PDAAT-792
ISN-45951

EGYPTIAN AGRICULTURAL MECHANIZATION PROJECT

Contract Number 263-0031-HHC-01

ACTIVITY REPORT NUMBER 6

1 July 1982 - 30 September 1982

Submitted by

LOUIS BERGER INTERNATIONAL, INC.
100 Halstead Street
East Orange, New Jersey

CONTENTS

1.0 Summary 1

Annex A.

A.1 Planning and Evalualtion Subproject 32

A.1.1 Planning and Financial Subunit 32

A.1.2 Farm Management Subunit 36

A.1.3 Evaluation Subunit 39

A.2 Research and Development Subproject 48

A.3 Extension and Training Subproject 56

A.4 Local Manufacturing Subproject 80

A.5 Service Center/Village Workshops 82

A.6 Land Improvement Subproject 92

Annex B. 108

Required Accounting Procedures for Management of AID Furnished Local Currency Funds 108

Annex C. 111

Land Improvement Workplan 111

Working Paper No. 1
Soil Improvement Subproject
"Basin Surveys: Minia Governorate" 179

Working Paper No. 2
Soil Improvement Subproject
"Land Improvement Demonstration Basin Construction Program" 202

Annex D.

Management System for Project Demonstration/Training Equipment 217

Annex E.

Village Programs Workplan of the Machinery Management Extension and Extension Training Plan 221

1.0 SUMMARY

Thirty-three percent (US$ 13,376,508) of the $40 million United States contribution is in the pipeline and expended category (see Section 3.0 for details). This means that funds a) are in-process by USAID and/or MOA; b) are in bank accounts and directly available to the Project, and c) have been physically disbursed. This compares to 20 percent (US$ 8,256,603) in this category a year ago. Thus, there has been an increase of 62 percent in the pipeline/expended category. However, there has been an even greater change than these figures indicate: all major categories now have funds available to the Project whereas a year ago only two categories--technical assistance and commodity procurement, had funds available.

The Service Center/Village Workshop subproject is reviewed in Table 1.1: LE 476,000 are at the banks awaiting approval, while LE 1,005,000 are in-process at the Project level. If these current applications are sent to the banks and processed by March 22, 1983, this program will be on schedule, since sufficient time remains in the Project to move the remaining two tranches of the Service Center project on a yearly basis. However, this is possible only if the bank processing can be accelerated: the LE 476,000 have been at the banks since the end of July.

The technical input totaled 219 man-months compared to an anticipated input of 234.5 man-months. A major reason for the 15.5 man-months deficit is that the extension advisor position has not been filled since June. Nevertheless, this shortfall is recoverable during the life of the Project.

The major activities of the subprojects were, briefly:

1. Planning and Evaluation: Working Paper No. 3, "Comparative Societal and On-Farm Costs of Irrigation Water-Lifting in the Arab Republic of Egypt," was completed (see Section 2.2.1 for the summarized results). The farm management study's data collection is on schedule but collation is lagging. A request for $1 million was received to initiate

TABLE 1.1: SERVICE CENTER AND VILLAGE WORKSHOP LOANS IN-PROCESS AT GOVERNORATE BANKS AND WITHIN THE PROJECT

PARTICIPANT	LOCATION	DATE SUBMITTED	LOAN VALUE(LE
LOAN IN-PROCESS AT GOVERNORATE BANKS			
1. SERVICE CENTER			
a. Mr.Mohsen Azmy	Beni Mazar,Minia	July	250,000
b. Mahmoudia Motor	Mahmoudia,Beheira	June 17,82	200,000
c. Total Service Centers			450,000
2. VILLAGE WORKSHOPS			
a. Mr.I.Atteya	Delengat,Beheira	July27,82	15,000
b. Mr.M. Kohla	Delengat,Beheira	July27,82	11,000
c. Total Village Workshops			26,000
3. Total Service Centers and Village Workshops			476,000
LOANS IN-PROCESS AT PROJECT LEVEL			
4. SERVICE CENTER			
a. Egypt Trac	Qalub,Qalubia	-	250,000
b. Hammami	Abou Hommos,Beheira	-	185,000
c. Shaity Co.	Tanta, Gharbia	-	240,000
d. Diabex	Aga ,Dakhlia	-	250,000
e. Total Service Centers			925,000
5. VILLAGE WORKSHOP			
a. Mr.F.Shouman	Meshtoul ElSouq,Sharkia	-	19,000
b. Mr.R.AbdelKarem	Meshtoul ElSoug,Sharkia	-	10,000
c. Mr.N.ElBahnasi	Kafr El Dawar,Beheira	-	15,000
d. Mr.H.El Sayed	Shalaby, Beheira	-	19,000
e. Mr M.Darhous	Zifta, Sharkia	-	17,000
f. Total Village Workshops			80,000
6. Total Service Center and Village Workshop			1,005,000
OVERALL			
7. Service Centers			1,375,000
8. Village Workshops			106,000
9. TOTAL SERVICE CENTERS AND WORKSHOPS			1,481,000

the Machinery Introduction Fund. An initial set of papers based on the area mechanization study have been identified:

a) The role of agricultural cooperatives in the distribution of machinery in Project Villages;
b) The relationship between increasing mechanization and the need for hired agricultural labor;
c) Farmer's preferences and requirements in agricultural machinery;
d) An evaluation of machinery workshop services, and
e) Irrigation and drainage concerns of farmers.

Considerable effort has been made on the part of the Minia Village Study team in assisting the Land Improvement Subproject to identify two demonstration basins for their activities. A draft evaluation workplan for 1982-83 has been submitted for Project review.

2. Research and Development: Applied Research Fund contracts are in the final stages of preparation, and initial funding is in place for disbursement when this is done. Consulting services to the mechanized farm at West Nubaria have continued on a weekly basis. Machinery Development has concentrated upon modifications of two Italian mower/binders as harvesters for wheat and rice (see Section 2.3.2). In addition, a pickup reel is being designed to assist in lodged crops.

3. Machinery Management Extension/Training: A Village Program Plan has been prepared for the mechanization specialists (Annex E). This will be implemented first by the mechanization specialists recently graduated from the Sakha Training Center and assigned to Beheira and Gharbia governorates. The second group of mechanization specialists started their training and will be assigned to Project Villages in Qaliubia, Sharkia and Minia governorates. Also, an extension pamphlet on water pumps has been completed, and one on tractor maintenance is in preparation.

In training, the first participant training observational tour was instituted during this quarter: this tour involved agricultural mechanization practices in selected regions of

the U.S. During this period, 78 participants took part in 13 courses: 51 were in training center programs, 15 were in intensive English courses, and two were in the U.S. on observational study tours.

4. Local Manufacturing Program: The continued development of an all-crop thresher dominated the activities of this program: problems limiting capacity in the concave area were overcome, and wheat tests indicated theoretical intake rates of 2.7 metric tons on straw and 0.9 metric tons of grain per hour.

5. Land Improvement Subproject: A basic field demonstration unit is being acquired that will cover the activities of landleveling, subsoiling, drainage, and gypsum incorporation. The underlying workplan has been finalized and is presented in Annex B of this report. An analysis of the preliminary basin survey in Minia governorate indicated: 1) the median size basin is 70 feddans; 2) 77 percent of the surveyed area requires some form of land improvement (by subjective analysis), and 3) of the surveyed area, 25 percent requires landleveling. This survey represented 63% of the agricultural area (273,434 feddans) in Minia governorate. Several computer programs were also written for the Project's HP85.

Implementation schedules are reviewed in Section 4.0 so will not be repeated in this Summary. During this period several implementation issues were resolved: delivery of the previously ordered prototype research equipment has been arranged; the Senior Accountant position has been approved; and the lack of training facilities has been partially alleviated. Several issues are sufacing, but of primary concern is the development of the academic overseas training program. To date the candidates submitted have not been qualified, and those who are seeking prequalification are not meeting the English language requirements.

2.0 PROJECT ACCOMPLISHMENTS

2.1 Overall Accomplishments

1. USAID initially disbursed the local currency equivalent of US$ 1 million for the Machinery Introduction Fund. This fund will support the Extension subproject's demonstration effort and will be an important mechanism for spreading machine services to the farming community.
2. The Senior Accounting Advisor's position was approved by USAID.
3. USAID formally approved the three conditions precendent for disbursements of funds for the Machinery Management Extension program.
4. USAID formally approved the conditions precendent for disbursement of funds for the Applied Research Fund.
5. New guidelines for the management of local currency have been prepared (Annex B).

2.2 Planning and Evaluation Subproject

2.2.1 Economic and Financial Planning

1. In the Pretest of Waterlifting Credit Fund in Beheira governorate, initial results indicate a favorable reception without any serious implementation problems. The initial pump size distribution of 15 pumps was: 10 units of 11 hp, 2 units of 7.5 hp, and 3 units of 5 hp.
2. In conjunction with the Service Center/Village Workshop subproject, changes in the Service Center Credit fund have been proposed (Annex A.1). These changes should alleviate some of the problems encountered by the Service Center/Village Workshop technical team.
3. The Porject's working paper number three, "Comparative Societal and On-farm Costs of Irrigation Water-lifing in the Arab Republic of Egypt" was completed, with the following summarized results:

Waterlifting Method	Financial Costs (LE/feddan)	Economic Costs (LE/feddan)
1. Cattle powered Sakia	46.46	-
2. Buffalo-powered Sakia	57.84	
3. 12 Hp diesel pump	18.90	28.26
4. 9 HP diesel pump	21.40	31.88
5. 7.5 Hp diesel pump	22.90	34.00
6. 5.0 Hp diesel pump	31.80	46.23
7. 15 Hp diesel pump	22.90	33.90
8. 7.5 Hp electric pump	27.20	39.20
9. 5 Hp electric pump	39.00	54.65

4. The Farm Management field data is progressing as scheduled: a) all winter crop data has been collected from the field and b) summer crop data collection operations are in full swing.
5. A $1 million tranch to initiate the Machinery Introduction Fund was requested and received from USAID.
6. A Project local currency cash needs request for LE 574,591 was submitted to USAID and LE 454,721 was received.

2.2.2 Evaluation Subunit

1. As stated in the last quarterly report, the area mechanization survey will serve as an important resource base for the Project. Thus an initial set of papers based upon this report will be developed over the coming months:
   a) the role of agricultural cooperatives in the distribution of machinery in Project Villages;
   b) the relationship between increasing mechanization and the need for hired agricultural labor;
   c) farmers' preferences and requirements in agricultural machinery;
   d) an evaluation of machinery workshop services;
   e) irrigation and drainage concerns of farmers.
2. A draft evaluation workplan for 1982-83 has been submitted for Project review.
3. Village studies activities included the following:

a. Completed data collection on investment patterns, cooperative and exchange labor, and census of village machine owners;

b. Minia team collected data on irrigation basins in Project villages for the Land Improvement subproject:
   (1) Soil and water conditions;
   (2) Number of landholders, their feddans, and crops in each basin;
   (3) Ranking of basins in each village on problems of drainage, irrigation water, salinity, alkalinity, weeds, and levelness of fields;
   (4) Selection of basins for initial implementation of the Land Improvement program based upon the above factors (i.e., choosing the basins with the greatest problems

c. Dr. Abdel Basset El Sayyad completed the pump and sakia use study in Qaliubia; the preliminary results:
   (1) There was no significant movement towards electrification of waterlifting devices;
   (2) A shift from sakia to pump did not result in a decrease in animal holdings;
   (3) In most cases, livestock numbers increased or remained the same.

d. The Sharkia team supervised by Dr. Shahat Mohamed Zaki has undertaken a tractor-use study during the current post-harvest and tillage period.

4. Internal Project Evaluations:

a. Extension waterlifting materials: Farmers did not readily understand the written materials; it was recommended that more self-explanatory pictures be used.

b. Sakha training program: A mid-term evaluation was conducted by the Director of Evaluation.

c. Farmers' attitudes toward the Deutz 770 combine: the farmers' impression was that costs were reduced--reduced labor costs and reduced turn-around time.

2.3 Research and Development Subproject

2.3.1 Research and Testing

1. Applied Research Fund
   a. Contracts between the Project, universities and principal investigators are in the final stages for formation.
   b. Eight research projects have been approved and are awaiting final contracts so that funding can proceed.
2. Consulting services: Weekly visits to the mechanized farm at West Nubaria concerning cotton mechanization have continued. The focus has been upon a proper soil surface to accomodate mechanical harvesting. Although conditions are improved over last year, the soil surface is still not appropriate for fully effective mechanical harvesting: soil clods and ridges near the base of the plants will negate effective mechanical harvesting of the lower cotton branches.
3. A research project pertaining to soil compaction and tractor traffic was initialized with Dr. Araby.
4. The effect of long-term subsoiling on a casual basis at Baltim was investigated: an area that had been subsoiled two years showed no evidence of subsoiler tracks nor root penetration beyond a few centimeters; an area subsoiled one year earlier showed paths to 35 cm and weed root penetration to this depth (the land had not been cropped during this year). Statistically valid research is needed before conclusions can be generalized.
5. Research prototype equipment, ordered for nearly a year, will finally be available for initial testing during the next quarter.
6. A RAU heavy duty chisel was tested against the locally manufactured Beheira chisel. Due to the lack of personnel, instrumentation and time, not all desired measurements were made. The measurements taken were: draft, wheel slippage, and fuel consumption; those measurements not taken were soil profile (before and after), aggregate soil particle size distribution, and bulk density.

2.3.2 Machinery Development

The emphasis during this reporting period has been upon modification of two imported Italian self-propelled mower/binders (Camon F10 and Olympia) to meet Egyptian rice conditions. The activities are summarized as follows:

1. The Camon F10 was field tested in an over-ripe wheat field at El Saadeen on August 1, 1982. Conclusions: the typical wheat crop, with plants up to 1.5 meters tall and customary cutting 2.5 to 5 cm above the ground, is not compatible with binders designed for use in shorter crops that are cut 15 to 30 cm above the ground. Since the F10 is designed to tie bundles only 19cm above the butt ends, these long stalked bundles flared outward so that the machine's frame would not pass over the bundle.
2. The Olumpia mover/binder conversion to a harvester for tall Egyptian wheat and rice began this reporting period:
   a. A pickup reel was designed and assembled;
   b. The lefthand cutter support was modified to provide clearance for the reel and winrow;
   c. The rear caster wheel support frame was modified for easier control and durability;
   d. A modified steering linkage was designed and built;
   e. Swath-control shielding was designed and installed.
3. An alternative sickle drive was designed for the Camon F10 since removal of the binding mechanisms also removed the sickle drive.

2.4 Machinery Management Extension /Training Subproject

1. Funds were in place for the first procurement of demonstration/training equipment.
2. A Village Program Plan for the Extension/Training Subproject has been prepared (Annex E).

2.4.1 Extension Subunit

1. Village programs of mechanization specialists in Beheira and Gharbia governorates were finalized for presentation at the Agricultural Mechanization Extension Specialists' Workshop scheduled for October.
2. Training of district and village mechanization specialists

for Sharkia, Qaliubia and Minia governorates began during this period.

3. An Extension pamphlet on water pumps was completed and distributed and another pamphlet on tractor maintenance is in preparation.
4. Waterlifting credit fund extension efforts began in four pretest villages.
5. A management system for Project demonstration/training equipment was prepared (Annex D).
6. A television program on tractor maintenance was prepared.

2.4.2 Training Subunit

1. The first participant training observational tour was instituted during this period. The tour covered agricultural mechanization practices in selected regions of the U.S.
2. The first revision of the Participant Training Manual was completed.
3. During this period, 78 participants took part in 13 courses: 51 were in four training center programs, 10 were at field-site locations, 15 were in intensive English language programs, and 2 were in the U.S. on a participant training observational tour. (See Table 4.1).
4. The Technical Training Specialist, in cooperation with Sharkia extension personnel, continued demonstrations and training with the peanut harvester.
5. Preparation of machinery extension specialist's workshop for October 2-5 was completed.

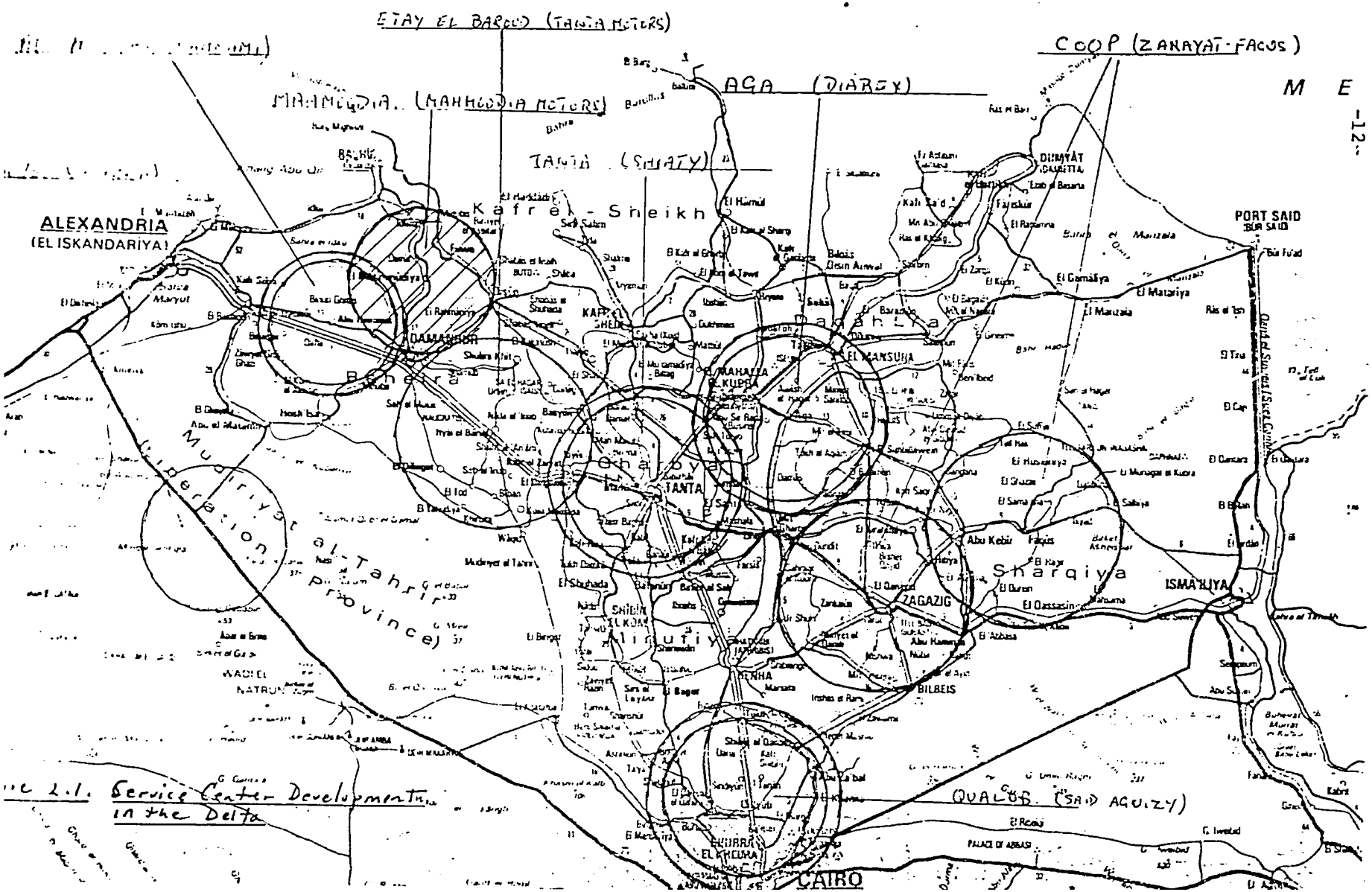
2.5 Local Manufacturing Program

1. The continued development of an all-crop thresher dominated the activities of this program. The initial manufacturing phase has now entered into a machine development period. The objective is to have a prototype thresher than can serve as a specific model for improving local manufacturing capabilities in this area.

2. The final results were (see Annex A for details):
   a. Problems limiting capacity in the concave area were overcome, and
   b. Wheat tests indicated a theoretical intake rate of 2.7 metric tons per hour of straw and 0.9 metric tons per hour of grain.

2.6 Service Center/Village Workshop Subproject

1. The activities of the Service Center section are best viewed in Figure 2.1 and Figure 2.2:
   a. Two proposals are at governorate banks: Mahmoudia Motors (Mahmoudia, Beheira) and Mr. Abdel Mohsen Azmy (Beni Mazar, Minia).
   b. Four proposals are in the processing stage at the Project level in preparation for bank submission: Hammami (Abu Hommos, Beheira); Shiaty (Tanta, Sharkia), Diabex (Agha, Dakahlia), and Egyptrac (Qaliubia).
2. Several constraints have been identified that are inhibiting the progress of this program, e.g., down payment requirements for village workshops and loan limitations. In conjunction with the Economic and Financial Planning subunit, proposed changes to the Letter of Understanding have been submitted to the PBDAC and USAID for concurrence.
3. The random villages in Sharkia governorate were surveyed for village workshops: none of the villages had a workshop, but had reasonable access to repair services in nearby villages; something may materialize in El Saadeen.
4. Catalogs on shop equipment and machinery and catalogs of agricultural machinery available in Egypt were completed and indexed.
5. During the period, 51 visits were made in conjunction with the village workshop program.
6. The Service Center and Village Workshop loans currently in the banks and being processed by the subproject total LE 1,481,000. This is summarized in Table 1.1 (p. 2).


ETAY EL BAROUD (TANTA MOTORS)
COOP (ZANAYAT-FACUS)
AGA (DIAREX)
MAHMOUDIA (MAHMOUDIA MOTORS)
TANTA (SHATY)
ALEXANDRIA
(EL ISKANDARIYA)
PORT SAID
(BUR SAID)
DEMYAT
(DAMIETTA)
Kafr el-Sheikh
Gharbiya
Dakahlia
Sharqiya
Beheira
Muhafazat al-Tahrir
(Liberation Province)
DAMANHUR
TANTA
ZAGAZIG
ISMA'ILIYA
BILBEIS
MENHA
SHIBIN EL KOM
EL MANSURA
MAHALLA EL KUBRA
KAFR EL SHEIKH
WADI EL NATRUN
QUALUB (SAID AGUIZY)
CAIRO
Figure 2.1. Service Center Development in the Delta

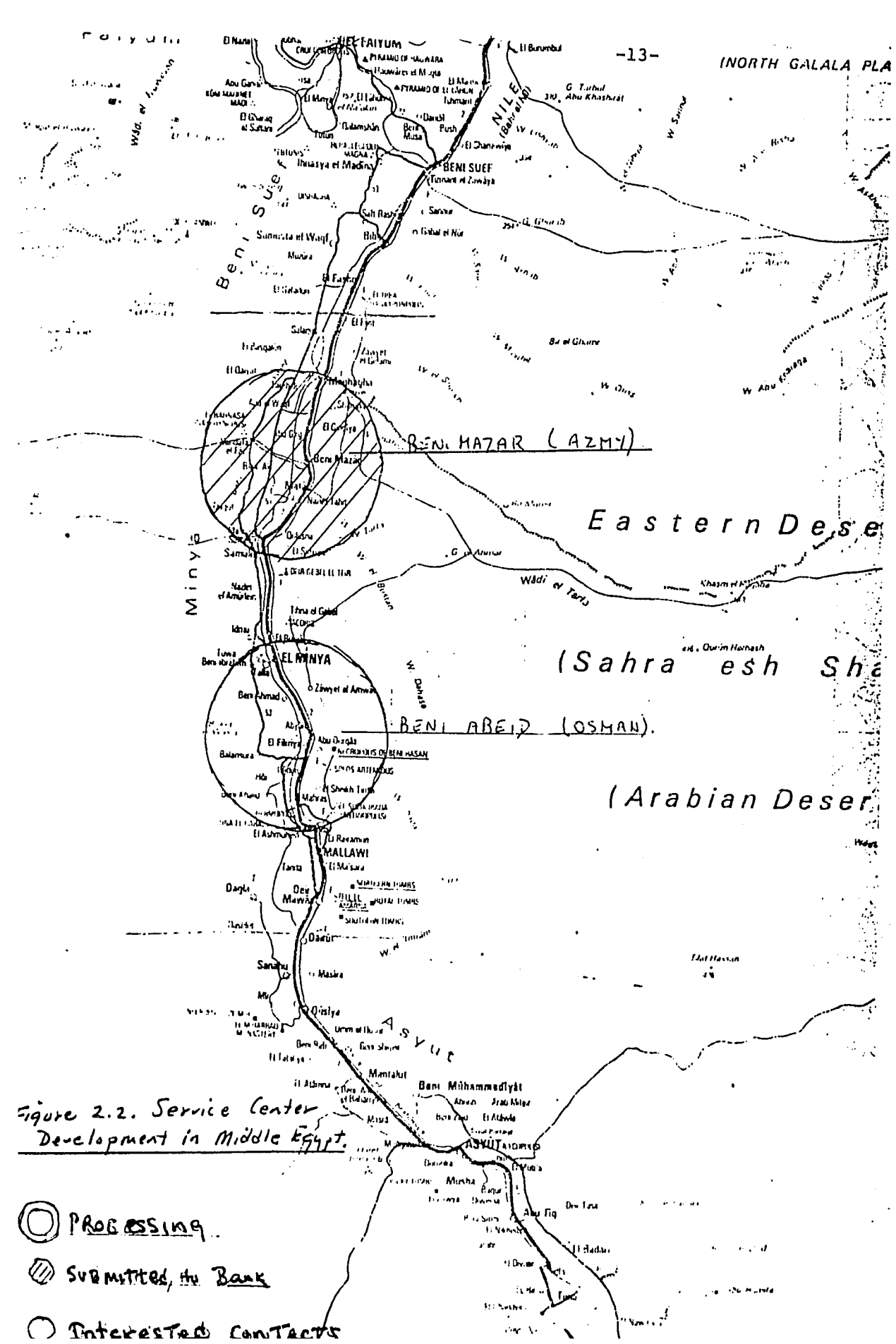


Figure 2.2. Service Center Development in Middle Egypt.

2.7 Land Improvement Subproject

1. A field demonstration and training unit is being accumulated from the local market. It will include:
   a. three 65 hp tractors with laser-controlled scrapers for landleveling;
   b. one 45 hp tractor with chisel plow to loosen the soil;
   c. one 130 hp tractor with mole plow and subsoiler;
   d. gypsum application/incorporation equipment.
2. Data anlaysis of the preliminary basin survey in Minia government has been completed. The survey covered basins that represented 63% of the agricultural area, or 273,434 feddans. The results indicated:
   a. The median basin size is approximately 70 feddans;
   b. 77 percent of the surveyed area requires some form of land improvement (subjective analysis), e.g., landleveling, subsoiling, gypsum application;
   c. Of this area, 25 percent requires landleveling.
3. The basic land improvement workplan has been completed (Annex C). The approach that emerges, in summary, is:
   a. The land improvement problem is basically one of soil salinity, requiring an integrative approach for solution;
   b. The remedial activities of landleveling, subsoiling, gypsum incorporation, and drainage are also interdependent and their application must be coordinated.
   c. The workplan therefore calls for grouping these remedial activities into a specific equipment set capable of landleveling, subsoiling, gypsum incorporation, and drainage within a basin area. The basin as here defined is "the smallest area to which water is delivered by the Ministry of Irrigation and the smallest administrative unit identified by the Ministry of Agriculture."
   d. The rehabilitation work within a basin will be based upon topographical, soil, and socio-technical surveys. This will lead to the development of a basin design; acceptance and/or modification of the proposed design by the farmers; and implementation of the design.

Because implementation must take place between cropping seasons when the land is clear, a high degree of coordination between the farmers and the technical input is vital and critical.

e. The first demonstration basin shall start in Minia governorate with the extension of similar demonstrations in basins in Fayoum, Beni Suef, and Assiut. It is anticipated that the diffusion effect will lead to the full institutionalization of this project as a permanent program.

4. An operational analysis of the laser landleveling by the Delta Sugar Company at Baltim was completed. Of primary interest is the evaluation of laser-controlled earthwork: earthwork volume, time required, direct operating costs, and power requirements.
5. Work was done developing and/or altering several computer programs for analyzing survey data:
   a. Tractor requirements associated with earth movement;
   b. Analysis of topographical data;
   c. Design and rehabilitation of quarternary irrigation channels;
   d. Design of zero level fields from survey data and calculated earthwork volumes.
6. From the preliminary basin survey in Minia governorate, 54 villages were selected for detailed basin surveys to define the scope of land improvement activities needed in Minia governorate.
7. Soil compaction studies were initiated in collaboration with the Research and Development subproject.

3.0 FINANCIAL AND TECHNICAL LEVEL OF EFFORT

3.1 Financial Level of Effort: USAID Funds

Table 3.1 summarizes the financial level of effort from inception of the technical assistance through September 30, 1982. The categories of money flows are defined as follows:

1. Grant agreement (Colum 1): USAID obligated funding established by the Grant Agreement with the Government of Egypt.
2. USAID subobligated funds (Column 2): Funds that have been subobligated and are available to the Project following appropriate administrative procedures.
3. Expenditures and/or funds in process (Colum 3): Funds requested and in process from USAID or MOA representing, for example, specific expenditures, cash needs advances, or credit fund advances.
4. Fund-available balance (Column 4): Funds directly available to the Project.
5. Funds expended (Column 5): Funds physically expennded by the Project.
6. Pipeline and expended funds (Column 6): The total of Columns 3, 4, and 5 where Columns 3 and 4 represent pipeline funds.

On an overall basis, 33 percent of the Grant Agreement funds are in the pipeline or have been expended: on the foreing currency side, 43 percent of the foreign currency funds are in this category, while 25 percent of the local currency is in the pipeline and expended category. Compared to the last reporting period ending June 30, 1982, this represents an increase of four percent, from 29 percent to 33 percent.

On the basis of funding currently available to the Project (Column 2), 39 percent of the overall funding is in the pipeline/expended category.

TABLE 3.1 : Financial Level of Effort : Foreign Currency and Local Currency from September 15, 1980 through September 30, 1982.

	(1) GRANT AGREEMENT	(2) USAID SUBOBLIG-ATION	(3) EXPENDIT-URES, FUNDS IN PROCESS	(4) FUND AVAILABLE BALANCE	(5) FUND EXPENDED	(6) PIPELINE (3+4+5) & EXPENDED FUNDS
Foreign Currency :						
1. Technical Assistance	6,424,000	5,955,418	216,775	3,939.152	1,799,691	5,955,618
2. Commodities	9,133,000	9,133,000	1,500,000	-	385,336	1,885,336
3. Training	2,023,000	2,023,000	-	-	8,900	8,900
4. Research Support	1,005,000	1,005,000	84,699	-	127,329	212,028
5. Special Studies & Evaluation	215,000	215,000	-	-	-	-
6. Total :	18,800,000	18,331,618	1,801,474	3,939,152	2,312,356	8,061,882
7. % in Pipeline expended						43%
Local Currency (US$ Equivalent)						
1. Technical Assistance	2,302,000	1,688,361	47,191	1,176,497	518,882	1,805,570
2. Commodities	2,000,000	2,000,000	250,584	-	-	-
3. Training	1,000,000	267,117	120,590	45,532	41,527	210,649
4. Vehicles operating expenses	100,000	100,000	20,290	-	-	-
5. Facilities	70,000	70,000	-	-	-	-
6. Credit Funds	13,000,000					
a. Service Center	5,000,000	5,000,000	-	1,500,000	-	1,500,000
b. Water lifting	2,000,000	2,000,000	-	429,012	70,988	500,000
c. Machine Introduction	4,000,000	2,000,000	-	1,000,000	-	1,000,000
d. Uncommitted	2,000,000	-	-	-	-	-
7. Research Support	2,000,000	2,000,000	-	-	-	36,433
8. Special Studies & Evaluation	728,000	728,000	-	-	-	-
9. Total :	21,200,000	15,853,478	475,088	4,154,041	694,397	5,323,526
10. % in pipeline/expended						25%
Overall						
1. Total	40,000,000	34,185,096	2,276,562	8,093,193	3,006,753	13,376,508
2. % in pipeline/expended						33%

Notes :

1. Expended through 31,July,1982.

3.2 Technical Level of Effort

Table 3.2 summarizes the technical level of effort. There is a 15.5 man-month differential between the actual effort and that anticipated in the inception report. The difference is recoverable during the life of the Project. The actual level of effort is falling behind because the position of extension advisor has not yet been refilled.

