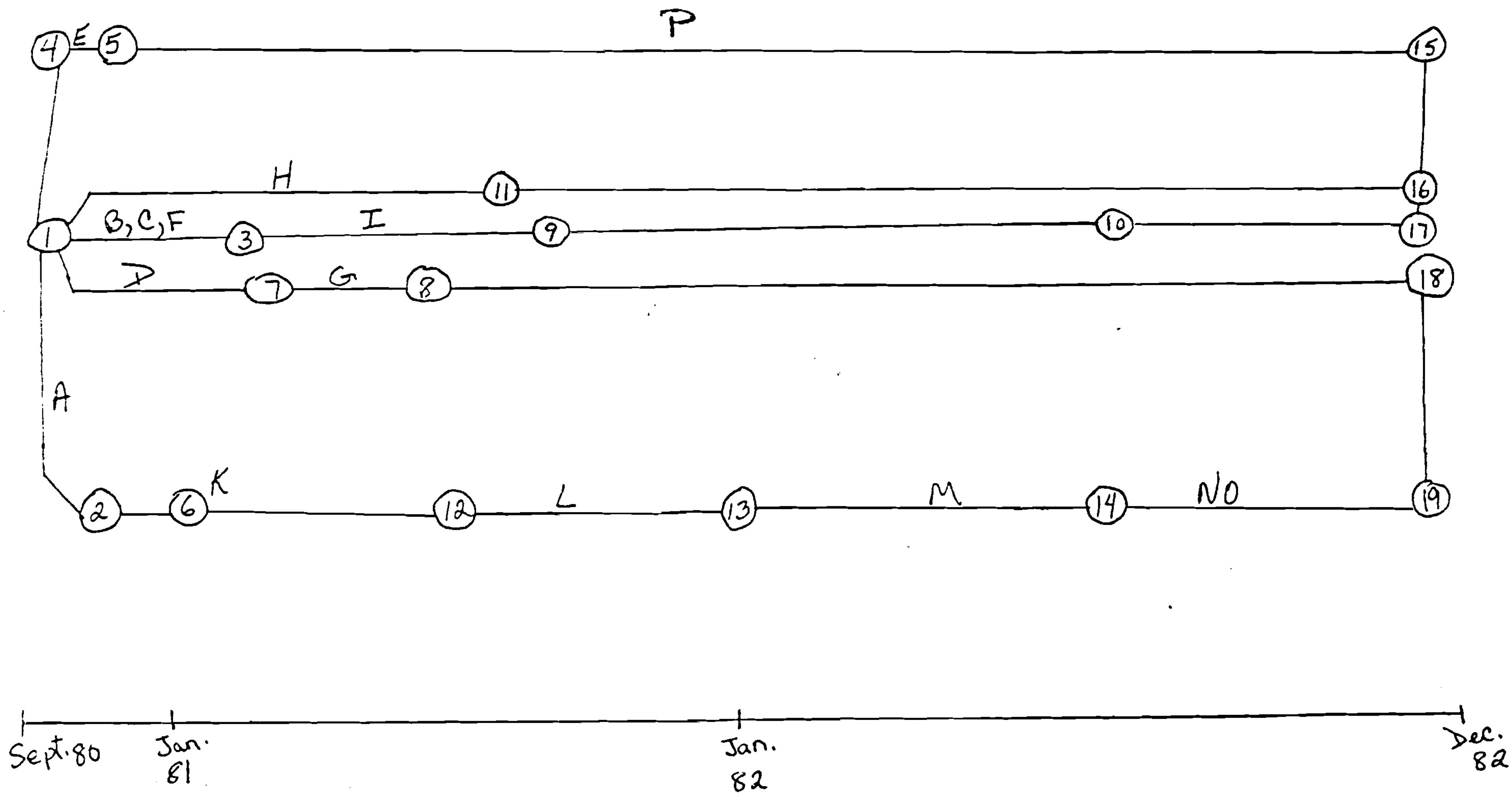
A. Methods of Evaluation

1. Economists will constantly monitor the economic impact of all technical changes. Their data collection will focus on farms where more concentrated technical changes are made. The economic effects of the technical changes will be compared to the base economic data for similar farms in the immediate area.
2. Technical evaluations will be made as activities are conducted. It will be important to evaluate the success of each change in the farm system in order to make further recommendations.
3. Sociologists must evaluate their success in developing the farmer organizations. Further the sociologists should evaluate the implementability of all technical changes. This implementability evaluation should consider the farmers' attitudes toward the technical changes, the farmers' resources for implementation and the degree to which the farmers actually make the proposed technical changes. Constraints to technical changes must be carefully documented.
4. Engineers will evaluate the impact of changing the water delivery system on the position of the water table.

B. Responsibility for evaluation is assigned to the pilot program coordinator, the economist and the Mansouria team leaders.

C. Responsibility for reporting progress will be that of the coordinator of the pilot program.

PERT Network Chart for Elevation of Meska #10



IV-11

IV. Conduct of the farmer field day and the final report summarizing all data and technical changes, and for making further recommendations will be the responsibility of the Mansouria team leaders.

IV.B.3. Mansouria, Meska #2, El Hammami

I. Description of Essential Features

A. The geographic area will be the irrigated land served by meska 2.

B. Technical changes to be introduced.

1. The meska 2 pipeline will be a lateral pipeline off the main pipeline. It will replace the existing meska with a continuous supply of water. The water in the pipeline will be under sufficient pressure to insure distribution to farm fields without additional water lifting.
2. A farmer organization will be established for coordinating good water management and scheduling along the meska. This group will also develop a meska and drain maintenance program.
3. Make recommendations and assist farmers with better on-farm irrigation systems. This may include the use of gated pipe for the efficient irrigation of individual fields.
4. Provide good crop production recommendations and use demonstration plots as needed to reinforce these recommendations. These recommendations will center primarily around good variety selections and effective insect control.

C. Objectives to be Reached by December 1982

1. All farmers will be irrigating by a gravity system provided by the water pressure inside the pipeline. Their irrigation will be according to an irrigation schedule regulated by a farmer user organization which will also arrange and control a maintenance program.
2. Farmers will be implementing better on-farm irrigation practices as recommended by EWUP. Several farmers will be using gated pipe for irrigation on a trial basis.

3. Farmers will use effective insect control means and use the best suited varieties.

II. Implementation

A. Responsibility for coordination and implementation. The pilot program coordinator will be Sociologist Naguib, assisted by Agronomist Salah, Engineer Hammam and Economist El Shinnawi plus all the other members of the Mansouria team. Activities, events and a PERT network chart of the pilot program plan will follow.

B. Procedures and Strategies for Implementing Change

	Activities	Responsible Person
a.	Prepare land ownership maps and conduct farmer equipment survey.	Naguib
b.	Survey farmers to establish their understanding and reasoning supporting their various agronomic practices.	Naguib
c.	Establish good relationships with farmers by making agronomic recommendations as requested by farmers.	Salah
d.	Introduce and develop farmer interest and understanding of the pressurized pipeline system.	Naguib
e.	Make continuous observations on the pre-selected farms for irrigation practices and farm records.	Hammam El Shinnawi
f.	Promote equipment sharing and leasing among the farmers.	Naguib
g.	Construct pipeline.	Hammam
h.	Conduct economic analysis of the elevated meska.	El Shinnawi
i.	Begin discussions with farmers to facilitate development of a farmer organization for irrigation scheduling with the elevated meska including a maintenance program.	Naguib
j.	Promote good on-farm irrigation practices by recommendations with demonstrations on the previously selected farms. Use gated pipe as part of the program.	Hammam
k, l, m.	Monitor progress and write report.	Hammam
n.	Make all necessary evaluation surveys.	Naguib
o.	Analyze and summarize all farm record data, engineering, sociology, and agronomy data and conduct farmer field day.	Mona, Bill

	Events	Date
1.	Start	Sep. 80
2.	Ownership maps and initial surveys completed	Nov. 80
3.	Farmers, in increasing numbers, will be following improved agronomic practices and using equipment more efficiently among themselves.	Feb. 81
4.	Select several farms for base economic data collection and future on-farm irrigation development.	Nov. 80
5.	Farm records and irrigation practice information reported continuously, including water table position.	Nov. 80
6.	Base line report completed.	Dec. 80
7.	Finish design of the pipeline.	Jan. 81
8.	Complete construction of pipeline.	? ?
9.	A functioning farmer organization for good irrigation scheduling along the entire meska.	? ?
10.	Good on-farm irrigation practices followed especially on the pre-selected farms.	? ?
11.	Economic analysis of the elevated meska, preliminary report.	Aug. 81
12.	Progress report due.	June 81
13.	Progress report due.	Jan. 82
14.	Progress report due.	June 82
15, 16, 17, 18.	End program.	Dec. 82
19.	Make final report.	Dec. 82

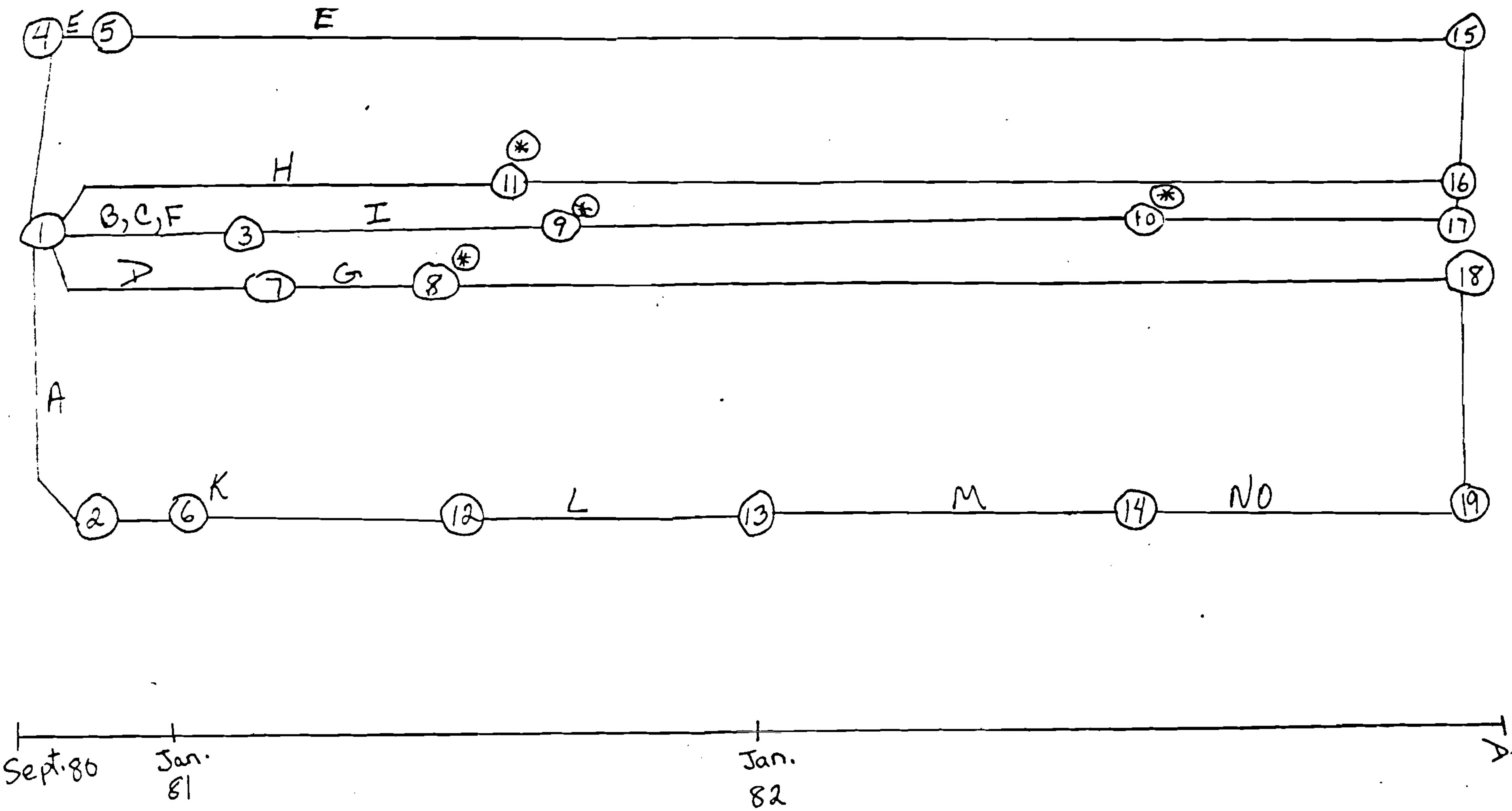
III. Evaluation Plan

A. Methods of Evaluation

1. Economists will constantly monitor the economic impact of all technical changes. Their data collection will focus on farms where more concentrated technical changes are made. The economic effects of the technical changes will be compared to the base economic data for similar farms in the immediate area.

2. Technical evaluations will be made as activities are conducted. It will be important to evaluate the success of each change in the farm system in order to make further recommendations.

PERT Network Chart for Meska #2, El Hammami Pipeline



*Not sure of completion dates.

3. Sociologists must evaluate their success in developing the farmer organizations. Further the sociologists should evaluate the implementability of all technical changes. This implementability evaluation should consider the farmers attitudes toward the technical changes, the farmers' resources for implementation and the degree to which the farmers actually make the proposed technical changes. Constraints to technical changes must be carefully documented.
4. Engineers will evaluate the impact of changing the water delivery system on the position of the water table.

B. Responsibility for evaluation is assigned to the pilot program coordinator, the economist and the Mansouria team leaders.

C. Responsibility for reporting progress will be that of the coordinator of the pilot program.

IV. Conduct of a farmer field day and final report summarizing all data and technical changes, and for making further recommendations will be the responsibility of the Mansouria team leaders.

IV.B.4. Minya, A Model Farm-Gate Gravity, Irrigation Water Delivery System

I. Essential Features

A. The geographical area will be all the land served by meska 26 on the Abueha Canal system. The meska contains approximately 60 feddans farmed by 25 farmers.