TABLE 3.2: Level of Effort:Technical staff, from Sept 15,80 through September 30,1982, in Man-Months

Position	Starting Date	Actual Effort	Anticipated Effort
1. Team Leader	4/10/80	23.9	24.0
2. Planning/Evaluation Advisor	15/9/80	24.5	24.5
3. Research Director	3/11/80	22.9	23.0
4. Evaluation Advisor	7/12/80	21.8	22.0
5. Extension Advisor	12/1/81	16.6	20.0
6. Farm Management Advisor	15/4/81	17.5	17.0
7. Service Center Director	9/4/81	17.7	17.0
8. Equipment Repair Advisor	3/6/81	16.8	17.0
9. Soil Improvement Director	13/7/81	14.6	15.0
10 Training Advisor	9/9/81	12.7	14.0
11 Machinery Development Advisor	5/1/82	8.8	9.0
12 Local Manufacturing Advisor	3/2/82	7.9	9.0
13 Soil Improvement Irrigation Eng.		6.0	13.0
14 Short Term Technical Assistant		10.3	10.0
Total Man-months		219.0	234.5 [1]

1) As reflected in the Inception Report, p.52

4.0 IMPLEMENTATION

4.1 Workshop Implementation Schedules

4.1.1 Planning and Evaluation Subproject

The data collection phase of the farm management study is on schedule. However, it will need to be extended through December 1982 because the farmers at the start of this study phased-in their crops from October through December. The economic evaluation of tractors and equipment is progressing very well: tractor costs have been through two iterations and water-lifting costs have been identified. Although the collection of machinery data has not been set to a time frame, the sources of these data have been identified. And, as data are developed, the economic and financial subunit is reacting immediately to their analyses. The village studies program is on schedule as regards field work but the reports resulting from this work is lagging. The most pressing matter is the Project's village profile report.

4.1.2 Research and Development Subproject

The planned in-house tillage research program is nearly a year behind schedule because the prototype research equipment has not arrived. However, its arrival is definitely scheduled for October so that this part of the program will be activated next quarter, at which time a new schedule will be established. The Applied Research Fund is also nearly a year behind schedule. The current problem is that an acceptable contract between the Project, university, and researcher has not been finalized. The modifications to the Olympia harvester and a newly designed pickup reel are nearly on schedule so that they can be tested next month in the rice crop. The Alexandria workshop facility is operational from a physical standpoint, but workshop management is below standard and has been an inhibiting factor, e.g., a prototype cotton stalk cutter submitted to the workshop in June has received little attention.

4.1.3 Machinery Management Extension & Training Subproject

The extension activities are proceeding in accordance with the time-scaled network diagram in Figure 4.1. Village workshops have been developed for the Project villages in Beheira and Gharbia by these mechanization specialists and the second group of mechanization specialists have started their program at the Sakha Training Center. On completion of this training program, they will develop workplans for the Project Villages in Sharkia, Qaliubia and Minia governorates.

The training program is reviewed in Table 4.1. Thirty-one courses were scheduled for this quarter, and thirteen were completed. Four have been rescheduled leaving 14 that were not undertaken or re-scheduled. Eight of these 14 courses are overseas academic programs and two are overseas observational study tours. The academic program has not started to date because qualified candidates have not been nominated; the basic problem has been the lack of English proficiency on the part of the interested candidates.

There has also been a lack of extension field courses because the extension unit has been undergoing reorganization.

4.1.4 Land Improvement Subproject

The basic field activities for this quarter are presented in the network diagram as represented in Figure 4.2. Landleveling data was collected at Baltim; a cooperative relationship was established with EWUP; basins were identified for Project investigation, and topographical survey training was conducted. The IFB for the land improvment equipment has been advertised and will be opened next quarter. The workplan has been completed but has not been time-framed.

4.1.5 Service Center and Village Workshop Subproject

Because of the many variables beyond the control of the Project, it is difficult to place this program in a predictable time-frame. However, one way to view it is through the expenditure of funds relative to the life of the program. This divides the

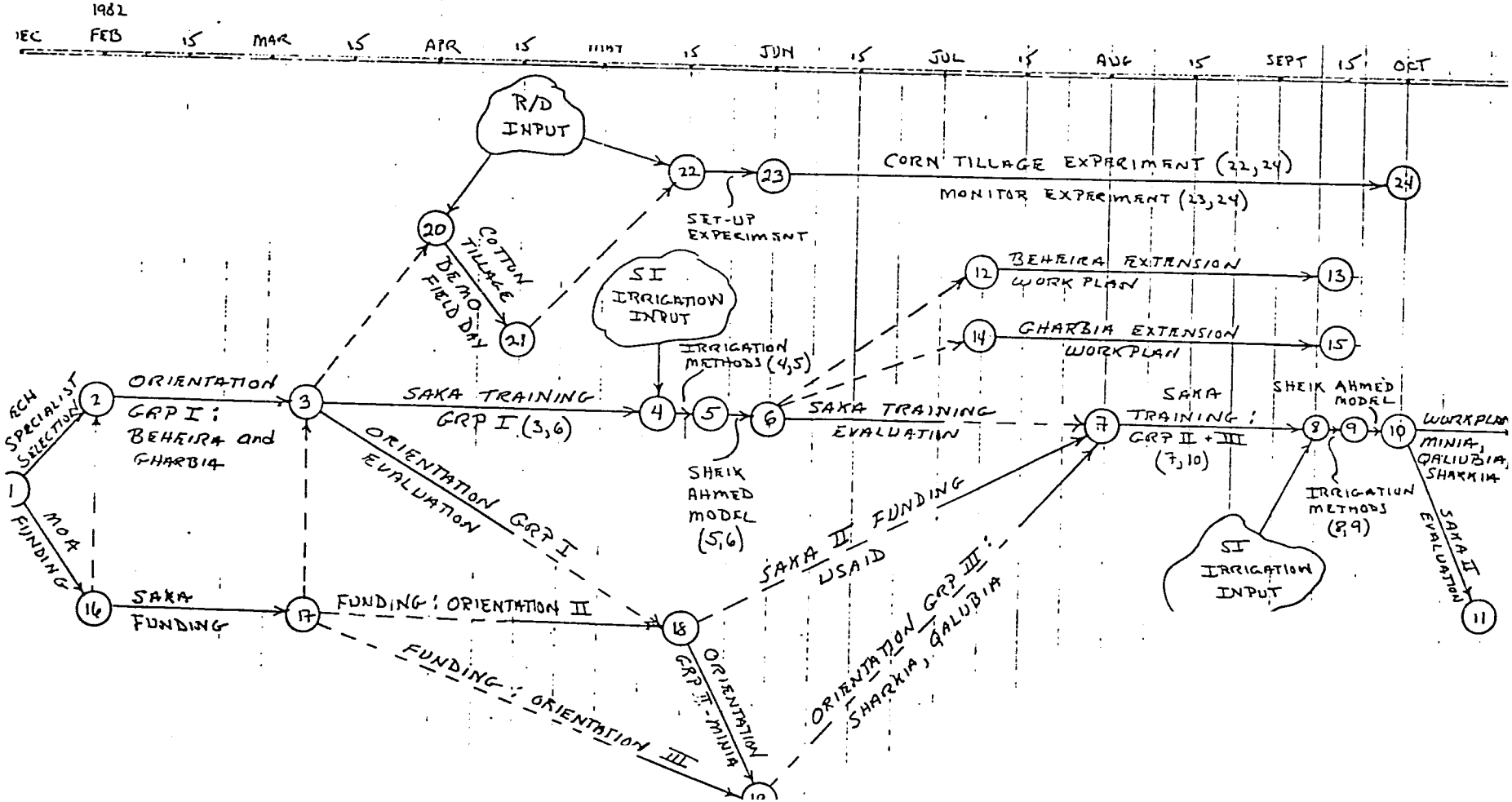


Figure 4.1. TIME-SCALED NETWORK OF MAJOR EXTENSION ACTIVITIES, DEC, 1981 - OCT 1982.

Figure 4.2 Land Improvement Activities To 1 October 198

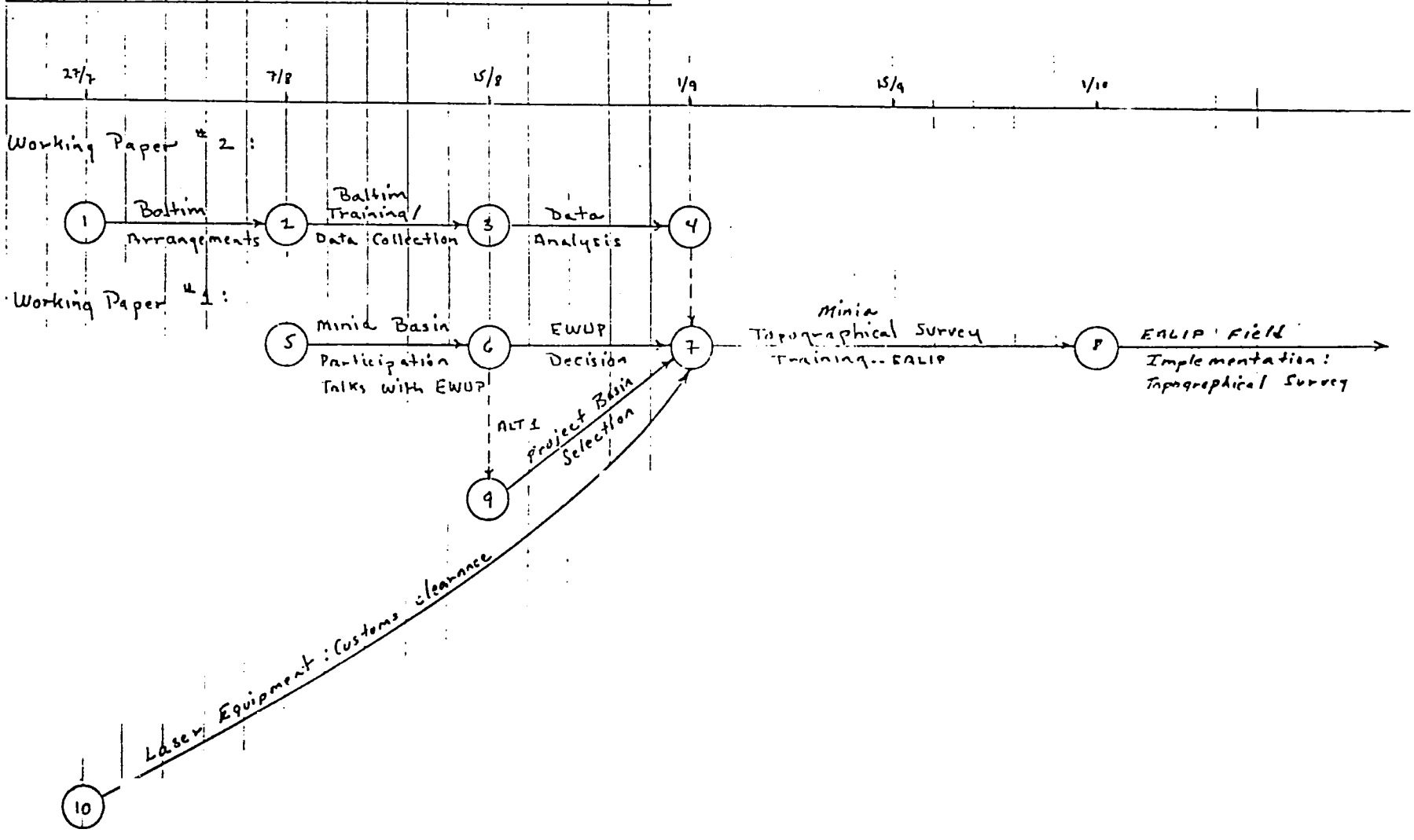


TABLE 4.1 : TRAINING COURSES SCHEDULED FOR JULY-SEPTEMBER 1982 AS PER TRAINING PLAN AND RESCHEDULED COURSES

COURSE NO	TITLE	JULY	AUG	SEPT	NUMBER/ LOCATION
1. EXTENSION					
2EX36	Farm Tractor driving	x	x	x	(12)Saadeen
2EX39	Farm Tractor driving	o	o	o	-
2EX40	Instruction Methods	Rs-(Mar83)			Sakha
2EX41	Intensive English	x	x	x	(1) AUC
2EX42	Mechanic level II	Rs-(Jan83)			Maamoura
2EX43	Prev. Maintenance		o	o	-
2EX44	Junic ractor operation		o		-
2EX45	MSc degree:Agri.Mech		o	o	-
2EX46	PhD:'gri Mech Ext.System		o	o	-
2EX47	PhD:Agri.Mech.Ext		o	o	-
2EX48	Obs. Tour			o	-
2EX256	Mech.Ext.District level		x	x	(13) Sakha
2EX16	Mech.Ext.Village Advisor		x	x	(12) Sakha
2EX18	Mechanic Level I		x	x	(14)Maamoura
2PH3	Peanut Harvesting			x	(6)Field.
2. SOIL IMPROVEMENT					
~~2Si10~~	~~Obs.~~Tour	o			-
2Si11	Intensive English			x	(1)AUC
2Si12	PhD : Soil Science			o	-
2Si13	MSc : Agronomy			o	-
2Si14	MSc : Soil Inst			o	-
2Si15	MSc : Data Proc			o	-
2Si16	MSc : Computer Prog			o	-
3. SERVICE CENTER					
2SC8	Mechanic Level 3	Rs-(Feb83)			Maamoura
4. TRAINING					
2T 1,4,7,8	Workshop	Rs-(Oct82)			-
2T5	Obs.Tour.Mech.Agri.		x	x	(2) USA
2T3	Teaching Methods	o			
2CP2	Computer	x	x	x	(1) Cairo
2T10	Intensive English			x	(3) AUC
5. PLANNING AND EVALUATION					
2PE5	Intensive English		x	x	(5) AUC

CONT'D

COURSE NO	TITLE	JULY	AUG.	SEPT	NUMBER/ LOCATION
6. RESEARCH AND DEVELOPMENT					
1RD1d	Intensive English	x			(5)AUC-Alex
7. LOCAL MANUFACTURING					
2LM1	Industrial Technology	x	x	x	(3)Beheira Co.
TOTAL PARTICIPANTS					78

NOTES:

o not undertaken

x completed

RS rescheduled

funding into three tranches from March 22, 1982 to March 22, 1984. Although no funds have physically moved, as can be seen from Table 1.1, approximately 40% of the first tranch is in-process within the Project. The objective will be to have these funds committed by March 22, 1983. On this basis, this Subproject can meet its schedule.

Figure 4.3 describes the activities to be taken in the development of a service center. With reference to this guideline, Table 4.2 indicates the current status of each active service center participant.

4.1.6 Local Manufacturing Program

The planning precedence network, Figure 4.4, has not been time-sequenced because this program is in the machine development stage. However, a time-frame network for the next quarter is shown in Figure 5.5. With reference to Figure 4.4, the main thrust to date has been along the sequence of 1,5...35 and concentrated on event 15,20 during this period. It should be noted that development of the prototype thresher (15,20) is actually proceeding concurrently with events 5,10 (shop practices) and 7,10 (application engineering).

4.2 Implementation Issues

1. The overseas academic part of the training program has not gotten off the ground for two reasons: a) English proficiency is limited pre-qualification candidates, and b) only one candidate has been proposed for processing and that candidate failed to qualify.
   Remedial Action: Intensify and broaden the search for qualified candidates and continue to move prequalifying candidates into intensive English programs. This will move the timing of this program back, but at this point the program is still achievable.
2. The Applied Research Program Fund has not been activated because a contract has not been approved for use between the Project and researcher.

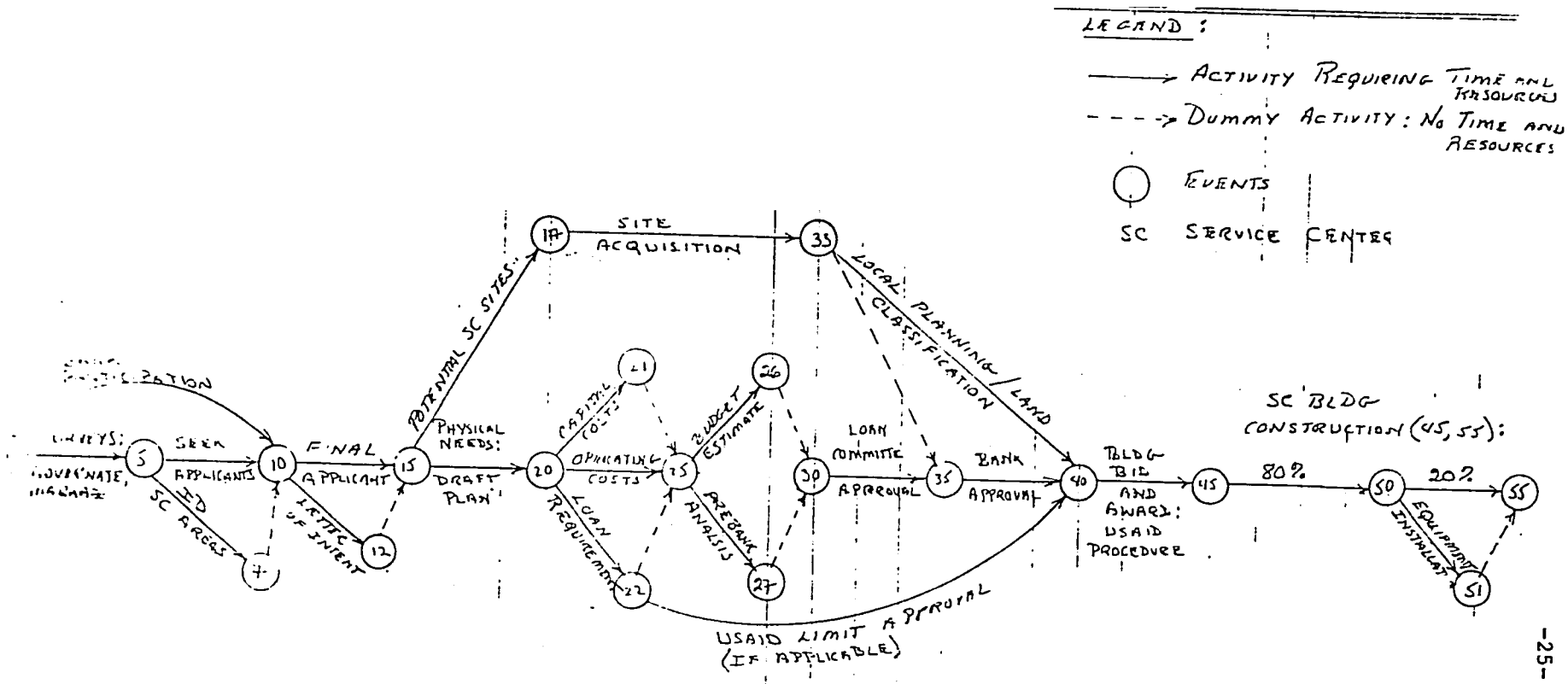
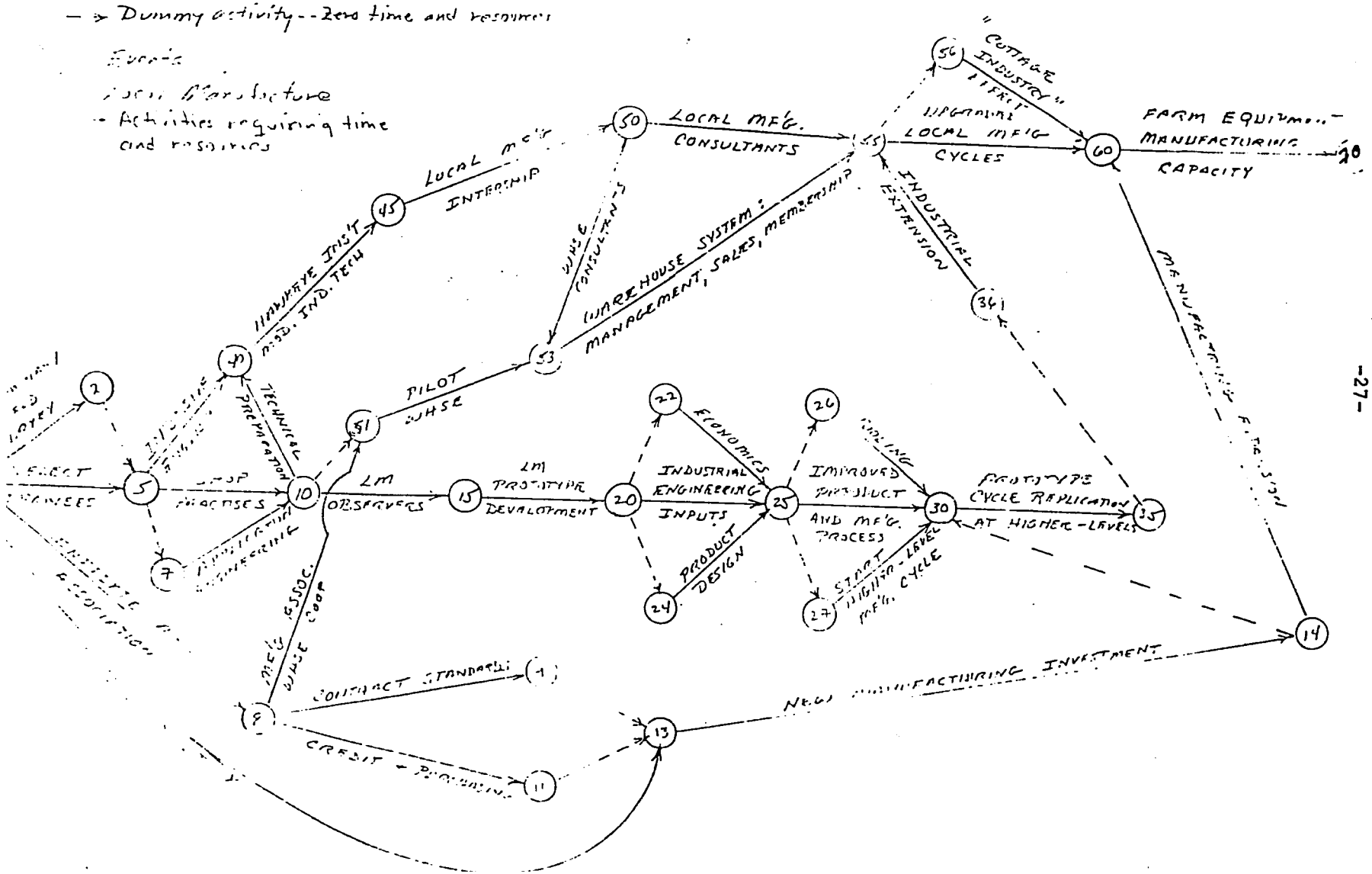


Figure 4.3 Service Center Development Planning Network.

TABLE 4.2: SUMMARY OF ACTIVE SERVICE CENTER APPLICANTS AND THEIR PROGRESS RELATED TO THE SERVICE CENTER PLANNING NETWORK AS OF 30 SEPTEMBER,82

Applicant	Governorate	Location	Current Activity	Laat completed Activity
1. Mohsen Azmy	Minia	Beni Mazar	(35,40)	35
2. Mahmoudia Motors	Beheira	Mahmoudia	(35,40)(77,33)	35,17
3. Egypt trac	Qalubia	Qalub	(25,26)(25,27)	33
4. Hammami	Beheira	Abu Homus	(20,21)(20,22) (20,25)(17,35)	
5. Shaity Co	Gharbia	Tanta	(15,20)	
6. Diabex			(15,17)(15,20)	
7. Samtrade	Gharbia	Kafr Zayat	(20,25)(17,35)	

Figure 4.34. Precedence Network for Local Manufacturing Technical Assistance and Training Program



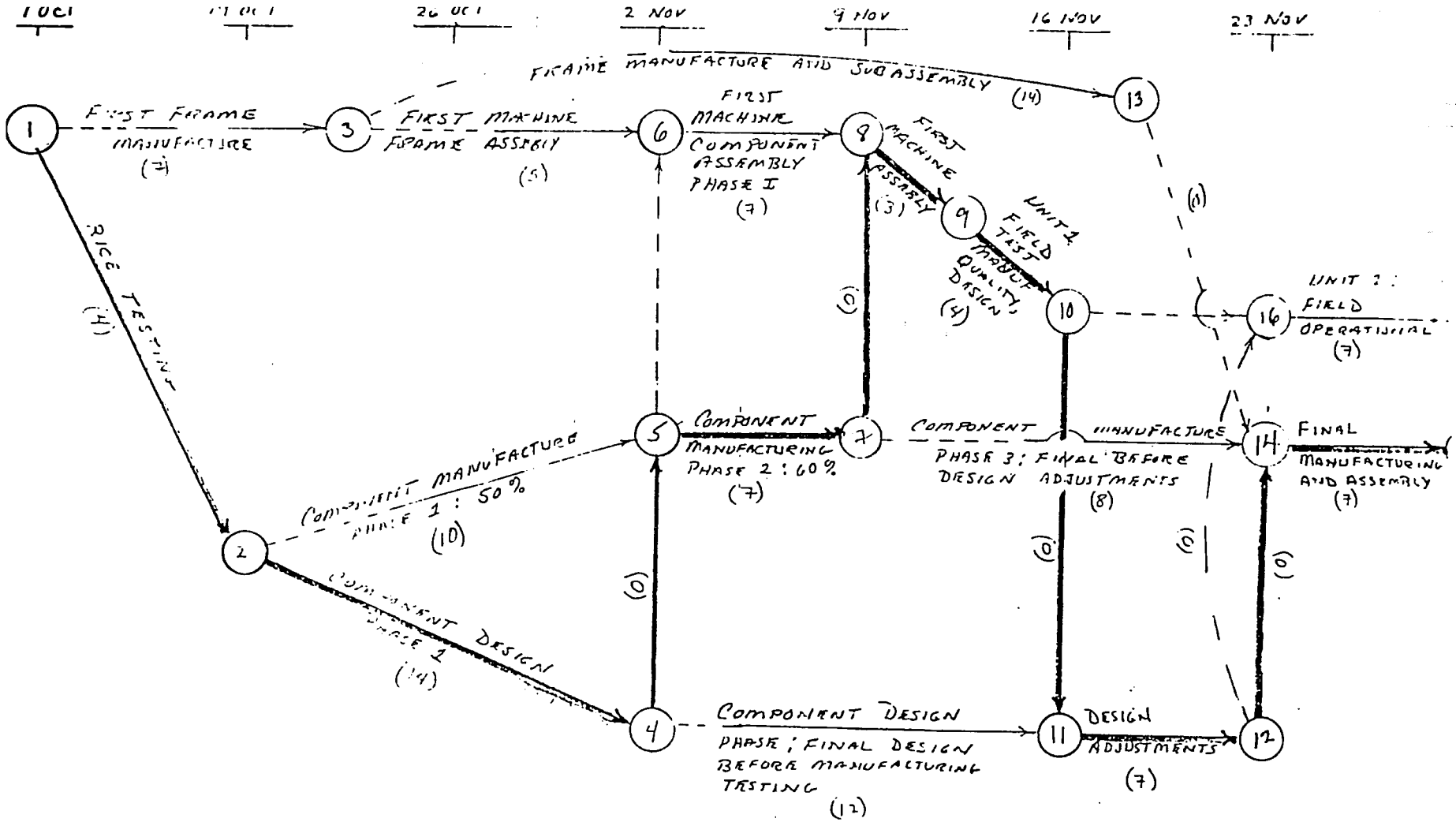


Figure 4.5 Local manufacturing thresher development network.

Remedial Action: Approval of the drafted agreement between the Project, universities and researcher.

3. Monies for the Service Center Fund are not moving through the banks. LE 476,000 have been waiting for bank approval since the end of July or before.
   Remedial Action: Closer monitoring of an applicant's progress with the bank. Amendments to the Letter of Understanding that facilitate financial processing and alleviate qualification constraints.
4. Shop Management at the Alexandria Research Center is still an ongoing issue.
   Remedial Action: A closely supervised shop management system.
5. Lack of Training Facilities is delaying machinists, welders and equipment operators training.
   Remedial Action: Obtain additional training support from West Nubaria Training Center and other MOA training facilities.

During this reporting period, steps have been taken to address several fo the previously reported implementation issues:

1. Approval of the Senior Accounting Advisor;
2. Facilitating amendments to the Service Center Fund's Letter of Understanding have been agreed upon;
3. Delivery of the previously ordered research prototype equipment has been definitely arranged;
4. Lack of training facilities was partially alleviated except for the above mentioned programs.

5.0 MAJOR OBJECTIVES

5.1 Overall Project Objectives

1. Strong emphasis to be placed upon moving local currency funds;
2. Initiate machine introduction activities;
3. Demonstraing/training equipment procurement;
4. Award IFB for land improvement subproject equipment.

5.2 Planning and Evaluation Subproject

1. Working paper No. 5: Computer Tractor Cost Model
2. Working paper No. 6: Project Village Profiles
3. Finalize evaluation workplan for 1982-83 Project year
4. Reorganization of the Evaluation field unit
5. Phasing out of the data collection activities of the farm management study.

5.3 Research and Development Subproject

1. Initial testing of the prototype I research equipment and training of the research testing crews
2. Disbursement of initial payments for the Applied Research Fund
3. Continuing monitoring of the West Nubaria cotton crop
4. Testing of the prototype harvester in rice.

5.4 Extension/Training Subproject

1. Primary emphasis upon field demonstrations in Project villages pertaining to cotton stalk cutting and wheat planting with grain drills
2. Completion of training for mechanization specialists in Sharkia, Qaliubia, and Minia; draft first village work-plans in these Project villages
3. Training seminar for key farmers and additional courses during this next reporting period
4. Conduct a mechanization workshop at Sakha Training Center for mechanization specialists and Project personnel
5. Finalize approximately 10 observation study tours and initiate first group of acadmic participants

6. Development of extension materials: pamphlets, posters and visual aids
7. Extend water lifting fund activities.

5.5 Local Manufacturing Program

1. Continued development of the prototype harvester in rice
2. Construction of five prototype units
3. Identify in detail the training activities relative to the prototype construction program

5.6 Service Center/Village Workshop Subproject

1. Concentrate village workshop activities in Sharkia, Qaliubia and Gharbia with the objective of completing five village workshops for bank submission.
2. Initiate workshop contacts in Minia
3. Develop two service center proposals for bank presentation

5.7 Land Improvement Subproject

1. Complete detailed survey work and initial basin design development for two selected basins in Minia governorate
2. Start landleveling training with the demonstration/training equipment unit
3. Working paper No. 4: Basin Survey in Minia Government; Results of the Preliminary Survey
4. Continued research on soil compaction in collaboration with the Research and Development subproject
5. Initiate mole drainage experiments
6. Topographic survey in Minia governorate

ANNEX A

A.1 PLANNING AND EVALUATION SUBPROJECT

A.1.1 Planning and Financial Subunit

Activity Report
July-August 1982

Submitted by: Zaki Helmy
Mohammed Shoukry
Steven Shepley

Activities undertaken during the reporting period include the following.

Water Lifting Credit Fund: The Water Lifting Credit Fund pre-test has been initiated in Beheira Governorate. To date, LE 18,248.98 has been disbursed in Nakhla El Enab village for procurement of 15 diesel water pumps. The distribution of this equipment according to power size was:

10 units	11 hp
2 units	7.5 hp
3 units	5 hp

Farmer response to the credit fund terms and conditions appears favorable but we have encountered some complaints concerning the slowness and delays in processing loan application forms. We have brought this matter to the attention of the Beheira Agricultural Development Bank which has promised to accelerate the application process.

We have also uncovered another problem related to dealer prices for loan financed equipment. As we have learned, dealers are marketing on a two-tiered price structure which sets a cost preimum for loan financed procurements. Prices for loan financed pumps were found to be 5-6% higher than for straight cash transactions. The reason for this difference is that the banks are accustomed to deducting a distribution commission on all equipment financed through their credit auspices and dealers are simply trying to recover these added charges. On August 25, 1982, the Subunit sent an official letter to the PBDAC in Cairo advising that institution of this problem. We also recalled the terms and conditions of the Letter of Understanding which specifically prohibits imposition of surcharges and requested that the PBDAC take immediate steps to affect cessation of this unwanted practice. The Subunit shall monitor compliance with this request and shall be conducting periodic random investigations to assist the banks in persuading dealers to abandon the two-tiered price structure once the banks have terminated the distribution surcharge levies.

Another problem requiring immediate attention is the absence of water lifting extension activities within the pre-test areas and Project random villages. We have been advised that the Extension Subproject has developed a water lifting extension plan but no activity has yet taken place. We cannot emphasize too strongly the need for such activity as our economic evaluations of water lifting alternatives have shown that considerable cost

savings can be realized from selection of the most appropriate equipment. Farmers also require urgent instruction in proper operating and maintenance procedures for their equipment.

Service Center Credit Fund

It has come to our attention that some of the terms and conditions of the SErvice Center Credit Fund may be serving as disincentives to greater program activity. These issues were fully discussed at a meeting held between ourselves and the Service Center Subproject staff on August 25, 1982. During the meeting the following proposed amendments were agreed upon:

1. As a measure to stimulate greater activity on the part of bank personnel, the MOA will explore ways to provide incentives.

2. As village workshop applicants do not have the means to make down payments, downpayment requirements for this category of borrowers will be rescinded.

3. As village workshop owners have few assets, they cannot meet existing guarantee requirements. These shall be waived. Banks will instead be given the right to repossess any items procured under the loans in the event of default.

4. The grace period for village workshop loans shall be extended from six months to one year.

5. Guarantee requirements for service center loans for buildings, machinery and tools shall also be rescinded with banks retaining right of repossession. Guarantees shall be retained for spare parts, raw materials and operating capital.

6. Banks are too restrictive in their interpretation of what can be financed under the loan program. Banks shall be advised that any procurement required for the service center project is eligible.

7. Loan limits shall be raised to LE 250,000 for service centers and LE 50,000 for village workshops.

8. Downpayments for service centers, currently 20%, can be waived by the Project Director. All service center borrowers must own the land upon which the facility sits. Title to such land will rest with the bank until payment of all principal and interest has been made.

9. The above revisions are made retroactive to March 22, 1982, the date of service center fund activation.

On August 20, 1982, the Subunit sent an official letter to the PBDAC requesting that they advise the governorate banks of these changes.

Machinery Introduction Fund

A Letter of Understanding for the recently approved Machinery Introduction Fund

Rental entities must make a 20% downpayment in kind or in assets committed to the business. Loans for this category of borrowers can be made for up to a period of ten years at 8%, including a 2% administrative fee for the bank. For farmers, loans can be made up to 100% financing for periods ranging from 5 to 7 years dpending on land area size. This provision weights the program slightly in favor of the small farmer. This fund shall be the primary vehicle for putting agricultural machinery developed and tested under the Project into the hands of farmers and should be preceeded by a comprehensive agricultural machinery demonstration program.

Financial Consulting Services

The Subunit has spend a considerable amount of time during the reporting period preparing guidance and technical assistance concerning the management and accountability for USAID funds. This effort included preparation of detailed guidelines for cash requests and accountability procedures and preparation of required fiscal documents for the various subprojects. This material is included in Appendix 1 of this report.

On November 15, 1981, a request was submitted to USAID to establish a senior accounting advisory position for the Mechanization Project. This position was requested in recognition of the Project's financial complexity with three major credit programs and project local currency budget which totals some $US 21.2 million. These funds are being managed by various entities of the Project and Ministry of Agriculture, a central credit bank, five governorate banks and 23 village banks, none of which have familiarity with AID fiscal and accountability procedures. The creation of the senior accounting position is considered to be of utmost urgency to insure proper management of AID funds. In ten months, AID has chosen not to respond to this urgent request.

Analysis of Machinery Costs and Returns

During the reporting period, the Subunit has prepared two additional reports, attached. These include a report on the "Economic Use Optimization of Tractor Power in Selected Land Improvement Operations," and a report on "Comparative Societal and On-farm Costs of Irrigation Water Lifting in the Arab Republic of Egypt."

The first report evaluates the economic and financial costs per unit of land area for six sizes of tractors used in subsoiling and determines area use optimization for each of the tractors evaluated. The report also provides preliminary estimates of land leveling costs.

The second report is a continuation of an earlier effort to provide a comparative analysis of irrigation water lifting costs. The report provided herein evaluates water lifting costs of a wide range of technological alternatives available on the local market. These are summarized below for reference.

Comparative Water Lifting Costs in the Arab Republic of Egypt

	Financial Costs LE/feddan	Economic Costs LE/feddan
Cattle powered sakia	46.46	
Buffalo powered sakia	57.84	
12 hp diesel pump	18.90	28.26
9 hp diesel pump	21.40	31.88
7.5 hp diesel pump	22.90	34.00
5 hp diesel pump	31.80	46.23
15 hp electric pump	22.90	33.90
7.5 hp electric pump	27.20	39.20
5 hp electric sakia	39.00	54.65

The attached report provides a complete description of the methodology and the data base used in the analysis and clearly illustrates the economy of scale and other sensitivity effects of input factor and shadow pricing to arrive at the above results.

It was concluded that replacement of animal powered water wheels would have significant effects on both societal and on-farm costs savings with an internal economic return range of 34 to 57 percent.

A.1 PLANNING AND EVALUATION SUBPROJECT

A.1.2 FARM MANAGEMENT SUBUNIT

Activity Report
July 1982

Submitted by: M.I. Faltas, Mohammed Ismail, Fouad Metri, Samir El Dessouki, Youseff A. Naeam, Layla El Bambi, G.B. Stringer

1. Data collection is proceeding properly in all three governorates. Most of the winter crops were completed during this month. However, there is till a certain amount of activity pertaining to the winter crops such as the collection of berseem seed, winnowing of wheat and collection of onion seed. It is expected that all winter crop data collection will be completed in August. Summer crop operations are proceeding as expected with the exception of the problems related to rats. Up to this point it does not appear that any adequate measures have been taken.

2. The third quarter data (April, May, June) has been collected from Qaliubia and Gharbiya but the data from Beheira will not be collected until near the end of August. The delay is due to the change of the Supervisor and enumerator. This delay gives the new supervisor time to check all the data for completeness prior to bringing it to Cairo. We have found that this is a time saving action in transliteration.

3. Transliteration of the data for the third quarter is proceeding somewhat more slowly than has been the case previously. This is due basically to the loss of Magda Marzouk, vacations taken by staff members, and the addition of the requirement to record in English the dates for each agricultural operation. Use of the dates, which are on the original forms, will allow for projections of peak demands for various operations.

4. Our budget expenditures are well within the projections and will enable us to finish the survey during the additional time that will be required

Total budget:	LE 138,945
Spent to date:	40,663
Balance unspent:	981,282, of 73% of budget

This balance will allow us to keep the enumerators and the supervisors for the necessary extended period of time until the winter crop activities are completed.

5. It is hereby requested that the authorization for seconding all the enumerators and supervisors be extended from 15 Oct. to 1 Dec. 1982, and that half the enumerators be extended to the end of December, 1982. The exact number of enumerators will be known when we see how the crops are finishing up.

A.1.2

Activity Report
August, 1982

Submitted by: M.I. Faltas
G.B. Stringer

1. Data collection is proceeding properly in the three governorates. There is now a very limited area of land that is being prepared for the winter crops. Summer crop operations are in full swing and going well with the exception of the problem related to the rats. Rat control has started in Qaliubia this month. It is scheduled to start in the other governorates during the coming month. It is too early to assess the results of the campaign.

2. It has been agreed that data on any new winter crops which are started during the time that the survey is going on will be collected just as for the summer crops. We can then stop data collection when we desire without missing something. This will also serve to fill in any blanks which resulted last year from the 1st of October start.

3. Transliteration of the data for the third quarter is complete for Qaliubia. Gharbia data is now being worked on and is expected to be completed by the end of the coming month. In the data work Mr. Fouad Mitri has left us. Mr. Magdy Biomy and Mr. Galal Abdel-Mohsen have joined us for a short time. Mr. Fawzy El Sakka and Mr. Mohamed Hegazy have joined us as permanent staff.

4. Since the summer crop operations will not be completed by the end of October we have extended the term for the field staff until the end of November. We also expect to extend half of the field staff until the end of December or the completion of the field work for the summer crops as necessary. The budget balance will allow this:

Total budget	LE 138,945
Spent to date	44,138.13
Balance unspent	94,806.87
Present rate of expenditure	3,500

5. It is intended to intensify the amount of field supervision during the end of the survey. This will help insure that the quality of the data remains high. This is becoming more of a necessity now that people are openly discussing the end of the farm manangement survey. This has a bad effect on the staff.

A.1.2

Activity Report
September 1982

Submitted by: M.I. Faltas
G.B. Stringer

1. Data collection is proceeding properly in the three governorates. The summer crop operations are starting to wind down. By the end of the month some of the summer crop operations have been completed on a few farms, for example, some plots of corn and the picking of cotton.

2. Transliteration of the data for the third quarter is completed for Qaliubia. Gharbia will be finished during the first week of October. The Beheira data transliteration will start in the second week of October. As the data is gone over in the Cairo office, there are occasional questions regarding some of the recorded operations. These are made note of and answered on site during the next trip to the area. This, along with the inspection of each sheet prior to collection helps to insure that the data, when completed, will have as few mistakes as possible.

3. Budget data as of the end of September:

Total budget:	LE 138,945.00
Amount spent to date:	47,769.53
Balance unspent:	91,175.47

The payment to farmers and running expenses through December will expend approximately LE 20,000. Thus, there will be a balance at the end of the survey of approximately LE 71,000. We would like to request at this time that steps be taken to make this money available for use in the activities that we shall undertake starting after October.

4. Pickup of the fourth quarter data will be as follows:

Beheira: 15 October, tail-out data will be collected at the end of November. After November the Supervisor will collect and inspect the data from an enumerator at any time that all enumerators' farmers have completed their summer crop operations.

Gharbia: End of October, tail-out data same as above.

Qaliubia: 15 November, tail-out data as above.

5. After the rat campaign we saw no rats for quite a while. Now they are again becoming quite visible. It appears that the population is again on the increase.

A.1 PLANNING AND EVALUATION SUBPROJECT

A.1.3 EVALUATION SUBUNIT

Activity Report
July 1982

Submitted by: Peter Reiss

A. Mechanized Farming Survey

1. During the period: The final report based on the mechanized farming survey was submitted by Nicholas Hopkins and Soheir Mehanna of the Social Research Center and Bahgat Abdel Maksoud of the University of Assiut. Copies have been distributed to all members of the Agricultural Mechanization Project and all interested parties, including the members of the Supreme Council for Agricultural Mechanization.

2. Follow-up: Because of the length of the written report, the numerous tables, and their comprehensiveness, it was felt that an introduction to the survey report through a variety of short papers is advisable. A series of papers based on the survey and reviewing particular aspects of agricultural mechanization will be presented to project members. The topics of these reports will grow directly out of the Project Paper and component workplans, tying in with implementation plans. This ought to increase their usefulness and, in so doing, encourage staff members to return to the original report.

B. Village Studies Program

1. During the period: Members of the program have worked at collecting information about investment patterns and indications of cooperative and exchange labor. The teams have also completed all previous work including the census of project village machine owners. In addition, the individual teams have begun working on studies which are particular to their governorate or which will be expanded to other governorates in the future.

   The Minia team, under the supervision of Dr. Bahgat Abdel Maksoud, has played an active role in collecting information about basins for work in conjunction with the Soil Improvement project. We now have information concerning soil and water conditions in each village; name, number of feddans and landholders and crops in each basin; and a ranking of the basins in each village with regard to the following problems: drainage, irrigation water, weeds, salinity, alkalinity, and level of fields. The Evaluation Unit has been requested to select a basin in Minia in which landleveling and irrigation activities will begin. The

basin to be selected is to have 60-80 feddans and have no trees or sugar cane. A review of initial material supplied by the Minia monitors reveals that the villages have the following number of basins in which such work could begin:

Beni Ebeid	16
Beni Musa	3
El Berba El Kubra	4
El Atlat	1
Seila Gharbia	3

A group of basins will be selected from these on the basis of their soil and water conditions and a visit will be made for the final selection. It is possible that the Project will cooperate initially with the EWUP in its village, Abyuha, in which case the project village basin will be entered at a later point. Following the determination of the basin, Abyuha or elsewhere, a sociological study will begin to examine the organization of the basin, both physically and socially, under the Evaluation Unit and with the assistance of one of the Minia team monitors.

The Qaliubia team has completed the first stage of a study on sakia and pump use and preferences. Among the findings, we found that there was no decided movement towards using electricity for water-lifting devices, either pump or sakia. Nor does a shift from sakia to pump use indicate a decrease in animal holdings of a farmer. In the vast majority of cases, stock number increased or remained the same. However, the construction of new dwellings appears to be a limiting factor in holdings. It is likely that the actual construction of a house is not the decisive variable, but is rather an indication of a different sort of resource management or a heightened interest in or involvement with work outside the farm.

The Sharkia team, under the supervision of Dr. Shahat Mohamed Zaki of Zagazig University, has undertaken a study of tractor time-use during this period of intensified activity in post-harvests and tillage. With the participation of Dr. Nabil Habashi, a senior economist in t he Agricultural Economics Research Institute and Chairman of the Evaluaiton Advisory Committee, the study will be expanded to include economic variables concerned with tractor costs and returns.

Members of the Evaluation Unit in the Cairo office have been involved in data analysis and preparing for a report on the project villages. Aiman El Tunsi has been working through the information from village leaders on problems in agriculture and agricultural mechanization, while Raafat Lutfi has focused on information about the labor situation in the project villages. Nour El Din Nasr, the newly appointed Director of Evaluation, has been involved in an intensive course on the use of the mini-computer; he will eventually record all data from the monitors to be stored for later analysis efforts.

2. Follow-up: The Beheira team ought to begin a study suggesting appropriate ways in which the project may distribute equipment to project villages. The Gharbia team will undertake a study and evaluation of the activities of the Central Delta Soil Improvement Organization.

   A visit to Minia is planned with Dr. Adel Orabi and James McClung, both of the Soil Improvement unit, during the next month. The scope of this visit has already been discussed.

C. Evaluation of Project Extension Brochures

Dr. Zakaria El Haddad requested that the Evaluation Unit visit project areas and show farmers a tentative design for an extension brochure on water-lifting devices. We found that farmers could not understand the material readily and that the basic design had to be rethought. Some printed material with clear and self-explanatory pictures and a minimum of words would be much more preferable. Then farmers would be able to explain the material to others in their household or area.

D. Workplan for the Evaluation Unit

A workplan for evaluation activities covering the period from August 1982 through July 1983 has been submitted to the project directors. In addition, copies have been given to the Director of Evaluation and the Chairman of the Evaluation Advisory Committee for their consideration. The workplan discusses the activities and accomplishments of the unit to date, on-going activities, and proposed work for the coming year. Evaluation activities fall into three areas: project evaluation, assessment of mechanization impact on rural life, and the collection of information for project component implementation. Copies of the workplan will be distributed to all members of the Evaluation Advisory Committee for their consideration and approval during the coming month when a committee meeting will be scheduled.

A.1.3

Activity Report
August 1982

Submitted by: Peter Reiss

A. Mechanized Farming Survey Follow-up

As mentioned in the previous monthly report, a series of short papers based on the final report is planned. These papers, written with particular subprojects in mind, will serve as an introduction to the final report and highlight the findings of the survey. The following titles have been chosen as the initial set: 1) "The Role of Agricultural Cooperatives in the Distribution of Machinery in Project Villages;" 2) "The Relationship between Increasing Mechanization and the Need for Hired Agricultural Labor;" 3) "Farmers' Preferences and Requirements in Agricultural Machinery;" 4) "An Evaluation of Machinery Workshop Services;" 5) "Irrigation and Drainage Concerns of Farmers."

B. Evaluation Workplan

A workplan for evaluation activities during the coming twelve month period has been submitted to project management and the Evaluation Advisory Committee. There has been general agreement about the content and scheduling of activities. However, a second version will be written which places the activities in a subproject rather than a chronological order.

C. Village Studies Program

1. During the period: Activities within the framework of the Village Studies Program consisted of the following: data collection and analysis; delineation of final reports to become part of the Project Working Paper series, and a meeting of the Evaluation Advisory Committee.

   Research activities focused on tractor time use and programs for machinery distribution within the project villages. Dr. Nabil Habashi has been working with Dr. Shahat Mohamed Zaki to broaden the study of time use for tractors to include the economic factors involved in tractor use. Dr. Ahmed El Adly and Dr. Abdel Tawab El Yamani have undertaken the plan for determining machinery distribution in project villages through agricultural cooperatives. Dr. Abdel basset El Sayyad has completed an investigation of pump and sakia use in Qaliubia. The Minia team under the supervision of Dr. Bahgat Abdel Maksoud has been continuing its examination of basins in anticipation of soil improvement activities.

   During the next few months the following final reports, based on information collected and processed through the Village Studies Program, will be issued:

1. Project Villages Profile
2. Agricultural Labor and t he Wage Structure in the Project Villages
3. Saqia and Pump Use and Preferences: Findings in Qaliubia
4. Tractor Time Use and Economics
5. Changing Soil and Water Conditions in Minia Governorate
6. A Tentative Plan for Machinery Distribution in the Project Villages
7. The Socioeconomic Organization of Irrigation Basins in Minia

During the meeting of the Evaluation Advisory Committee, the evaluation workplan was discussed and the above list of working papers was approved.

2. Follow-up: During the first stage of the Village Studies Program, basic information about the 23 project villages was collected in anticipation of project evaluation activities. This information concerns village characteristics, agricultural and mechanization problems, existing machinery, and the agricultural labor and wage situation.

   In the second stage of the program, a smaller number of villages will be chosen from the 23 vilages for intensive monitoring and evaluation activities. The reduction in the number of villages for evaluation seems appropriate at this time because basic information has been collected and processed. By choosing a small number of villages which reflect the range of variation we should still have an accurate idea of project impact. Although monitors will be assigned a particular village to conduct most of their work, they shall be expected to make periodic trips to neighboring project and control villages to examine project impacts on village life. A reduction in the size of the program staff will accompany the change in number of villages intensively monitored.

D. Soil Improvement Activities

1. During the period: The Evaluation Advisor and Director of Evaluation have accompanied members of the Soil Improvement component to take part in inspecting and selecting basins for implementation in Minia. During one of these visits we met with members of the Water Use & Management project and discussed ways in which the two projects can cooperate. In addition, meetings were held with the Undersecretary for Agriculture, Mohamed El Gamal, to inform him of recent activities and plans. Village monitors in Minia have already begun to examine the organization of selected basins that are good candidates for project work.

2. Follow-up: T he Evaluation Advisor expects to make regular extended visits to the Soil Improvement sites to talk to and work with farmers in the selected basins. Their cooperation is crucial in landleveling work. Evaluation will also take part in basin selection in Fayou, Beni Suef, and Asyut.

E. Bringing Farmers into Project Activities

At the request of Dr. Zakaria El Haddad, the Evaluation Advisor will play an active role in the attempt to encourage farmers to cooperate with project staff and bring them into the decision-making process. To that end, I have talked to Youssef Abdel Naim about his working with me once he has completed his work on the Farm Management Survey.

F. Evaluations Undertaken

1. Sakha Training Program: A mid-term evaluation of a training session in Sakha was completed. Program participants included village-level mechanization extension representatives from Qaliubia, Sharqia, and Minia governorates.

2. Combine Operation: At the request of Dr. Haddad, the Evaluation Unit examined farmers' attitudes to the operation of the Deutz 770 combine in Gharbia governorate.

G. Home Office Management Visit: During the period, Jennifer Bremer of the DAI Development Staff reviewed the project and the DAI-related activities. The Evaluation Advisor was on leave from 6 September through 4 October 1982.

A.1.3

FIELD TRIP REPORT: Basin Selection in Minia

Peter Reiss, Evaluation Advisor
Nour El Din Nasr, Director of Evaluation

30 August 1982

As part of our effort to coordinate activities between the Evaluation Unit and the Soil Improvement Component, we accompanied Adel Orabi and James McClung on a tour of the project villages and a visit to the Egyptian Water Use and Management Project (EWUP) site in Minia for three days.

The aims of the field trip were: preliminary inspection of basins in the project villages in preparation for the final selection of a demonstration area for the Soil Improvement Component; discussion with representatives of EWUP to apprise them of the recent meeting between the two projects about coordinating Minia activities; and meeting with Undersecretary of Agriculture Mohamed El Gamal to inform him about recent activities and plans.

Preceeding the trip, the Evaluation Unit had village monitors in Minia (working in the Village Studies Program) collect pertinent information about basins in the five project sites. This information included number, size, name, and landholders in each basin. Summer, winter, and permanent crops with area were determined. In addition, monitors were asked to speak to knowledgable individuals who could rate the basins on the bases of salinity, alkalinity, leveling problems, weeds, irrigation and drainage. Using this information, an initial selection was made of two or three basins in each village which seemed to fit the basic criteria for selection: preferred size of 60-80 feddans, absence of trees and long-term crops such as sugar cane, and have a recognizable land level problem.

We were able to visit one or two basins in El Atlat, Beni Abeid, and Seila Gharbia, to see irrigation and drainage problems on site, examine the physical organization of the basins, and discuss with those farmers who were in the fields how they perceived their soil and water problems.

Problems with drainage and land levels appear to be most accutely felt in El Atlat. Canals are clogged with weeds; little maintenance has been done recently. According to a cooperative official, tile drainage was installed in the village (still uncompleted) three months ago. None of the other villages has tile drainage so far. Beni Abeid exhibits canals in good condition, regular in shape and surprisingly free of weeds. Farmers and officials mentioned a drainage system which was installed before independence, but whether it is a drainage system or a sewage system is still unclear. In any case, it seems to play little role in irrigation activities, being so near the village. The low level of water in the irrigation canals (possibly a water delivery problem) is a significant problem in Seila Gharbia, one

which has existed for more than a year. Large tracts of land are no longer cultivated, and people have taken to irrigating from drainage canals (where the salt level appears to be low).

Certainly, the final selection of a demonstration site for soil improvement activities will not be made until the soil and topographical surveys have been completed. However, the initial examination of the basins leads us to suggest El Atlat or Beni Abeid as the choice. As a demonstration area, the site ought to be convenient to farmers from the village and from the surrounding area. El Atlat, near Matai City, is easily accessible and has serious problems which require immediate attention. However, Beni Abeid might be even better since it is a central village, with a key place politically and organizationally. It is the largest of the project villages in Minia and near the other two villages in Abu Qurqas district.

The examination of basins has also led us to reconsider its usefulness as the unit of implementation. It must be remembered that the basin was originally a tax unit established by a cadastral survey undertaken at the beginning of this century. At present, it appears to have little actual meaning. EWUP has chosen as its unit that land irrigated by the same mesqa. In most cases, that land unit is isomorphic with the basin. In the preliminary stages of work, the land limited to one mesqa might be more manageable.

In discussion with Eng. Abdel Raouf and Dr. Erwin Nielsen of EWUP, they expressed their interest in our project's cooperating in mesqa renovation and landleveling in Abyuha village. They mentioned the main achievements of their work: establishing a more equitable distribution system for water, reducing irrigation time from five to less than two hours per feddan, and a reduction in the amount of water used by 50%. They were particularly proud of their assisting farmers in creating a system for water distribution which seems to have few conflicts. Their description of gaining the cooperation of farmers is especially useful if the Evaluation Advisor is to play a role in working with farmers in the basins.

EWUP sociologists began their activities by talking with farmers in a single mesqa to determine particularly influential or respected landholders. In all, roughly thirty were identified out of the more than eighty. From these vent leaders were selected, and from these three reach leaders were picked. The mesqa had been divided into three reaches along its length. Again, from these three, one mesqa leader was selected by them with the subtle guidance of the project's sociologists. They deliberately chose a younger man (whose father was still living) who would likely be more dynamic and flexible.

While this structure sitll exists in the mesqa, later organizational attempts were handled differently. The project is now instituting a system of mesqa committees comprised of a group of landholders. It was decided that the three-tiered system was "too formal."

Despite the organic development of the structure, it must be noted that the project still faced problems when dealing with the farmers at the time of the first irrigation using the new distribution scheme. They spoke of forcing the farmers to accept the plan. Still, the farmers were very soon pleased with the results and are said to be cooperating since then. This is to be taken as a warning: the immediate acceptance of farmers is unlikely to be forthcoming, despite extensive educational sessions and the creation of an indigenous administrative structure. It is also interesting that EWUP has found it preferable to move from a formal to a fluid organization.

In the meeting with Mr. Mohamed El Gamal, the Undersecretary expressed his eagerness for implementation activities to begin as soon as possible. He did not approve of Beni Abeid as the village for the demonstration basin, because it is such a large unit. However, in later conversation it ought to become clear that demonstration sites are best chosen for greatest visibility.

A.2 RESEARCH AND DEVELOPMENT SUBPROJECT

Activity Report
July 1982

Submitted by: Carl A. Reaves
Samir Younis

1. The Machine Shop made no progress towards finishing the soil sampler. One F10 Camon binder was purchased and used in some preliminary trials on wheat near Zagazig. Beebe's report will contain results of these preliminary trials. Some progress was made by two of the station engineers on design of a proposed spinning disk type of cutter for cotton stalks. A list of various sizes and shapes of steel for a stock supply for the machine shop was selected and given to the station personnel to obtain bids.

2. The cotton mechanization farm in West Nubaria was visited Mondays of three weeks, to observe the status of cultivation and to discuss with Mr. Khalil the requirements of surface soil conditions to accomodate mechanical harvesting. Conditions of the surface soil are much better this year than last year, though there are still some problems with soil clods and also with location of the surface soil with respect to cotton plants. Plans have been made to try several different tools to create a proper surface soil contour. Mr. Khalil thinks this operation must be done after the last irrigation, so hopefully the cotton plants will not be too large at that time. It is too late this year, but next year all tillage operations must be planned so that each operation leaves the soil surface in a condition suitable for mechanical harvesting. This period includes all operations from soil preparation through final cultivation. Hopefully, R&D will have adequate equipment next year to conduct research on one field of cotton that will include all operations except harvesting.

3. The R&D Executive Council held three meetings during the month. Several projects were reviewed and returned to the principal investigators for revisions. Considerable time was devoted to finalizing the contract form for applied research projects. A different possibility was discussed for financial management of the monies. The primary difference from the original form is that the money would be controlled from a central unit that would be located at the Tractor Testing Station rather than by universities and institutions. The committee decided to present the two different proposals to the Project Director.

4. Specifications were written to purchase part of the RAU equipment in a duty free lot in Egypt, and obtained bids from two companies. The Dodge pickup truck has been deadlined for almost two months with a broken front spring. The dealers promise to provide it but we have not yet received it. A long discussion was had with Dr. Abu Saba on mechanization needs in Egypt and priorities of work, and Dr. Gaiser was in Alexandria for three days.

A.2

Activity Report
August 1982

Submitted by: Carl A. Reaves
Samir Younis

1. Some more progress was made by two of the station engineers on the design of a proposed spinning disk type of cutter for cotton stalks. Bids were not obtained on the submitted list of steel for a stock supply for the machine shop. One soil sampler that the machine shop started fabricating in May was almost finished, but only ten percent of the sample tubes were cut. We need at least one more sampler fabricated. The Dodge pickup has been deadlined for almost three months. We finally asked Dr. Gaiser to telex LB Inc. to send the needed parts by air freight and hope they will arrive by Sept. 10.

2. A list of nuts, bolts and washiners was assembed for a stock supply for the machine shop and given to station personnel on August 4 to obtain bids, but bids have not been received. Bids were sent to Cairo to purchase some secondary tillage equipment and some potato planting, cultivating and harvesting equipment. A request will be made for a check to purchase this equipment, and for a check to purchase the first order of soil test equipment as soon as revised bids are obtained. Visited Tanta Motors to obtain an invoice and pay for the two binders, Agostini 3-point hitch type.

3. Four Executive Committee meetings were attended. The contract form and list of steps to sign a contract was finalized. We now have eight subprojects completed and ready to be financed. There seems to be general consensus within the committee that the present recommendations on incentives for subproject personnel are too low. I have encouraged the chairman to take action on changing these before the first contract is signed.

4. Evaluation tests for the RAU heavy duty chisel versus the Beheira Co. chisel were planned. This is a cooperative project between Alexandria University, Beheira Co., and R&D. Measuring equipment will be assembled or constructed and tests will be conducted during the first part of September 1982. Quantities to be measured include draft, forward speed, depth of operation, fuel consumption; bulk density, moisture content of soil, penetration resistance, clod size distribution, and surface roughness.

5. The cotton mechanization farm was visited each Monday; I have been recommending that different cultivation tools be used to prepare the surface soil for mechanical harvesting, but the conventional ridgers are still used, creating excessive soil clods and leaving ridges of soil near the row of cotton that will make if difficult, and impossible in places, to harvest cot ton from the lower limbs. The reason given is irrigation

requirements, but this is not logical since other types of tools can be adjusted to leave a furrow.

6. More studies were planned on soil compaction by tractor tyres and the durability of subsoiler tracks in Delta soils, with Dr. Oraby of the Soil Improvement subproject. I took three young engineers to meet Dr. Orabi in Baltim to investigate one area on the sugar beet farm that had been subsoiled two years ago and one area that had been subsoiled approximately one year ago. On the 2-year area, we found no evidence of subsoiler tracks, nor was there any evidence of plant root penetration more than a few cms. On the area subsoiled one year ago the subsoiler paths were located and found to be a maximum of 35 cm deep. Spacing between subsoilers had been very erratic. Considerable plant roots had penetrated to the bottom of the subsoiler tracks, apparently weeds, since no crop had been grown on the area since the subsoiling was done. We concluded that before making any further investigations on the lasting qualities of subsoiling we must locate an area where the subsoiling was done more properly.

A.2

Activity Report
September 1982

Submitted by: Carl A. Reaves
Samir Younis

1. Some progress was made on the spinning disk type cutter for cotton stalks; a work worder was given to the machine shop to fabricate the two gearboxes. Bids have not been received on the list of steel or list of bolts, nuts, and washers. The first soil sampler has been completed but work has not yet started on the second one. The Dodge part still has not been found.

2. Two trips were made to the West Nubaria cotton farm and on September 13 I was informed a decision had been made to hand harvest rather than by mechanical pickers. We still have a chance to do some research in small plots on defoliation and mechanical harvesting. We will formulate a proposal and discuss it with Mr. Khalil.

3. Helped coordinate chisel tests in cooperation with the Beheira Co. on the RAU and Beheira chisel plows with and without secondary tools. Because of time shortage, problems with available dynometers, and available personnel, we could not make all of the measurements that had been planned, but further tests will be conducted in the future. Measurements made include draft, forward speed, wheel slip, and fuel consumption for the two chisel plows plus two different chisel plows with secondary tools at three depths of operation. Before satisfactory research can be done, it will be necessary for the R&D unit to obtain tractors and train some fulltime operators; it is impossible to control test procedures with untrained operators.

4. Considerable time was spent with Dr. Orabi planning some research on compaction by tractor tires and on extending our investigation on the lasting effects of subsoiling heavy clay soils. It was decided to rent some land in the Damanhur area for three months for the compaction tests. These tests will consist of using a common size (65-70hp) tractor to make from 1-10 passes in the same track. Variables studied will include moisture content, weight on tractor tires, and percent slip. Soil condition will be measured after each pass of the tractor tire to determine the possible effects of intensive cultivation.

5. The R&D Executive Committee held three meetings and finalized two more contract research projects. Dr. Sahrigi increased incentives for the machine shop personnel and the hours of duty so production has increased considerably.

A.2 RESEARCH AND DEVELOPMENT SUBPROJECT

A.2.1 Machinery Development Advisor

Activity Report
July 1982

Submitted by: R.A. Beebe
M. El Naggar

The Machinery Development Advisor and Counterpart engaged in the following activities during the month:

1. Directed and assisted the junior engineers assigned to the Tractor Testing Station in the preparation of drawings of the detail parts and sub-assemblies for the pickup reel prototypes; an estimated 75% of the required drawings are complete.

2. Made several trips into the Alexandria shop area to obtain drafting instruments, scales and supplies.

3. Purchased and arranged delivery of one drawing board, complete with drafting machine, for use in design layouts.

4. Made several trips into the Alexandria market place to locate "V" belts and other components for the pickup reel prototype.

5. Helped Dr. Reaves draw up lists of drill bits, steel, and fastener supplies required for the workshop.

A.2.1

Activity Report
August 1982

Submitted by: R.A. Beebe
M. El Naggar

1. The primary activity of the month was completion of the design for the prototype pickup reel for the Olympia self-propelled mower and expediting the building of its components in the R&D Station workshop.

2. Several trips, from and hour to a full day, were made to the Alexandria shops area to locate and obtain materials and small tools required for building the prototype. As of August 29 only 50-65% of the detail parts are completed and no welding assemblies have been started. We have obtained most of the raw materials and have all the bolts, nuts and other standard hardware on hand. We have found "V" belts and believe the prototype can be completed in time for field testing in the 1982 rice harvest.