B. The technical changes to be introduced are:

1. Raise the banks and improve the meska to deliver the water with a minimum of 25 cm head.
2. Precision land leveling and establishing of improved level basin and/or level furrow irrigation.
3. Headgate at the beginning of the meska.
4. Tail-escape at the end of the meska.
5. Check structures along the meska.
6. Permanent farm-gate turnouts.
7. Delivery pipes through the banks.

8. Temporary use of a pumping unit to provide the 25 cm head.
9. Apply micro-nutrients to wheat and maize.
10. Improve on-farm irrigation.

C. The social changes necessary are:
1. Formation of a farmer controlled organization to operate and maintain the meska system.
2. Adopt and conform to a sequence schedule for irrigating each farm.
3. Establish stronger communications between farmers and the Ministry of Irrigation.

D. Objectives to be reached by December 31, 1982:
1. Installation of the engineering changes listed above.
2. Formation of the farmer organization.
3. Functioning of the farmer organization independently from the government institutional organization but interacting with government institutions.
4. Farmer acceptance of the authority of the organization.
5. Farmer acceptance of the "good" gravity delivery system to begin to make efficient use of the water applied, to increase yields, and to decrease labor requirements.
6. Increase crop yields through application of zinc sulphate fertilizer.

II. Implementation Plan

A. Responsibility for the overall coordination of the program is with Esmat Wafig.

B. The following tables give the procedures and strategies for implementing the plan. The person responsible and the time allotted to each activity is given. The PERT diagram summarizes these data.

	Activities	Responsible Person
a.	Develop preliminary description plan of the pilot project.	Raouf
b.	Arrange a meeting with the farmers	Elia
c.	Plan the construction of the access road.	Esmat

	Activities	Responsible Person
d.	Plan the construction of the water control structures.	Esmat
e.	Obtain farmer's input on planning the system.	Esmat
f.	Construct access road.	Esmat
g.	Construct and install water control structures.	Esmat
h.	Gather data and prepare report describing the present physical and socio-economic features.	Elia
i.	Organize a farmer-controlled organization that will operate and maintain the meska gravity system.	Elia
j.	Plan program of micro-nutrient application.	Awad
k.	Plan two-way communication system with farmers.	Elia
l.	Develop the scheduling and enforcement of the plan for water distribution to the farm.	Elia
m.	Monitor progress and write report.	Elia
n.	Continue communication with the farmers.	Elia
o.	Continue program of micro-nutrient application.	Awad
p.	Monitor system for adjustments and assist farmers in using the system.	Esmat
q.	Monitor progress and write report.	Elia
r.	Monitor progress and write report.	Elia
s.	Monitor progress and write report.	Elia
t.	Collect data for final report and arrange for farmer field day to show results to other farmers and government officials.	Raouf

	Events	Date
1.	Start	15 Sep. 80
2.	Preliminary description plan complete.	15 Oct. 80
3.	General meeting with the farmers.	15 Oct. 80
4.	Plan for access road complete.	15 Oct. 80
5.	Access road complete.	15 Dec. 80
6.	Plan for water control structures complete	21 Dec. 80
7.	Water control structures complete.	21 Jan. 81
8.	Physical and socio-economic survey report due.	1 Mar. 81
9.	Farmer organization formed.	15 Feb. 81
10.	Two-way communication system established.	1 Mar. 81

	Events	Date
11.	Water scheduling and enforcement plan complete.	15 Mar. 81
12.	Plan for micro-nutrient applications complete.	15 Mar. 81
13.	Progress report due.	1 July 81
14.	Progress report due.	1 Jan. 82
15.	Progress report due.	1 July 82
16, 17, 18, 19.	End program.	1 Dec. 82
20.	Final report due. Hold field day with farmers.	31 Dec. 82

C. The above plan is designed to be used on any of the other meska on the Abueha Canal, and could be easily shifted in the event it became necessary.

D. Resources, in addition to the personnel and equipment now at El Minya, are needed for the following activities:

1. Technical:
   c,d,f,g.
2. Socio-economic:
   b,j,m,n.

The only sociologist on the El Minya team is on leave for an extended time. Some arrangement must be provided to help the team with the work.

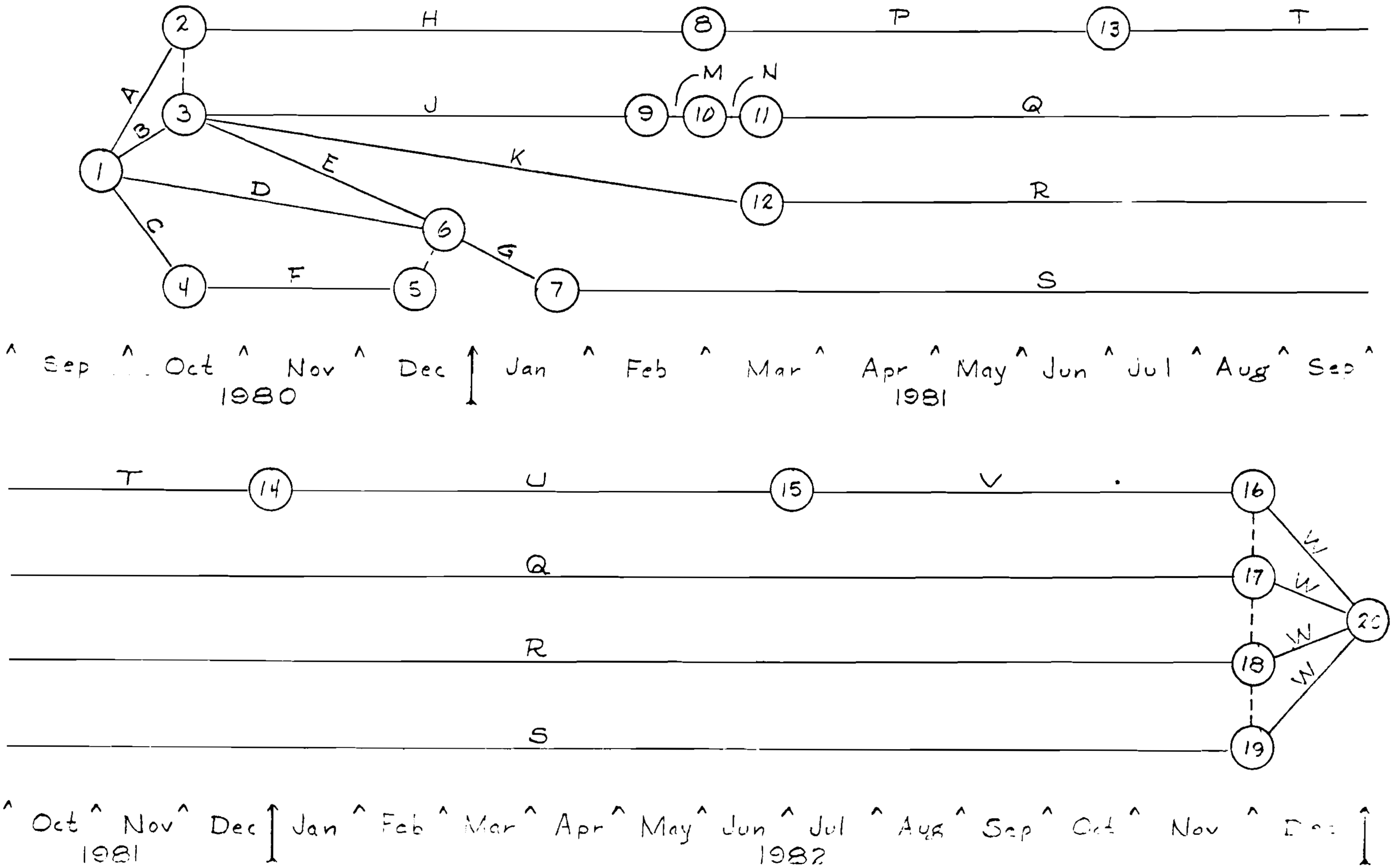
Assistance in preparing engineering design of the raised meska and associated structures is needed from the main office.

E. The Cooperative and the Community Center at Abueha have worked very closely with the EWUP team, and it is expected these relationships will continue.

III. Evaluation Plan

A. The most crucial part of this plan to evaluate will be the degree of success the farmers have in farming and functioning as an organization, and in their ability to sustain the organization independently from outside direction or assistance. Data for this evaluation will be collected through both formal and informal farmer interview. Economic data will also be obtained in the

PERT Network for Developing a
MODEL GRAVITY IRRIGATION WATER DELIVERY SYSTEM
Pilot Program, Abueha, El Minia



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same manner. Evaluation of the technical changes will be by the same technique. In addition, observations and opinions of all the professionals connected with the program will be obtained.

B. Elia Sorial will be responsible for the socio-economic evaluations, Esmat and Mohamed Awad for the technical phases and Abdel Raouf for the overall evaluation.

C. Elia Sorial will be responsible for the periodic reporting and documentation of the program.

IV. The final report for the pilot program will be prepared by Abdel Raouf, team leader, with the assistance of the entire team. The final report will present documentation of progress, results of the evaluation, conclusions drawn from the data, and recommendations for extending and/or expanding the pilot program. A field day will be held to give the farmers an opportunity to show the results of the pilot program to other farmers and government officials.

IV.B.5. Kafr El Sheikh, Dakalt Canal, Hammad and Manshia Meskas

The areas served by the Hammad and Manshia meskas have been chosen as pilot areas. Each meska serves 200 and 235 feddans respectively. The technical changes and objectives to be accomplished for the two areas are nearly the same. The Manshia pilot area has more salinity and sodicity problems than Hammad. Therefore, the magnitude of the proposed changes may be different for each area but the essential features of technical changes will be the same.

I. Description and Essential Features

A. Dacalt Canal, Kafr El Sheikh Governorate

1. Hammad meska. Area served approximately 200 feddans. Length = 1.8 km, 27 sakias and one diesel pump. Bounded on the east by Drain #7, on the west by Om'sen drain, on the north Om'sen drain and Drain #7, on the south by the initial east-west reach of Hammad meska itself (along Abo Raia Road). The average ownership is 2-4 feddans. The largest (Om'da) about 35-40 feddans; the smallest about one feddan. Around 60 farmers on the meska.

2. Manshia meska. Area served approximately 235 feddans. Length = 1.8 km, 25 sakias and one diesel pump. Bounded on the east by Manshia drain, on the west by Drain #4, on the north by Manshia drain, on the south by Dakalt Canal and a collector drain to Drain #4.

B. Technical changes to be introduced
   1. Farmer improved delivery system (Meskas and Marwas)
   2. Farmer improved on-farm water management, including redesign of irrigation layout with associated land leveling if needed, using correct amounts of irrigation water at proper frequency.
   3. Farmer improved agronomic practices that include proper use of minor elements, proper plant stand density and the use of chemicals for sodicity control and control of insects.

C. Objectives to be reached by December 1982
   EWUP will have provided extension education and demonstration programs for improved agronomic and irrigation practices in order that:
   1. Farmers will work together toward maintaining the meskas and in the use of water.
   2. Farmers will use improved water management practices such as timely irrigations with the proper amounts for high yields.
   3. Farmers will use proper micro- and macro-nutrients, proper quality and quantity of seeds, and other management practices that directly affect yields.

II. Implementation
   A. The responsibility for Coordination and Implementation of the pilot will rest with the group assigned to each meska.

1. Hammad Meska

   Ahmed Ismail (A)

   Magdy Awad (A)

   Abdel Fattah Metawie (E)

   Ahmed El Attar (S)

2. Manshia Meska

   Kamal Ezz El Din (E)

   Amany El Kayal (E)

   Mahmoud Said (A)

   Mohamed Meleha (A)

   Abdel Fattah El Masry (S)

A leader for each group will be assigned from the group. It should be noted that no economists are on either team. Steps will be taken immediately to assign agricultural economists to the Kafr El Sheikh team.

B. The general procedures and strategy to be followed by the teams in each pilot area for implementing the work is shown in the following activities, event and PERT network charts:

General Activities

a. Develop materials for meetings with co-ops, farmers, etc., to explain next phases of project work and goals.

b. Groups define additional base data needed in each area and collect as necessary.

c. Establish relations, open communication with farmers, cooperative, other officials. Information exchange of project status, statement of future project work and goals. Determine leaders, opinion leaders, ways to initially organize farmers, etc.

d. Evaluate meetings, results of questionnaires, preliminary site selection. Develop further communication and information exchange channels, etc.

e. Inform and work with selected farmers; determine their plans for winter season; develop relations, specify project plans, etc.

f. Develop and finalize on-farm designs, decide about land leveling.

g. Revise proposals, redesign, etc., as necessary.

h. Implement on-farm design, begin on-farm pilot work.

i. Finalize preparations for large-scale pilot work, i.e., delivery and drainage system. Continue development of farmer cooperation, organization, cooperative involvement, etc. Information exchange, new letters, farmer opinion gathering, etc.

j. Follow all on-farm pilot work through winter season. Document findings, report progress, etc.

k. Farmer reactions/response to changes, evaluate farmer cooperation in this work. Farmer organization building for sustenance and maintenance of completed work.

l. Continued planning for future pilot work in area.

m. Prepare final report on progress accomplished by end of winter season 1980-1981.

	General Events and PERT Chart	Date
1.	Submit initial proposal plans	Sep. 80
2.	Team and group meetings	Sep. 80
3.	Meetings with farmers, co-ops, other officials to present pilot proposals, etc.	Sep. 80
4.	Evaluate meetings, conduct further meetings, questionnaires, etc.	Sep. 80
5.	Select farm units for winter season on-farm pilot work	Oct. 80
6.	Finalize farms for winter season in terms of plans, farmer cooperation, etc.	Oct. 80
7.	Summarize pilot area base data collected, formulate alternatives, integrate into proposals, i.e., for specific work on delivery system, etc., submit	Oct. 80
8.	Finalize on-farm designs and pilot work	Nov. 80
9.	Submit proposals for large-scale pilot work for final approval	Nov. 80
10.	Start on-farm pilot work implementation	Nov. 80
11.	Implement changes during winter closure	Jan. 81
12.	Mid-season report on winter season on-farm pilot work	Feb. 81
13.	Report on success of implemented changes during winter closure	Mar. 81
14.	Summer season 1981 proposal work plans: meetings and discussion, finalize by	Mar. 81
15.	Summarize progress and formulate report for end of winter season	May 81

Note: Detail plans for remainder of the two years to be completed later.