3. A second, Italian built, self-propelled binder, Camon F-10, was field tested at El Saadien in a very over-mature wheat crop on August 1st. The results of this test verified our previously stated conclusions: the typical Egyptian wheat crop, with plants ranging up to 1.5 meters tall, combined with the practice of cutting 2.5 to 5 cms above the soil surface, is not compatible with binders designed for use in shorter crops cut some 15-30 cms above the soil surface.

4. The coming F-10 is designed to tie bundles about 19 cms above their butt ends, so the heads tend to flare out to the extent that a typical bundle may be up to 1.2 meters in diameter at the heads, which prevents the machine's structure from passing over it. Frequent plugging of the bundles under the machine's undercarriage, requiring 2-10 minutes to clear out, was encountered.

5. We have investigated the possibility of modifying the Camon F-10 so as to locate the twine some 20 cms above its present location, on the theory that bundles so tied would be kept from flaring out so much at the heads, thus clearing the rig's undercarriage. It appears to be mechanically feasible to do so and we plan to carry out these modifications as the R&D workshop work loan permits.

6. Preliminary studies are under way for the design of an Egyptian-built self-propelled mower. Tentative plans are to use an imported engine (probably Italian manufactured) and the gearbox (transmission) from a locally assembled automobile. This would reduce design time considerably and eliminate a large tooling expense.

7. We completed design of a sweep attachment for chisel plows; a prototype is on order in the R&D workshop which will be tested as a cotton stalk cutter later in the fall of 1982.

A.2.1

Activity Report
September 1982

Submitted by: R.A. Beebe
M. El Naggar

1. The month's activities were concentrated on the modifications to the Olympia self-propelled binder. This work, peformed in the R&D workshop, included the following:

   a) completing the detail parts and sub-assemblies for the pickup reel attachment;

   b) assembling the pickup reel on the base machine, designing and building bracketry and links to provide adjustable positioning of the reel;

   c) modifying the left hand cutter bar support components to provide clearance for the reel and winnow;

   d) modifying the rear wheel support frame to eliminate yielding and tilting of the rear, steered castor wheel;

   e) designing, building and assembling a modified linkage and steering pedals to correct gross deficiencies in the rear wheel steering system;

   f) designing and building swath control components to form a semi-winrow of the cut material.

   At this time it is estimated that this machine will be ready for initial field-testing not later than October 1982.

2. We have designed an alternate sicle drive for the Camon self-propelled binder. Preliminary field testing early in August had indicated that this machine's binding mechanism was not able to cope with wheat in excess of 110 to 120 cm tall, so it was decided to convert the unit to a mower. The removal of the binding mechanism necessitated the provision of this alternate sickle drive. The shop order for this conversion was submitted September 19. It is estimated that the revised Camon machine will be ready for initial field testing on October 18, 1982.

3. Some parts for the cotton-stalk cutter attachment for chisel plows have been completed in the workshop.

4. Unfortunately, the R&D workshop has proven to be under-productive to date. When the Machinery Development Advisor is physically present in the shop, laying out work step by step, a fair quantity of work is accomplished, but production seems to drop to near zero in his absence. The shop supervisior and his assistant appear to have very little control over the men's work habits, and have displayed no desire to improve the situation. Absenteeism is unacceptably high and too much time is spent visiting and drinking tea.

5. The station's facilities have been significantly improved in the past few weeks by the installation of new plumbing fixtures, new window glass, repairing stairs, and painting the exterior. We still suffer in appearance, however, from a total lack of janitorial service. The new toilets have not been cleaned since their installation, nor have the stairs and hallways been swept or cleaned in several weeks.

6. Anticipated activities for October include field testing the Olympia and Camon self-propelled mowers to evaluate the performance of the following in rice harvesting:

   a) pickup reel on the Olympia;

   b) conventional bat reel on the Camon;

   c) sickle with stub guards on the Olympia;

   d) sickle with double guards on the Camon;

   e) winrow-forming devices on both machines;

   f) improved rear wheel support and steering mechanism on the Olympia;

   g) modified sickle drive on the Camon.

   The prototype cotton stalk attachment for chisel plows will be built in the shop. Preliminary design layout for a new, Egyptian-built self-propelled mower will be started.

A.3 EXTENSION AND TRAINING SUBPROJECT

Activity Report
July 1982

Submitted by: Fred Schantz
Samir Shawky

A. Summary, Training and Extension Activities

1. Submission of the training subunit's and machinery management subunit's quarterly cash need statements to project management for approval. The statements were subsequently combined into one statement (In-country Training Local Currency) and approved by the Project and USAID accounting.

2. Reviewed the machinery introduction and local manufacturing workplans with the extension and training committee of the MOA, which approved both plans.

3. Began two more mechanization extension training courses at the Sakha Training Center for district level specialists and village level advisors who will be assigned to the remaining project districts and villages by November 1982.

4. Finalized the Project's first participant observation tour, taken by Dr. Ahmed El Sahrigi and Dr. Samir Younis to the USA to examine agricultural mechanization practices.

5. Continued extension and training activities as scheduled (see Appendices A, B, C, D).

6. Attended two meetings.

B. During the Month

1. The cash need statement for the next quarter (changed to August-October 1982) was submitted to the Project and approved by USAID. These funds will now cover not only the normal project in-country training activities but also training administration costs, and the first increment of badly needed demonstration-training equipment. The specifications for the needed machines are now being reviewed and purchases should be made in the next two months. The project mechanization specialists working in the Beheira and Gharbia governorate project villages will then have equipment to implement mechanized agriculture demonstrations and other activities according to the village programs they are now drawing up and completing. The extension director and his staff are trying to intensify their support to the specialists in order to insure a successful field effort.

2. It must be mentioned at this time that with the Extension Director now involved in organizing field demonstrations and field days for other projects (small scale mechanization, rice mechanization project, etc.), in addition to his role in supervising the development of the project's village programs, he may soon have difficulty in phsyically covering all the required activities. The soon-to-be appointed

regional coordinators for the central and south regions should ease this problem, which may worsen if the Extension Director is not able to closely supervise their activities. The timely recruitment of an extension mechanization technical advisor for the field efforts would greatly aid this situation, and is receiving due attention.

3. There has been only limited progress concerning the water lift credit extension program in the four pretest villages designated to receive loan funds. As the loan funds begin to flow, and the pump sets, increased attention will be given to this effort. Plans are now to begin collecting necessary technical information which will be presented to farmers with other pertinent advice as the activity intensified.

C. Meetings

1. In addition to regular weekly meetings, an important extension and training committee meeting was held in Mr. Farouk Afifi's office at his request. Though Mr. Afifi and some of the committee members were unable to attend, the machinery introduction and local manufacturing program workplans were approved by those in attendance. USAID also approved the local manufacturing program and released funds for the machinery introduction workplan which is under review.

2. Detailed reports of the Extension Subunit (Appendix A), Training Subunit (Appen. B) and the Technical Training Specialist (Appen. C) are attached, as well as the monthly training activities (Appen. D) and the In-country Training Financial Report (Appen. E).

D. Problem Issues

1. A project procurement officer who can also be in charge of materials is badly needed.

2. Additional vehicles are now necessary for the mechanization extension/training activities.

A.3

Activity Report: Appendix A: Machinery Management Extension Subunit
July 1982

Submitted by: Dr. Mamdouh El Baz

A. Summary of Activities

1. Field day in Kafr El Sheikh, 7/8/82, on rice mechanization, for key farmers and training officers from Beheira, Gharbia, Sharkia and Dumyat.

2. Visit to Qaliubia and Gharbia to select extension people to join second training course in Sakha; opening this course on 31 July.

3. Printing and distributing the extension pamphlet in six governorates.

4. Receiving the technical material (computer) about irrigation by sakia and pumps, and transferring it to extension farms.

B. Progress:

1. Listing AV aids and gathering bids

2. Pamphlets on pumps distribution to be reviewed and revised.

3. Photocopying and printing about 100 photos and slides on rice mechanical transplanting.

4. Asking specialists to provide technical materials about maintenance of tractors.

5. Programs at village level not yet finished.

C. Problem Issues:

1. Money in bank not available to buy extension equipment or to pay costs of printing the first extension folder.

2. Difficulties in getting typing done.

A.3

Activity Report: Appendix B
July 1982

Submitted by: Samir Showky

1. Visits: El Saadyeen service stations
Sakha Training Center
Sidi Bishr Training Center
USAID English & Training Dept.
Nubaria Training Center
Beheira Co.

Meetings:
Mr. Halfenrector, USAID
Dr. Lagect, A.U.C.

2. Progress:

a) A complete plan for tractor drivers training course has been discussed and prepared.

b) An English Training Course was planned for the staff.

c) At Sakha Training Center, Maamura and Nubaria, and the plan for the coming training course was discussed and agreed to be started July 31, 1982.

d) At Beheira Co., three engineers joined the local manufacturing training activities.

A.3 Appendix C: Training Technical and Machinery Specialist

Activity Report
July 1982

Submitted by: Salah Bakar

Activities:

1. Participated in the purchase of a self-propelled harvester from one of the Mansoura companies.

2. Met with the Director of Agriculture concerning the repair and maintenance of the machinery and equipment at Sheikh Ahmed. Some of the machinery was moved to Cairo. The digger was fixed through the agent and is presently in Sakha Training Center.

3. A visit was made to the peanut fields in Sharkia to see mechanical uprooting, with the cooperation of Eng. Ahmad Hafez, Director of Agriculture in Sharkia.

4. Visited Sakha Training Center with Dr. Zakaria El Haddad, and went to the Agricultural Directorate in Gharbia for further contacts between the project and service centers. We also visited local workshops in Sharkia with Mr. Snyder and Eng. Wagdy.

5. Agricultural laborers from Mahmoudia markaz were prepared for the current course at Maamura. Field trips for farmers were planned in order to increase their awareness of machinery through practical training.

6. The spread of awareness among farmers facilitates utilization of machinery in cultivation and harvesting, with the cooperation of the agricultural officials in the governorate.

7. T he slowness of machinery provisions for training and experimentation in extension farms, even through rent, causes a great loss of time. The farmers look forward to obtaining machinery due to the shortage of labor.

8. We have forfeited participation in training sessions due to problems after the sessions in choosing subsequent participants. We should be informed of a training course plan before its implementation in order to be able to review the plan and choose suitable agriculture engineers.

July 19 82 TRAINING SCHEDULE

DATE	TIME	LOCATION	COURSE NO.	COURSE TITLE	COMMENTS
MACHINERY MANAGEMENT EXTENSION					
31 July	Nov 11	Sakha Training Center	2EX25b	Mechanization Extension District Level	6 students
31 July	Nov 11	Sakha Training Center	2EX16	Mechanization Extension Village Advisors	12 students
(Ongoing)		Cairo Office		Computer operation.	(1) students
31 July	30 Sept.	Maamoura Training Center		Mechanic: level I	13 students
PLANNING AND EVALUATION					
			NONE		
RESEARCH AND DEVELOPMENT					
July- Sept		Alexandria	1RD/c	Regular English	5 students
SOIL IMPROVEMENT					
			NONE		
SERVICE CENTERS					
			NONE		
LOCAL MANUFACTURING					
June-December		Behera Co Training Center	2LM1	Industrial Technology for Development I	(2) students

APPENDIX D

AGRICULTURAL MECHANIZATION PROJECT AID GRANT NO 263-0031
MINISTRY OF AGRICULTURE
ARAB REPUBLIC OF EGYPT

TRAINING SUBUNIT: JULY 1982
MONTH

The following is a summary of the financial report in Local Currency related to the referenced Training Subunit.

Line Item	Budget LE	Expenditure July 1982 LE	Balance LE
1. Instructors fees	200.00	-o-	200.00
2. Equipment Rental	100.00	-o-	100.00
3. Petrolium,Oils and Lubricants	200.00	-o-	200.00
4. Training Aids	1000.00	486.66	513.34
5. Training Equipment	20,000.00	102.59	19,897.41
6. Room and Board	3000.00	105.00	2,895.00
7. Transportation	1000.00	28.00	972.00
8. Training Materials	1000.00	107.50	892.50
9. Incidental Living Expenses	1000.00	42.00	958.00
10 Training Center Fees	5000.00	79.30	4,920.70
TOTAL:	33,500.00	951.05	31,548.95

APPENDIX E

A.3

Activity Report
August 1982

Submitted by: Fred Schantz
Ibrahim El Ghatas

A. Summary:

1. Activated the water lifting credit fund extension effort in Beheira governorate.

2. Secured from AID funds to purchase the extension demonstration /training equipment, audio visual aids and local manufacture program materials to implement planned training activities through 1982.

3. Presented the local manufacturing staff with the approved budget for their ongoing activities.

4. Secured the assistance of a parttime extension technical advisor (Mr. Gordon Stringer) to assist the machinery management extension director, regional coordinators and village mechanization specialists in developing their village programs. Also secured, from July 1, Mr. Heiza, a training officer for the Training Unit. Mr. Heiza will be instrumental in covering our administrative requirements and monitoring vilalge training stations.

5. Attended five meetings and went on three field trips.

6. The Extension and Training Coordinator was on annual leave August 1-12; the Training Director 12-19 August, and the Extension/Training Counterpart 24 August to Sept. 5.

7. Participant trianing activities continued with the first observation tour participants traveling to various agricultural areas in the U.S. The plan to send the project's first academic trainee has been delayed until additional English language training is completed. Three other observation tours are now being decided on and should begin processing next month.

B. During the month:

1. The Water Lifting Credit Fund extension effort was begun during the month with a field visit by the extension officer Mohamed Abdel Aziz to the pretest villages in the Beheira and Gharbia governorates. He was accompanied by Mr. Zaki Helmy of the Financial and Planning Unit who introduced Mr. Mohamed to the pretest villages. As more funds flow from AID to the project village banks the extension effort will intensify accordingly.

2. During the month AID funds were secured making possible the purchase of the subproject commodities and the financing of extension and training activities. The distribution of

these funds was temporarily delayed, however, due to the absence of an authorized person to sign the checks. This condition will continue until early next month when signatures can be obtained. At that time the pending extension audio visual aids and demonstration-training equipment to be approved can be purchased.

3. Concerning the critical need for an extension technical advisor to assist technically in the filed, Mr. Gordon Stringer has been assigned part time to aid the extension specialists develop their village programs. His primary role will be to examine the existing cropping pattern in the project villages and from this information assist those concerned in first selecting and eventually utilizing the appropriate demonstration/training equipment for which the project now has funds. As clearly shown in the monthly reports of the Machinery Management Extension Director (see Appendix A), the Director is primarily involved in audio visual aids development which is critical to the success of the mechanization effort, and will be helped by the addition of the field mechanization support of a technical advisor who is called for in the Project Paper.

4. Among the meetings and field trips were:

   a) Discussions with Dr. Tantawi concerning grain combines the project is considering.

   b) Attended a commodity procurement committee meeting in Dr. Aly El Hassary's office to examine 12 bidders for the project's demonstration/training equipment. Another meeting will be held in September to decide which equipment to buy from which dealers.

5. Detailed reports of the Extension Subunit (appendix a), Training Subunit (Appen. B) and the Technical Training Specialist (Appen. C) are attached, as well as the monthly training activities (Appen. D) and the In-country Training financial report (Append. F).

C. Problems:

1. A project procurement officer is need to keep project comoodities records and assist in commodities procurement.

2. Additional vehicles are needed for the field effort: The northern Regional Coordinator was without transportation for two weeks during the month, which has resulted in a slower development of the village programs for the region.

A.3

Activity Report
August 1982
Appendix A: Machinery Management Extension Subunit

Submitted by: Dr. A. Mamdouh El Baz

The month included the following activities:

1. Attending a practical trial of wheat mechanical harvesting in Sharkia

2. Two televized programs were prepared: a) how to maintain a tractor, at Sakha Training Center (aired August 15), and b) conventional and modified types of irrigation.

3. Held 2 field days and 3 practical demonstrations in Beheira, Sharkia and Qaliubia

4. Held a meeting with the extension staff and Undersecretary of Agriculture to constitute the executive body of this unit in Beheira governorate.

5. Gave two lectures at Sakha to our extension trainees on training and agricultural extension, and discussion of a field case study.

6. Made bids and orders for 10,000 copies of a folder about replacing sakias by water pumps and 5000 copies of posters about irrigation by siphon and long furrows.

7. Developed and printed six films on extension activities, transparencies and opaques.

8. Revised the technical material of a specific bulletin on maintenance of tractors.

A.3

Activity Report
August 1982
Appendix B: Training Director

Submitted by: Samir Showky

Activities:

1. Meetings: USAID for English training
Training and Extension Committee
Training Department, Ministry of Agriculture

Visits: El Saadyeen Mechanic station (Sharkia)
Sakha Training Center
Maamura Training Center
El Beheira Co.
El Sabahia (Alexandria)

2. The following training courses were begun:

Village extension specialists, 6 at Sakha
District extension specialist, 12 at Sakha
Tractor divers, 12 at Saadyeen
Mechanic Level I, 14 at Maamura

3. The first non-academic Training/Observation tour to the USA was carried out by Dr. Ahmad El Sahrigi and Dr. Samir Younis.

4. Local manufacturing at Beheira Co. has one more student.

5. A translator is needed, and a storekeeper for the training equipment.

A.3

Activity Report
August 1982
Appendix C: Salah Bakar

Objectives:

1. To be aware of the acceptance of farmers in purchasing suitable agricultural machinery either through our explanation or field visits or demonstrations, for example, the purchase of mowers in preparation for the next season.

2. Ways and means of using machines like the digger esepcially fo proper cultivation and no losses; ways of attaching of equipment to the tractor and indicating the appropriate speed; utilizing the tractor in combination with a backhoe, showing farmers a solution to shortage of labor and increase in wages;

3. Practical field training for farmers either by field visits or visits to companies to identify the availability of new machinery.

Problems:

1. There is a difference in execution and implementation of goals; for example, there are some trainees living far away from locations of training. A farmer should live close to agricultural machinery and be able to use it.

2. Agricultural machinery is available in training centers. Training periods should be longer with participation of machinery specialists and officials.

3. A televised program is being made to explain the most suitable ways of using tractors in Sakha Training Center. Lectures should be given at the Center on the most suitable equipment.

AUGUST 1982 1982 TRAINING SCHEDULE

DATE	TIME	LOCATION	COURSE NO.	COURSE TITLE	COMMENTS
MACHINERY MANAGEMENT EXTENSION SUBUNIT					
31 July-11 Nov.		Sakha Training Center	2EX16	Mechanization Extension: VILLAGE level	(6 students)
31 July-11 Nov.		Sakha Training Center	2EX25b	Mechanization Extension: DISTRICT level	(12 students)
"		"	"	" "	(1 student from the Sudan)
8 July-18 Sept.		El Sardien Training Station	2EX36	Tractor Driving	12 students
31 July-30 Sept.		Maamoura Training Center	2EX18b	Mechanic: Level I	(13 students) 1 new student
August		Project Governs.		Farm Equip. Operation and Maintenance	5 students from Ag. Fac.
August		Sharkia Gov.		Peanut Digger Operation/Maint.	6 students
PLANNING AND EVALUATION					
Ongoing		Cairo office		Computer Operation	(1 student)
August-November		American Univ. Cairo	2PE5	Intermediate English	4 students
LOCAL MANUFACTURING					
June-Dec.		Behera Co. Training Center	2LM1	Industrial Technology for Development	(2 students) 1 new student
TRAINING					
8 Aug.-4 Sept.		USA	2T7	Observation Tour: Mechanized Agriculture	2 persons

AGRICULTURAL MECHANIZATION PROJECT

AID GRANT NO.263-0031
MINISTRY OF AGRICULTURE
ARAB REPUBLIC OF EGYPT

FISCAL REPORT

IN-COUNTRY TRAINING: August 1982
(Month)

The following is a summary of the fiscal report in local currency related to the referenced In- Country Training.

Line Item	Budget LE	Expenditure August 1982 LE	Balance LE
1. Instructors fees:			
a) Workshop/locational training	200.000	-o-	200.000
b) Field demonstrations	100.000	-o-	100.000
c) Sub-total	300.000	-o-	300.000
2. Equipment Rental	300.000	-o-	300.000
3. Petrolium,Oils and Lubricants	300.000	-o-	300.000
4. Training Aids	1,500.000	1,100.000	400.000
5. Training Equipment	20,500.000	831.000	19,669.000
6. Machine Operator fees	100.000	-o-	100.000
7. Room and Board	3,050.000	130.000	2,920.000
8. Transportation	1,100.000	29.000	1,071.000
9. Training Materials	1,000.000	196.000	804.000
10 Incidental Living Expenses	1,000.000	210.000	790.000
11 Training Center Fees	5,000.000	8,000.000	(3,000.000)
12 Administrative Expenses	1,000.000	-o-	1,000.000
TOTAL:	35,150.000	10,496.000	24,654.000

APPENDIX E

A.3

Activity Report
September 1982

Submitted by: Fred Schantz
Ibrahim El Ghatas

Summary:

1. Secured the first draft of the Village Programs (110) from the Beheira and Gharbia governorate mechanization extension specialists.

2. Finalized the procurement procedures with the project procurement committee representatives for eight pieces of project demonstration/training equipment. Also developed a management system plan for the equipment when it is placed in the field.

3. Finalized plans for the extension specialists' workshop at Sakha Training Center October 2-5.

4. Finalized the first revision of the Participant Training Guide which is now being typed before final approval from USAID and the project is obtained, after which it will be printed and distributed.

5. The first participant training observation tour was completed this month by Dr. Al El Sahrigi and Dr. Samir Younis. The remaining tours have been delayed pending the naming and clearing of participants to attend these courses. The academic study hopeful candidate was also delayed due to the English language requirement which has prevented a number of potential candidates from being processed this year. It appears that unless quick action is taken, none of the other participant training programs (32 for 1982) will be carried out this year.

6. Attended ten meetings and went on 7 field trips.

During the month

1. As planned the first draft of the Village Programs (10) were completed during the month by the mechanization specialists from Beheira and Gharbia. These programs were discussed and revised in preparation for their formal presentation at the Sakha Training Center Oct. 2-5. All subproject managers have been contacted and asked to present an hour talk on their subprojects/units while being exposed to the various Village Programs at alternate times.

2. While the programs were being developed by the specialists and the Project's field staff, eight pieces of equipment were approved for purchase by project management (August 1982 list) and acted upon by the Project Procurement

Procurement Committee under the direction of the Under-secretary for Engineering Affairs. The equipment includes cotton stalk mowers, seed drills, ridgers, scrapers, mower/binders, planters, disc harrows, and rice trans-planters. The first units (cotton stalk-or-silage mowers and seed drills) will be moved to the field in October as needed and the additional equipment will be placed in the villages according to the needs of the Village Programs. The absence of a comprehensive management system to handle the equipment called for in the specifications of the June 13 Memorandum was resolved by Memorandum Sept. 6, 1982, and makes a number of recommendations critical to the successful manangement and maintenance of the equipment. These recommendations are now being acted upon.

3. Concerning the water lifting credit fund extension program, no further effort was expended in the pretest villages as per the directive from Project management. Activities in the Project villages when the funds begin to reach the banks in October will have to be carried out by the briefly trained mechanization extension specialists who have recently returned from mechanization training to their areas. Intensive mechanization short courses on irrigation extension and water pump operation and maintenance will have to be scheduled as soon as possible to familiarize the specialists with this information until a full time mechanical engineer (requested by the Financial Planning Subunit in a status report concerning the water lifting credit fund, included in their Monthly Report for May-June 1982) is assigned to carry out this activity.

4. Among meetings and field trips were:

   a. Attending the second project commodities procurement committee meeting at which the final decison as to which company(ies) would receive the bid or bids for the approved demonstration/training equipment was made. While there was not complete agreement by all as to which equipment should be purchased and in what quantities, the majority agreed with the final decisions. Mr. Ali Kamel of the USAID/MOA liaison office began processing the approved list and predicted that the equipment would start reaching the field by early October in time for the cotton/rice harvest and wheat planting.

   b. Discussed with Mr. Berky of the Local Manufacturing Unit his plans to procure needed training equipment for his program. He agreed to complete the specifications for the equipment by October when we will put them out for bid. The approved funds for this program are in the bank ready to be used for the August-October 1982 quarter.

   c. Met with Dr. Gaiser and Mr. Pierre Sales (Checchi & Co.) concerning the extension advisor/specialist replacement who is badly needed for the next 3 months during harvest and planting time.

d. Held meetings in Tanta and Damanhur with Beheira and Gharbia mechanization specialists to review and collect the drafts of their Village Programs. Also toured the 10 project villages with the Regional Coordinator, Moh. Abdel Aziz, in order to determine which of the villages were able to receive and support what types of Project demonstration/training equipment. Notes on these visits are being typed and recommendations prepared.

e. Traveled to Menufia research station with Dr. Farouk of the World Bank project to exmaine and test a double-knifed silage mower on cotton stalks. It was briefly tested and showed promising results for mowing cotton stalks this season. Based on this trip, the specifications for a cotton chopper were changed in order to procure this silage mower. It will cut the stalks at the base, thus leaving them for firewood use as tradition requires, instead of chopping the stalks into small pieces which only the larger farmers would allow at this point.

f. Traveled to Mansura with Dr. Ansary, Mr. Pete and Salah Bakar to view a one-row cultivator (motorized) and a two-row IRRI planter. The design for the one-row planter was obtained from the farmer visited and following the request from the Project Coordinator, one unit will be fabricated for testing in the field.

Attached are the detailed reports of the Extension Subunit (Appendix A), Training Subunit (Appen. B.), Training Technical Specialist (Appen. C), Project Technical Specialist (Appen. E), as well as the monthly training activities (Appen. D) and in-country training financial report (Append. F).

Problems

1. A critical need now exists for an extension specialist/advisor to assist the regional coordinators in refining their Village Programs, settling the demonstration/training equipment, and training the inexperienced mechanization extension specialists.

2. Additional vehicles to implement the field extension effort are still critically needed, especially during the present harvest/planting season (Oct.-Dec.). The regional coordinator for Beheira/Gharbia remained without a vehicle for the entire month, which has seriously hampered the extension implementation efforts in this area.

3. The in-country training fund check cashing procedure has prevented funds from flowing due to the absence of one or other of the two persons authorized to sign the checks. In addition, the Ministry now requires more justification concerning project expenditures which has slowed the flow of funds. A third problem is the lack of storage facilities and a commodities officer to log purchased equipment which has held up the purchase of a large amount of approved visual aids equipment.

4. Our monthly training expenditure reports which we receive from the Project's MOA/USAID accountant have been changed continuously since the training funds began to flow in April 1982. Although this is not entirely the fault of the accountant, since some of the training centers have returned small amounts of money they requested for a particular course, the inaccurate financial reporting which is reaching our monthly reports needs to be resolved.

A.3

Activity Report
September 1982
Appendix: Machinery Management Extension

Submitted by: Dr. Mamdouh El Baz

Summary of activities:

1. A week of annual vacation
2. Another week for Bairam holiday
3. Introduced a sketch for the second poster on pumps and sakia
4. Met with extension agents in Gharbia and Beheira
5. Went over drafts of the specific bulletin about maintenance of tractors
6. Received 5000 copies of the first poster
7. Attended a field day in Menufia about long-furrow irrigation
8. Prepared bids and purchase order to buy 2000 siphon tubes

A.3

Activity Report
September 1982
Appendix B: Training Director

Submitted by: Samir Showky

1. Visits: USAID English Training Dept., Sidi Bishr Training Center, Maamura Training Center, Beheira Co., Project's Alexandria Office, Nubaria Training Center

2. Progress:

English training began for students from the project: 21 candidates from participants have been tested by AUC.

Farmer leader courses will be carried out at Sidi Bishr (4 courses, 2 weeks) during Dec./Jan., for 115 farmers each.

Visited Mechanics Level I course at Maamura and discussed the program and plans for coming activities; reported to the training funds accountant, Mr. Abdel Aziz.

Visited Beheira Co. to follow up activities run by the local manufacturing subunit, and the Alexandria office to discuss preparation for the Sakha Seminar for village extension, participant training, and English language training.

Visited Nubaria to discuss the possibility of staring the planned training courses (3) and if they can start soon after contacting the training department in Cairo.

A.3
Activity Report
September 1982
Appendix c: Technical Training Specialist

Submitted by: Salah Bakar

Summary

1. Visited the peanut fields at Sharkia to follow up experiments with the selfpropelled harvester at Mashtul markaz.

2. Moved the grain drill and a self propelled harvester to Sakha.

3. Field trips with workshop officials and also central workshops in Sharkia,; attended meetings in Sharkia; moved cleaning machine from Sakha to Diar Benegm for more experimentations.

4. Visited with Mr. Schantz and Dr. El Ansary a farmer's field in Dakhalia governorate to inspect a locally manufactured seed drill.

5. Attended a meeting of Dr. Sahrigi and the Governor of Sharkia concerning the objectives and plans of othe Project.

6. Moved a double knife mower to El Saadyeen for preparation; gave lecture at Sakha on tractor parts.

September 1982 TRAINING SCHEDULE

DATE	TIME	LOCATION	COURSE NO.	COURSE TITLE	COMMENTS
MACHINERY MANAGEMENT EXTENSION					
31 July-11 Nov.		Sakha Training Center	2EX15	Mechanization Extension: Village Level	(6 students)
31 July-11 Nov.		"	2EX25b	Mechanization Extension: District Level	(13 students, one from the Sudan)
8 July-18 Sept.		El Sardoon Training Station	2EX36	Tractor Driving	(12 students)
31 July-30 Sept.		Maamoura Training Center	2EX18	Mechanic: Level I	(14 students)
Sept.		Sharkia gov.	(new)	Peanut digger oper./maint.	(6 students)
Sept.		" "	"	Small motorized blade mower ("tree eater")	12 students
PLANNING AND EVALUATION					
Ongoing		Cairo office	(new)	Computer operation	(1 student)
Aug-Nov.		AUC	2PE5	Intensive English	(4 students)
RESEARCH AND DEVELOPMENT					
			-none-		
SOIL IMPROVEMENT					
			NONE		
SERVICE CENTERS					
			-none-		
TRAINING					
8 Aug.-4 Sept.		USA	2T7	Observation Tour: Mechanized Agriculture	(2 persons)
LOCAL MANUFACTURING					
June-Dec.		Behoira Co. Training Center	2LM1	Industrial Technology for Development I	(3 students)

APPENDIX D

A.3
Activity Report
September 1982
Appendix E: Project Technical Specialist

Submitted by: Ahmad Beheiri

1. Had several meetings with extension specialists in Gharbia and Beheira about wheat planting next season, and location, size of plots and machines available.

2. Arranged a car to move the seed drill from Mansura to El Sheikh Ahmad.

3. Attended English courses at AUC.

4. Joined a group of farmers from Beheira to visit our trial at Abu Wafia farm.

AGRICUL TURAL MECHANIZATION PROJECT

AID GRANT NO 263-0031
MINISTRY OF AGRICULTURE
ARAB REPUBLIC OF EGYPT

FISCAL REPORT

TRAINING AND EXTENSION SUBUNIT

Month of September 1982

The following is a summary of the fiscal report No in Local Currency related to the referenced Training Subunit.

Line Item	Budget	Expenditure	Total to date
	LE	LE	LE
1. Instructors Fees :		—	
a) Workshop / Locational trainig			
b) Field demonstration			
c) Subtotal		—	
2. Equipment rental		352.000	
3. Petroleum, oils, lubs		—	
4. Training Aids		110.340	
5. Training Equipment		—	
6. Machine Operatori Fees		—	
7. Room / Board		209.000	
8. Transportation		124.000	
9. Expendable training materials		554.000	
10. Incidental Living Expenses		5,906.000	
11. Training center fees		1,032.000	
12. Administrative expenses		— 0 —	
Total		8,287.340	

APPENDIX F

F.4 LOCAL MANUFACTURING SUBPROJECT

Activity Report
June-September 1982

Submitted by: R. Berkey

June 1982

1. Procured and stored approx. 5 feddans of wheat and barley at the tractor testing station.

2. Axial flow of material impeded, capacity reduced; tendency for air to blow out the seed opening; experimented with baffles, open and closed cylinders, etc., to obtain axial air flow.

3. Preparing training course outline in cooperation with Dr. Kadeem according to training amendment.

4. Designed and built welding fixture for production of cylinder, hub, ring, spoke assembly.

5. Developed proper camber for action of trail wheel.

6. Supervised design of helical cylinders and designed four prototypes with different anlges and shaft sizes.

7. Shifted center of activities to tractor station.

8. Designed new concave with helical rod placement; made concave adjustable.

9. Training program on welding, band saw blades, at training station; took on new trainees Mohamad and Adel; started training program in welding, press and shear, use of pipe cutter, objectives of workbenches and layout design and building; finished augur extension.

July 1982

1. Continued June activities; sporadic training at training center with continual breakdowns and inadequate repair facilities.

2. Tried various shelling bars and plates with no success.

3. Have a transport, and exit clearances, between Beheira and the center

August 1982

1. Designed and partially built upper concave; new pulleys for all cylinders ordered; designed a tool storage crib and started its production using trainees, including a newcomer, Fawzi.

2. Built hitch on Blazer and ordered special wagon and license in preparation for transfer of wheat to Beheira and bringing early rice crop to Beheira.

Implementation Problems

1. The thresher testing program was a total washout during this quarter. We were concentrating on the improved grain capacity but could discover no lines of attack with predictable results. The problem was lack of support of the concave due to poor design of adjustable supports and deformation of the concave. This was not obvious because of many other minor deficiencies masking the major problem. For example, an improperly machined V-pulley limited the power and speed of the cylinder to the point that the separation was a mess, plugging, forcing heads through the concave, and many other confusing results.

2. Remedial actions suggested: a) to recognize that in machine development, everyone is a trainee and that pressure for quick results is usually counterproductive; b) importance of focusing on one problem at a time; c) work on straightforward work while waiting for inspiration or help on a more complex problem.

3. The expatriate training program has been postponed first from October to January and now until June, and contains only three fullfledged trainees. Suggested remedies: Apply every quarter for 50% of the salaries and other lecturing line items through Beheira and submit monthly billing for the balance; get approval of Kadeem's outline; recruit more trainees; bring over Arabic-speaking teachers from the US and get the local program moving.

September 1982

1. Obtained satisfactory feeding characteristics by adding four flat helix type flights to the 35° cylinder, but also it continued to plug the straw rack and slip the main drive belt.

2. Made an informal visit to the Muslim Bank of Development to investigate their credit facilities for small manufacturers or agricultural processing.

3. Three workbenches were built by trainees; tool crib built by trainees; prepared equipment specifications according to training program work plan; some special prototype tools were purchased.

4. Developed a test procedure for determining thresher capacity using minimal wheat and designed some feed trays to make consistent results possible; determined that feed rate was limited by drive belt power and made temporary improvement; supervised testing at feed rates up to 2.7 tph straw/.9 tph grain.

5. Demonstrated threshing machine and explained training activities to USAID officials.

A.5 SERVICE CENTER/VILLAGE WORKSHOPS SUBPROJECT

Activity Report
July 1982

Submitted by: R.E. Snyder
Wagdy Metry

1. In July we spent a lot of time trying to process two loans at the PBDAC in Damanhur for Abrahim Ateya and Mohamed Kohla. Each time we visit, we think we have finally solved all the problems, only to find we must start all over again next visit. The bankers evidently do not know the full extent of their responsibilities or authority. They have even tried to add restrictions of their own to our already agreed upon letter of understanding. The problmes with the banks have taken away from our field time. We expect these problems will be resolved after we have finalized the first few loans.

2. The one loan in Sharkia is temporarily held up while Mr. Sabry gets the land on which he will build his new shop registered. Mr. Sabry insists that it should be completed the first week in August. Hopefully PBDAC in Zagazig will be more cooperative than in Damanhur.

3. We are planning to incorporate a CPM chart with our monthly report. At this point however we are not quite certain about which activities/documents will follow which. As soon as this is determined, we shall proceed with the CPM chart.

4. During the month we made 19 visits to small workshops, coops, and random villages. Of these, six were new contacts. Our first impression is that at least three are good prospects that we will visit again. Eight were repeat visits to shops that we consider to be fair to good prospects. The rush season in these shops has now slacked and the owners have more time to consider shop improvements, new machinery and training.

5. We made three visits to random villages in Sharkia. None of these has a workshop and nobody we talked to seemed much interested in developing one.

6. July 29 Dr. Gaiser accompanied us on 3 of the above mentioned visits in the Zifta area, to let him see firsthand what type shops and people we are dealing with and how we approach our clients.

7. We visited two coops in Sharkia. The supervisor of the coop at Mashtou El Souk is a very ambitious individual and realized the importance of good maintenance. We introduced him to a nearby shop owner whom we are trying to help with machinery purchases. They got along well and the supervisor suggested that since this shop is so convenient, he would send them some

business. The supervisor also asked for some on-site training for his drivers and maintenance persons. We expect to provide this training in 3-4 days in August.

8. One of the aforementioned visits was made with Mr. Salah from Cairo training section. We were disappointed to spend so much time acquiring a guide at the Ministry office that we were only able to make one call, at the village of Equa. The call did, however, turn up a good prospect. We shall continue these calls until we have covered all the workshops that Mr. Salah knows about. However, it would be more helpful if the names or locations of these shops were given to us so that we could handle them in our normal work schedule.

9. In our June report we suggested some amendments to the letter of understanding. We have discussed these changes with the Executive Committee, Dr. Gaiser and Mr. Shepley. We feel that with the changes, business would pick up considerably with these small shops, which live a hand to mouth existence and need our help the most.

10. Eng. Anwar Nada is now training with R. Snyder and Eng. Metry When Anwar has sufficient knowledge of the project, we will form two teams and be able to cover much more territory.... assuming we get additional transport.

11. Abdel Hamid is still collecting information on farm machinery dealers, importers and spare parts availability. He is also doing the followup work on trainees, such as progress reports. Abdel Hamid also at times guides some of our clients to machinery dealers in Alexandria and Cairo.

12. We started 3 more trainees at Mamoura Training Center on 30 July. Unfortunately, one man was rejected for being too young. He is only 12 years old, but has been working as a mechanic's helper for 3 years. The unfortunate part is that there are hundreds of these young boys working in small shops and we cannot offer them training of any sort. We were able to fill the vacancy left by the rejected trainee with one on our waiting list.

13. As more contacts are made and more loans granted there will be surely more demand for training. We now have a waiting list of ten who would like training in mechanics.

A.5

Activity Report
July 1982

Survey of Random Villages

Submitted by: R. Snyder
Wagdy Metry

On 12 July Engrs. Wagdy Metry, Anwar Nada and R. Snyder visited two random villages in Sharkia governorate.

The first, Mit Yazid, is just 1.5km from Minia el Kamh. There are no repair facilities or mechanics in this village. The supervisor was out, so we left a note explaining our project and offering training for their personnel. Minia El Kamh is a markaz town and has most farm machinery services available. Due to the proximity of adequate repair facilities, we feel it would not be necessary or even wise to develop a repair shop in Mit Yazid.

The seond village was El Saadine. There is a mechanic who works on taxis and trucks. There are, however, no repair facilities for farm machinery. The supervisor of the coop said he knew a man who might be interested and promised to contact the mechanic, explain the project and have him contact us if he is seriously interested. This village is about 10 km from Minia El Kamh and a small shop in this location would be very helpful to the local farmers.

On July 13 we visited the random village of El Tellin in Sharkia. This village has no repair facilities of any kind, or any mechanics. The chairman of the coop says he doubts that anyone would be interested. They are approximately 6 km from Minia el Kamh where most services are available. The coop personnel did express interest in having some of their people trained as tractor drivers and mechanics at a later date. We do not plan to pursue workshop development any further in this location.

A.5

Activity Report
August 1982

Submitted by: R. Snyder
Wagdy Metry

General: Our problems with the PBDAC were not resolved this month. We have requested the assistance of Mr. Shepley and Mr. Zaki, as our problems are so basic in nature they will most surely have to go through the Central Bank in Cairo.

Field trips: We made 20 visits to banks, workshops, random villages and coops: 8 in Sharkia; 5 in Gharbia; 5 in Beheira; and 2 in Qaliubia.

Of these, 7 were new contacts. Nine were repeat visits to prospective clients, two to the banks and two visits to random villages. The two visits to random villages conclude our survey of random villages in Gharbia governorate. We have found two persons in the Gharbia random villages showing interest in cooperating with our project: one in Qelyb Abiar village, Kafr El Zayat markaz, and one in Keniset Damsheet in Tanta markaz. These visits are described in the attachment to this report.

Loan activity: Activity may be the wrong word to use: though we have had considerable contact with prospective loan recipients, none have actually been finalized. Our recent amendments to the letter of understanding have prompted the bank to design a new contract form for our loan recipients in liew of the original. The contract form has not been completed.

On 17 August we recieved 2 letters of proposal, both from Sharkia, one from Fouad Shoeman adding to his origianl request (approx. 10,000 total) and one from Ramzy Abd El Karrem initially requesting approx. LE 10,000. We received a proposal from Moh. Darhous in Gharbia for approx. LE 17,000, and a letter of intent from El Said Ateya Mohammed Amr, who is in the process of acquiring land for a new shop.

Training: We still have three young men in training for Mechanics Level I at Maamura Training Center. We also have ten people on our waiting list for trianing; two of these require machinist training which has not been available to date, and the others are waiting for Mechanics Level I.

On August 23-25 we dispatched Abd El Hamid to the Ministry Service Station at Mashtul El Souk where he conducted training for 8 station personnel in tractor maintenance. The director of the station wrote a very complimentary letter requesting more cooperation of this type in the future. Anwar Nada is still in training with Mr. Snyder and Eng. Metry and should conclude this next month.

Other: Abd El Hamid, with the help of Eng. Shoukry, completed and indexed the catalogs system on shop machinery and equipment and the catalogs on agricultural machinery. Any further work will be to update and possibly improve upon it.

Station activities: New toilets have been installed in the office building, but no janitors hired to clean them. Work continues on refurbishing the exterior. All air conditioner units have been installed and most are operable. We still have no telephone communications, except the inter-office system which works fine. The access road from the agriculture road to the RR tracks has been paved, an enormous improvement.

Surveys & Visits
Small Workshops
Month of August

Date	Name	Location	Govt.	Remarks
Aug	(Small workshop) Mohammed Sadek Selem	Hosh Issa	Behera	Original Licensed for Welding. Added Tractor Repair to Lic. 10 May 82, but not performing as Tractor Shop. Will not consider loan at this time.
Aug	(Small workshop) Abdel Menem Adly Hassan	Hosh Issa	Behera	Licensed to repair trucks. Add Tractor repairs on 10 May 82, but not performing on tractors will not consider a loan at this time.
Aug	(Small workshop) Hassan EL Said Shaddy	Zawit Gassal	Behera	Will contact us after his land is properly registered. Tractor repair shop. Wants Drill Press. Will visit again soon.
Aug	Damanhour Bank	Damanhour	Behera	Discussed Atya & Kahla loan PBDAU will send files to Cairo Bank.
Aug	(Small workshop) Atya Mohammed Amer	Tafhna El Arab	Garbia	2nd visit. Has purchased land. Would like us to return after land is registered. Gave us a letter of intent. Total loan request - 15,000 LE
Aug	(Small workshop) Nabiel EL Bahnasi	Kafr EL Dawar	Behera	Will finish new building in 30 days. Have received letter of proposal. Land not completely paid for. Will visit again soon. Wants mach shop to support Tractor Repair
Aug	Zagazik Bank	Zagazik	Sharkia	Nobody in. Had not started work on loan in their possession for 12 days.

Surveys & Visits
Small Workshops
Month of August

Date	Name	Location	Govt.	Remarks
16 Aug	Zagazik Bank	Zagazik	Sharkia	Nobody in. Had not started work on loan in their posession for 12 days.
16 Aug	(Small workshop) Aze El Dine	Hehya	Sharkia	Owner not in. Will visit at next Trip.
16 Aug	(Small workshop) Sabry Ibrahim Eid El Said	Ibrahimia	Sharkia	Found he was trying to procure a loan with fraudulent documents. Will not pursue this further.
16 Aug	(Small workshop) Salah Atya Mohamed Said	Akwa-Diarb-Negm	Sharkia	2nd visit. Business still not licensed. Land not properly registered. Will visit again soon. Needs bldg & machinery. Approx. loan 10,000
[illegible] Aug	(Small workshop) Hassan Abdel Farah Abdel Megeed	Qalyob-Ramada	Qalubia	First Contact - will study terms & conditions. We will visit again soon. Lic. OK
17 Aug	(Small workshop) Fouad Shaban	Mashtol El Souq	Sharkia	2nd visit. Added to his cr. letter of proposal. Will comm. loc. in 3 weeks.
17 Aug	Station of Agriculture-Mech	Mashtul El Souq	Sharkia	Introduced Abd El Hamid further tractor maint. trn. for Coop persons. Trn was done on Aug. 22-23. Coop acts very pleased.

Surveys & Visits
Small Workshops
Month of August

te	Name	Location	Govt.	Remarks
4	(Small workshop) Ahmed Mohammed Alam	Shebine EL Kanatr	Qalubia	Owner not in. Left terms and conditions for him to study will visit again (First visit)
4	(Small workshop) Ramizy Abd el Kreem	Mashtol EL Souq	Sharkia	2nd. visit - Wrote letter of proposal. Properly licensed machine shop in Agg. area. Will visit again soon.
4	Mr. Lotfy Abd EL Rahman	EL Hamidia	Sharkia	Wealthy Gas Sta. operator and fuel transporter, wants a service center & Mfg. facility. Probably not enough business for so so will persuade small shop operation
4	(Random Village) Kafr Dimea village	Kafr EL Zaiat Markaz	GHarBia	Will send a list of persons they want Trained. Will recommend a local man to establish a small shop. Will visit again
4	(Random Village) Qelyb Abiar	Kafr EL Zeiat Markaz	Gharbia	Will send a list of persons they want trained. Will recommend a local shop owner who we may wish to help. Will visit again
4	(Small workshop) Abrahim Abd EL Shafy EL Hadad	Qelyb Abier	Gharbia	Shop is very near Qelyb Abiar Coop. Only shop in this area. Licensed for Tire repair. They do Tractor & Sprayer repairs Gave us a letter of proposal for machinery & Tool at approx. 1500 LE
4	(Small workshop) Abd EL Aziz Nosser	Shabsher EL Hasa	Gharbia	2nd visit - Properly licensed will finish his new bldg in 2 mo. Then he wants a loan for machinery. Approx. 10,000 LE

A.5

Activity Report
September 1982

Submitted by: R. Snyder
W. Metry

General: We continued to make calls on small workshops in Beheira, Sharkia and Gharbia. We were informed that we would begin making loans to private mechanization coops in Sharkia government; there is much confusion about this, detailed in another report.

Field trips: We made 12 calls/visits to small workshops, banks, coops and random villages: 6 in Beheira, 2 in Sharkia, and 4 in Gharbia.

1. One of these visits was a new contact. The client, Mr. Ahmed Ahmed Shamia of Keniset Damsheet is headmaster at the local school and has no mechanical experience. He would like to have a loan to build a shop behind his house in the village. There is quite a large shop 5 km toward Qatour that handles most repairs in this area. We shall study the possibilities further, but feel at this time that he would not be likely to succeed in this location, and also because of his lack of experience.

2. Five visits were repeats. We visited two clients in Dilingat who were becoming discouraged with the slow progress at the bank in Damanhur. It is imperative that our problems with the bank be solved immediately. We visited Mr. OmarMohamed in Messine. He is waiting for his partner who works in Jordan to arrive after the feast so they can make a decision on how much machinery and spare parts they should buy. We visited Basouni Abu El Gheit in Samla, who will make a decision after the feast. He is now considering an engine overhaul shop in Qatour (Gharbia). Nabil El Benassy of Kafr El Dawaar says he will finish building his shop in 30 days (as said before), and take a loan for machinery. He also has to complete his application for a commercial license.

3. Two visits were to random villages in Gharbia, one to Kom El Naggar where we had a long meeting at the coop where it was established that although the village had no repair facility, it was unlikely that one could be developed. It seems most people go to Basiouni where there are 8-10 workshops. The other was Keniset Damsheet where we met Ahmed Ahmed Shamia mentioned above.

4. We made two visits to the Agricultural Ministry at Zagazig. On 6 Sept, we were informed that we would be helping to develop repair facilities for the Agricultural Mechanization Coops which are in fact private sector. Afterwards we visited a new (unfinished) coop repair facility in Kaniyat. If this facility was designed as a service center as they said, I would say they surely need help. The building was in no way

adequate for a service center. On 21 Sept. we visited the Ministry again, to visit some potential building sites, but the confusion that ensued is reported in a note to Dr. Gaiser and Dr. Zakaria of Sept. 22.

5. We visited the bank in Damanhur 9 September and were told that we still could not proceed with loans as they were waiting for the newly designed contract from the central bank in Cairo.

   Due to our problems in the bank, loan activity this month was nil. One of several persons who visited our office, Mr. Hassan El Said Shalaby from Zawiet Gazaal did submit a letter of proposal to purchase machinery in the amount of LE 20,000.

Training: We had a request from the Saadeen governemnt coop for tractor maintenance training for 11-13 October. It has never been made clear to us whether or not we are infringing on another Subproject's responsibility by doing this type of activity. We have made this training material available to the training section, and would like guidance on whether or not we should discontinue activities of this type. Anwar Nada is now competent to work on any facet of the small shops project without supervision.

Special Problems:

1. Still no phone at the Alexandria office.

2. Though the revised terms and conditions for small workshops has made shop owners much more receptive to our program, we still have a few problems, sometimes slowing the process, in other cases bringing loan activity to a halt:

   a) No. 1 and most troublesome is the difficulty in getting land registered; anything from a question of ownership to collecting the proper letter and signatures often brings things to a halt;
   b) No. 2 and next most common is the lack of, or reluctance to, acquire a business or commercial license, due most often to reluctance to pay taxes;
   c) No. 3, especially where buildings are concerned, is trying to acquire building permits to build on agricultural land, a slow if not impossible task.

A.6 LAND IMPROVEMENT SUBPROJECT

Activity Report
July 1982

Submitted by: Dr. Adel Orabi
Dr. Ahmad El Araby
Eng. Hassan El Banna
Eng. Ahmad El Fayoumi
Eng. Amr Maréi
Mr. J. McClung
Mr. E. Coles

Basin Survey: The second part of the Minia Basin Survey was initiated and the statistical analysis of the basin size distribution within each of the areas and number of basins was completed and reported in draft. The main purpose of analysis is to obtain the magnitude of the land improvment operations. The next stage will be to select a representative sample of basins for detailed surveying.

Landleveling Computer Program: The use of the EEC computer program has proved useful in preliminary investigations for the land leveling investigations estimating earth volumes at the Delta Sugar Co. However, it appears that the Subproject should develop a suitable computer program for specific application. Work on the program is now proceeding.

Related to this is the need to develop a method for determining tractor power requirements to move the volumes involved. An interactive model has been developed and will be tested using data from the Delta Sugar Co. observations. A technical paper on the development of a computer program is being prepared.

Research Program: The development of experiment layouts for the Fayoum area is in progress and so is the preliminary work for the Beni Suef and Minia areas.

Training Project: Various sources of training materials suitable for adapting to the land improvement program have been reviewed. The water management training manual compiled by Colorado State Univ. for use in Pakistan provides some useful guidelines for the Land Improvement manual. However, much of the data will have to be revised to suit Egyptian conditions, and a great deal of new material created, as land improvement is a new concept in agriculture.

Demonstrations: The development of a demonstration program for land improvement and basin rehabilitation is closely tied to the training project and the basis of the program is being reviewed. An area in Minia will be selected in one of the villages.

Maps and Plans: Arrangements to purchase maps and aerial photos is in satisfactory progress.

Work in Progress: Working Paper No. 2 is completed. Technical Paper No. 1 awaits receipt of the Nebraska test reports. Technical Paper No. 2 awaits field trials on heavy clays of furrow intake rates. Tech. Paper No. 3 (Basin Survey) is in draft form.

A.6

Activity Report
August 1982

Submitted by: A. Orabi
A. El Arabi
H. El Banna
A. El Fayoumi
A. Marei
J. McClung
E. Coles

Landleveling Project, Delta Sugar Co.: On August 7-14, the whole staff of the Land Improvement Subproject and members of the Executive Authority of Land Improvement participated in an operational analysis and training session at the Delta Sugar Co. in the Baltim area. The field trip introduced the team members to differential level surveying using laser equipment and to landleveling procedures used by the DSC.

The prime motive for this trip was to carry out the study outlined in Working Paper No. 2: operational analysis of laser plane controlled lanleveling operations of the Delta Sugar Co., particularly determining the earth volumes moved. Grids were laid out in each tarkeeb (a plot approximately 25m x 250m, separated by drains) both before and after the leveling operation. The team also collected data on the time required for the leveling operation and the length of individual runs.

During the field trip, activities concentrated on collecting data of the field operations and training on laser equipment. Analysis of the results is taking place and will be presented in technical paper No. 4.

Computer Programs: Preliminary analysis of the data collected at the DSC was made using the laser landleveling program on the Apple II+ computer of the Egyptian Computer Company. The results are being incorporated in technical paper No. 4. Unfortunately, power fluctuations caused poor printout of the graphics; also, the program is designed to use data laid out in a different grid configuration from ours.

A computer program which could be used for design work on the HP-85 was completed in September. Also, a computer program was developed to assist in the design and rehabilitation of quaternary irrigation channels. A sample printout is provided for reference. Details of this program will be presented in a forthcoming technical paper.

Basin Survey: 54 villages were selected for detailed basin surveys and this information was incorporated in technical paper no. 1 Preliminary reconnaissance was carried out in project villages included on this list.

Demonstration Basin Program: Potential demonstration basins were visited in there of the project villages. Discussions were also held with EWUP personnel regarding cooperation on land leveling and mesqa rehabilitation activities at their Abuja site, which would serve both as a training and demonstration site.

Training: Work continued on the development of the training manual, with several lectures being developed and translations completed.

Research Activities: Sites were selected for experimental areas in Beni Suef, Fayoum and Minia. Tentative experimental layouts at each site are currently being developed.

Work in Progress: Technical paper no. 2 has been drafted and awaits field activity for completion. Technical paper no. 3 was completed and under review while appendices are being prepared for printing. Analysis of DSC data continues for technical paper no. 4. Reconnaissance for a demonstration basis has begun. Work on the training manual lectures and demonstration continues.

Field trips: Delta Sugar Co., Baltim, Aug. 7-14: Dr. A. Orabi, Dr. A. El Araby, Mr. A. Marei, Mr. El Fayoumi, Mr. H. El Banna, Mr. J. McClung, and E.D. Coles. Minia: Dr. A. Orabi, P. Reiss, and Mr. J. McClung.

A.6

Activity Report
September 1982

Submitted by: A. Orabi
A. El Araby
H. El Banna
A. El Fayoumi
A. Marei
J. McClung
E. Coles

Basin Survey: Reconnaissance was completed in the project villages and basins selected for detailed survey. The preliminary survey report was completed and sent to the printer. Work continued to obtain aerial photos for survey use and other long term planning purposes.

Computer programs: A computer program to design engineered zero level fields from survey data and to calculate earthwork volumes was completed. A printout of this data is attached.

This program was developed particularly for the operational research activities carried out at the DSC. The data has been processed through the program and is discussed below.

Operational Analysis of Landleveling Operations:

1. The analysis of the DSC data was completed. The initial results indicate that between 24 and 50 cubic meters are being moved per tarkeeb, an area of approximately one feddan.

2. The data is also being used to evaluate an interactive model to determine the tractor power requirement to move these earth volumes. This analysis should be completed during October.

3. The first laser survey unit has been delivered and was tested at the EWUP project site. This field trip to Minia was undertaken at the invitation of EWUP to familiarize EAMP staff with the landleveling methods used at EWUP. The trip also served to familiarize EWUP staff with laser equipment. The laser unit proved effective and will be utilized in the first detailed basin survey soon.

Training: Various training materials continue to be under review and new materials are in the process of being developed. Several lectures to be included in the training manual have been completed.

Demonstrations: Two potential demonstration basins have been tentatively selected in Minia. The detailed survey and design development for these basins will be done in October.

Bids were received and evaluated for the purchase of a small set of equipment for demonstration, training and research; it is expected in October or November.

Research: Two research activities are going on simultaneously. The first is the construction of three experiments in Fayoum, Beni Suef, and Minia, and the other deals with soil compaction with the collaboration of C. Reaves of the R&D subproject. Research areas have been selected, treatments and schemes of work have been established.

USAID EGYPTIAN AGRICULTURAL MECHANIZATION PROJECT

Louis Berger International,Inc.

DESIGN OF QUATERNARY CANALS
Based on Critical Tractive Force
and Limiting Froude Number

SIDE SLOPE 1:1.50

BOTTOM WIDTH/DEPTH (b/d) =1.25
FROUDE NUMBER (FR) =0.10
TRACTIVE FORCE (T) =0.20
MANNINGS N (n) =0.03
REDUCTION FOR CTF (Cf) =0.08

Q(l/sec)	B(m)	D(m)	V(m/sec)	S(m/m)	A(m^2)
30.0	0.1192	0.0953	1.2000	0.044091	0.025
30.0	0.1300	0.1040	1.0086	0.027743	0.030
30.0	0.1400	0.1120	0.8697	0.018685	0.034
30.0	0.1500	0.1200	0.7576	0.012933	0.040
30.0	0.1600	0.1280	0.6658	0.009167	0.045
30.0	0.1700	0.1360	0.5898	0.006634	0.051
30.0	0.1800	0.1440	0.5261	0.004891	0.057
30.0	0.1900	0.1520	0.4722	0.003666	0.064
30.0	0.2000	0.1600	0.4261	0.002788	0.070
30.0	0.2100	0.1680	0.3865	0.002150	0.078
30.0	0.2200	0.1760	0.3522	0.001677	0.085
30.0	0.2300	0.1840	0.3222	0.001323	0.093
30.0	0.2400	0.1920	0.2959	0.001055	0.101
30.0	0.2500	0.2000	0.2727	0.000848	0.110
30.0	0.2600	0.2080	0.2522	0.000688	0.119
30.0	0.2700	0.2160	0.2338	0.000563	0.128
30.0	0.2800	0.2240	0.2174	0.000463	0.138
30.0	0.2900	0.2320	0.2027	0.000384	0.148
30.0	0.3000	0.2400	0.1894	0.000321	0.158
30.0	0.3100	0.2480	0.1774	0.000269	0.169
30.0	0.3200	0.2560	0.1665	0.000227	0.180
30.0	0.3300	0.2640	0.1565	0.000193	0.192
30.0	0.3400	0.2720	0.1475	0.000165	0.203
30.0	0.3500	0.2800	0.1391	0.000141	0.216
30.0	0.3561	0.2849	0.1344	0.000129	0.223

Best Available Document

[illegible] EGYPTIAN [illegible]

[illegible] Berger International Inc

Engineered Zero Level
(All units are in meters)

DE[illegible] [illegible] COMPANY
F,[illegible]

Inc[illegible] F Indicates [illegible] AND C Indicates Cut
[illegible] Indicates Below [illegible]
[illegible] Indicates Above Elevation

[illegible]	C .12 9.84 9.9[illegible]	C .15 9.84 9.99
-.1 9.84 9.74	F-.1 9.84 9.74	F-.05 9.84 [illegible]
F-.0[illegible] 9.84 [illegible]	F-.05 9.84 [illegible]	F-.01 9.84 9.83
F-.0[illegible] 9.84 9.83	F-.0[illegible] 9.84 9.79	C .0[illegible] 9.84 9.86
C .04 [illegible] [illegible]	C .09 9.84 9.88	9.84 9.93
C .0[illegible] 9.84 9.85	F-.02 9.84 9.81	F-.0[illegible] 9.84 9.98
F-.02 9.84 9.8[illegible]	F-.03 9.84 9.82	9.84 9.81
F-.0[illegible] 9.8[illegible] 9.8[illegible]	C .02 9.84 9.84	9.84 9.86
C .0[illegible] [illegible] [illegible]	F-.06 9.84 9.84	9.84 9.98
C .0[illegible] [illegible] [illegible]	C .01 9.84 9.85	C .07 9.84 9.8[illegible]
C .[illegible] [illegible] [illegible]	C .21 9.84 10.05	C .09 9.84 [illegible]

[illegible] .43
[illegible] .2[illegible]

GRI[illegible] [illegible] DIRECTION IS 20 meters
GRI[illegible] [illegible] DIRECTION IS 9.25 meters
[illegible] [illegible] 7.43
[illegible] [illegible] 58.8[illegible]

A.6.1

FIELD TRIP: MINIA
Report

Submitted by: M. McClung
A.A. Orabi

Field trip to Minia by Dr. Peter Reiss, Dr. Adel Orabi, Mr. Nour El Din, and Mr. J McClung, August 24-26.

Reconnaissance of Basins in Project Villages: We visited 3 of the 5 project villages and walked the boundaries and mesqas of 5 basins. The villages and basisn visited were:

Markaz	Village	Basins
Matai	El Atlat	El Beek/Ganina
	Seila El Gharbia	Manharawi/Hazina
Abu Qurqas	Beni Abeed	

Hodh El Beek: This basin, approx. 90 feddans, has a general E-W orientation (see sketch, Figure 1). The crops are a mix of maize, cotton, soybean and vineyards. The basin is bordered on two sides by roads making access with construction equipment possible. The third side is a large drain, which is currently clogged with reeds and debris and requires maintenance. The basin is serviced by two large mesqas and five smaller branch mesqas. The water source is two canals, one located on the E. border of the basin, the second some distrance to the W of the basin. Water is conveyed across the main drain by a pipe bridge, which is in poor condition.

Hodh El Ganina: El Ganina is adjacent to El Beek, 36 feddans, and has a general N-S orientation (see Figure 1). The entire basin is cropped in cotton. The village agricultural officer estimates the basin will be clear of crops for only about 15 days, at the beginning of October. It is bordered on the E. side by a mesqa running into the main drain. The farmers believe that their land is sloped to the W. and is somewhat uneven. The N. end of the basin is a mesqa which also serves El Beek. The water source is acorss the piepbridge also.

Hodh Manharawi: This basin is 57 feddans in a long rectangular shape. There are a variety of crops including cotton and maize. The basin is bounded on one side by a main drain and on the other by a mesqa. Three sub-mesqas and a dirt road run from the mesqa to the drain (see Figure 2). Farmers in this basin complain vigorously of a lack of water. The mesqa was less than a quarter full at a time the farmers claim is the peak of their rotation. This situation seems to have existed for over 18 months. Farmers in the area were observed to be pumping water from the drain. The condition of the mesqa itself is poor. The top width varies from 1.5 to 6 meters, and there are trees and vegetation growing in it.