C. Resources required

1. It is anticipated the following project equipment shall be needed in Kafr El Sheikh:

   a. Kafr El Sheikh land plane (1 Oct. - 15 Nov.)

   b. Kafr El Sheikh border/ridger (1 Oct. - 15 Nov.)

   c. Giddings drill rig (Sept.)

   d. 4 piezometer sets (1, 2, and 3 m lengths per set)

   e. 2 Oakfield probe, soil sample kits

   f. camera assigned to Kafr El Sheikh (plus film)

   g. small fiberglass trapezoidal flumes (6)

   h. blue and red flag stakes (25 each)

   i. new current meter and maintenance of old one (Gurley No. 622 price current meter)

2. New equipment needed:

   a. proposal for project or institute to purchase ditch-cleaning equipment for use with project tractors (requires further investigation for type, cost, etc.)

   b.

   b. mud/snow tires or chains for vehicles for use during winter season

   c. 1 new battery and spare tire for 3-wheel Heald Hauler

   d. 100 soil sample cores with caps on both ends (2 in. dia., 6 in. length)

   e. 1 - 50 m surveying chain

   f. 2 Dutch augers extendable to 2 m length

   g. 1 Rapido-graph set for drafting

   h. 4 simple calculators

   i. 1 portable pH meter

   j. 8 flashlights

   k. 50 Reddington counters (type PCU-35, 6 x 157)

   l. 1 100-150 kg spring scale

   m. 1 stand for soil moisture retention test (filter funnel stand #1300, Soil Moisture Equip. Co., Santa Barbara, Calif.)

   n. 100 250-550 cc water sample bottles with tight lids

D. Cooperation planned with other organizations. This pilot program will work with the cooperative and a lot of help and assistance involving the cooperative people is expected.

1. Extension service among the pilot area farmers.
2. Infrastructure support like:
    a. Pesticides
    b. Seeds
    c. Fertilizers
    d. Machines such as sprayers and tractors

It is expected that the cooperative people will support the pilot area with the adequate amounts of the above components in the proper time.

3. Extension program for the Abo-Raia Co-op and the other cooperatives. After achieving reasonable success in the pilot program work plan and with the project people and the Abo-Raia cooperative people working together, there will be a need to make an extension program for the other cooperatives to show them the improvements.
4. <u>Some special programs for increased cooperation</u>
    a. <u>Farmer newsletters</u>:

    These will be distributed periodically and will be designed with drawings and symbols to show our ideas and recommendations to the farmers (especially those who cannot read or write) about the irrigation and agronomy improved practices, the project's work and progress, further explanation of goals, etc.

    1. Decrease the gap between the project and the farmers.
    2. Open more communication channels with the farmers.
    3. Provide the farmers with all information and recommendations for the on-farm water management and improved agronomy practices and pest control, etc.
    4. Distribute farmers' ideas, work, progress, etc.

b. Information bank:

This special bank will be set up in the field office to serve as a source of further information for the farmers:

1. Answer the farmers' questions about the project goals and pilot programs type of work.
2. Deliver to the farmers the technical information about irrigation, agronomy and water management practices. Information of farm record keeping, planning, etc.

c. Meetings:

We plan to hold a regular meeting with the cooperative people and the farmers to keep the communication channels open, and for extension works and also to answer all the farmers' questions as necessary. Continued development of trust and confidence, development of farmer organization, etc., are major goals.

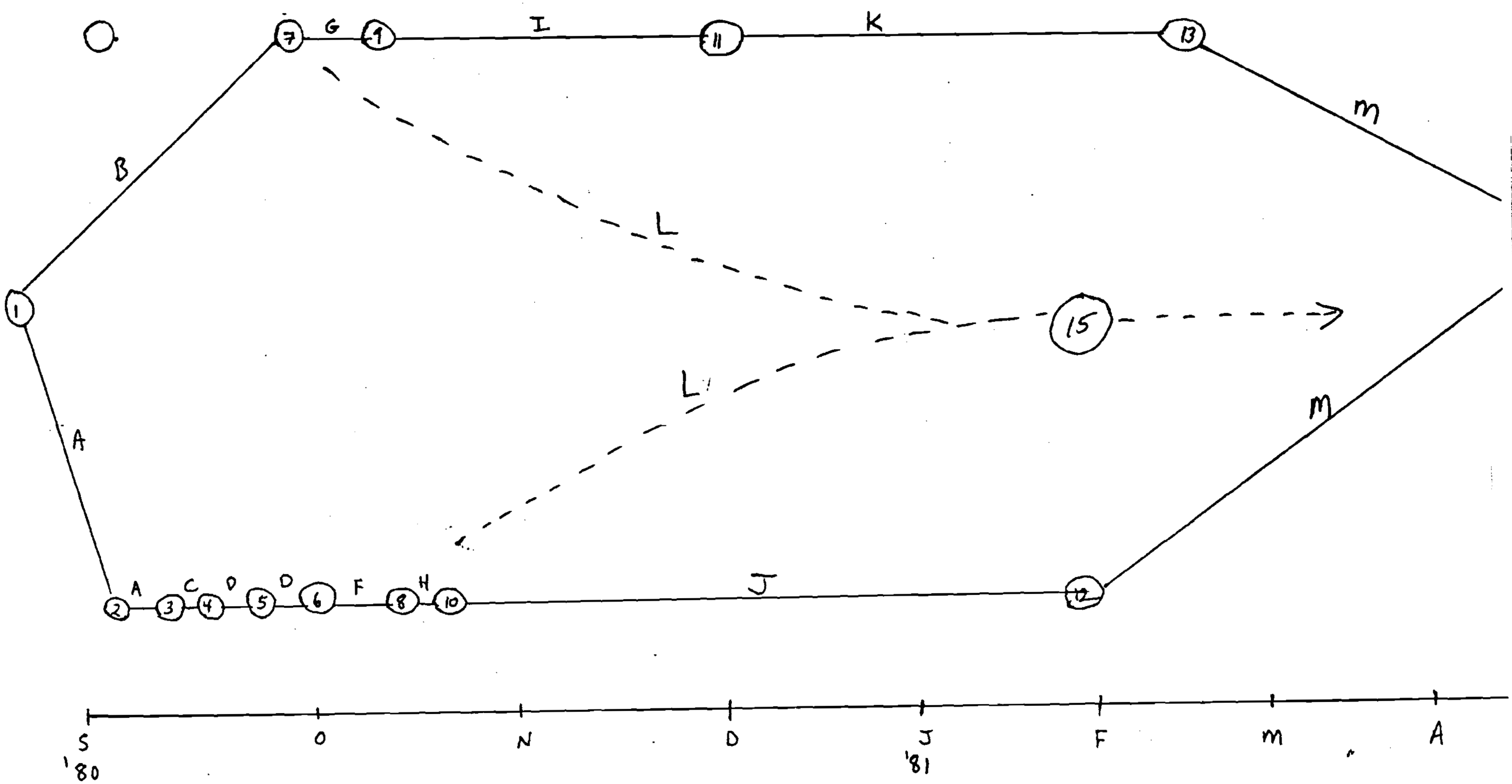
III. Pilot Program Evaluation

Two aspects of the procedures and stragegies for introducing changes in pilot areas, and of the evaluation of the pilot program itself are:

1. measuring the ability of the farmer to implement the proposed changes and if inability exists what are the operational and institutional constraints.
2. measuring the farmer's willingness to accept and implement proposed changes; his interest; his response.

Program development with the creation of extension type administrative approaches implies creation of advisory type services with simultaneous demonstration of program proposals. The main point to be made is that in the pilot program implementation the team should act as the advisory service and supply demonstrations of proposals, however, they should not interfere by providing artificial support. Such a case would not give a measure of the ability of the farmer to implement the proposed changes.

GENERAL EVENT-ACTIVITY CHART



As an example, land leveling is not a practice farmers can easily implement in this area due to lack of equipment and trained personnel. The benefits may be well known; the farmers may be very willing to try it after seeing the field trials which included land leveling. However, the teams cannot provide this artificial support and expect it to continue after the project moves on. This proposed change lends itself as a demonstration-type technological improvement, but the extent and scope of such a demonstration remains open to question.

There are likely several more proposed changes which may be blocked by constraints on the farmer. The evaluation process must identify and document specifically why the failure occurred. In evaluation of the ability to implement a proposed change the groups will be looking at whether the job gets done and if not, why; whether the maintenance or sustenance of the change occurs, and if not, why; and whether the change actually functions as an improvement, and if not, why. Technical changes can be evaluated in this way and the social impacts of the changes monitored at the same time. From an economic viewpoint, cost-benefit ratios of the change, updated farm records for indications of farmer acceptance and comparison of improvements with farmers' perceptions of necessary gains before improvements are attractive will be used to evaluate any changes.

At any rate, initial interactions with the farmers and the continued two-way communications process must work with the concept of evaluating farmers' abilities to implement practices, farmers' acceptance of the new practices and continuous modifications of practices as a result of evaluation to provide more easily adaptable solutions to identified problems.

The responsibility for the evaluation lies within three groups of disciplines. The measuring of successful implementation of technical changes will be the responsibility of the engineers and agronomists. The acceptance and evaluation of the farmers' ability to adapt the changes will be the responsibility of the sociologists. It will be the responsibility of the economists to make a quantitative evaluation of the changes. Have these changes brought about a greater income and provided the farmer with additional resources to upgrade his farming operations? Evaluation of the pilot with reference to the objectives of the project is the ultimate goal.

It should be recognized that the field team staff will be working closely with the main office discipline leaders in the implementation and evaluation of the pilot. Considerable experience is required to make an effective evaluation.

IV. Reporting

Reporting of progress, evaluation, documentation of progress and evaluation is the responsibility of each group and will occur on a regular, timely basis. It is expected that periodic reporting of progress, results, problems, etc., will be used as a tool for the expected continuous planning of future events and activities. Team leaders are responsible for final reporting and for conducting a farmer-centered field day for the purpose of giving the farmers an opportunity to show other farmers and government officials the results of the pilot programs.

V. ADDITIONAL WORK PLANNED FOR PROBLEM IDENTIFICATION AND SEARCH FOR SOLUTIONS

Although pilot programs will receive priority attention by the project during the next two years, certain issues are considered so important they should receive additional work and attention even if outside of pilot programs. Also some issues, given preliminary identification as "problems" will require further research before adequate solutions are available. Still other issues are important because they support project efforts to conduct successful pilot programs.

This section lists and discusses issues suggested by EWUP staff as being most likely to contribute substantially to project goals and therefore most worthy of continued attention.

V.A. Field Drains at Kafr el Sheikh

Data have been collected regarding the function, practicality and usefulness of small in-field drains. Analyses of these data indicate:

1. The drains presently do not function as drains for the removal of subsurface water. Farmers do not practice regular maintenance procedures. Common drain depths range between 40 and 60 cm (design depth $\geq$ 90 cm). Average water table elevation for whole area is 70-100 cm, often higher for several days after irrigation.
2. The drains facilitate surface water removal and surface water distribution. However, the need for them to serve in this capacity is unnecessary and contrary to the definition of good water management.
3. In their present state the field drains occupy, on the average, 12-15 percent of the cropped area.

Problem identification data show that subsurface water movement away from the drains (drains acting as a source) is as common as movement toward the drains. Field trials have indicated that the removal of drains does not effect water table elevations or crop yields. However, at the same time, there is no conclusive evidence to suggest that some secondary salinization of the root zone does not occur. There is speculation that the salinity of the root zone may be in a stable state with or without the field drains. Why? Since the field drains do not facilitate subsurface water removal, the removal of leachate is limited. Seasonal water table levels are the same for sites with and without field drains. Due to irrigation practices there may be a fresh water lense contributing to crop consumptive use which is above the permanent, more saline water table. Although some lateral movement of water occurs the saturated hydraulic conductivity rates are low, 3-5 cm/day according to one test near drain #7. Consequently the volume of water laterally removed is not likely to be highly significant.

Given our present understanding there remains some important questions for further investigation.

1. It is possible the field drains would function more effectively if the secondary and collector drains were improved. This should be investigated.
2. Continue to study the dynamics of soil, water and salinity. Perhaps a 2-year leaching cycle (every rice crop), good on-farm water management and improved function of secondary/collector drains for removal of leaching water would obviate the need for the small in-field drains.

V.B. Plant Population Density

It has been observed that under normal farm conditions plant stand density at all three sites is generally less than recommended by the Ministry of Agriculture. This condition can be caused by planting too few seeds per unit of land, poor seed germination, over-thinning and physical destruction of plants by insects, disease, overirrigation, etc. Project data, as well as secondary data from national and international sources indicate that yields are a function of plant population density. Less clear, however, as the causes of low plant population density. In some cases farmers appear to deliberately establish a stand that is below recommended density. To address such a problem the project could establish demonstrations to show farmers the advantage of changing this practice. Simultaneous dialogue with farmers and use of formal structured questionnaires could provide additional insight into the reasons for specific farmer behavior. If it is verified that farmers deliberately strive for suboptimum plant population densities then appropriate educational programs could be developed to change farmer behavior.

V.C. Sweet Corn Production at Mansouria

Field trials at Mansouria indicate there is a good opportunity to develop sweet corn production for sale to the Cairo foreign community. Experience to date however has revealed serious marketing problems. Sweet corn must be harvested within very limited time constraints. Then it must move through the market system and into consumer kitchens very quickly. Growers and merchants are not familiar with the unique characteristics of the product's quality and the market system is not adapted to moving it quickly through the system.

One of the chief benefits of the field trials has been to teach project personnel and farmers about the coordination needed between production and marketing in order to develop new products and improve existing production. Farmers and project personnel have had an opportunity to deal with all phases of production and marketing sweet corn. Such a learning opportunity is not usually afforded with existing well-established systems of production and marketing.

Additional field trials with sweet corn could be continued. It is an excellent learning exercise for project personnel which creates interest and goodwill among farmers. It requires a relatively small input of project resources.

V.D. Relationship between Farmers and Institutional Supporting Services

Farmers are served by village cooperatives, banks and extension services. More information is needed to find out how farmers obtain specific services and how farmers perceive these services in order to develop more effective pilot programs and other techniques for diffusing project technology into the total agricultural system. Questionnaires and informal dialogue with farmers at project sites should be utilized to obtain data for full documentation of the institutional infrastructure support and farmer's needs.

V.E. Dejure vs. Defacto Application of Irrigation Law in Egypt

Lack of uniformity in distribution of water has been identified as a major problem at three project sites. At the same time it has been observed that illegal outlets and pumping stations are common. Project personnel have been reluctant to seriously propose the establishment of new systems which more uniformly distributes water to farmers but at the same time deny certain individuals the opportunity to continue illegal practices. It can be expected that such farmers will resist new distribution systems. More information is needed with regard to how farmers perceive this situation and how they rationalize present practices. Such knowledge may permit the development of distribution systems which are more uniform and in the aggregate, more productive of agricultural commodities.

V.F. The Dynamics of Farm Management on Small Farms

Egyptian peasant farmers are generally considered to be "conservative" and backward about adopting more productive and profitable innovations. Additional documentation of the rate of adoption of recent innovations is needed to help understand the amount and type of change farmers will accept. Insites into these questions can be of substantial advantage in developing pilot programs and extension education activities.

V.G. Land Leveling

Land leveling has been tested with some success in Kafr el Sheikh but not all aspects have been fully explored. Therefore it should be further evaluated in field trials and pilot projects. Farmers have learned that it takes them less time to irrigate after leveling, thus saving labor and water. However, the effect on yield needs to be further studied. The water saving is of interest to Egypt, but not to those farmers who now have adequate free water. The technology exists in Egypt to perform land leveling. Financing could still be a problem, however, and needs to be considered in pilot programs.

An additional complication exists in rice growing areas. Traditional farmer practices of smoothing, leveling and puddling rice paddies may provide adequate and economically feasible land leveling. The "talweet" practice consists of pulling a scraper, by animal power, across flooded paddies thereby smoothing, leveling and puddling. Under good management and where rice is grown in rotation every other year, fields become quite level. It will require additional investigation to determine whether leveling with modern equipment is more advantageous.

In Mansouria, where many fields are less than one-half feddan, it is less likely that large-scale mechanized land leveling will become a profitable practice. Large land planes cannot maneuver in the fields, or even get over the narrow roads leading to the fields. Nevertheless some further trials are planned on a small-scale, in the hopes that satisfactory techniques can be found that would prove economical. The farmers already do a pretty good job of distributing the water by cutting the fields into basins small enough to have only a few centimeters difference in elevation within any basin. To be profitable land leveling must provide the economies that can result from enlarging these basins. For flat basins (no furrows) larger quantities of water may also be required.

Field trials are planned to answer both the "how to" questions and the questions of economics. At the same time, professional and nonprofessional people should be trained in the procedures and the techniques of land leveling and the subsequent redesign of the farm irrigation systems. It is assumed that the practice of precision land leveling will not become popular unless it is recognized by the farmers as profitable. That is, the government could not level the land for the purpose of saving water and expect it to stay level unless the farmers also realize the value.

V.H. Gated Pipe, Siphon Tubes and Spiles

The project has available several sizes of siphon tubes, some made locally and some imported. It also has rigid aluminum and flexible plastic gated pipe, as well as some lay-flat tubing with gates that can be attached. It is planned that these should be tested in row crops in at least two of the work areas. The easiest place to test them would be in those areas to be served by an elevated meska or buried pipeline. Otherwise the head available from a typical marwa may be only about two or three centimeters, which is not enough to fill a pipe. Therefore, they could be tested in the pilot project areas served by meska 10 in Beni Magdoul, meska 2 in El Hammami or in El Minya.

Both siphon tubes and spiles have been tested briefly in Kafr el Sheikh and spiles in Beni Magdoul. In both cases the available head was too small for complete satisfaction, and in addition the siphon tubes would lose their prime when the animal on the sakia stopped. The brief training period with the siphon tubes was insufficient to develop any skill in setting them, so training must be a part of the trial for EWUP personnel and the farmers. Even though some of these trials will be conducted within a designated pilot area, it must be made clear that they are trials, at least until the principal questions have been answered favorably.

V.I Practices to Increase Application Efficiency

The redesign of farm irrigation systems with larger basins and longer runs adds more requirements for water control. Water must reach the ends of the longer furrows or borders in a short time, or the irrigation will not be evenly and efficiently distributed. Trials here and elsewhere have shown the need for larger discharges to accomplish this, i.e., up to four liters per second per furrow and up to 60 liters per second per border. Additional trials are planned to learn how to handle these larger streams without overtopping or causing unnecessary erosion.

Row crops present the greatest challenge. Maize rows for example are usually planted on 70 cm spacing. On this spacing it is not easy to maintain a furrow deep enough to carry three or four liters per second without overtopping in the low spots. The inevitable clods in clay soil offer much resistance to the advancing stream, especially on the first irrigation when the intake rate is very high, a factor which also slows the rate of advance. One procedure to be tested is to increase the row spacing to 90 or 100 cm, thus permitting deeper, larger furrows. Another is the use of a bed shaper. This is a machine which slightly compresses the soil surface into the shape of a deeper furrow and a smooth, flat bed between the furrows. The resulting furrow is smoother, thus offering less resistance to the advancing stream. The slight compaction will likely decrease the intake rate as well. Because the furrows are deeper, this method can be applied to fields that are not quite perfectly level, without flooding water over the surface of the beds in the low spots. Thus it may at least partially relieve the problem of not being able to obtain precision leveling in very small fields.

A model developed by project economists for evaluating irrigation systems can be used for comparing alternatives. The model determines net income, field irrigation efficiency and water consumption.

V.J. The Proposed El Hammami Pipeline

Plans are well along to construct a buried pipeline to replace the El Hammami Canal and both its branches. Two pumping plants along the Mansouria Canal are called for which will supply water at low pressure to the two systems. The system will be able to supply the needs of the crops without operating at night, but it will be expected to operate every day during the peak season. It will not follow the rotation schedule of the Mansouria Canal. The outlets from the pipeline will be to the existing meskas.

The Hammami pipeline is large enough and important enough to be considered a pilot project. It will supply adequate water to about 800 feddans which now receive less than half their reasonable share. It may lower the water table by a measurable amount in spite of doubling the capacity of the system, because of reduced canal seepage. How well it will be received by the farmers is yet to be determined. Will it be respected and protected, or misused and abused? Can a new style of laundry facility, to be supplied by water from the pipeline, be designed that will be a satisfactory replacement for the present laundry practices along the canal? Will the measurement of the quantity of water supplied to each meska by the district be an acceptable practice for both the farmers and the district? Will the farmers on each of the meskas take advantage of the availability of water under pressure by organizing themselves to install and maintain a buried pipeline to replace their meska? Can the cost of the system be justified on the basis of increased production, labor saving, and water saving? These and other questions must be answered before EWUP and the GOE will be ready to recommend this type of installation for other branch canals.

V.K. Basic Farm Management Data Collection

In order to provide data for evaluating irrigation and agricultural alternatives, basic farm management data collection should be continued. Presently 9 to 12 farm plans and farm records are prpared each year at each of the three sites. This process keeps project personnel knowledgeable about current problems and practices of cooperating farmers and in addition provides a valuable data base for evaluating the economic feasibility of proposed changes in technology. Crop enterprise budgets for crops produced at each site have been prepared and a system of updating and storage of the data in computer files has been developed. Continutation of this activity can provide the project with a valuable source of farm planning data.

V.L. The Role of Livestock

Farm animals are intricately related to irrigated agriculture in Egypt. In a most obvious and direct way they provide power to lift water for farm irrigation. They also provide power for other farming operations, transportation, meat, milk, fuel and they serve as a store of wealth. Any changes in the role of livestock is quite likely to effect irrigation efficiency, cropping patterns, water duties, and demands on water delivery systems. Consequently the role of livestock is important to on-farm water management.

The project has identified water lifting costs as an important constraint to farmer's income. A better understanding of the role of livestock will permit improved analysis of alternatives relevant of farm water and agricultural systems.

Project studies have indicated that the short-run marginal cost of using animals to provide power for waterwheels is lower than that reported by earlier studies. It is hypothesized however that long-run marginal costs (after allowing for increased genetic capacity of animals and improved nutrition and management) are substantially higher. The reasoning is that in the short run farmers use undernourished cows with low meat and milk capacity (often non-lactating) to turn waterwheels and that the opportunity cost is low. In the long run, given programs of better breeding, nutrition and management the opportunity cost must be much higher.

Further investigation is needed to test this hypothesis. The site at Kafr el Sheikh, where animals are used extensively for turning waterwheels, and the site at Minya, where animals are seldom used for farm work, provide unique opportunities for studying this question. An accurate evaluation of the true cost of using animals to lift water would provide a guide to determine the investment limits of alternatives such as fuel powered water lifting, systems of delivery to fields by elevated meskas, etc.

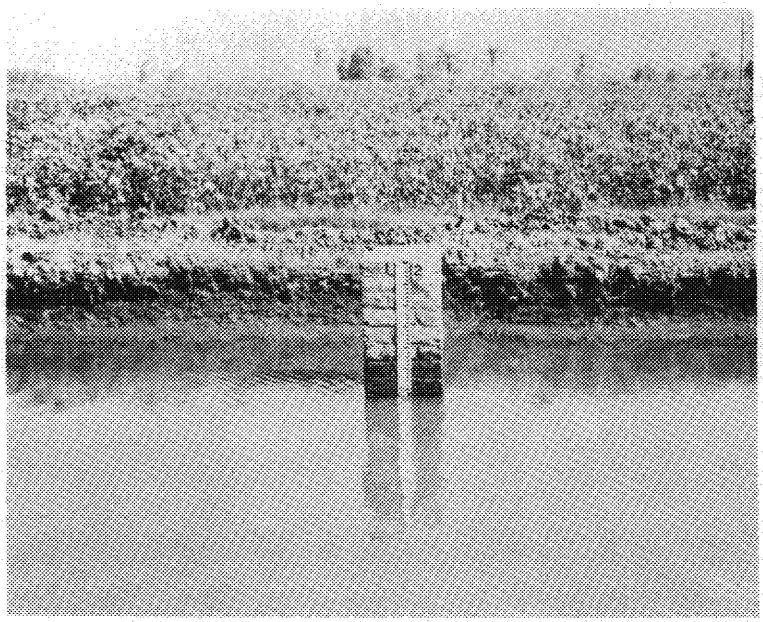
V.M. Linear Program Model for Cropping Systems at Kafr el Sheikh

Rice, cotton and maize are major summer crops at Kafr el Sheikh. Each crop has a substantially different water requirement and growing season requirement. Canals are seldom if ever designed to provide enough water for rice production on 100 percent of the land served by the canal. It sometimes happens, however, that certain areas are allocated heavily to rice and serious water shortages develop at critical irrigation times. It would be substantial help to Ministry of Agriculture officials who are responsible for setting crop quotas and to Ministry of Irrigation officials who are responsible for delivering water to have a computer model which would measure production and income effects of shifts in cropping patterns subject to land and water delivery capacity constraints. Personnel from both Ministries would gain insights into these important interactions and the effect on farm income.

The crop enterprise budgets prepared by the project plus secondary data from Ministry of Agriculture and Irrigation offices at Kafr el Sheikh provide sufficient data for such programming. Several months of concentrated effort could produce very useful results for pilot programs and general extension efforts in the rice producing region of Egypt.

VI. PICTORIAL ANECDOTES

Following the dictum that "a picture is worth a thousand words" a collection of pictures from project sites is included in the chapter. Although not a complete comprehensive summary of activities, the following forty pictures and by-lines are intended to convey ideas and information relative to the project goals.