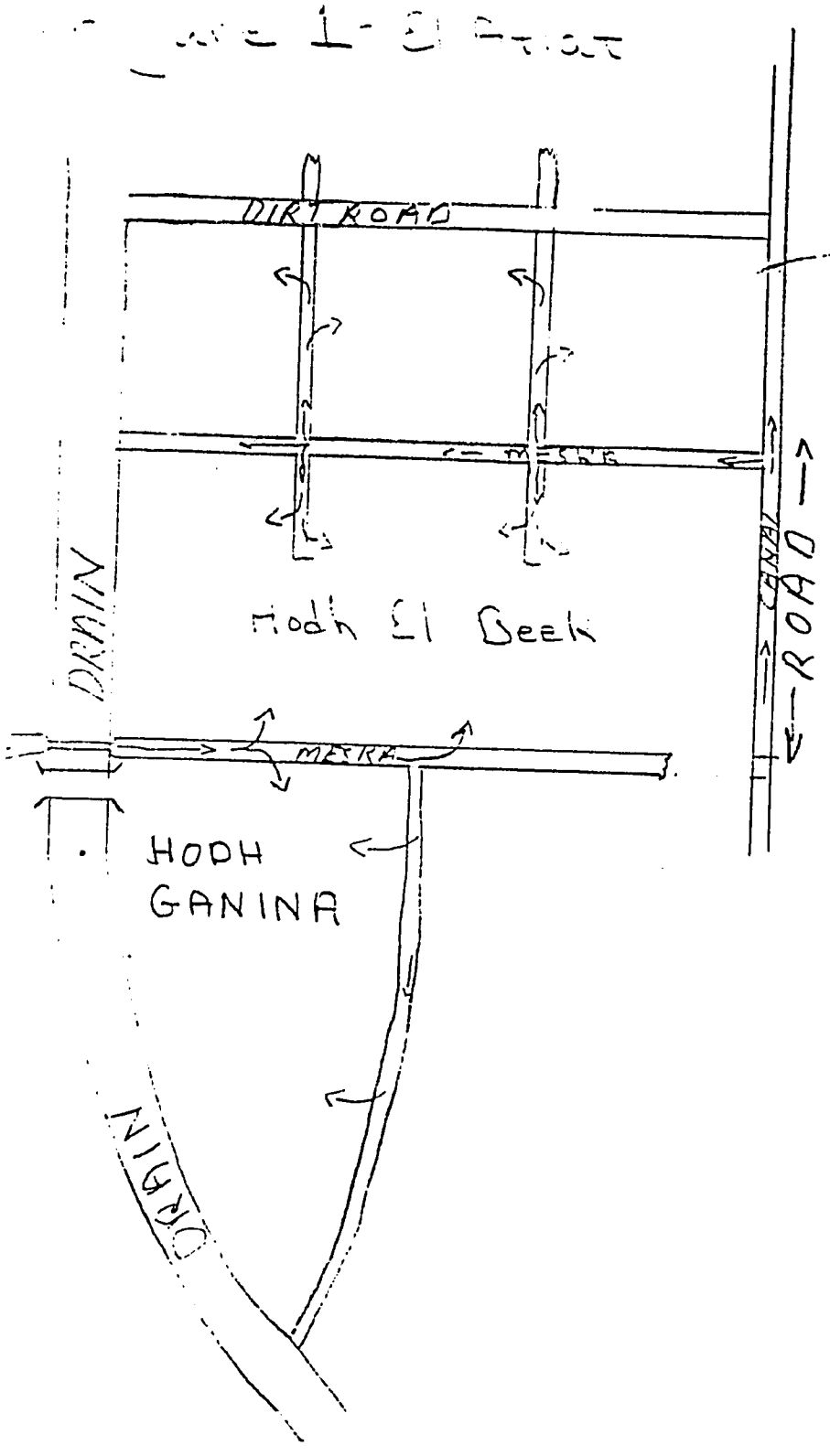

DIRT ROAD
MESKA
CANAL
ROAD
DRAIN
Hodh El Beek
MESKA
HODH
GANINA
DRAIN

Figure 2

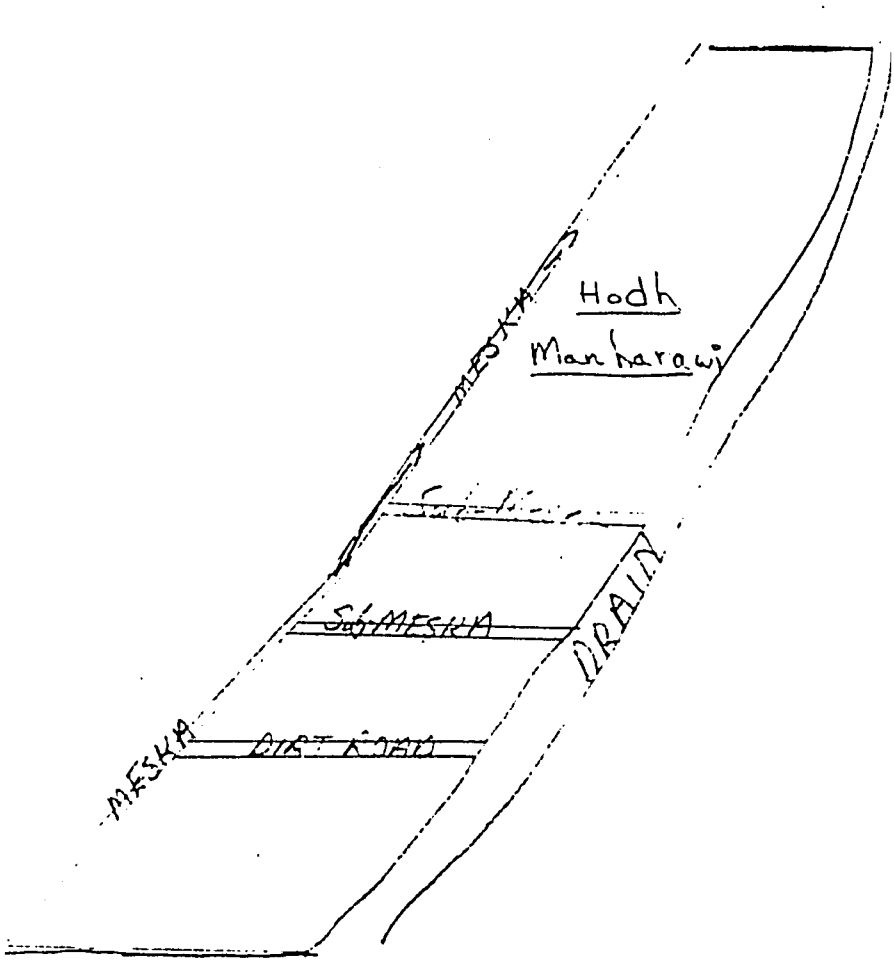


Figure 3

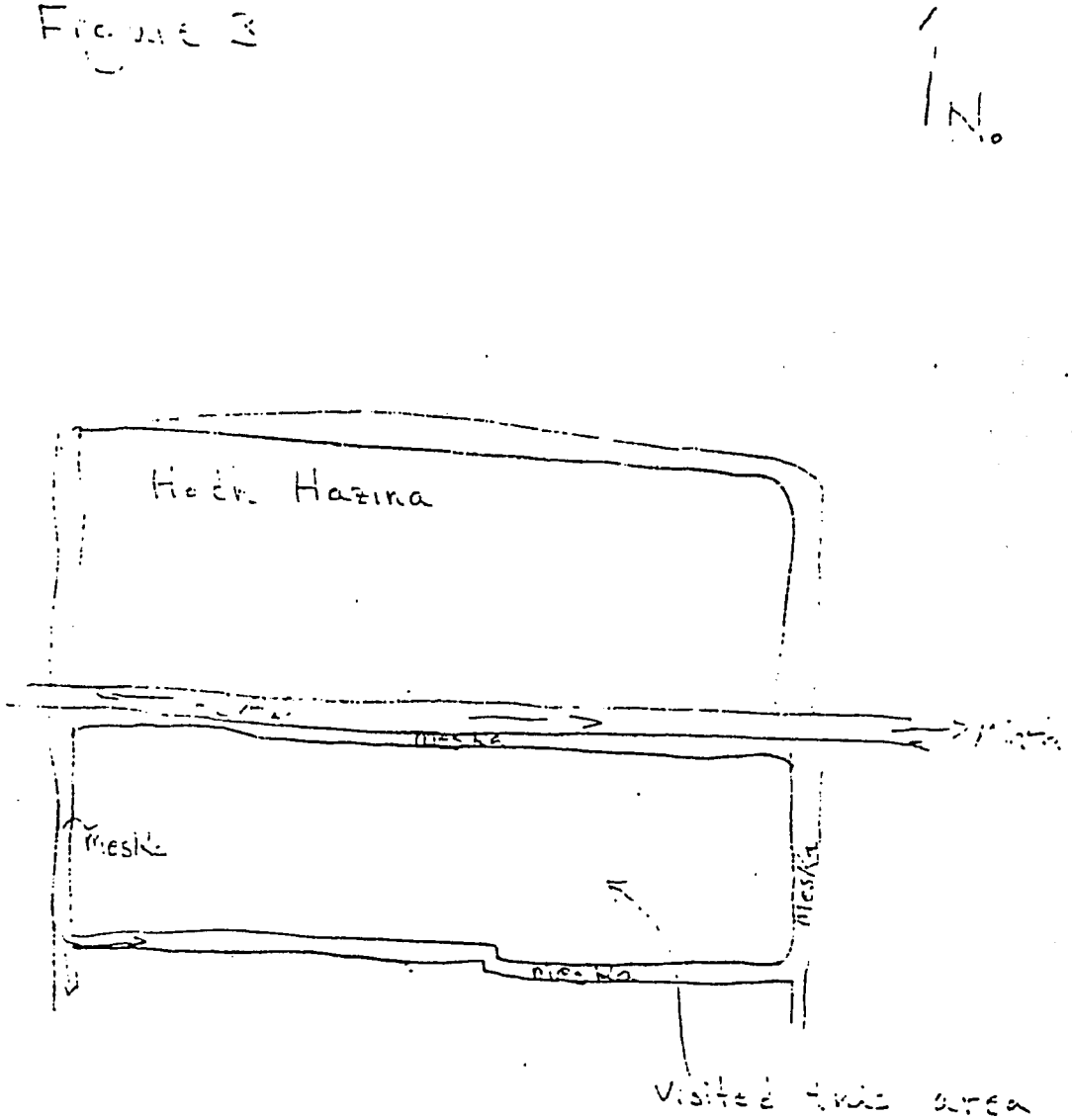
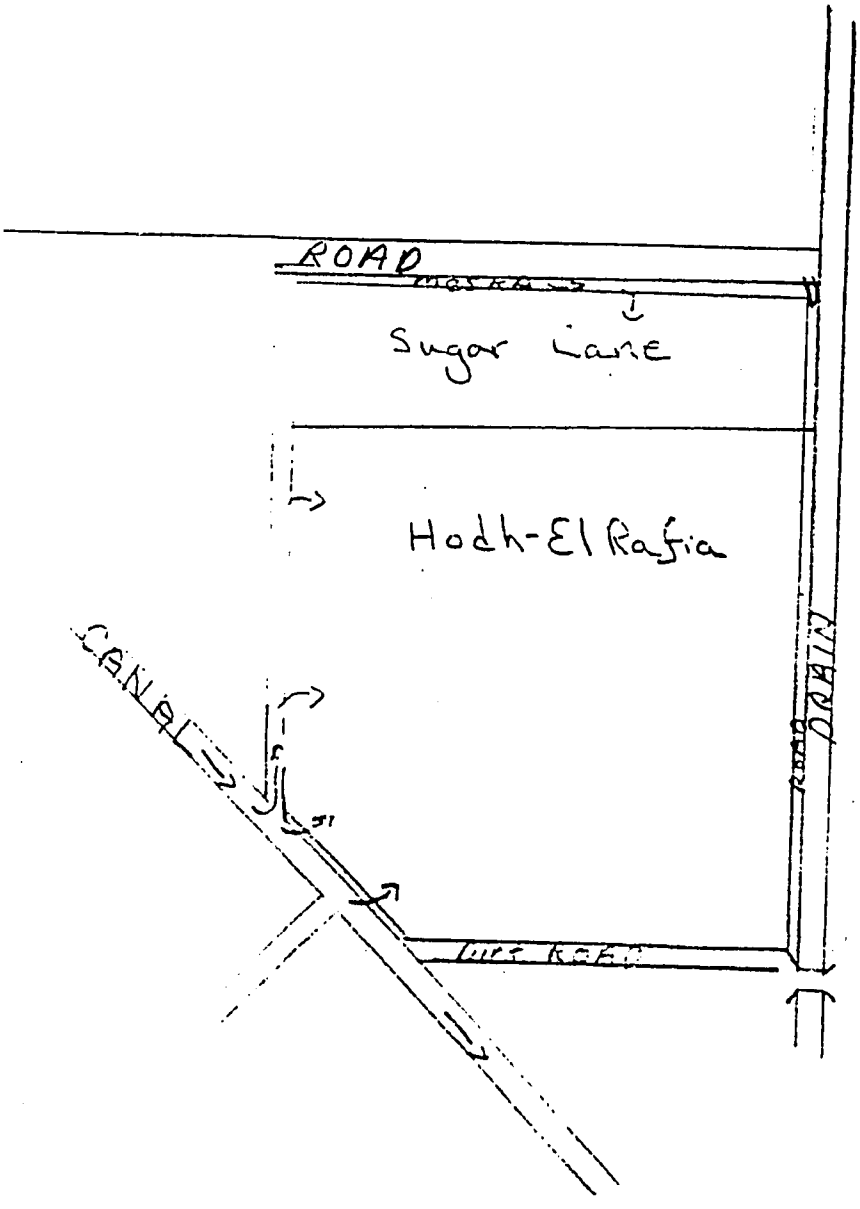

N.
Hadar Hazina
Meshek
Meshek
Meshek
Meshek
Visited this area

Figure 4 - Beni Abeed



A.6.1

Hodh Hazina: This basin is approximately 70 feddans in size and divided by the main road. Figure 3 also indicates the area of the part we visited. The basin contains a mix of crops, and is surrounded on all sides by mesqas. Originally, the farmers were suing a gravity system but are now forced to use tambours due to the water levels in the mesqas. These mesqas are reasonably maintained but have trees growing in them and on the banks.

Hodh El Rafia: This basin is approximately 65 feddans with a NW orientation. About 1/10th of the basin is in sugar cane and the rest has a mix of crops (see Fig. 4). The basin is bounded on the E. by a large, well-maintained drain. Three sides are served by mesqas with farms running the direction of the drain. The area is well serviced by roads, though the road near the drain is full of small chnnels which make the passage possible only for 4WD or construction equipment.

General Comments:

This preliminary reconnaissance indicates that the basin unit is a good one to use for selecting potential work areas. The area may, however, have to be split into sub-areas by mesqa for actual construction. Of the five basins visited, it is not certain that any would be free of crops in October for a period long enough to allow landleveling to take place.

The stand of crops is such that no survey could take place at present. Starting in September, as crops begin to come off the fields, the surveys may begin.

Visit to EWUP Site: We spend some time at the EWUP site, with Mr. Abd El Raouf and Dr. E. Nielson, discussing alternatives for cooperation and learning about EWUP activities in Minia. Two possibilities for cooperation appear to exist in Minia for the project: 1) in the mechanization of mesqa renovation and 2) in land leveling in the EWUP project area. We discussed problems EWUP has had in renovating mesqas in the past. They used a standard American-type v-ditcher to form the canals, but this ditcher kept falling into the canal and the tractor was constantly stuck in the ditch. The farmers had to complete the job by hand. Renovation involved leveling the berms of the mesqa into the canal and then reconstructing it to a uniform cross section. The varying top width of the existing canal is such that a tractor cannot always straddle the canal. We agreed to begin the process of selecting alternatives for the next construction period.

The EWUP staff were extremely responsive to having its leveling equipment working in its area in a training program. They are also very enthusiastic about using laser-controlled equipment. They are ready to begin leveling in one mesqa in early September, when they expect crops to be coming off the fields. The EWUP project staff will mount a laser mast in their leveling unit, if we so desire.

The staff also explained the development of mesqas 7 and 26, which included canal renovation, landleveling and formation of water user groups. Earthwork movement has taken place along the length of indivudal farms to avoid moving soil from one farm to another. Also, leveling has had to take place over 2 seasons to account for settlement of filled areas; they tend to overfill in an effort to avoid this problem.

Office Space and Housing: We discussed the availability of office space with Undersecretary Mohamed El Gamal and were informed that space would be made available to the project when the Department receives its new building.

A.6

FIELD TRIP: Minia, Sept. 19-22

M. McClung, A. El Fayoumi, H. El Banna, A. Marei

As agreed upon by Mr. E. Coles and Dr. A. Orabi, members of the Soil Improvement Subproject staff spent three days at the EWUP project site in Abyuja, testing the El-1 laser survey unit and observing the EWUP landleveling procedure.

EWUP personnel were leveling an area of 4 feddans which comprised four farms. They set out a grid space, 10m x 10m, marked by short blue and white flags. Dr. Nielson commented that their usual procedure was to stake out individual farms and vary the grid spacing to fit the farm boundaries, the maximum spacing being 10 m. Irregularities in the field are accounted for at the last grid spacing. This system allows earthwork calculation using the summation method (in 10m grid, 1 cm elevation represents one cubic meter). Although this method gives volumes 10-20% higher than more accurate methods, it is practical for field operations. Design elevations and cuts and fills are calculated in the field and a cut to fill sheet presented to the operator.

The system being used by EWUP involves earth movement in one direction, return to the top of the field being with the blade up. In Minia, the EWUP uses a land plane which, due to the long wheel base, has problems at the ends of fields. The four feddans surveyed were leveled in approximately 4 hours. The next day, the field was resurveyed to check for any additional leveling requirements, within a 1-2 cm leeway. The laying out of the grid deserves comment: The edges of the four sides of the field were taped out, as well as a cross piece midway down the field. This layout is shown in Fig. 1. The remaining pegs were placed by simply siting along two pegs down the field and two pegs across the field. This system, while providing sufficient accuracy, is much quicker as it eliminates a good deal of taping.

Another feature of interest is the use of three rod men in conjunction with the optical level. This allowed the 5-member survey team to complete the 4 feddans in about 20 minutes. This is in contrast to the 1-2 persons using laser equipment, who take approximately 45 minutes. The laser takes long due to the fact that only one rod is used and the shortcomings of that particular rod. This is detailed further in the memo. The concept of using several rods is particularly appropriate to the laser equipment. As reduced levels are not used, care must be taken to ensure that the use of rod readings does not result in reverse slopes. This had inadvertently been done by EWUP staff.

The El-1 laser unit is stated to be accurate to approx. 70 meters with an on-center accuracy of $\pm$ 1.5mm. The receiver will receive at longer distances with a consequent loss of on-center accuracy. This range is sufficient for surveying fields such as we saw. Some problems were encountered in using the level eye-receiver unit. The particular model and rod used were designed for finishing work on contstruction sites; the eye level has no backing and was prone to falling off the rod in the conditions we were working under. Since our return, we have discovered that another

rod and attachment unit is available.

During the trip, visits were made to the offices of Mr. Mohamed El Gamal, Undersecretary of State, and Mr. Ali Saada, Director of Agriculture, to inform them of project activities and to demonstrate the laser unit.

ANNEX B

REQUIRED ACCOUNTING PROCEDURES
FOR
MANAGEMENT OF AID FURNISHED LOCAL CURRENCY FUNDS

Annex B

Required Accounting Procedures for
Management of AID Furnished Local Currency Funds

Steven C. Shepley
Planning and Financial Advisor

Reference is made to the existing Accounting and Procurement Procedures for Management of Local Currency Funds Furnished by USAID. The procurement procedures and documentation requirements contained therein are still applicable.

Since publication of the above-mentioned document, the USAID Office of the Comptroller has directed format changes in the quarterly cash need statements and in the certified fiscal reports. The following sections provide guidelines to Sub-project Managers in the use and institutionalization of these format changes. These requirements pertain only to local currency requests and expenditure documentation and do not affect foreign currency operations.

Local Currency Budgets

As per Project Implementation Letter No. 17, amending Project Grant Agreement No. 263-9931, the AID furnished local currency budget for the Agricultural Mechanization Project was raised from $7,194,000 to $21.2 million. This budget has been sub-divided into the following categories.

Project Local Currency Budget
(LE)

Item	Amount	Purpose
Commodities	1,663,360	Demonstration/Training equipment (implements)
In-country training	831,680	Local training activities
Operating expenses	83,168	Vehicle operations
Facilities	58,218	R&D construction
Research support	1,663,360	Applied research
Studies/evaluation	605,463	Planning and evaluation
Credit funds	10,811,840	Service center, water lifting, and machinery credit funds

In order to sub-obligate these obligated funds, AID requires that quarterly Statements of Cumulative Expenditures and Certified Cash Needs be prepared and submitted with AID Form 1043 and Certified Fiscal Reports of previous expenditures prior to authorization for and disbursement of new funds. Use of these documents are explained below.

Advances are obtained on a quarterly basis through the cash need statement when previous advances have been accounted for. Cash need statements are to be prepared by each Subproject using an itemized budget format showing the categories of expenditures and amounts required. As the project local currency budget has been subdivided into six broad categories as per the table on page 1, above, there should be submitted individual cash need statements by Subproject and budget line item category. For example, if Training and Extension requires both In-country training and Commodity Funds, the Subproject Manager should submit a separate cash need statement for training and extension together with separate expenditure reports for both Commodities and for In-country Training. Submissions of these documents will be made to the Project Central Accounting Unit which will aggregate these Subproject documents in a general project-wide report for submission to USAID. The following documents are required to affect a cash advance:

1) Cash Need Documentation

   a) Voucher Form SF-1034

   b) A Certified Statement of Cash Need

2. Expenditure Information

   a) Voucher Form AF-1034

   b) A Certified Fiscal Report

All of the above documentation must be submitted in an original and three copies.

Use of Funds

All funds provided by USAID may only be used for the payment of allowable costs items under the Grant and any amendments thereto. For the purpose of accountability, any AID financed currency shall not be co-mingled with other currencies provided by the Grantee, the Government, or any other donor.

Forms and Illustrations

The Statement of Cumulative Expenditures and Certified Cash Needs, Form SF-1034 and the Fiscal Report are presented on the following pages as an illustration of the Advance-Review process for a typical Subproject transaction.

Accounting Files

The Project accounting file system shall be established and subdivided according to the six budget line item categories shown on the first page. These files shall document the expenditures of all Subprojects.

ANNEX C

C.1 LAND IMPROVEMENT WORKPLAN: SUMMARY

The following workplan consists of three sections:

1. Section 1: a review of the Egyptian situation and problem statement
2. Section 2: the research effort needed to address the problem statement
3. Section 3: the field implementation activities in the form of three working papers:
   a) Working Paper 1: Basin Survey in Minia Governorate
   b) Working Paper 2: Operational analysis of laser plane landleveling operations of the Delta Sugar Co.
   c) Working Paper 3: Land Improvement Demonstration Basin Program

In order to view the relationships within the overall workplan context, it is useful to show the causal relationships as follows:

Vertisol Soil Characteristics	Productivity Problems	Research Effort	Field Implementation
Section 1		Section 2	Section 3

This is the idealized relationship the Project will seek to establish. In the beginning the Land Improvement program will move from productivity problems to field implementation on a demonstration basis, based upon past research and existing practical knowledge. The research effort will come into play as the results become apparent. This summary review therefore concentrates on Section 1 and Section 3.

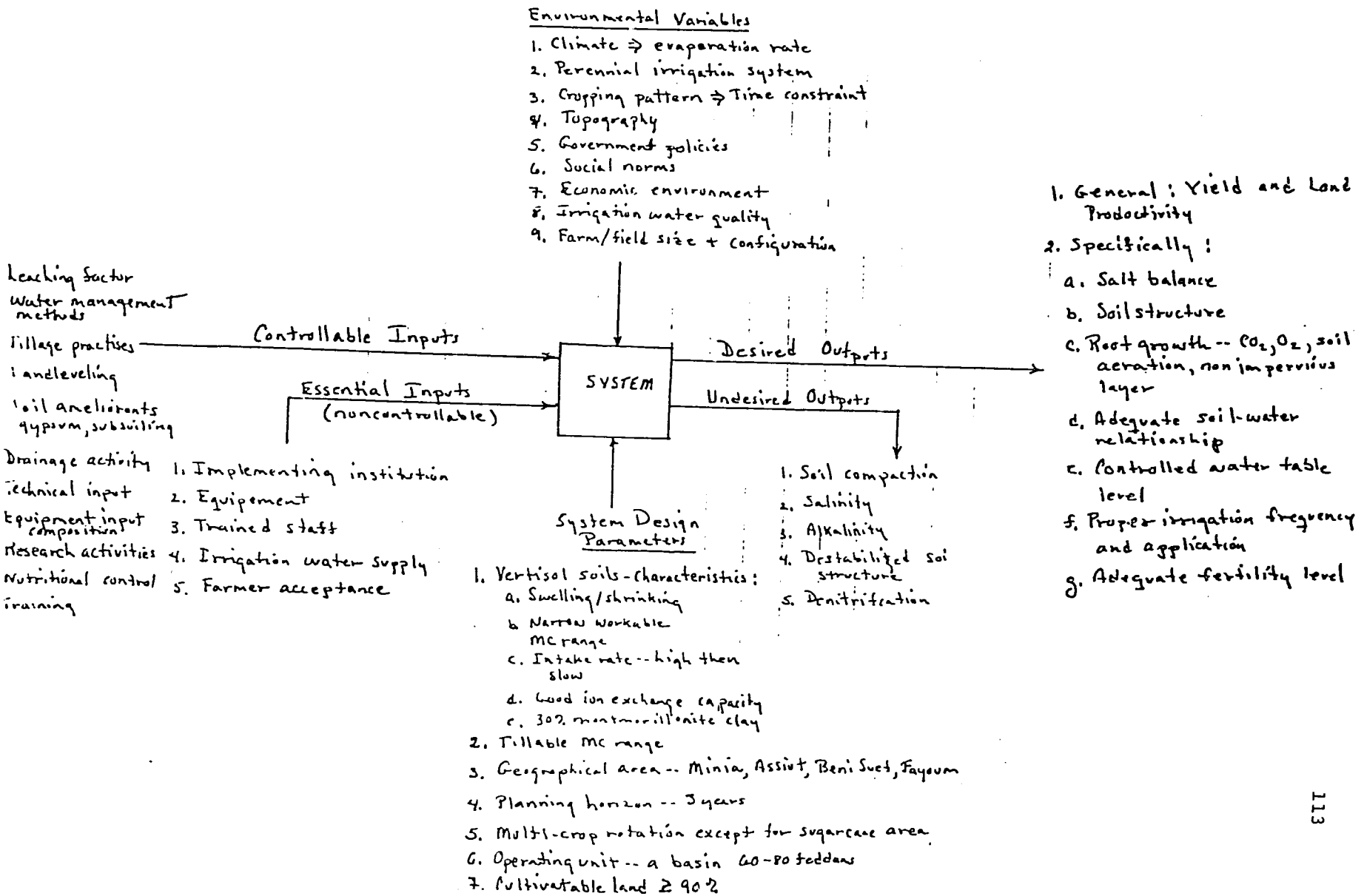
As Section 1 sets the foundation for the workplan, it is important to understand its implications. This will be done in two stages: 1) through the use of an input/output model, or a "black box" approach, and 2) a description of the basic structure of the input/output model. The purpose of the black box approach is to establish a framework in which pertinent variables can be organized in a systematic and orderly fashion. The result will

be a better understanding of the system's components and its boundaries. Then, the essential structure of the system can be discribed, i.e., a description of what parts affect what other parts. Once the basic structure is identified, then Working Papers 1, 2 and 3 can be fitted into the program rather than being reviewed as separate and unrelated activities. It must be remembered that this is a rather simplistic statement to a complex problem, but its purpose is to view the "whole" in a less complicated manner. It therefore does not reflect the detailed effort that has gone into developing parts I and II of the workplan and the first three Working Papers.

The input/output model is seen in Figure 1. First, the input and output categories must be identified:

1. Output variables
   a) Desired output: the objective variables of the system
   b) Undesired output: those variables that the system should minimize
2. Input variables
   a) Environmental variables: noncontrollable variables outside of the system that affect the system. They themselves are unaffected, or only weakly affected, by the system (otherwise, they would be included within the boundaries of the system)
   b) Design parameters: decision variables that are fixed during operation of the system, describing the boundaries of the system and the attributes of the system's structure
   c) Noncontrollable essential inputs: necessary inputs for the system to function, therefore essential and noncontrollable, e.g., fuel and oil in a tractor system
   d) Controllable inputs: variables that can be altered during system operations, variables that are responsive to feedback signals during system operation.

Returning to Figure 1: the desired objective is an increase in soil productivity expressed in yield. This is more specifically stated in terms of desired and undesired soil characteristics. Fundamental to this is controlling a proper salt balance at a minimal sodium level. Of the design parameters, the vertisol soil


Environmental Variables
1. Climate ⇒ evaporation rate
2. Perennial irrigation system
3. Cropping pattern ⇒ Time constraint
4. Topography
5. Government policies
6. Social norms
7. Economic environment
8. Irrigation water quality
9. Farm/field size + configuration
Leaching factor
Water management methods
Tillage practices
Landleveling
Soil ameliorants gypsum, subsoiling
Drainage activity
Technical input
Equipment input composition
Research activities
Nutritional control
Training
Controllable Inputs
Essential Inputs (noncontrollable)
1. Implementing institution
2. Equipement
3. Trained staff
4. Irrigation water supply
5. Farmer acceptance
SYSTEM
System Design Parameters
1. Vertisol soils - characteristics:
a. Swelling/shrinking
b. Narrow workable MC range
c. Intake rate -- high then slow
d. Good ion exchange capacity
e. 30% montmorillonite clay
2. Tillable MC range
3. Geographical area -- Minia, Assiut, Beni Suef, Fayoum
4. Planning horizon -- 3 years
5. Multi-crop rotation except for sugarcane area
6. Operating unit -- a basin 60-80 feddans
7. Cultivatable land ≥ 90%
Desired Outputs
Undesired Outputs
1. Soil compaction
2. Salinity
3. Alkalinity
4. Destabilized soil structure
5. Denitrification
1. General: Yield and Land Productivity
2. Specifically:
a. Salt balance
b. Soil structure
c. Root growth -- CO_2, O_2, soil aeration, non impervious layer
d. Adequate soil-water relationship
e. Controlled water table level
f. Proper irrigation frequency and application
g. Adequate fertility level

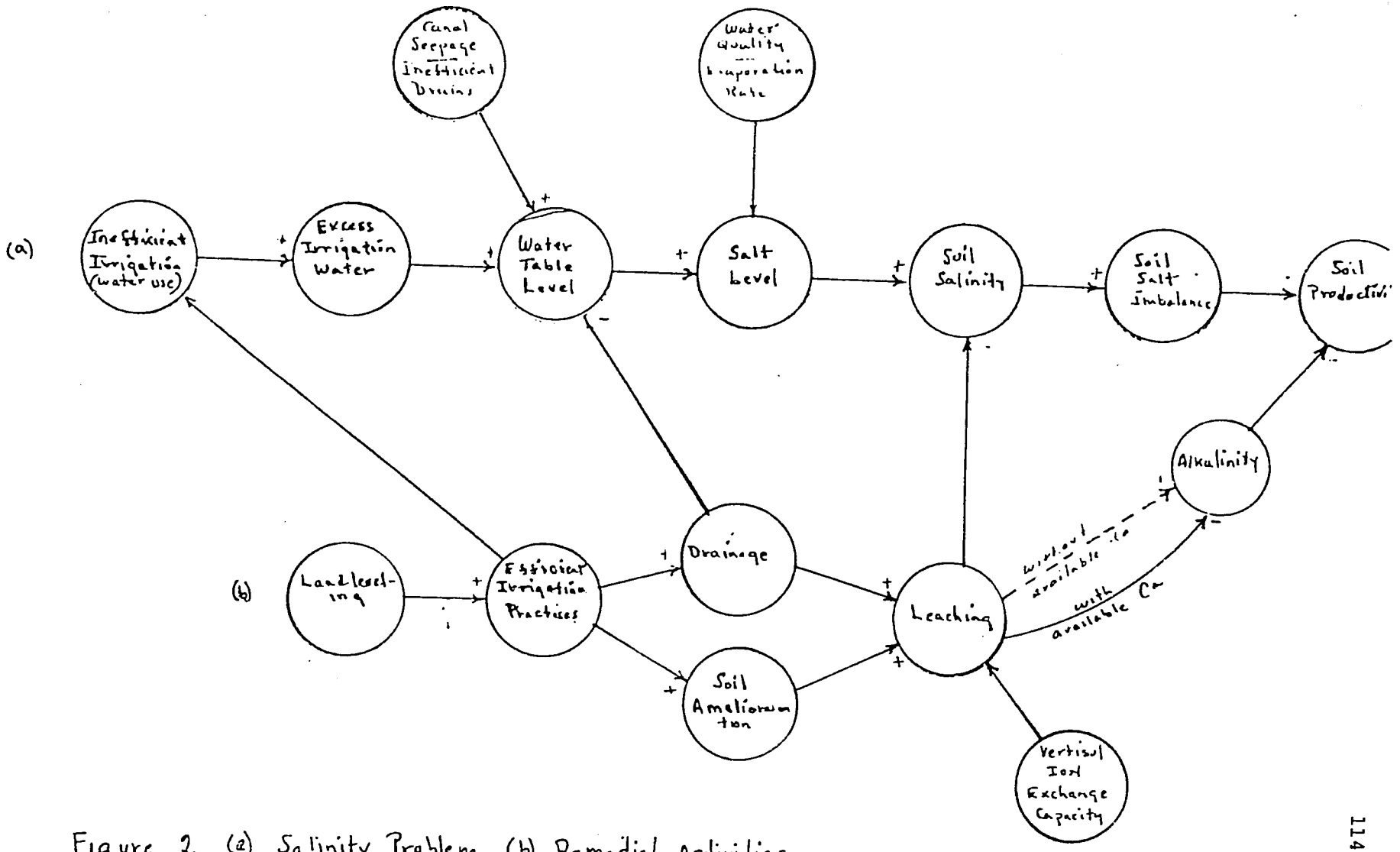


Figure 2. (a) Salinity Problem (b) Remedial Activities

is the most dominant factor, while the other parameters deal with the geographic, agronomic, and spatial limitations of the system. The environmental variables are self-explanatory; the list does not pretend to be all-inclusive. There are several key variables associated with the essential input category: 1) an implementation organization, since the Project does not have an implementing capacity; 2) trained staff and equipment to carry out the work, and 3) acceptance of Project activities by the farmers. The controllable inputs are self-explanatory. These inputs can be adjusted as feedback occurs from the operating system.