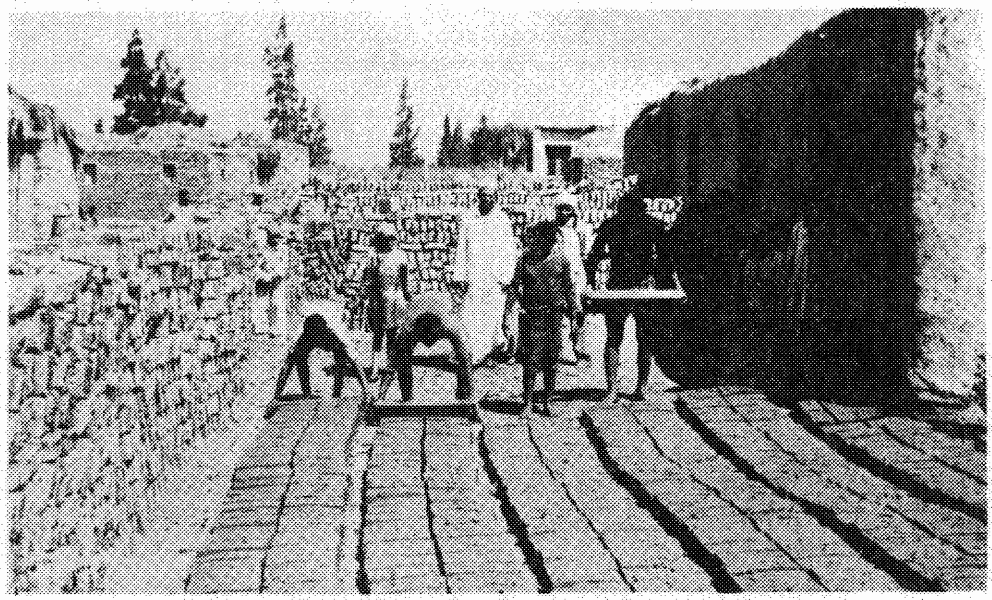


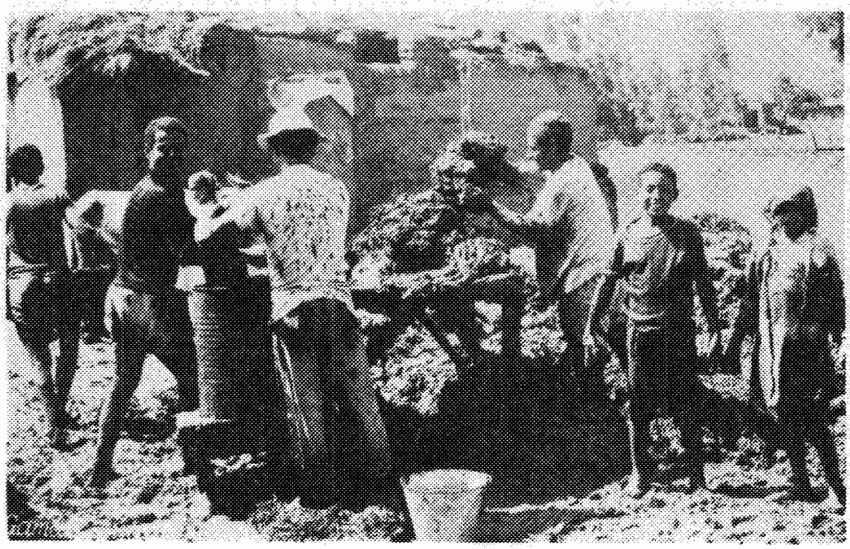
A staff gauge measures the level of water in a distribution canal. Distribution is controlled by adjusting water levels.

Low gradient of canals contributes to rapid siltation.

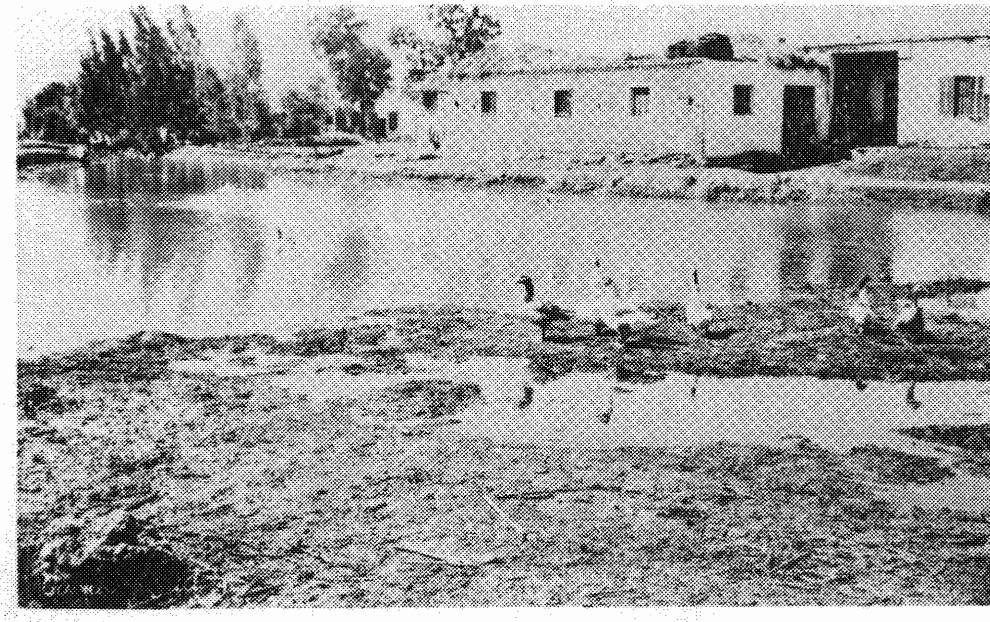
The use of canals by animals and people contribute to degradation.

The water-loving buffalo is especially destructive of canal cross sections.

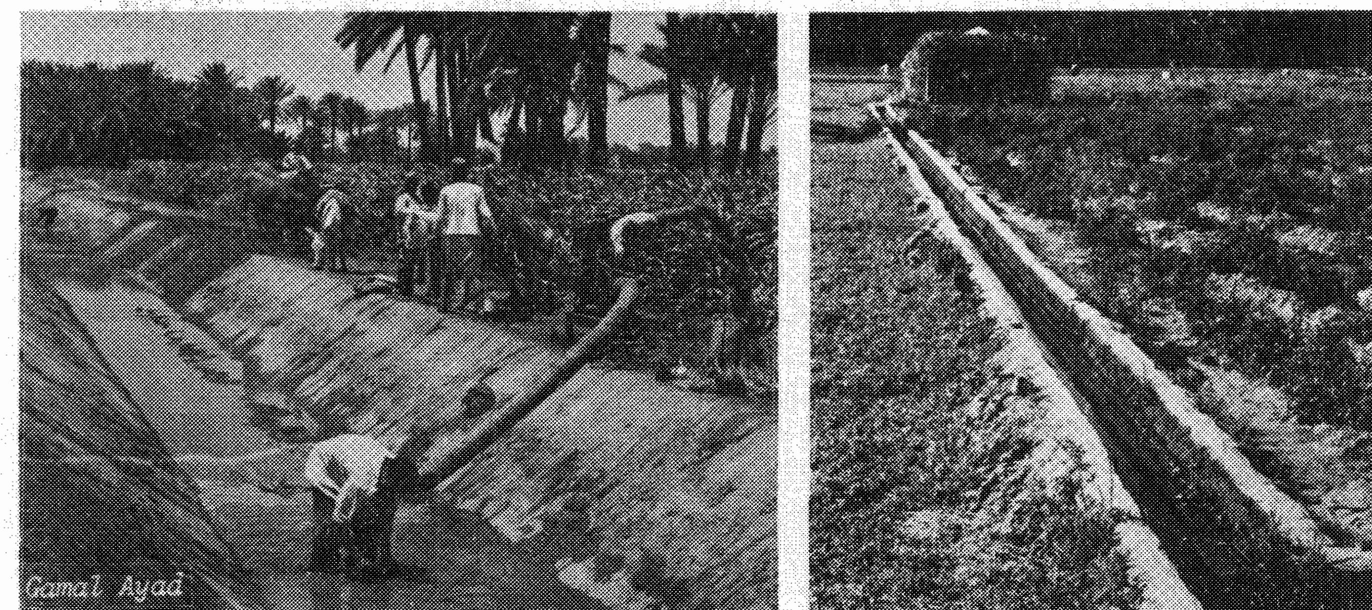




Brick making, while essential to the housing requirements of Egyptian villages, uses soil from canal banks. In the bottom picture notice the wide cross section in the canal shown in the background.



After years of soil depletion for brick making, canal cross sections become veritable lakes.



Concrete lined canals may have a future but they are expensive and somewhat incompatable with present socio-culture patterns.

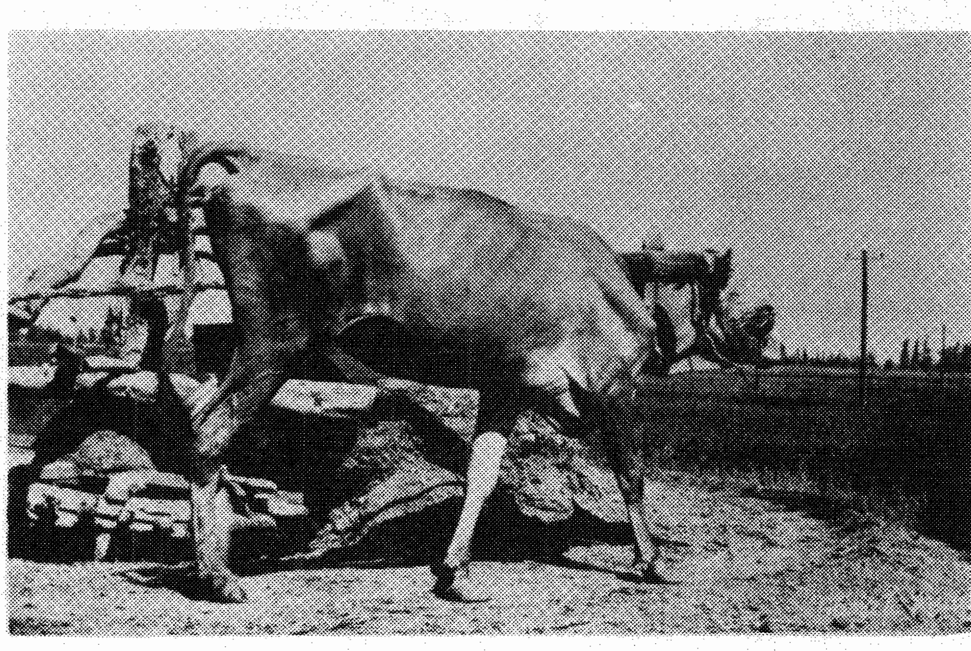
Water is often in short supply at the tails of canals.

Drains become ineffective because of weed growth. Organizing effective community action to clean drains and canals is an important objective of EWUP.

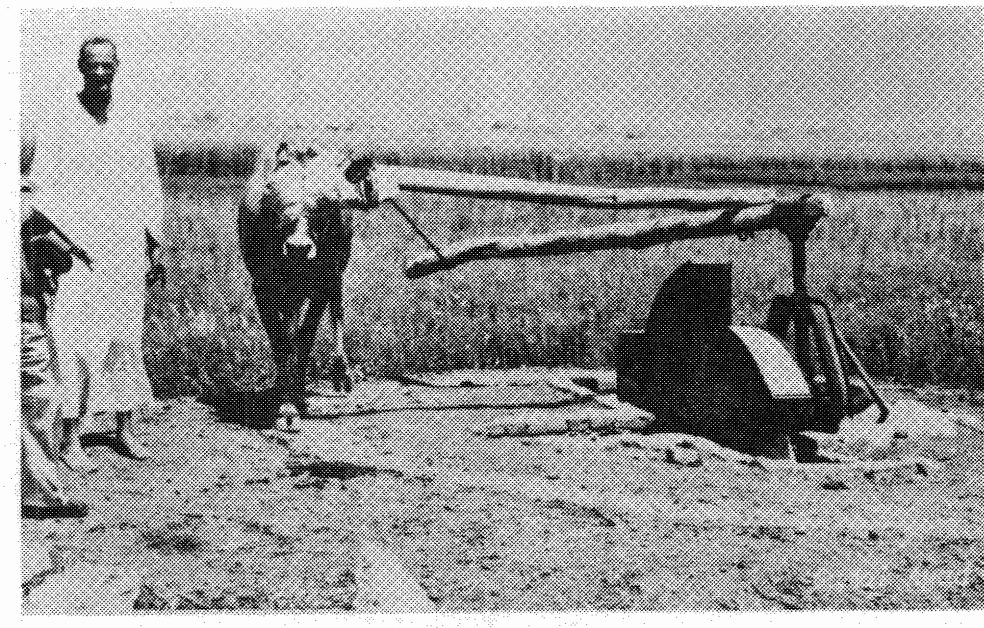
Irrigation by tambour may require more than one hundred man-hours of labor per year per feddan.

Labor for lifting water with a tambour is especially excessive when the static head approaches one meter.

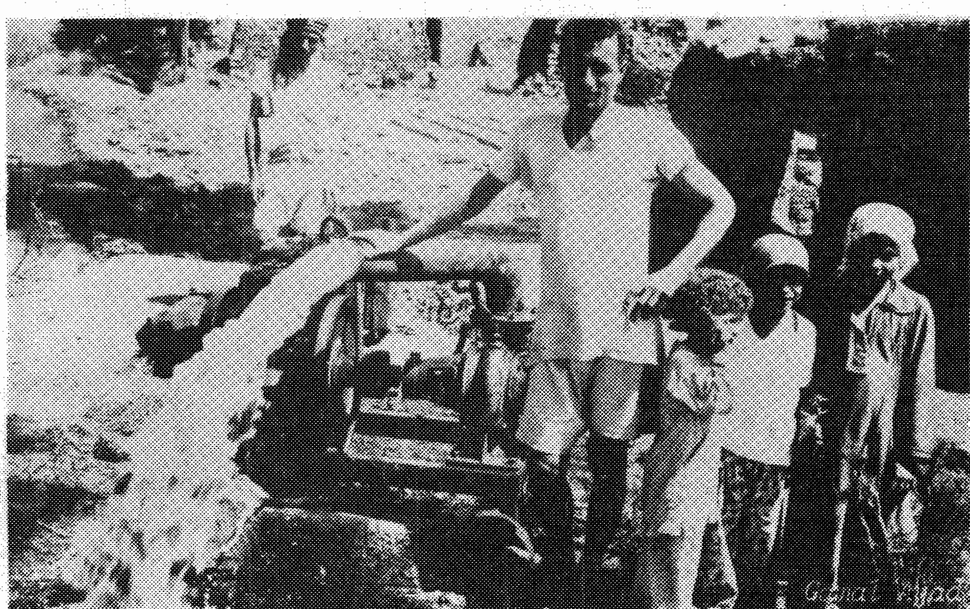
Tambours are easily transported along narrow ditch banks.



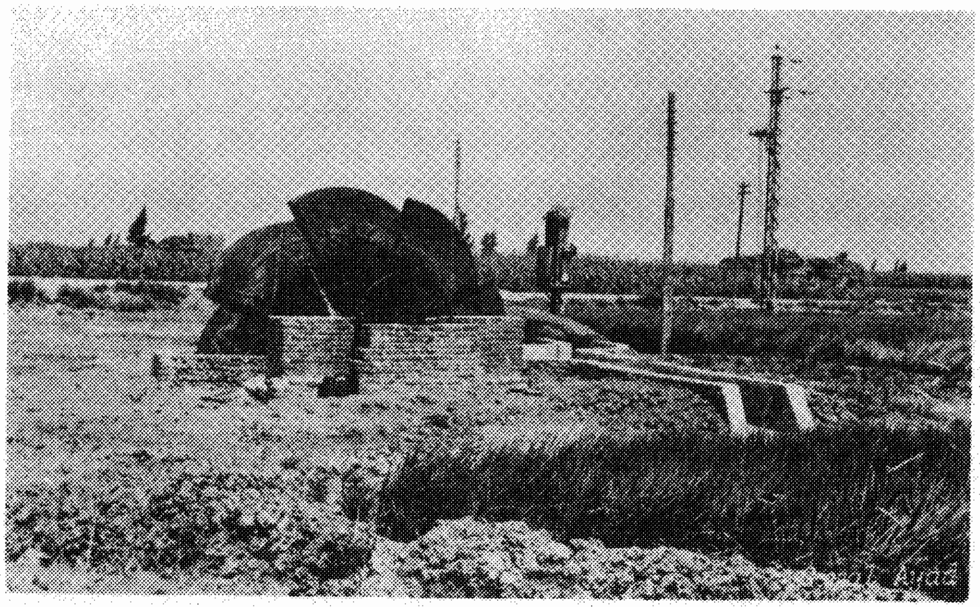
Animal powered water wheels increase irrigation capacity and reduce labor requirements.



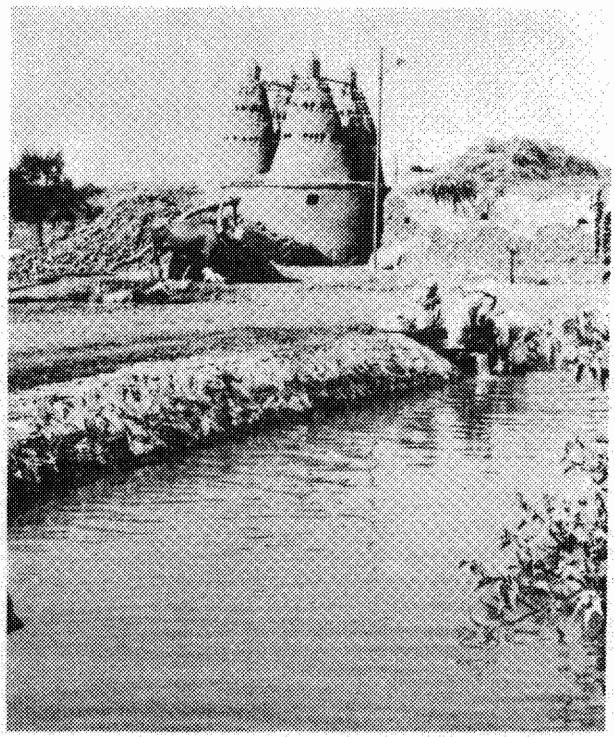
The cost of animal power is a complex issue which is undergoing further study by EWUP.



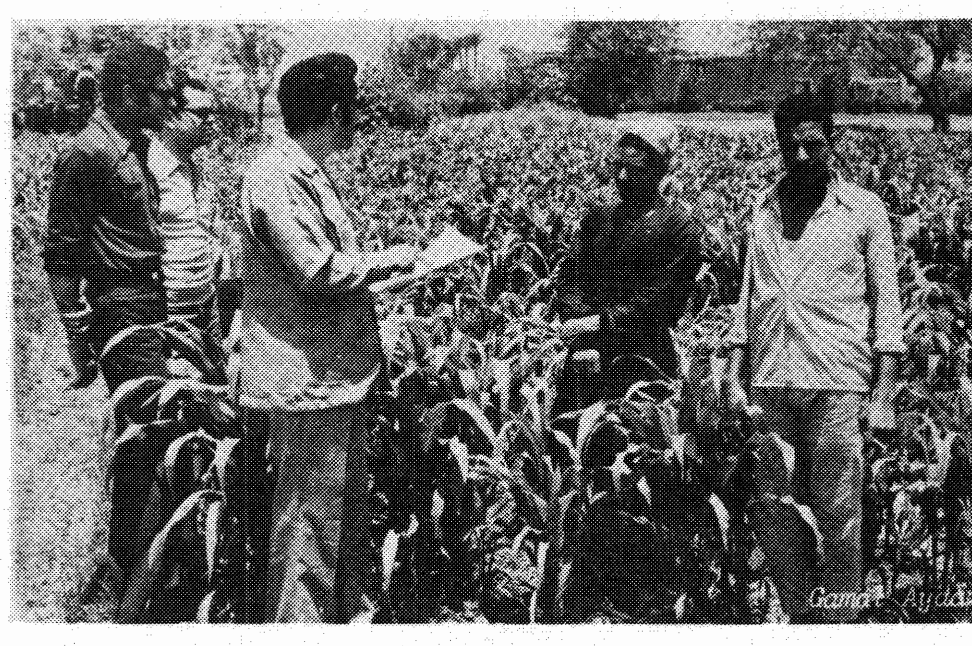
Recent increases in petroleum prices cast doubt on the economic feasibility of small diesel pumps.



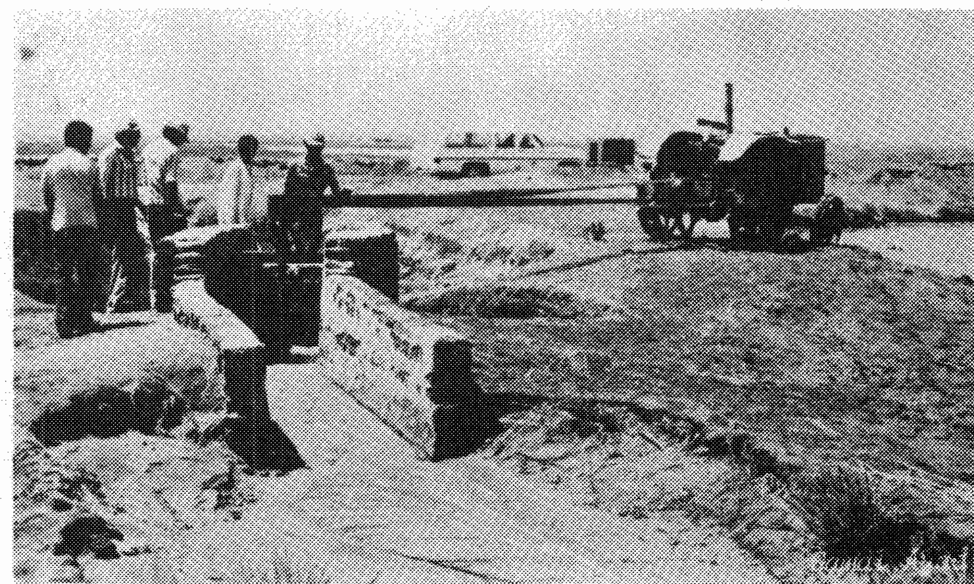
Increasing electricity costs and the danger of extended power outages require that this alternative for lifting water should be studied skeptically even for areas already served by transmission lines.



Traditional methods may give way to modern technology but many questions need to be resolved. Even washing clothes has a social tradition which requires motivation and time for change.

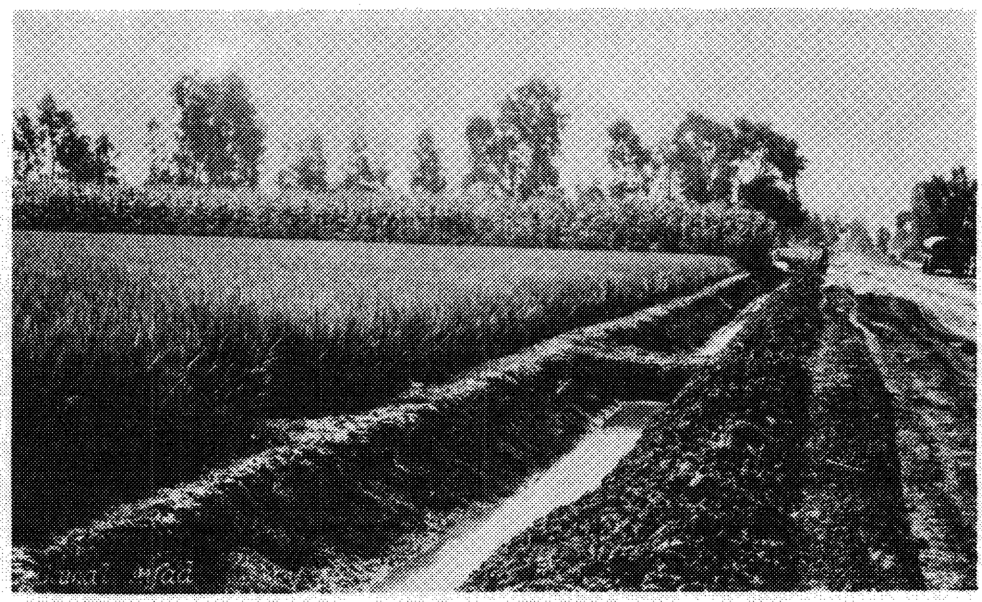


Project personnel assist cooperating farmers to make farm plans and to keep farm records.



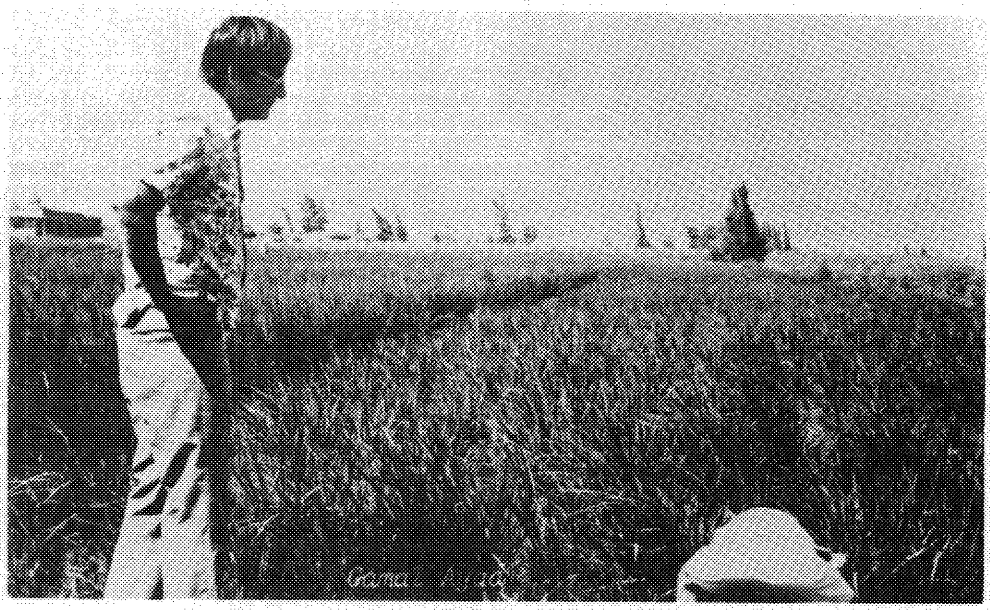
Egyptian farmers show interest in new labor saving methods. EWUP assists them with economic analyses.

The consequences of excessive salinity are obvious in lower Delta rice producing areas.



High yields of rice are possible under good management. Maize borders the rice paddy in the background.

Rice in Egypt frequently responds well to the application of zinc.

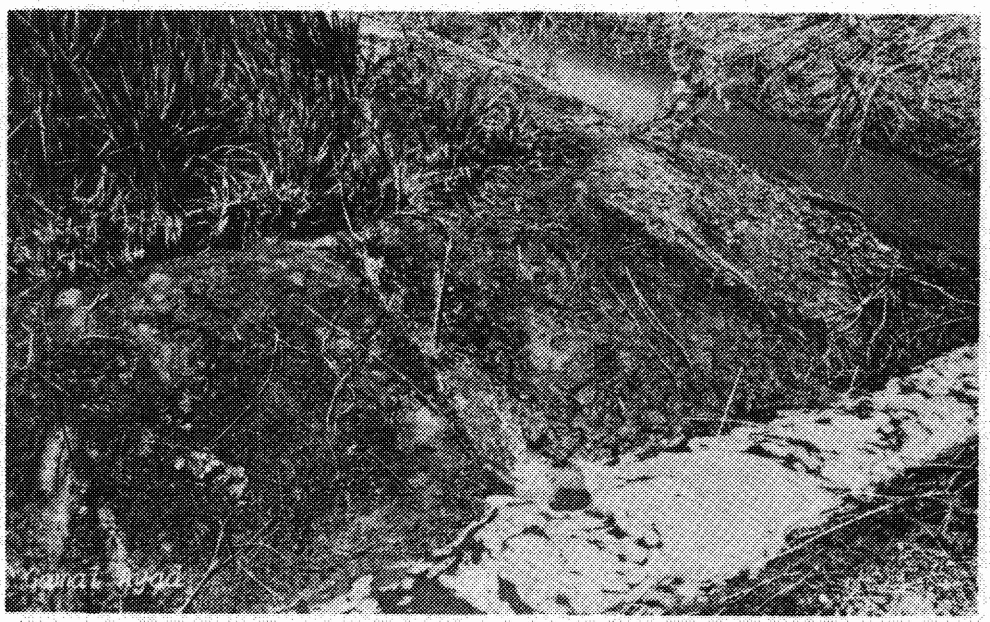


The mechanical transplanting of rice promises to relieve critical seasonal labor shortages. Further testing is needed, as shown by this poor stand, before it can be generally recommended.

Fields are shaped and planted by hand.

Irrigation is typically done with small field canals and basins.

Carefully prepared, hand shaped field ditches and basins at el Minya can be irrigated with relatively high field efficiencies.



Moles and crickets damage borders of rice paddies causing over load on drainage system.

Planting in dry soil. The field will be irrigated immediately after planting.

Flumes are used to measure water for cooperating farmers.

The use of tensiometers by EWUP technicians provides precise measurement of soil moisture conditions.