The structure of the system can be described through the interaction of the variables that influence the soil salt balance and sodium level. The existing process is described in Figure 2a: inefficient irrigation increases excess irrigation water, and along with canal seepage and inefficient drains, increases the water table. This is turn adds to the salt level which in turn adds to soil salinity. Soil salinity increases the soil salt imbalance, descreasing soil productivity. Soil productivity is also decreased as alkalinity increases.

Figure 2b suggests a rememdial approach by landleveling, to increase efficient irrigation practices, as efficient irrigation reduces inefficient water use and increases drainage and soil amelioration activities (i.e., subsoiling and gypsum application, on the lands the Project is concerned with). Increased drainage lowers the water table and supports leaching, which in turn reduces soil salinity and exchangeable sodium, on the assumption that there is available calcium. Leaching is possible because of the ion (base) exchange capacity of the vertisol soils.

The problem then is basically one of soil salinity, which requires an integrative approach for solution, since remedial activities are highly interdependent. Again, it should be noted that the simplistic presentation in the diagrams masks its actual complexity.

The initial plan for activation of these amelioration activities are developed in the first three Working Papers and in the development of a training manual. Their relationship to the problem is shown in Figure 3. Briefly, the Working Papers comprise:

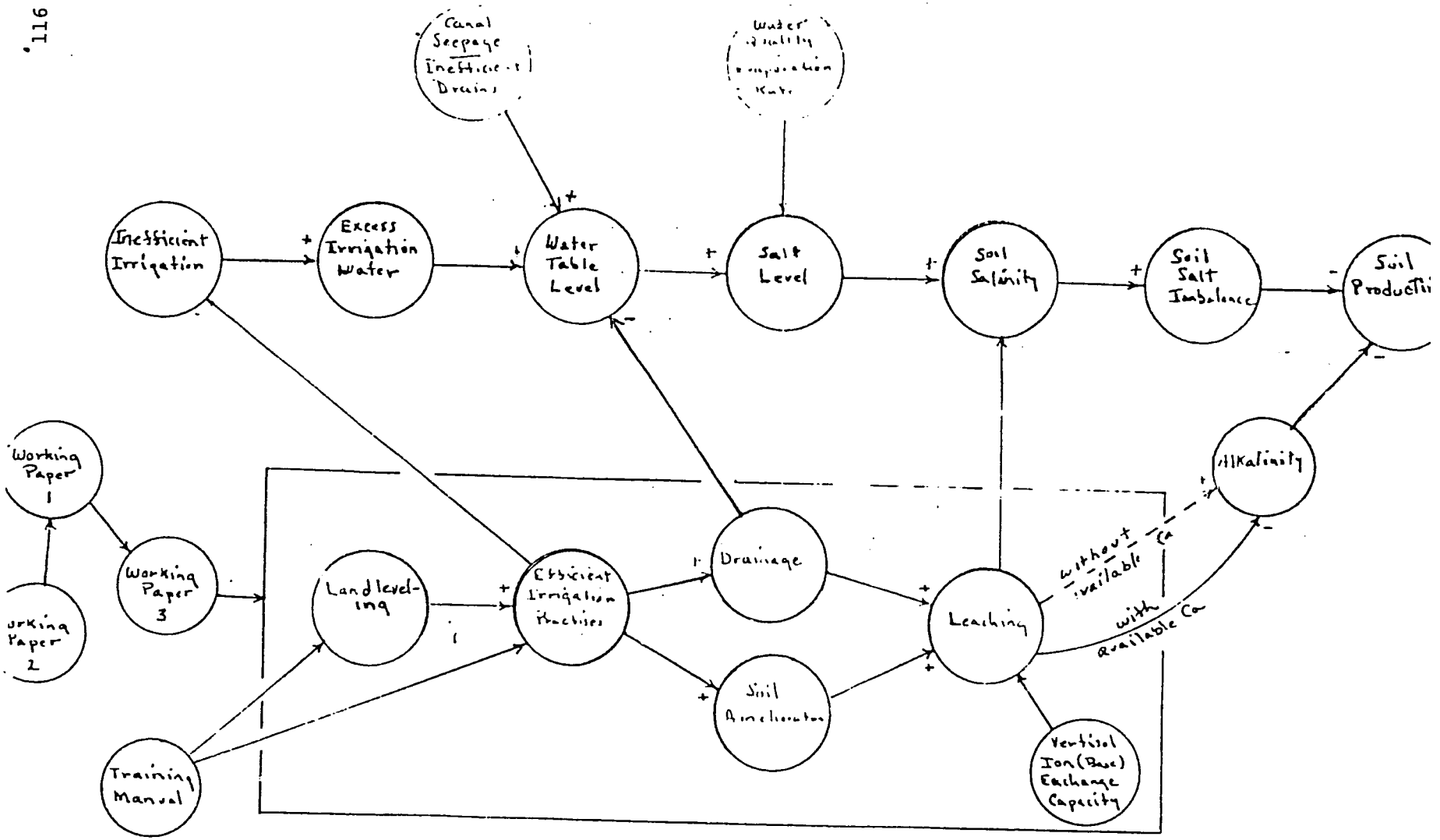


Figure 3. Initial Project Activities Relative To Amelioration Activities

1. Working Paper No. 1: Basin Survey, Minia Governorate
The purpose of this Working Paper is to determine the extent of land improvement activities in Minia Governorate. This survey is divided into two parts: Part I relates to the preliminary data-gathering activities identifying a) the number of basins, b) their size and approximate area per markaz, c) the field crops, orchards and nonproducing areas, and d) the cultivable land out of production and season. Part 2: Basins are selected involving two types of studies, a topographic survey, and a sociological survey. The net result is a description of Minia Governorate that details: a) earthmoving volumes; b) types of landleveling, i.e. primary and secondary leveling; c) equipment selection and equipment capacity; d) specific amelioration activities (subsoiling and/or gypsum application); e) available working time; and f) farmer acceptance and implementation attitudes. The conditions are thus set for beginning with a specific demonstration basin to act as a training exercise for the SAO for evaluating the land improvement needs of Minia Governorate.

2. Working Paper No. 2: Land Improvement Basin Demonstration Program. The purpose of this working paper is to present a plan of action that will demonstrate the basin improvement methodology in the four governorates of the land improvement activity, Assiut, Minia, Beni Suef, and Fayoum. Essentially, this is an expansion of Working Paper No. 1, from the Minia model to the other three governorates. Consequently, Working Papers 1 and 3 may be reviewed together. The highlights of the two papers include:
   a) Establishment of demonstration basins in Assiut, Beni Suef, and Fayoum showing basin design, construction, and reclamation methodology;
   b) Selection of a basin in each markaz of each governorate for improvement;
   c) In each basin an implementation procedure that will identify basin needs, setting the stage for field implementation activities;
   d) A PERT network plan for implementing the needed activities in each basin.

The approach that emerges may be summarized as follows:

a) The land improvement problem is basically one of soil salinity, requiring an integrated approach;
b) The remedial activiteis of landleveling, subsoiling, gypsum incorporation, and drainage are interdependent and must be applied in a coordinated manner;
c) The workplan therefore calls for grouping the remedial activities into a specific equipment set capable of landleveling, subosiling, gypsum incorporation, and drainage within a basin area. The basin as here defined is "the smallest area to which water is delivered by the Ministry of Irrigation and the smallest administrative unit identified by the Ministry of Agriculture."
d) The rehabilitation work within a basin will be based upon topographical, soil, and socio-technical surveys. This will lead to the development of a basin design, acceptance and/or modification of the proposed design by the farmers, and implementation of the design. Because implementation must take place between cropping seasons when the land is clear, a high degree of coordination between farmers and the technical input is vital and critical.
e) The first demonstration basin will be in Minia governorate, followed by similar demonstrations in Fayoum, Beni Suef, and Assiut governorates. It is anticipated that the diffusion effect will lead to full institutionalization of this project as a permanent program.

PART I: PROBLEM IDENTIFICATION

Soil Factors

A great deal of research data has been published in the field of soil science, but little of this research has led directly to improving agricultural production or to halting the steady march of soil deterioration. There is no complete or systematic soil survey of the Nile Valley, although an extensive "land classification" survey was conducted in 1963.(1) This survey is still used as a basis for planning soil improvement programs and cropping programs. Land classification surveys are empirical and require frequent revision or resurveying, while a systematic soil survey provides basic information on the essential properties of the soil from which specific data can be obtained for predicting the performance of crops under various cultural practices. Inferred qualities include productivity, fertility, drainability, tillage requirements and measured factors of infiltration, hydraulic conductivity, moisture retention, and changes in these factors can also be predicted. Topographic characteristics can be simultaneously recorded with other field work and such factors as the need for land leveling can be predicted.

In present circumstances, a detailed inventory of the soil resources of the Nile Valley which can be interpreted from time to time is needed to give enlightened answers on the above parameters without carrying out new field surveys each time a major soils problem arises.(2)

A partial soil survey was carried out in various parts of the Nile Valley in 1963(3) using the local soil classification system to describe the soil series. This survey was, however, incomplete and was primarily used for new lands development and reclaimed areas in the Delta. Since then, the Egyptian Academy of Science(4) has begun collating soil data describing the soils in terms of U.S. Soil Taxonomy.(5) It should be pointed out that while this system is widely adopted because of its precise methodology of classifying soils, the FAO system(6) is used in several countries and the "soil map of the world" (1979) is based on the FAO system.

Soils of the Nile Valley

The soils of the Nile Valley are derived mainly from materials deposited by annual floods and have developed into mature profiles under the influence of temperature, water and the activities of man, while the soils of the northern delta region have been influenced by marine activity. The soils adjacent to the Nile Valley are different in that they are more sandy and tend to be calcareous and of recent formation.

There appear to be three main soil orders in the soil continuum of the Valley and valley edges:

1) Vertisols: Vertisols are defined as soils that are heavy, cracking clayey soils with more than 35% clay and greater than 50% 2:1 lattice minerals in the clay fraction, usually shrinking and swelling, forming deep wide cracks when dry, and sealing up when wet, and having a high bulk density between cracks. Some soils show self-mulching characteristics, have slicken-sides and wedge-shaped peds, and a gilgai micro-relief is common. Variants of this soil are shown in Table 3.

The soil, though fertile, presents many problems to modern agricultural practices, particularly when irrigated. Because of the flat terrain on which vertisolic soils usually occur, it is usually assumed that such areas are ideal for irrigation (e.g., the Gezira region of the Sudan). Actually, these soils present great soil manangement problems when subjected to mechanization and irrigation. These soils account for only a small area of the world's soils, approximately two percent.(7) Thus, they have not attracted a great deal of scientific interest until recently.(52)

2) Aridisols: An aridisol is defined as a soil that occurs in areas with a very dry climate. An outline of the variants of this type of soil is shown in Table 3. In Egypt, typical soils of this type are found in the Fayoum Oasis area. This soil order occurs extensively throughout the arid regions of the world and occupies some 18 percent of the total soils.(7) They occur also in the "New Lands" of the Nile Valley and to some extent along the fringes of the Valley.

3) Entisols: The entisols are newly formed soils usually not having a well developed profile, except perhaps for a bleached horizon from which clays and free oxides have been leached; the horizon shows no development. These soils occur in the Nile Valley as sandy soils or recent alluvial soils, and are found along the VAlley walls, the "New Lands," and in the New Valley (Kharga Oasis area).

As the vertisols are the most widely distributed soils in the Nile Valley, accounting for approximately 90% of all soils, and since most of the Agricultural Mechanization Project work will be concerned with them, the properties of this class of soils will be examined in some detail.

The Physical Properties of Vertisols

The physical properties of vertisols differ markedly from other clayey soils, in that the primary clay fraction is montmorillonite. This mineral consists of alternate layers of silica and alumina separated from each other, the mineral has the ability to take on other molecules in large numbers, and it swells when wetted and shrinks when dried. Exchange capacity is very great, so that salinized soils can easily be leached and hence "reclaimed." However, the wetting and drying cycle can cause extreme shrinkage and swelling, leading to many engineering problems: foundations crack, structures tilt, and canals leak, if not kept permanently wet.

A notable characteristic of the vertisols is slickensides in the subsurface section--smooth, polished or grooved soil aggregate surfaces--while the upper layer (or horizon) may be mechanically mixed and display typical self-mulching characteristics. This feature also has a great effect on tillage operations, irrigation, crop plant selection, and generally on overall management activities of crop production.

The properties of heavy clay soils have been summarized as follows, given what facts are known about clay soil structure and incorporating hypotheses supported by measurement: (53)

1. The type of clay is the dominant soil property determining structure in soils with more than 35% clay.

2. Micropeds, of + 250 micron size, are very common in clay soils. They can be weakly developed to the point where they determine apparent soil texture.

3. Clay particle movement, including swelling and shrinking, results in spaces between units of structure.

4. Cracking patterns in clayey soil properties and environmental conditions:

   a) The pores can be related to different levels of organization of the soil structural units. Taking into account the sizes of pores and of biota in soils, the importance of such processes as fluxes of water and gas can be inferred.

   b) The vlume of these pores decreases or increases in different ways on wetting and drying. Pores holding plant available water decrease on drying, but large transmission pores increas.

   c) A fissure, once formed, will occur again on redrying. Particle rearrangement at the ped surface results in a plane of weakness.

5. The plant root environment as well as successful manipulation of the physical conditions of clayey soil by tillage depends upon the pores. Fluxes of water, gases and nutrients occur in the pores; the friable conditions of the soil results from separation of structural units.

6. Slow swelling, over several weeks, seals fissures between peds. This occurs under zero suction, when the soil is water-saturated.

7. Wet sieving to measure size distribution of stable aggregates larger than 0.5mm is <u>not a valid test</u> for stability of clayey soil structure.

8. The significant aspect of stability of clayey soil structure is the permanence of fissures or pores. Therefore, measurement of stability should measure this

characteristic. Changes in water retention, curves on wetting and draying cycles or permeability of slaked samples are such measurements.

9. Organic matter has its largest role in the fabric and strength of small structure units, 1.50 micron conglomerates and 50-500 micron micropeds.

The Soil Profile

The soil profile, a vertical face exposed down to 1.5m, displays the essential horizonation characteristic of the soil type. These horizons, together with the color, texture, structure and certain chemical proportions are diagnostic of soil type. A description of a typical vertisol, aridisol, and entisol are given in Table .

Vertisol: Physical Factors

Vertisols are strongly structured, the dry surface layer having a fine, granular structure (self-mulching) to fairly coasre, blocky structure. The cracks between the peds (soil blocks) may be as much as 20-40mm wide and as deep as one meter, or more in very dry soils. Surface cracking usually displays a polygonal pattern and a gilgai surface relief is typical.

The next horizon, 300-500mm below the surface, displays slicken-sides to some degree, cracking is apparent, and gypsum or lime may be present.

The real porosity of the soils may be very low, while the bulk density of the soil peds is high. Thus, the apparent porosity depends on the degree of cracking: in highly deflocu-lated soils the porosity will be very low, bearing in mind that defloculated clays tend to be alkaline as a result of leaching of excess slats without replacement of exchangeable sodium with calcium. Such soils are highly dispersed; sodium saturated clays may be transported townward in the profile and accumulate, forming dense layers or clay pans.

Soil aggregation--or structural stability--is used as a measure of soil structure and is measured by wet sieving. However, this technique has not proved satisfactory for clay soils and is certainly not adequate for vertisols, though infiltration rates give some indication of structural stability. Water retention curves of the wetting and drying cycles provide a satisfactory method of measuring stability.

Table indicates the threshold levels of infiltration for some soil orders. The infiltration rate in the vertisols is obviously much lower than in soils of other orders; the initial infiltration of clays is usally rapid for a short time, then decreases to a very low rate.

The poor aggregate stability of the vertisols is associated with low organic matter content and high levels of soluble sodium.

These soils are tilled at a much narrower moisture range than other soils, but when they are dry, shrinkage and swelling break them into massive clods of such strength to make most tillage practices unfeasible. Conversely, when wet, they are too soft and too sticky.(8) Thus, their workability is limited to a narrow soil moisture range when preparing a seedbed. Under Egyptian conditions, the seedbed consists of fairly coarse clods on the surface on which seeds are sown. The field is flooded and the coarse clods disintegrate, covering the seeds. The dry condition may be better for deep tillage, or subsoiling, for the soil would break up to a greater depth; but the question is what would happen when the soil is saturated after such costly operations and how long the beneficial effects would last. Indications are that the benefits would be shortlived.

Compaction of vertisols with low sodium content is almost impossible, due to their swelling and shrinking cycle. This has been observed in the construction of roads in many parts of Africa. Many methods have been used in an attempt to stabilize such soils--sealing the road prism with PVC sheets to maintain a constant moisture level, or using various salts. Under irrigated conditions, the slow addition of salts (mainly sodium) from the irrigation water, together with agitation of the soils from plowing and other tillage practices, tends to make the sodium-saturated clays move down, forming a compacted layer. Mechanical compaction of the topsoil progresses as more sodium is added to the soil and as calcium is leached in the lower layers. Hence, regular use of gypsum is indicated.

Water Movement

Vertical movement of water through the profile of a vertisol ranges from a very high rate when the soil is dry and cracked to a very low rate when saturated. The fissures are therefore important for the movement of water between the soil peds, as this is the primary route of water movement. The movement of water within the peds, which have a high bulk density of 1.4 to 1.5 gms/cm^3, is very slow. Intrinsic permeability in a vertisol, i.e. the property of the porous body alone and not of the fluid, expressed as length squared, may be much less than the apparent permeability, which is expressed as length and is normally measured in the field by the augur hole method. This value is the basis of drainage design in non-shrinking clay soils, while in these heavy clay soils, hydraulic conductivity is very low compared with other, lighter soils (Table 2). Furthermore, the rate of water movement through the soil is not constant over time and varies with the chemical content of the water. Figure 1 shows that it is possible to maintain the permeability of the soil irrespective of the level of sodium saturation by using water with a comparable electrolyte strength. The electrolytic concentration of irrigation water can be increased by adding gypsum, or in the case of highly alkaline, defloculated soils, by adding sodium chloride or saline drainage water. As the soil becomes more permeable, the level of salt water is reduced in successive steps and calcium is added to maintain the calcium content. This method is known as the "salt dilution" technique. When alkaline soils become defloculated, shrinking and swelling become less pronounced. The

surface characteristics change, becoming finely divided, fluffy and in extreme cases, salt crystals are distributed on the surface. At this stage, water moves through the soil very slowly.

Water Retention

Although total pore space or porosity in heavy clay is greater than in lighter soils, the available soil moisture is also much higher, from field capacity to permanent wetting point (see Figure 2). Consequently, water applications are needed at greater intervals than on lighter soils, but where salinity is prevalent, less of the soil water is available to plants because of the increase in the osmotic pressure of the soil solution. Thus, the more saline the soil, the more frequently the soil will have to be irrigated to maintain the relative availability of water to the crop. The situation can arise where salinity increases to a level where the soil is completely saturated and normal crop plants will expire; an anerobic condition develops in which only halophytes and hydrophytes can survive.

Leaching

Once salinity levels reach a point where crop plants cannot survive, it may be too late to economically reclaim the soil. The only way that salts can be removed is by leaching the salts out of the profite or the root zone via a drainge system, either open drains or closed subsurface drains, unless an exceptionally deep, permeable subsoil exists with a deep, stable groundwater table.

The procedure for leaching soluble salts out of the soil profile or root zone consists of maintaining a salt balance within the tolerance limits of the crop plants to be grown. Nominally, crop tolerances are taken as yield decrements as salinity increases.

The leaching process requires a regular supply of water and adequate drainage facilities. The minimum depth is calculated on a monthly or annual basis. The leaching requirement may be based on the salt balance procedure, the continuous column model, or the series of reservoirs model.(11) Computer simulation may be used to study the salt balance in the soils of the Nile Valley.

Rooting Depth

Rooting characteristics are specific for each crop species. However, the species tends to adapt its rooting depth in inverse proportion to the water-holding capacity of the soil, thus making effective storage capacity of all types of soil appear uniform for a given crop species, while rooting depths are usually deeper in lightly textured soils than in clay soils.

There is evidence that roots are repelled by higher CO_2 concentrations at the deeper levels in heavy clays, and that other harmful organic compounds that accumulate in heavy clay inhibit root development, particularly if anerobic conditions develop. Optimum root development occurs when soil air content is 9-13%.(13) With low levels of carbon dioxide and a wetting-drying cycle, irrigation water tends to contain excessive levels of carbon dioxide and the water displaces oxygen in the soil. The relationships of irrigation methods--flooded basin or furrow methods--and tillage and their effects on root development need to be investigated.

SOIL MANAGEMENT

The yields of most of the commonly grown crops in the Nile Valley on heavy vertisol soils are relatively high and have been consistently high for many years. Recently, however, declines have been reported in these yields which are attributed to various causes that will be discussed in turn, after a description of the cropping systems.

In broad terms the Nile Valley can be divided into three main regions:

a) the southern region where the cultivation of sugar cane predominates, with minor mixed cropping;

b) the middle region where mixed or multicropping is practiced, and

c) the northern or Delta region, where a mixed system of mutlcropping and rice culture is practiced.

In the southern and middle regions, perennial irrigation is needed to maintain crops over the growing seasons. Cropping intensities are high, averaging over 100 percent, and they are in some instances as high as 120 percent or more. In the northern region wet rice culture is included in the rotation along with cotton and forage crops. Details of crop rotations and irrigation water allocations can be found in the literature.(14,15)

In each of these regions different soil management practices are required, the northern region being more complicated due to its long-term cotton crop and wet rice crop.

The more obvious factors contributing to declining yields may be summarized as follows:

1) Since the construction of the Aswan High Dam the irrigation regime in extensive areas of the Valley has been changed from annual flooding to continuous perennial irrigation. The rise in groundwater levels thoughout the Valley has been attributed to the High Dam, but the absence of proper studies relegates this factor to the realm of speculation. However, increased water applications for increased cropping intensities does contribute surplus irrigation water to the groundwater. The soil

has little opportunity to dry out and crack and thus allow some groundwater to dissipate by evaporation. With extensive overall increases in irrigation intensity, groundwater tends to build up universally, further reducing opportunities for dissipation. Intensive cropping's need for continually increased water applications leads to the next factor, salt imbalance.

2) Salt imbalance in the soil leads to a significant yield suppression. As salt content increases, plants show signs of moisture stress, more water is applied, and the vicious cycle of more water, more salt, sets in.

3) Excessive salt accumulation leads to the attempted cure of leaching the salts into the lower horizon, resulting in alkaline and finally sterile soils that reach a point of zero production.

4) Before the "zero point" is reached, farmers become aware of the problem and other difficulties arise: the soil becomes defloculated, difficult to till, crusting occurs and permeability is lost. At this stage yields are seriously curtailed and highly silled soil management is needed.

Soil management involves maintaining an equitable fertility level, favorable salt balance, and a moisture regime consistant with crop water needs in a particular environment. The management of clay soils is based on the following considerations:

1) Clayey soils with good structure can be very productive. Knowledge of the structure is required to determine the manipulation necessary to achieve a structure suitable for plant growth. Management of clayey soil structure requires a large input of knowledge of such a soil.

2) Alternating wetting and drying are necessary to maintain a friable clay soil structure.

3) Cracking, or drying, is necessary to provide the pores necessary for fluxes of water, gases and nutrients.

4) Cracking patterns, hence the size and nature of pores, can be influenced by the rate of drying and by alteration of chemical properties, e.g., the addition of free lime.

5) Infiltration of water is rapid in a dry clayey soil but decreases to very low values after the cracks are closed. Therefore, water should be applied to clay soils at a high rate of speed for short periods of time.

6) Clay soil should not be allowed to be water-saturated for more than a few days, in order to prevent sealing of the microfissures by slow swelling; surface and subsurface drainage helps achieve this.

7) Relative suitability of clay soils for crop production can be measured as stability of pores. An initial classification of structural stability should be made using the water coherence test.

8) The "mulch" of small aggregates formed at the soil surface by cracking is an important part of a suitable structure. This structure should extend as deeply as possible into the soil. Heaping up surface aggregates is one method of achieving good structural depth.

Maintenance of Fertility

The fertility of vertisols can be achieved by maintaining the clay fraction in a dispersed state and by maintaining a high organic matter content. For dispersal, calcium must be replaced in adequate quantities when the exchangeable sodium is leached from the soil. Maintaining a high carbon to nitrogen ration (C/N ratio) depends on a high organic content, achieved by applying manure or using crop residues (wheat and rice straw) or by growing cover crops, though this may not be appropriate in the Egyptian context.

In present soil improvement programs gypsum is used as an ameliorant. Investigations into using gypsum on a more regular basis, or applied in a different manner such as by adding it to irrigation water on a regular basis as with fertilizers, should be considered.

The interaction of the clay fraction and humic materials, as well as the role of colloidal materials such as allaphane, should also be investigated, particularly with respect to maintaining high fertility levels in heavy clays. The role of other fertility factors such as phosphates, potassium and micro-elements should not be excluded. Above all, the cost effectiveness of maintaining soil fertility at realistic levels will have to be established during the course of such work.

Salt Balance

Maintaining an equitable salt balance is essential to crop production and to keeping the soil in a dispersed state. The cost/benefit relationship will depend upon such parameters as irrigation intensity, drainage intensity, crop yield and tolerance of salinity. Much of this work can be done by simulation techniques and such work should precede costly field trials.

Tillage and Soil Aeration

Tillage, the mechanical disturbance of the soil down to the limit of the effective root zone, provides a favorable environment for plant roots, buries weed seed and incorporates fertilizers. Phenomenal increases in yields in the heavy vertisolic clays of the Nile Valley have been claimed fro various forms of "deep" tillage,(16) though precise measurements of yield increases have not been substantiated in the field. Though there is little doubt that such tillage practices are beneficial, the cost/benefits of deep tillage have not been established. Furthermore, the optimum depth and frequency of such tillage have not been studied in detail.

However, the mechanisms involved in manipulations of the soil have not been thoroughly investigated either. It has been fairly well establihsed that carbon dioxide does depress root growth in heavy soils(12,13) under a high moisture regime, and this needs to be investigated in the field by measuring the relation of various root depths and irrigation applications. These studies should be further related to various degrees of clay dispersion and alkalinity.

The formation of impervious layers, or "hardpans," may be attributed to the accumulation of dispersed clay illuviated through the top soil layer. Such illuviation can be caused by tillage action, by irrigation water or by the wetting and drying of the soil. The movement of tractors over the soil surface may be only a minor contributing factor in forming a compacted layer. Identification of the primary cause for such impervious layer formation should be a subject for study.

Irrigation and Drainage

Three considerations are involved in the subject of irrigation and drainage:(53)

1) the method of irrigation: traditional basin, level basin, level or sloping furrows;

2) leaching requirements to maintain the salt balance and fitting this into the regular irrigation regime, and

3) drainage facilities to control the water or only to maintain the salt balance.

Flooding the soil surface as in the basin method has resulted in yield depression for many crops on other types of soils, but this has not been investigated on Egyptian heavy clays. The benefits of ridge furrow systems compared to basin flooding may need to be examined in relation to more advanced mechanization techniques, though mechanization is not the only reason for selecting one method over another.

Soil management thus implies management of both irrigation and drainage in an equation that results in an equable salt level in the soil achieved by a means of adeuate drainage. Drains must be placed a correct spacing and depth, depending on the hydraulic conductivity of the soil and the leaching requirement (or, the drainage coefficient). The design principles will necessarily be different for "groundwater control," or maintaining its level at a predetermined level below the root zone.

The drain spacings applied in these soils in the Nile Valley appear to be too far apart and at too shallow a depth. Wide spacing and shallow depth are generaly due to cost factors. Laying drains by hand in open trenches is costly and the faster and less costly method of trenchless drain-layers laying perforated corrugated flexible PVC pipes should be considered.

The use of mole-plowing may be a cost effective method of improving drainage and leaching in the heavy clays, but investigations will be needed to develop techniques for their installation. (17)

The management of soils under the three forms of cropping or cropping systems will differ markedly. In the case of sugar cane, heavier implements and higher powered tractors are needed to till the soil and break up the cane roots and stalks. This operation occurs after the third or fourth ratoon, or every four or five years. Inter-row tillage occurs annually to control weeds after each cutting until the new canopy forms which shades out the weeds. Other factors concerning soil salinity and irrigation methods apply equally to sugar cane. The furrow method is most commonly used for irrigating sugar cane and unlike most other areas, the cane lands had always been leveled before planting. However, a rising watertable is causing decline in yields. Although this is attributed to the High Dam, it is more likely caused by unmaintained main and secondary drains. The farming conditions in the cane growing region differ markedly from other regions: cane harvested by farmers is processed by the central mill, which in turn provides all necessary inputs and then deducts the cost from the value of the crop.

In the multicropping regions the small family farm system predominates and is based on family labor and animal power for the main farm activities, while hired labor is used if at all only at harvest time. For the most part, mechanization is limited to hiring or contracting tractor plowing. The small two-wheeled multi-implement tractor used extensively in small farm systems in other areas of the world is not common in Egypt. Emphasis is placed instead on larger tractors, 60-70 horsepower, as these are more suitable for contracting work and are available from the village cooperatives or from private operators. Nominally, membership of small farmers in the cooperatives is compulsory and they exist in each village, serving as the main channel through which extension, credit and marketing are organized.

In the cane growing region, the most commonly used irrigation method is the traditional basin method, consisting of small basins 8-10 meters square in area but generally in longitudinal plots, bound by shallow drains on either side. An interesting feature of the drains is that they form boundary markers and drain off surplus irrigation water that would otherwise collect in lower level plots. Loss of irrigation water contributes to low irrigation efficiencies and to the detrimental effects of excessive flooding of the soil. Land leveling is used to improve irrigation efficiency and halt soil deterioration.

In the northern Delta region, rice is grown extensively together with cotton and fodder crops. Soil management consists of two, almost diametrically opposed, methods: puddling the soil and then flooding it for long periods to leach out salts.

Wet rice culture is then followed by cotton which, though tolerating salinity, requires free root zone conditions. The cost of preparing wet rice lands for subsequent cotton cropping is high if favorable yields are to be obtained.

Vertisol Nutrient Status

The fertility of heavy clay soils is a complex subject and cannot be addressed fully here except in the broader context of the relation of mechanical treatment to soil management.

Rice culture presents special soil manangement problems:

1) breakdown of aggregates;(39,40,41)

2) activity of microflora, mainly anerobic;

3) degeneration of soil stability and of the cementing agents;(38,41)

4) oxidation of rganic matter;

5) effects of chemical changes, redox factors, sodium saturation.

The puddling of rice plots is the most destructive activity, particularly if other crops are to be grown on the same soil. Puddling is a process of breaking down soil aggregates to a slurry by mechanical agitation of the saturated soil. Tillage activities will unintentionally puddle soils if carried out at high moisture content, resulting in yield decline. In rice culture, puddling of the flooded soil with a layer of water 400-500mm deep serves to level the paddy surface. Puddling a soil to slow down the percolation rates, which is advantageous during rice growing, may lead to the fermation of "clay pans" or an illuviated layer just below the puddled layer which may or may not be broken up during subsequent tillage operations in preparation for cotton. Puddling of vertisols or other heavy clay soils delays drying of the soil, thus restricting subsequent farming activities. Soils with a high organic matter content are the most difficult to puddle, while soils with high sodium content are the easiest. In addition to root restriction caused by unbroken clay pans following rice growing, complex chemical activities in flooded rice soils also effect the crops following rice: air and oxygen content is considerably reduced, leading to anerobic conditions; reduction of the soil components follows, first through deritrifiction, then reduction of the heavier metal ions and finally the sulphates and sulphites. Although this reduction-oxidation process, or redox function, is not detrimental to other crops, it may seriously affect the soil if it does not take place fully. Reoxidation follows rapidly once the soil is drained, but the reversal process can be delayed in puddled heavy clays if drainage is poor. The behavior of clay vertisols used for rice culture under the effects of tillage, and alternatives to puddling in view of the drainage and drying-off problems, should be researched.

Land Leveling

Land leveling is essential for efficient soil manangement, and can be divided into three operations:

1) Primary leveling which may involve benching or terracing or land forming. This requires movement of large volumes of earth and in the Nile Valley, with its small farm units, this leveling would have to be carried out on larger areas covering groups of farms. The basin unit appears to be a fasibly sized work unit.

2) Secondary leveling may be limited to a small group of farms, a "sakia unit," or even a single farm, and would involve moving relatively small volumes of earth.

3) Tertiary leveling, or field smoothing, is essentially a tillage operation carried out by farmers at frequent intervals to remove uneven areas caused by plowing or differential heaving of the heavy clay soils caused by wetting and drying.