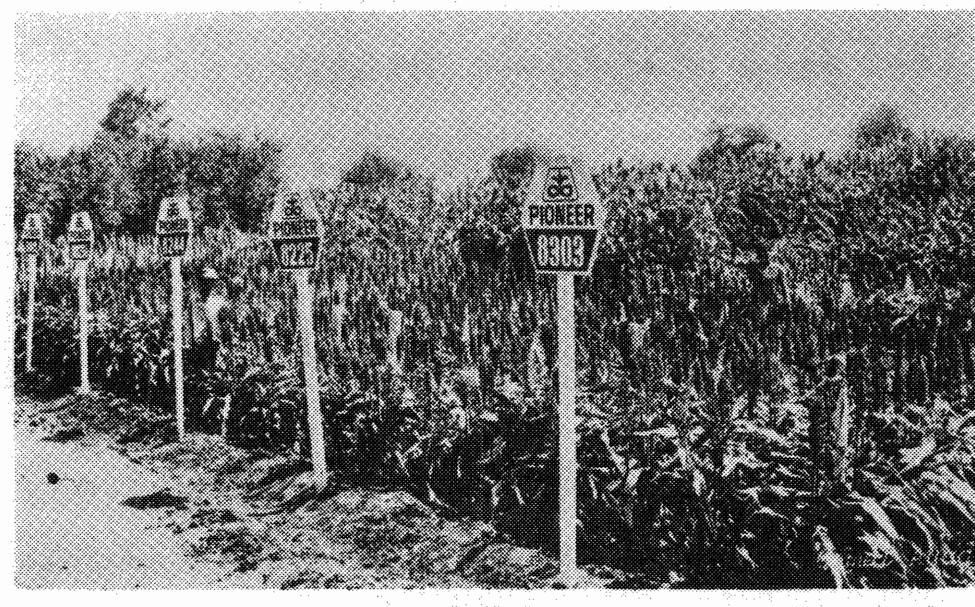
Farmers recognize the advantages of land leveling but such services are difficult to obtain in Egypt and poor roads inhibit access to farms.

Lack of roads also inhibits efficient marketing. Quality deterioration occurs before these vegetables reach central Cairo markets, some estimates peg losses at fifty percent.

Transportation of animal manure from villages to fields requires many man hours of labor.

Manual harvesting of flax and other crops creates seasonal labor shortages in rural areas and competes with planting of the next crop.

Mechanized harvesting systems are difficult to establish without adequate roads.



Commercial companies search for better crop varieties suited to Egyptian agriculture.

Village cooperatives provide seed, fertilizer, insecticides and tractor power for village farmers. The cooperatives also purchase government quota crops.

VII PERSONNEL WORKING ON THE PROJECT

A. Egypt

1. Main Office Government of Egypt Personnel

2. American Personnel

3. Egyptian Nationals

B. Fort Collins

C. Temporary Duty (TDY)

EWUP PERSONNEL ROSTER

September 1, 1980

GOE EMPLOYEES WORKING FOR EWUP...MAIN OFFICE

No.	Name	Percent Time EWUP	Title and Job Description
1.	Dr. Hassan Wahby	100	Director of EWUP
2.	Dr. Mahmoud Zanaty	100	Discipline Leader - Agronomy
3.	Dr. Anwar Keleg	100	Senior Agronomy
4.	Dr. Mohammed Sallam	100	Discipline Leader - Sociology
5.	Eng. Mostafa Saleh	100	Discipline Leader - Engineering
6.	Eng. Mahmoud Seif	50	Senior Engineer
7.	Eng. Bishara Ishac	100	Senior Engineer - Motor Pool
8.	Eng. Nadia Wahby	60	Senior Engineer - Water Requirements
9.	Eng. Gamal Ayad	100	Discipline Leader - Economics
10.	Eng. Ah. Farouk Abdel Al	100	Senior Economist
11.	Eng. Abdel Atti Allam	100	Engineer - Water Requirements
12.	Eng. Wadi Ragy	100	Engineer - Water Requirements
13.	Eng. Mohammed Nabil Nagib	60	Engineer - Water Requirements
14.	Eng. Farida Abdel Mequid	100	Engineer - Water Requirements
15.	Eng. Mohammed Helal	100	Engineer - Computer
16.	Eng. Ahmed Bayoumi	100	Senior Eng. - Farm Mechanization
17.	Eng. Azza Nasr	100	Engineer - Computer
18.	Eng. Ahmed Taha	90	Engineer - Motor Pool
19.	Dr. Ahmed Taher	100	Senior Agronomist
20.	Dr. Elwy Attalah	30	Senior Agronomist
21.	Mr. Mohammed Ahmed Salem	70	Senior Administrative - Personnel
22.	Mr. Ibrahim El Wakil	100	Senior Administrative - Public Relations
23.	Mohammed Said Moh El Shater	100	Senior Administrative - Expeditor
24.	Salah El Din Salem	100	Junior Administrative - Secretary
25.	Sayed Sakr	100	Junior Administrative - Store Keeper
26.	Zenab Abdel Gkani	100	Junior Administrative - Inventory
27.	Eklass Abdel Gkaffar	100	Junior Administrative - Secretary
28.	Magda Yassin Mahm.	100	Junior Administrative - Telephone Operator
29.	Ashgan Abdel Zaher	100	Junior Administrative - Photo Copier
30.	Mada Moh. Mosselhi	70	Junior Administrative - Secretary

GOE EMPLOYEES WORKING FOR EWUP...MAIN OFFICE - Page 2

No.	Name	Percent Time EWUP	Title and Job Description
31.	Bamba Shaaraui Aly	100	Junior Administrative - Photo Copier
32.	Maher Attalah	70	Junior Technician - Mechanical Works
33.	Abdel Naby Youssef	80	Technician - Mechanical, Motor Pool
34.	Ahmed Soliman Abdallah	80	Technician - Mechanical, Motor Pool
35.	Ahmed Ibrahim	80	Junior Administrative - Motor Pool
36.	Said El Said Elwi	80	Junior Administrative - Motor Pool
37.	El Araby Mansour Shahine	80	Junior Technician - Electrician
38.	Imama Sayed Wahba	70	Technician
39.	Osman Shaker	60	Junior Administrative
40.	Chaaban Moh. Abdou	25	Telephone Operator
41.	Boushra Beniamin	50	Senior Administrative - Accountant
42.	Ahlam Abdel Rahman	50	Junior Administrative - Accountant
43.	Eng. Taha Most.	100	Engineer - Water Laboratory
44.	Eng. Ikram Moh.	100	Engineer - Water Laboratory
45.	Ahmed Ghanem	100	Technician - Water Laboratory
46.	Susane Abou Shaddy	50	Junior Administrative - Library
47.	Abdalla Gad	80	Technician - Motor Pool
48.	Ahmed	80	Guard - Motor Pool

In addition to the above there are 29 drivers, laborers, or janitors, for a total of 77 employees.

EWUP PERSONNEL ROSTER

September 1, 1980

GOE EMPLOYEES WORKING FOR EWUP...MANSOURIA

No.	Name	Percent Time EWUP	Title and Job Description
1.	Dr. Mona El Kady	100	Team Leader - Engineer
2.	Wadie Fahim	100	Engineer
3.	Salah Abou El Ella	100	Engineer
4.	Moheb Ramzi Semeka	100	Agronomist
5.	Moh Loufty Nasr	100	Economist
6.	Hanfi Moh Mahmoud	100	Engineer - Farm Mechanics
7.	Moh. Nagib Mahmoud	100	Sociologist
8.	Mahmoud Khedr Afifi	100	Agronomist
9.	El Shinawi Abdel Atti	100	Economist
10.	Moh. Zaki El Dash	100	Senior Technician
11.	Sayed Kamal Marzouk	100	Senior Technician
12.	Farouk Abdel Al	100	Sociologist
13.	Gamal Fawzi	100	Economist
14.	Ahmed Tahoon	100	Agronomist
15.	Sabah Mahmoud	100	Agronomist
16.	Abdel Wahab Moh. Abdel Aziz	100	Senior Technician
17.	Badry Mahmoud Nadar	100	Senior Technician
18.	Ibrahim Zakaria	100	Senior Technician
19.	Hamdy El Sayed	100	Senior Technician
20.	Gamal Ahmed A' Megeid	100	Senior Technician
21.	Moh. A'Hamid A'Ghaffar	100	Senior Technician
22.	Said Rizk A'Mooti	100	Senior Technician
23.	Moust. Mahm. Moust.	100	Senior Technician
24.	Ibrahim Hussein Ali	100	Senior Technician
25.	Ibrahim Abdou Ibr.	100	Senior Technician
26.	Sayed Hamed Salem	100	Senior Technician
27.	Adel Abdel Moueim	100	Senior Technician
28.	Essam El Din Moust.	100	Senior Technician
29.	Ismail S. El Shimi	100	Junior Technician
30.	Moh. A'Moueim Idriss	100	Senior Technician

GOE EMPLOYEES WORKING FOR EWUP...MANSOURIA - Page 2

No.	Name	Percent Time EWUP	Title and Job Description
31.	Farouk Moh. Abdou	100	Senior Technician
32.	Ibr. A'Fattah Ibr.	100	Senior Technician
33.	Moustafa Sayed Saleh	100	Junior Administrative - Store Keeper
34.	Rokaya Abdel Mawla	100	Junior Administrative - Secretary
35.	Abdel Rahman Eid	100	Junior Technician
36.	Selim A. Tantawy	100	Junior Technician
37.	Moh. A'Rehim Guirgawi	100	Junior Technician
38.	Shawky M. El Awady	100	Junior Technician Laborer
39.	Farahat El Askhar	100	Junior Technician Laborer
40.	Fathi A. Aboul Nasr	100	Junior Technician Laborer
41.	Abdel Maaboud Ibr.	100	Junior Technician Laborer
42.	Ahmed Ragab	100	Junior Technician Laborer
43.	El Shimi Ismail	100	Junior Technician Laborer
44.	Hamed Aly Tahoon	100	Junior Technician Laborer
45.	Moh. Abdalla Ghalaby	100	Senior Technician - Surveyor
46.	Moh. Shaabay	100	Junior Technician - Carpenter
47.	Mokhtar A'Wanis	40	Junior Technician - Gate Operator

In addition to the above, there are 4 drivers for a total of 51 employees.

EWUP PERSONNEL ROSTER

September 1, 1980

GOE EMPLOYEES WORKING FOR EWUP - KAFR EL SHEIKH

No.	Name	Percent Time EWUP	Title and Job Description
1.	Eng. Moh. Samir	100	Team Leader
2.	El Sayed A'Hafez	100	Agronomist
3.	Magdi Moh. Awad	100	Agronomist
4.	Moh. Ragi Salah	100	Economist
5.	Sanaa Ezz El Din	100	Engineer
6.	Amany Hassan	100	Engineer
7.	Youseff Mahm. Youseff	100	Economist
8.	Ahmed Sayed Ismail	100	Agronomist
9.	Nehad Moh. Ibrahim	100	Agronomist - Farm Mech.
10.	Kamal Ezz El Din	100	Engineer
11.	Ahmed Dardir	100	Engineer
12.	Ahmed El Attar	100	Sociologist
13.	Mohamed Meleha	100	Agronomist
14.	Abdel Fattah El Masry	100	Sociologist
15.	Tarek A'Rahman Tewfik	100	Agronomist
16.	A'Fattah Metawie	100	Engineer
17.	Mahmoud Said	100	Agronomist
18.	Moh. Ahm. Abou Gmar	100	Senior Administrative
19.	Aboul Magd Shehab	100	Senior Technician
20.	Moheb A'Samad	100	Senior Technician
21.	Moh. Ahm. Badr	100	Senior Technician
22.	Atef Khalaf Sayed	100	Senior Technician
23.	Sayed A'Had A'Hamid	100	Senior Technician
24.	Abdel Hamid Said	100	Senior Technician
25.	Moh. Omar A'Megiud	100	Senior Technician
26.	Ramadan El Arabi	100	Senior Technician
27.	Hassan Moh. El Rifa	100	Senior Technician
28.	Farag Bassioumi	100	Senior Technician
29.	Magda Moh. Reda	100	Junior Administration

In addition to the above, there are 9 drivers and laborers for a total of 38 employees.

EWUP PERSONNEL ROSTER

September 1, 1980

GOE EMPLOYEES WORKING FOR EWUP - EL MINYA

No.	Name	Percent Time EWUP	Title and Job Description
1.	Eng. A'Raouf Hassan	100	Team Leader
2.	Abdel Settar Abdou	100	Agronomist
3.	Elia K. Sorial	100	Economist
4.	Esmat Wafik	100	Engineer
5.	Mohammed Awad	100	Agronomist
6.	Abdalla Saber	100	Sociologist
7.	Salah Abdel Samir	100	Agronomist
8.	Ahmed Abdel Nahim	100	Engineer
9.	Mohey El Din Yehia	100	Senior Technician
10.	Bakhit Nozer	100	Senior Technician
11.	Nashaat Younes A'Malak	100	Senior Technician
12.	Mahm. Wefty Nooman	100	Senior Technician
13.	Eman Mahm. Ebeid	100	Junior Administrative

In addition to the above, there are 4 laborers for a total of 17 employees.

EWUP PERSONNEL ROSTER

September 1, 1980

GOE EMPLOYEES WHO LEFT THE PROJECT

No.	Name	Percent Time EWUP	Title and Job Description
1.	Farouk Shahin	100	Irrigation Engineer - October 1977 to December 31, 1979
2.	Zaki Abou El Fotouh	100	Mansouria Team Leader October 1977 to December 31, 1979
3.	Dr. Mah. Abu-Zeid	100	Project Director October 1977 to December 31, 1979
4.	Kamel Helmy	100	Liaison Officer October 1977 to March 31, 1980
5.	Hassan Agha	100	Accountant October 1977 to June 30, 1979
6.	Adel Dawood	100	Administrative Assistant October 1977 to June 30, 1979

In addition to the above, 10 drivers have left the project for a total of 16 employees.

EWUP PERSONNEL ROSTER

September 1, 1980

AMERICANS ASSIGNED TO EWUP AND RESIDING IN EGYPT

No.	Name	Percent Time EWUP	Title and Job Description
1.	Royal H. Brooks	100	Technical Director - Main Office
2.	Eugene Quenemoen	100	Economist - Main Office
3.	John Wolfe	100	Irrigation Engineer - Main Office
4.	James Layton	100	Sociologist - Main Office
5.	Richard Tinsley	100	Agronomist - Main Office
6.	Erwin Nielsen	100	Agronomist - El Minya
7.	Thomas Ley	100	Engineer - Kafr El Sheikh
8.	William Braunworth	100	Agronomist - Mansouria
9.	Harold Golus	100	Agronomist - Mansouria
10.	Alex Dotzenko	100	Agronomist - Main Office
11.	Nancy Adams	100	Engineer - Kafr El Sheikh
12.	Edward Knop	100	Sociologist - Main Office

EWUP PERSONNEL ROSTER

September 1, 1980

LOCAL NATIONALS EMPLOYED BY EWUP

No.	Name	Percent Time EWUP	Title and Job Description
1.	Saad Mansour	100	Management Assistant - Main Office
2.	Hamdi Ahmed Hamdi	100	Translator - Main Office
3.	Laila El Sayed Fahmy	100	Secretary - Main Office
4.	Samaa Moh. Atwa	100	Secretary - Main Office
5.	Jihan Sadek Abdelnour	100	Secretary - Main Office
6.	Nagwa Moh. Ali Mazen	100	Public Relations & Administrative Assistant Main Office
7.	Nawal Abdalla Ahmed	100	Accountant - Main Office
8.	Moustafa Ibrahim Mahran	100	Electrician - Motor Pool
9.	Attia Moustafa Abdou	100	Tractor Driver - Kafr El Sheikh
10.	Salah Sadek Mahmoud	100	Tractor Driver - Mansouria

In addition to the above, there are 14 drivers for a total of 24 employees.

PERSONNEL WORKING ON THE PROJECT

Fort Collins, Colorado

Project Coordinator

E. V. Richardson	Engineering

Project Staff

Dorothy Rein	Staff Assistant
Beverly Jensen	Secretary
Pam Hobbs	Secretary

Planning and Coordinating Committee

Wayne Clyma	Engineering
Willard Schmehl	Agronomy
Melvin Skold	Economics
Daniel Sunada	Engineering
Max Lowdermilk	Sociology

Backstopping

See TDY list

TDY TO CAIRO

	Name	Arrival Date in Cairo	Departure Date from Cairo
1.	E. V. Richardson	June 10, 77	July 1, 77
2.	Larry White	June 10, 77	July 1, 77
3.	Alex Dotzendo	June 10, 77	July 1, 77
4.	E. V. Richardson	Oct. 9, 77	Nov. 17, 77
5.	Wayne Clyma	Nov. 26, 77	Nov. 28, 77
6.	Wayne Clyma	Dec. 8, 77	Dec. 16, 77
7.	M. K. Lowdermilk	Dec. 29, 77	Jan. 27, 78
8.	D. K. Sunada	Dec. 29, 77	Jan. 27, 78
9.	W. R. Schmehl	Dec. 30, 77	Feb. 16, 78
10.	P. N. Soltanpour	Dec. 30, 77	Jan. 26, 78
11.	James F. Ruff	Jan. 17, 78	Mar. 23, 78
12.	E. V. Richardson	Apr. 8, 78	May 6, 78
13.	Yack Moseley	June 20, 78	Aug. 15, 78
14.	K. C. Nobe	June 26, 78	July 3, 78
15.	Melvin D. Skold	July 21, 78	Aug. 19, 78
16.	Frank A. Santapolo	July 29, 78	Aug. 17, 78
17.	Verne Scott	Aug. 7, 78	Sept. 1, 78
18.	W. R. Schmehl	Aug. 8, 78	Sept. 1, 78
19.	E. V. Richardson	Sept. 9, 78	Oct. 5, 78
20.	Gaylord V. Skogerboe	Sept.16, 78	Sept.23, 78
21.	D. K. Sunada	Oct. 6, 78	Nov. 19, 78
22.	Wayne Clyma	Oct. 24, 78	Nov. 22, 78
23.	Richard McConnen	Nov. 11, 78	Dec. 10, 78
24.	E. V. Richardson	Nov. 28, 78	Dec. 15, 78
25.	P. N. Soltanpour	Dec. 12, 78	Jan. 9, 79
26.	Robert Heil	Dec. 30, 78	Jan. 18, 79
27.	Melvin D. Skold	Dec. 31, 78	Jan. 18, 79
28.	Thomas Sanders	Jan. 5, 79	Jan. 21, 79
29.	W. R. Schmehl	Jan. 14, 79	Feb. 12, 79
30.	W. F. Keim	Feb. 6, 79	Feb. 15, 79
31.	Richard McConnen	Mar. 15, 79	Apr. 13, 79
32.	James F. Ruff	Mar. 26, 79	Apr. 24, 79
33.	Robert Laroque	Apr. 12, 79	May 17, 79
34.	W. O. Ree	Apr. 16, 79	May 30, 79
35.	E. V. Richardson	May 13, 79	May 20, 79
36.	J. C. Loftis	May 16, 79	July 3, 79
37.	E. V. Richardson	June 22, 79	July 29, 79
38.	Louis Zurcher	July 18, 79	Aug. 9, 79
39.	Bernie Henrie	July 21, 79	July 29, 79
40.	J. R. Davis	July 21, 79	July 29, 79
41.	D. D. Johnson	July 21, 79	July 29, 79
42.	Frank Santapolo	Aug. 6, 79	Sept. 6, 79
43.	Albert Marsh	Aug. 29, 79	Oct. 3, 79

	Name	Arrival Date in Cairo	Departure Date from Cairo
44.	William W. Sayre	Sept. 4, 79	Dec. 16, 79
45.	L. D. Luft	Sept. 18, 79	Oct. 22, 79
46.	W. O. Ree	Oct. 1, 79	Oct. 31, 79
47.	Kern Stutler	Oct. 4, 79	Nov. 10, 79
48.	Melvin D. Skold	Oct. 15, 79	Nov. 13, 79
49.	David Redgrave	Oct. 15, 79	Nov. 15, 79
50.	August Robinson	Oct. 17, 79	Nov. 13, 79
51.	Thomas Ley	Oct. 20, 79	Nov. 19, 79
52.	Richard McConnen	Oct. 29, 79	Dec. 14, 79
53.	P. N. Soltanpour	Nov. 5, 79	Dec. 13, 79
54.	George Radosevich	Nov. 7, 79	Nov. 12, 79
55.	Verne Scott	Nov. 17, 79	Dec. 14, 79
56.	Ron Miner	Nov. 20, 79	Nov. 25, 79
57.	E. V. Richardson	Nov. 29, 79	Dec. 19, 79
58.	D. A. Benton	Dec. 1, 79	Dec. 15, 79
59.	J. E. Hautaluoma	Dec. 1, 79	Dec. 15, 79
60.	Richard Cuenca	Dec. 12, 79	Jan. 11, 80
61.	J. C. Loftis	Dec. 29, 79	Jan. 24, 80
62.	D. K. Sunada	Dec. 29, 79	Jan. 24, 80
63.	M. K. Lowdermilk	Dec. 29, 79	Jan. 24, 80
64.	James Layton	Dec. 29, 79	Jan. 24, 80
65.	E. V. Richardson	Jan. 15, 80	Feb. 4, 80
66.	David Redgrave	Jan. 21, 80	Feb. 10, 80
67.	August Robinson	Feb. 5, 80	Apr. 28, 80
68.	Alex Dotzenko	Feb. 13, 80	Mar. 29, 80
69.	James F. Ruff	Feb. 13, 80	Mar. 29, 80
70.	W. O. Ree	Mar. 2, 80	June 13, 80
71.	Neil Biggs	Mar. 17, 80	Apr. 28, 80
72.	Norman Illsley	Mar. 19, 80	June 19, 80
73.	Mohammed Haider	Apr. 21, 80	Aug. 18, 80
74.	Edward Knop	May 5, 80	June 9, 80
75.	E. G. Hanson	May 19, 80	July 2, 80
76.	Gale Dunn	May 19, 80	July 17, 80
77.	David Redgrave	May 19, 80	July 17, 80
78.	Al Madsen	May 19, 80	June 20, 80
79.	Yack Moseley	May 19, 80	July 17, 80
80.	Larry Nelson	May 19, 80	July 14, 80
81.	Joyce Ham	May 19, 80	July 17, 80
82.	Roger Slack	May 19, 80	Aug. 18, 80
83.	Thomas Edgar	May 19, 80	July 17, 80
84.	Nancy Adams	May 19, 80	July 17, 80
85.	E. V. Richardson	June 2, 80	July 2, 80
86.	Robert King	June 20, 80	July 30, 80
87.	James Mayfield	June 24, 80	July 24, 80
88.	Forrest Walters	July 19, 80	Aug. 18, 80
89.	W. O. Ree	Aug. 27, 80	Nov. 30, 80

1.	E. V. Richardson	June 10, 77	July 1, 77
		Oct. 9, 77	Nov. 17, 77
		Apr. 8, 78	May 6, 78
		Sept. 9, 78	Oct. 5, 78
		Nov. 28, 78	Dec. 15, 78
		May 13, 79	May 20, 79
		June 22, 79	July 29, 79
		Nov. 29, 79	Dec. 19, 79
		Jan. 15, 80	Feb. 4, 80
		June 2, 80	July 2, 80
2.	Larry White	June 10, 77	July 1, 77
3.	Alex Dotzenko	June 10, 77	July 1, 77
		Feb. 13, 80	Mar. 29, 80
4.	Wayne Clyma	Nov. 26, 77	Nov. 28, 77
		Dec. 8, 77	Dec. 16, 77
		Oct. 24, 78	Nov. 22, 78
5.	Max Lowdermilk	Dec. 29, 77	Jan. 27, 78
		Dec. 29, 79	Jan. 24, 80
6.	D. K. Sunada	Dec. 29, 77	Jan. 27, 78
		Oct. 6, 78	Nov. 19, 78
		Dec. 29, 79	Jan. 24, 80
7.	W. R. Schmehl	Dec. 30, 77	Feb. 16, 78
		Aug. 8, 78	Sept. 1, 78
		Jan. 14, 79	Feb. 12, 79
8.	P. N. Soltanpour	Dec. 30, 77	Jan. 26, 78
		Dec. 12, 78	Jan. 9, 79
		Nov. 5, 79	Dec. 13, 79
9.	James F. Ruff	Jan. 17, 78	Mar. 23, 78
		Mar. 26, 79	Apr. 24, 79
		Feb. 13, 80	Mar. 29, 80
10.	Yack Moseley	June 20, 78	Aug. 15, 78
		May 19, 80	July 17, 80
11.	K. C. Nobe	June 26, 78	July 3, 78
12.	Melvin D. Skold	July 21, 78	Aug. 19, 78
		Dec. 31, 78	Jan. 18, 79
		Oct. 15, 79	Nov. 13, 79
13.	Frank A. Santapolo	July 29, 79	Aug. 17, 78
		Aug. 6, 79	Sept. 6, 79
14.	Verne Scott	Aug. 7, 78	Sept. 1, 78
		Nov. 17, 79	Dec. 14, 79
15.	Gaylord Skogerboe	Sept. 16, 78	Sept.23, 78

16.	Richard McConnen	Nov. 11, 78 Mar. 15, 79 Oct. 29, 79	Dec. 10, 78 Apr. 13, 79 Dec. 14, 79
17.	Robert Heil	Dec. 30, 78	Jan. 18, 79
18.	Thomas Sanders	Jan. 5, 79	Jan. 21, 79
19.	W. F. Keim	Feb. 6, 79	Feb. 15, 79
20.	Robert Laroque	Apr. 12, 79	May 17, 79
21.	W. O. Ree	Apr. 16, 79 Oct. 1, 79 Mar. 2, 80 Aug. 27, 80	May 30, 79 Oct. 31, 79 June 13, 80 Nov. 30, 80
22.	J. C. Loftis	May 16, 79 Dec. 29, 79	July 3, 79 Jan. 24, 80
23.	Louis Zurcher	July 18, 79	Aug. 9, 79
24.	Bernie Henrie	July 21, 79	July 29, 79
25.	J. R. Davis	July 21, 79	July 29, 79
26.	D. D. Johnson	July 21, 79	July 29, 79
27.	Albert Marsh	Aug. 29, 79	Oct. 3, 79
28.	William W. Sayre	Sept. 4, 79	Dec. 16, 79
29.	L. D. Luft	Sept. 18, 79	Oct. 22, 79
30.	Kern Stutler	Oct. 4, 79	Nov. 10, 79
31.	David Redgrave	Oct. 15, 79 Jan. 21, 80 May 19, 80	Nov. 15, 79 Feb. 10, 80 July 17, 80
32.	August Robinson	Oct. 17, 79 Feb. 5, 80	Nov. 13, 79 Apr. 28, 80
33.	Thomas Ley	Oct. 20, 79	Nov. 19, 79
34.	George Radosevich	Nov. 7, 79	Nov. 12, 79
35.	Ron Miner	Nov. 20, 79	Nov. 25, 79
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37.	J. E. Hautaluoma	Dec. 1, 79	Dec. 15, 79
38.	Richard Cuenca	Dec. 12, 79	Jan. 11, 80
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48.	Joyce Ham	May 19, 80	July 17, 80
49.	Roger Slack	May 19, 80	Aug. 18, 80
50.	Thomas Edgar	May 19, 80	July 17, 80
51.	Nancy Adams	May 19, 80	July 17, 80
52.	Robert King	June 20, 80	July 30, 80
53.	James Mayfield	June 24, 80	July 24, 80
54.	Forrest Walters	July 19, 80	Aug. 18, 80