Land leveling is essential for soil management in improving irrigation efficiency and preventing gross soil deterioration. However, the cost effectiveness of land leveling has not been measured: first, in relation to improving soil management activities, e.g., tillage practices, fertility, etc; and secondly in relation to irrigation improvement (cf. ref. 17), and finally, reduction of soil deterioration.

For primary land leveling operations, the volume of earth to be moved per unit area for various land slope categories has not been ascertained in the Nile Valley and it will be necessary to measure this by means of a properly constructed survey. Computer simulation techniques can be used to obtain earth work volumes and optimum layout configurations. Once such a study has been completed the volumes of materials and equipment, sizes and numbers, can be determined. Following this, the cost factors will be studied and the organization and execution of the operation developed. Most of the secondary land leveling work needs will be covered, while tertiary leveling will be done by the farmer under the guidance of the extension sector.

Soil Management Extension

A comprehensive soil management extension program will be needed to implement any research findings together with the program for instituting tractorization of various farm operations, i.e., tilling, weeding, pest control, harvesting, and threshing.

The Tillage Factor

Tillage is generally considered necessary for proper crop production. Methods of tillage range from complete inversion of the "furrow slice", e.g. by the moldboard plow, to partial or semi-inversion by the disc plow, to use of non-inversion elements such as the chisel plow. Subsoiling tools are needed to penetrate deep into the soil and shatter impermeable layers.

Many tools of different shapes, all claiming dramatic and sometimes extravagant results, are available on the market in a great range of prices. Implements must be selected on the basis of cost effective optimum effects on the soil, i.e., least power input per unit area per unit of time.

There is disagreement regarding the usefulness of over-tilling, or deep tillage, of heavy clays (variously called vertisols, black cotton soils or gromosols), particularly on irrigated soils. The traditional "baladi plow" method used a wooden blade to turn up a coarse, cloddy tilth, followed by broadcast sowing or seed and subsequent irrigation. The coarse soil aggregates break down, covering the seed, and if the field was not too deeply flooded, the soil would not break down completely but just enough to cover the seed and not form a crust that would inhibit emergence. In the saline soils, aggregate disintegration is rapid; the soil almost "dissolves," covering the seed, and upon drying out a rough hard crust is formed and the radical cannot penetrate. Egyptian farmers have learned to deal with these soils, but circumstances have changed and they now have to adapt to new methods and techniques suited to the prevailing conditions.

The primary objectives of tillage are to maintain soil structure and fertility at a level consistent with optimum yields. This involves the use of crop rotations to limit pests and weeds and to replace organic matter through inclusion of legumous crops in the rotation to provide nitrogen. These tillage objectives are aimed at the long term of production of maximum yields. Practices leading to soil deterioration such as excessive tillage, increases in salinity, harvesting or burning all crop residue, and excessive use of artificial fertilizers, will lead to soil exhaustion and yield decline.

Tillage practices contributing to favorable crop growth include:

1) breaking or loosening up the soil to promote aeration, water infiltration and percolation through the soil profile;

2) providing a suitable tilth for seedbeds;

3) controlling weed growth, and

4) incorporating crop residue, weeds and fertilizers.

Although proper tillage may promote germination and initial plant growth, the surface layer must remain in a friable state or the effects will be transitory. In heavy clays, subject to wetting and drying, a loose soil structure will soon consolidate into a dense soil mass and the problem will be exacerbated as sodium saturation increases. Subsequent tillage would be required to reestablish the desired loose soil structure and this would be dangerous to the roots of growing plants.

Adverse Effects of Tillage

It goes without saying that not all tillage methods will produce the required results, and in many cases a tillage method may have adverse effects in both the short and long term.

Stability of aggregates is the primary soil factor related to optimum tillage practices, and the vertisols present special physical problems due to their shrinking and swelling following irrigation. The narrow range suitable for tillage is particularly narrow in these soils.

Shallow Versus Deep Tillage

A brief review of the limited literature[19,20,21] on the optimum depth of tillage indicates that there is little evidence of any marked benefit from deep plowing or from subsoiling unless:

1) there is a recognizable hard or impervious layer at shallow depth (not more than 250mm), bearing in mind that clay illuviation is also accelerated by tillage practices;

2) it is necessary to eradicate deep-rooted weeds;

3) tillage of heavy clays will improve drainage, or

4) it is necessary to incorporate crop residue and "cover crops."

The depth of tillage is directly related to the power required to draw the implement through the soil, the soil moisture content, and the design of the implement's tines which influence the power requirement. In better quality implements, design--e.g., shank shape, cross section, and tine or foot design--can solve many tillage problems. In addition to these technical considerations in achieving the desired results, the costs of operation and frequency of operation must be considered.

Frequency of Tillage Operations

There is no accurate measure for tillage frequency needed to provide the optimum environment for a crop. The correct number of passes depends entirely upon the farmer's knowledge of the soils and past experience with similar crops. Some research work[21] has been done on tillage operations in relation to yield, but no qualitative measurement appears to have been used apart from measuring the oxygen diffusion ratio by means of platinum electrodes. Tillage frequency in the Nile Valley heavy clays will have to be investigated, as will subsoiling (tillage to 600mm or more). Whether subsoiling contributes beneficially to crop production, improves drainage, or aerates the soil will have to be evaluated financially.

Tillage Equipment

The tillage practices commonly employed in crop production have evolved through a long succession of trial and error experiences by farmers.

Tillage practices are concerned with development of the plant root system and its environment. Terms such as seedbed preparation, crop rotation, weed control, irrigation and drainage denote attempts to improve and maintain the various soil characteristics affecting root development. Soil characteristics influencing the plant include soil structure, depth, water, aeration, fertility and temperature. As changes in cultural practices take place through the use of new implements and machinery, the influence on soil environment mjst be constantly evaluated.

The range of implements and machinery available for tillage operations in Egypt is great, though most of it is manufactured in other countries for use in those countries or even for particular localities. Ultimate selection of implements to deal with the vertisol soils of the Nile Valley will necessitate a careful examination of the prevailing soil conditions and crop requirements, including: optimum soil environment required for desirable root development using simple techniques such as ODR measurements; a least-cost analysis of each operation including required frequency.

From the foregoing discussion of the characteristics of heavy clay vertisols, it can be predicted that the most likely kind of implement to be found suitable will be a non-inverting, non-pulverizing tined tillage implement, for example a disc plow or offset disc harrow, penetrating 200-300mm.

The Drainage Effect

Almost without exception, irrigated lands require drainage, especially where drainage is needed to remove excess water from soils where inappropriately designed irrigation systems and poor water management by the farmer lead to a rising water table. Drainage is also required to maintain an equitable salt balance by means of periodic leaching. Even under the most perfect system, there is some "spilling" of surplus irrigation water. Drainage intensity decreases with increased irrigation efficiency, up to a point where leaching water and small irrigation water surpluses are the target of drainage in order to prevent groundwater build-up.

In the Nile Valley with its high cropping intensities and excessively high water deliveries, inadequate drainage may set a limit on continued long-term crop production. Under current crop rotation practices, considerable modifications may be required, for example: introducing fallow periods to allow for leaching and thorough drying of the soil; examining the role of rice growing as a salinity control measure, and the role of cotton in a similar context.

The use of vertical drainage or wells does not appear to have been considered in Egypt, let alone investigated, yet this method may offer advantages over the current high-cost horizontal drainage systems in use. Investigations of this subject should be included in the forthcoming research program and if such an investigation is already under way, it should be given some form of support.

DRAINAGE

Before examining drainage by itself, the objectives of drainage must be borne in mind:

1) to remove surface water originating in over-irrigation or rainfall (pertinent to N. Delta) by subsurface drains;

2) to control groundwater levels below the root zone;

3) to remove leachates to control salinity and to reclaim alkaline soils.

The benefits derived from drainage include the following:

1) improvement of soil structure;

2) improvement of soil aeration and thus of root development;

3) maintaining an equable salt balance by means of leaching;

4) other factors such as improved access to fields, better soil management and improved pest and disease control.

Drainage installation systems are divided into:

1) horizontal drainage, e.g., open drains or subsurface closed drains, and

2) vertical drains or drainage wells.

In general, horizontal (open and closed) and vertical drainage may be compared along the following lines. Open drains suffer the disadvantage of occupying from 10 to 15% of the land surface, and drains deeper than 2 meters tend to slump in the more unstable soils, are seldom properly maintained, and are costly to install. Subsurface tile drains, placed below the surface and covered so they do not utilize tillable land, are costly to install but if properly designed are most effective and require little maintenance. The third type, vertical drains, extensively used in the Indus River irrigated region, have proved highly efficient in controlling groundwater levels, supplementing irrigation water supply, and controlling salinity. Although they require pumping operations, they have proved to be cost-effective. One great advantage of vertical drains over horizontal is that groundwater levels can be effectively raised or lowered when required, while this is impossible with horizontal drains.

Drainage Principles

In the following discussion of drainage principles, only horizontal drainage will be considered, and these principles apply to both open and subsurface drains.

Drainage System

Field drains or field laterals are spaced at predetermined distances and parallel to each other. The laterals first join tto a collector drain and then connect to the secondary and primary drains. The field laterals are the critical factor in collecting groundwater beneath the fields but the regulation of groundwater levels may extend to the main drain. Maintenance of all drain elements is critical in controlling groundwater.

Basin Assumptions: In designing drains, the basic assumption is that the drains are parallel and that the water table between them is curved (Figure 4). The ground elevation is highest midway between the drains. The height of the water table will be influenced by the amount of water applied to the surface, or drainage coefficient; the soil properties, hydraulic conductivity and depth to an impervious layer; the depth and spacing of the drains; the hydraulic radius of the flow prism in open drains or the area of the drain pipe. These factors are the basic parameters in drainage equations and models and are related to two primary assumptions:

a) a uniform distribution of water over the surface to be drained between the drains, and

b) a two-dimensional flow regime in the cross sectional area perpendicular to the drains.

Flow equations considered here are based on the Dupuit-Forcheimer assumption of elliptical flow configuration.(27) Two flow characteristics are considered, namely, steady-state flow and non-steady state, or transient, flow.

Steady-state Conditions: The steady state condition assumes that the water table remains static over the range of conditions for which the drain was designed, i.e., that inflow is equal to outflow, as described by Darey's law. Three sets of soil conditions govern the application of the following equations and the location of a drain:

a) the depth of the impervious layer;

b) the occurrence of more than one layer of soil with a different hydraulic conductivity, and

c) an infinitely deep soil with artesian pressure.

Commonly used equations to determine drain spacing include:

Hooghoudt Equation(28): This equation is used for drains located on an impervious layer under a homogeneous soil profile. It is

based on radial flow, hence the equation is expressed in two parts. Its solution requires an iterative procedure and a monogram satisfies this purpose. The equation can be solved with small computers and forms the basis of many simulation models. It reasonably accurately describes the flow configuration of the drain.

Kinkham Equation[29]: The Kinkham equation is favored for the solution of drain spacings for soils of infinite depth with artesian conditions and is normally solved by means of a set of mongrams and graphs.

Ernest Equation[28]: This equation is used for multilayered soils and the interface between the layers may be above or below the drain in computing drain spacing.

Non-steady State Conditions

Where water is applied intermittently, irrigation water or rainfall, the water table level fluctuates and drain discharge varies over time, thus the appellation, "non-steady state."

Glover-Dumm Equation[30]: The Glover-Dumm equation is used to describe the lowering of the water table as a function of time, locality, drain spacing and soil conditions.

Kraijenhof-Maasland Equation[31]: This equati;n was derived for non-steady state conditions of groundwater flow to drains with steady-state surface inflow. The solution of the equation is complex and usually requires a computerized solution. It is a more exact model of conditions over a long period of time for drain flow conditions, such as in leaching of salts.

The use of these equations requires detailed knowledge of field conditions and crop growth, and economic considerations.

Drainage Criteria

In order to apply the above equations, appropriate drainage criteria must be chosen which depend upon the following considerations:

1) the quantity of excess water to be removed within a specific time and the leaching requirement;

2) agronomic factors regarding the crops grown, such as cropping practices, duration of submergence, root depth, tolerance to moisture, and salt balance;

3) soil characteristics, primary of which is hydraulic conductivity or the rate that water moves from one point in the soil to another; soil aeration and moisture retention capacity; physical conditions of the soil; capillary rise, and groundwater level;

4) economic factors, e.g., the cost effectiveness of drainage in terms of installation costs and improved production.

The two parameters of prime concern in establishing drain criteria are:

1) the height of the midpoint of the water table above the drain, and

2) the value of the drainage coeffficient, ie., the amount of water that will move from the surface through the soil into the drain.

The complexity of the relationships between these factors means that drainage criteria are regarded as no more than an attempt to express the aims of a future drainage system in terms of a single value or ratio that can be dealt with by a computer simulation.

WATER TABLE DEPTH

Apart from maintenance of a "dry" root zone, water table depth means a level at which capillary action will not transport salt upward into the root zone.

Salinity Control

In the Nile Valley, where perennial irrigation is practiced, there may be little opportunity for the soil to dry, or for a high water table to be lowered through gravity or by evaporation. In this situation, salts may move upward by capillary action from the very slowly receding water table. When the water table reaches a depth at which vertical moisture movement and salt movement are zero, the water table is said to be a "critical drainage depth." This stage is defined at the point when capillary transfer is less than 0.5mm per day. The rate varies with different soils, being greatest for medium textured soils and less for coarse and fine textured soils. The graph in Figure 6 shows the relationship between depth below ground level and an upward capillary flow. It will be noted than minimum upward flow occurs below 5mm per day and that the measured threshold level is 0.5mm per day.(33)

Measurement of capillary rise in the various soils of the Nile Valley and the salt transfer mechanism should be related to the irrigation regime practiced. This process can be studied by computer simulation techniques.(34,35) Such simulation techniques should be used to test various options in soil dynamics studies so as to eliminate unnecessary or overly elaborate methodologies. In other words, established simulation models should be refined in order to narrow down the alternative model situations.

Irrigated Conditions

Under irrigated conditions two factors must be considered when deciding upon optimum water table depth. The first is the root depth of the crops to be grown and their tolerance to submergence, i.e., the length of time the roots can be saturated

without yield suppression, and the second is the state of drainage--steady state or non-steady state. Under steady state conditions, submergence should not be allowed to occur, while under non-steady state conditions, saturation should occur for only limited periods.

A typical optimum rooting depth and hence optimum water table limit in the steady state condition may be 1.0 meter, while in the non-steady state condition, the same rooting depth would allow an optimum water table level of between 0.75 and 1.0 meters. Fluctuations of the water table during the irrigation season follow specific patterns and the water table rise during irrigation should not exceed the optimum water table depth. These series of events are shown in Figure 5 as a water table hydrograph. It is apparent that maintaining the chosen optimum water table depth will depend upon the amounts of water applied and the drain configuration.

Two primary considerations must be kept in mind with regard to water table control: a) for a given drain discharge (water added at the surface) and a given hydraulic head (mid-point height of the water table above the drain), drain spacing is inversely proportional to the square root of the discharge rate and proportional to the square root of the hydraulic head. Due to the inaccuracy in hydraulic conductivity values, and the approximate nature of drain spacing equations, drain spacing calculations provide only an order of magnitude rather than exact values. A small change in the discharge rate or the hydraulic head will not affect the overall efficiency of the drain system;(36) b) it may be assumed that irrigation water appolication does not vary greatly under efficient regulation and application techniques; inefficient regulation or application, or "overloading," however, will raise the water table above the drain design level.

Present irrigation water applications in the Nile Valley are generally considered to be excessive, calling for high drainage intensity. The technique known as the Dynamic Equilibrium concept(36) should be used to study the water table hydrology or irrigation regimes currently practiced, and to design attempts to restrict water applications for leaching. Again, simulation techniques would provide the best guidelines for the implementation of field studies.

FIELD INVESTIGATIONS

Drainage investigation studies have been carried out quite satisfactorily by various governmental agencies in Egypt, and it is only necessary here to describe briefly the various steps that such studies have involved, and to indicate where more study is required.

Reconaissance Surveys

These surveys obtain data on a broad range of topics including climate, soils, topography, farming practices, cropping

patterns, land tenure, and other sociological parameters. Normally, mapping is on a scale of 1:50,000 to 1:25,000. This work is undertaken as the evaluation, or feasibility, stage.

Semi-detailed Studies

At this stage, preliminary designs may be prepared for economic feasibility evaluation and cost-benefits calculated with an accuracy of ten percent (for World Bank purposes, the basis for project appraisal). To achieve this accuracy, mapping at 1:25,000 to 1:10,000 is required at 0.25m contour levels. In addition, detailed soil assessments are made showing salinity, groundwater levels and fluctuations, infiltration rates, hydraulic conductivity measurements for layers up to a depth of 2.5m, and a soil series survey using accepted taxonomy.

Detailed Surveys

For the final construction design and for final economic and financial analyses, detailed data and data changes are finalized, specifications written and tendering documents completed. Surveys at this stage would be on a scale of 1:25,000 to 1:5000 for both topographic maps and general design drawings.

While many modern innovations may be used in field investigations, the basic pattern is that described above. One essential aid is aerial photography of small scale and high quality to aid both the mapmaker and field investigators.

An aid that has been used in detecting and monitoring salinity is 35mm or 70mm infrared color photography. The cost of the equipment is low and is operated from light aircraft. Such photography is qualitative rather than quantitative, yet it provides a rapid and simple method of detecting changes in soil conditions.

In conclusion, the various procedures for conducting field investigations for drainage works are extensively documented in the literature and there is no reason why these procedures cannot be adapted to Nile Valley conditions.(37,38)

Drainage Conditions

As drain installations are proceeding in various areas under the auspices of other projects, only a few brief points are necessary.

Open Drains: The spacing and depth of open drains has been discussed in the foregoing sections.

Subsurface Drains: Drainage pipes generally come in various sizes from 100-200mm and from 200-600mm in diameter and small areas may be laid by hand or by backhoe.

However, where extensive drainage installation is anticipated, special rotary wheel type ditchdiggers are used. Sophisticated machinery with laser controlled excavation, pipe laying and gravel layering around the pipe and backfill are in use in the Nile Valley. The operation costs are high but the installation

is faster and more accurate.

A second method of drain installation which does not seem to have found favor in Egypt as yet is a trenchless drain laying technique. The implement is in fact a large self-propelled mole plow, penetrating to two meters. A flexible corrugated PVC pipe is fed through the plow apparatus and the machine lays gravel around and over the pipe. The unit is self propelled but in heavy soils may require assistance of an anchor tractor to winch it across the field. This machine operates most successfully in soils without rocks or tree stumps. The cost of laying drains is very low for either unit length or unit time. Another advantage is that it can lay drains without disturbing the soil surface or growing crops.

PART II: LAND IMPROVEMENT RESEARCH PROGRAM PROPOSALS

Summary of Soil Improvement Activities

The Executive Authority for Land Improvement Projects (EALIP) was established by the Egyptian Government late in 1971 to execuite a soil amelioration program on an inital area of 17,000 feddans. Since then, the area has expanded to its present area of 150,000 feddans. The original soil improvement program resulted from experimental work carried out from 1967 to 1970 in three experimental areas in the Delta. These large scale trials gave "promising results" from subsoiling at that time. Although improved soil productivity was evident, no true evaluations based on the yield response of different crops were made. Thus the Authority, after a decade of field work, is faced with technical problems that still await scientific and practical solutions.

Research Objectives

The overall objective of the land improvement research program is to demonstrate and evaluate various solutions to the soil amelioration equation through field trials in the pilot areas. While more specific objectives within this broad objective overlap and are interdependent, four facets of research objectives may be described as follows:

1. Prevention of soil deterioration: determining the role of agronomic practices and cropping systems to prevent soil deterioration;

2. Applying recent developments: developing new techniques for soil amelioration using recent developments in machinery design, and improving practical experience in the operation of such equipment;

3. Identifying cost effective methods: showing cost effective methods as determined by technical analysis and economic evaluation of trials in the pilot areas;

4. Demonstration: demonstrating soil improvement technology and amelioration methods to farmers by means of demonstrations and other extension methods.

Methodology

Research programs designed to test and develop soil amelioration techniques and practices on saline, alkaline or calcareous soils (whether inehrently poor or degraded) will include in their methodologies three basic categories of techniques:

1. Physical techniques: various kinds of subsoiling (or tillage) tools and precision landleveling at different grades, e.g., to facilitate leaching procedures;

2. Chemical techniques: using gypsum as an ameliorant with different methods of incorporation, depths of application;

3. Hydrotechnical methods: as in leaching of salts to improve soil productivity and maintain an equitable salt balance in the crop root zone by means of drainage techniques.

After the establishment of pilot and demonstration areas where research trials can be undertaken, there are five basic factors in the soil amelioration equation to be included in the research methodology to carry out the three basic categories of techniques mentioned above:

1. Optimum depth and spacing of drains (e.g., open drains, subsurface drains);

2. Depth and spacing of subsoiling using different implements, and soil moisture content required for optimal subsoiling results;

3. Soil compaction effect of machinery (tractors, plows);

4. Optimum quantities of gypsum and other ameliorants, and their depths and methods of application;

5. Frequency of various amelioration operations.

Location of Pilot Areas

The location of pilot areas and demonstration sites will be in selecged areas in four governorates. The original proposal considered eightareas, but a revised submission reduced this to four areas in the governorates of Minia, Asyut, Beni Suef and Fayoum:

1. Minia governorate: the pilot area in Minia is at Edwa where machinery and tillage implement trials will be conducted on heavy clay soils;

2. Beni Suef governorate: the pilot area is at Ehnassia where drainage trials, both open and subsurface, mole plowing and salinity of groundwater related to crop response, will be studied;

3. Asyut: the pilot area locality in Asyut governorate is not specifically mentioned in the proposal but "tile" or subsurface drainage, mole plowing, effects of gypsum application on loamy soils, will be studied;

4. Fayoum: in Fayoum Oasis area, drainage criteria for open drains will be developed for calcareous soils, including leaching requirements and the fluctuation and salinity of ground water and crop response to these various drainage practices will be studied.

Staff Allocations and Disbursements

Qualified and experienced staff are needed to undertake the proposed research program. The staff schedule and estimates of costs is found in Appendix 1. The total cost of personnel, field operations, transport, fuel, etc., amounts to LE 163,335 plus LE 30,000 for expendable laboratory equipment costs.

Remarks

The research proposals drawn up by the study and Research Section of EALIP for consideration by the Agricultural Mechanization Project are very broad in concept. The Research Section has an excellent laboratory facility and its staff is well qualified and experienced. The research proposals will be examined in detail in order to develop them further, where they are lacking either in details or consideration of certain fundamental factors. With some additional sophisticated equipment with which to apply new trends in soil research methodology, a wide range of applied research can be undertaken in an otherwise almost unknown field, the behavior of clays in the vertisol soils of the Nile Valley and their minerology.

SOIL FACTOR RESEARCH PROPOSALS

Introduction

Irrigated crop production in an arid environment with intractable soils requires proper drainage and soil management to sustain equable production and to combat yield decline, whether the soils are light textured entisols or aridisols, or heavy ventic clays subject to salinity. The following research program is not complete and will be augmented as the research proceeds and other research problems become apparent. The details of specific activities will be discussed through a series of working papers prepared by the staff of the Authority (EALIP). Each working paper will deal with a specific subject and include a review of the problem and relevant literature, and discussion of the research methodology and anlytical procedures to be used.

The proposed research is not basic research but applied research pertaining to spcific problems and conditions occuring in the Nile Valley. The methodology will be based on existing and proven methods and techniques. The research program will supplement the current work of EALIP and will cover its five main activities:

1. Laboratory research related to the properties and behavior of clay minerology under field conditions, soil chemistry related to clay modification, effects of amelioration on clay status, etc.;

2. Simulation research for analysis of soil-water relationships, reclamation procedures, economic and financial analysis of field equipment, machinery management, etc.;

3. Field research on tillage trials, mole plowing, drainage methodology, ameliorative practices, etc.;

4. Experimental field research in replicated trials on single crops rather than on multicrop farms.;

5. Other research areas, such as testing of tractor power output, testing implements in the field, testing pumps and other water-lifting devices; laboratory testing of

implements and equipment; the use of infrared color photography for identifying saline areas and monitoring expansion of salinity.

It should be emphasized that the prime objective of the research program will be to determine certain characteristics of the soils of the Nile Valley in order to measure the parameters pertaining to changes in the soils resulting from irrigation practices--i.e., water use practices and drainage under present cropping practices. The second primary objective is to determine the cost effectiveness of new practices that will halt soil deterioration and yield decline and thus bring better returns to the farmer.

VERTISOL SOILS RESEARCH

Clay Minerology

The properties of both clays and colloids in the vertisols should be investigated with particular reference to the salinization/desalinization process, the effects of tillage soil aggregation, the role of the clay fraction on drainage efficiency, the deposition of colloid material around drain pipes. Specific research activities should include:

1. Differentiation of clay minerals in the range of soil variants occurring throughout the Nile Valley and the chemical characteristics of the clays under varying conditions of salinzation or desalinization; x-ray refraction and thermal analysis techniques are well suited to rapid and accurate determination of constituents of a large number of samples.

2. Determining the preferential absorption of specific ions by the clays during salinization and desalinization and particle charge factors in cation and anion exchange; this process has a specific influence on soil fertility as well as on the irrigation and drainage properties of the soil during reclamation processes.

3. Determining the distribution of absorbed ions of the clay surfaces, by x-ray refraction and spectrographic techniques; this factor is specifically related to the swelling and shrinking of clay soils and their disperson properties, hence the hydraulic conductivity of the soil.

Clay Soils

The solid phase of a "clay soil" consists of particles of soil (greater than 0.2mm), silt (less than 0.2mm and greater than 0.002mm) and clay (less than 0.002mm). It is the clay fraction, the colloids (complex amorphous materials), oxides of various metal ions, and organic matter that form the active constituents of the soil.

When soils are irrigated, salts in the irrigation water accumulate and sodium, usually the predominant cation, becomes the dominant cation in the soil solution. Calcium and magnesium

absorbed on the clay complex is then displaced by the sodium. The physical and mechanical properties of the soil including aggregate stability, dispersion of clay particles, infiltration, hydraulic conductivity and structure are all sensitive to this ion exchange.

In general, "good" soils with favorable physical characteristics are "calcium" soils, while soils with poor physical characteristics are usually "sodium" soils. Crop responses tend to decline with increased sodium saturation; sodium is not normally toxic to field crops, though it is to woody crops such as citrus and stone fruit. However, sodium increases the osmotic pressure of the soil solution, making it increasingly difficult for plants to absorb water and nutrients.

NILE VALLEY SOILS DYNAMICS

After identifying the precise nature of the Nile Valley soils to be studied, the basic elements of soil dynamics can be studied in relation to these specific soil properties.

SOIL WATER RESEARCH

The retention, absorption, percolation, and evaporation of soil water are influenced by natural forces such as gravity, solute concentration, and pore pressure. The roles of these factors upon the behavior of soil water within the environmental and cropping conditions of the Nile Valley must be determined. Soil water potential, as defined by the INternational Soil Science Society (ISSS) as "the amount of work that must be done per unit quantity of pure water in order to transport reversibly and isothermally an infinitesimal quantity of water from a pool of water at a specific elevation at atmospheric pressure to the soil water at the point under consideration." This definition is of fundamental importance in understanding the movement of water through the soil, as discussed below. The various forces acting within the soil unit include: gravitational potential, pressure potential, the matrix potential, osmotic potential and hydraulic potential. Various methods are used to measure these potential forces, e.g., pressure plate apparatus to measure matrix potential to obtain moisture retention capacity, pressure differential apparatus to measure permeability, etc.

Important determinations of these factors have been made in the past using various methodologies, but it is necessary that soil water movement measurements be conducted concurrently with drainage trials, mole plowing and subsoiling (tillage at depths greater than 400-500mm).

Soil Water Retention and Hysteresis

Investigating this subject involves measuring the wetting and drying cycles of various soils, measuring the effects of salinity on drainage cycles, and measuirng the leaching of salts. The relatively inexpensive soil column technique is best suited to this investigation. The apparatus consists of an upright, large-diameter perspex tube filled with the soil to be measured,

1-1.5 meters long, fitted with a series of small access holes along the axis of the tube for measuirng pressure head or for inserting sensors.

Soil Water Flow Systems

Soil water flow systems include the movement of water into the soil (infiltration), through the soil (permeability and hydraulic conductivity), and upward movmement (capillarity) which is related to evaporation from the soil surface Each of these factors has an important bearing on the irrigation and drainage equation.

Solute Movement

Irrigation adds soluble salts to the soil profile. These salts may concentrate in the root zone or move into the deeper groundwater zone, or be leached through the soil profile by convective diffusive transport processes and solute interactions. Soil management practices under irrigation, where salinity is a perpetual hazard, are required to control salinity. This in turn depends upon an understanding of solute movement through the soil.

Solute movement theories are based on average macro-flow rates through a continuous porous medium. Mathematical expressions are then derived for a representative element in a sample size large neough for statistical analysis. The soil column technique may also be used to determine solute movement parameters in the water transport equations.

Hydraulic Conductivity

Hydraulic conductivity is the most important parameter in the drainage equation. The dynamic relationship between colloid and clay materials and the changing chemical status of the soil greatly influence hydraulic conductivity.

The theory of flow through non-swelling clays is described by Darcy's law, which describes the flow of the fluid relative to the solid soil matrix. Flow through swelling materials is based on the theory of one-dimensional movement in a clay/electrolyte system, where the clay is free to swell in the direction of the electrolyte movement. Another approach to measuring flow in swelling clays is to use a modified form of the open channel flow hydraulic principle to determine flow in soils that contain cracks. Infiltration in swelling clays, however, cannot be accurately measured by the methods usually employed for non-swelling clays, such as ring infiltrometers, neither hydraulic conductivity. A simulation model has been developed to measure the movement of water into and through swelling clays and should be employed to measure flow parameters in the Nile Valley heavy clays.

Soil Air

Soil air is an important parameter in plant growth; excessive soil moisture lessens the exchange of air between the soil

and the atmosphere. Thus, high water tables contribute to reduced soil air; highly compacted and puddled soil also lower soil air. Tillage practices loosen the soil, allowing greater movement of air. It appears that the threshold level of soil air porosity occurs between 8 and 15 percent, but critical air porosity depends on texture and structure (which can be altered) and electrolytic concentration (sodium concentration) which changes the physical characteristics of the soil and hence its air porosity.

Under normal conditions a sandy soil has a suction level between 100 and 300 mm, while clay soils show a 800-1500 mm level. This is measured by a bubbling pressure technique to obtain air entry values. Easier methods of measuring soil air are based on the oxygen diffusion ratio values obtained by using special platinum electrodes. A subject of research will be to determine if this technique gives good measurements of soil air strata under successive irrigation cycles and water table fluctuations.

TILLAGE FACTORS RESEARCH PROPOSALS

The emphasis in tillage investigations should be to improve soil management in order to sustain intensive cropping practices and halt yield decline. Tillage operations must be cost-effective, with tillage operations at a minimum using the most efficient implements and machines. Operation and maintenance are of crucial importance in the measurement of cost effectiveness and research must therefore include operation and maintenance training components. Tillage trials should be kep to a minimum and should be related to investigations of the effects of mechanical acitvity on the nature and properties of the soil.

Tillage research proposals are divided into two sections: the first dealing explicitly with field-based trials and the second dealing with investigations best carried out under experimental farm conditions that require detailed close observation.

Field Based Tillage Research

Field-based tillage trials should be located on the four selected sites in each of the respective governorates, though some trials may be carried out at other sites or experimental farms. The details of various trials will be discussed in a working paper describing the problem, the methodology and analytical procedures.

Effectiveness of Tillage Depths and Tillage Frequency

Deep tillage according to ASAE definition is tillage penetration not less than 250 mm and not greater than 400 mm, while subsoiling is penetration beyond 400 mm.

Trials should be carried out using a standard chisel plow at two depths, 250mm and 400mm. There is no information regarding the frequency of tilling heavy clay soils and this factor will have to be assessed, particularly as it has very significant bearing on the cost-effectiveness of tillage operations.

These trials should be conducted on three categories of clay soil conditions: "normal soils" (non-saline, non-alkaline soils), intermediate level saline soil and saline/alkaline soils, and lighter textured calcareous soils.

The selection of trial replications should be located on randomly selected farms rather than having all trials on one farm or across a contiguous set of farms, so as to avoid bias caused by farmer activities. Details of these trials should include:

1. Deep tillage in two depth ranges, ie., normal depth (200mm) and deep tilling at 400mm, to produce adequate comparison of the effects of depth on crop yields and factors concerned with changes in soil structure due to tillage activity;

2. A chisel plow with shanks and tines chosen from experience should be used with a tractor to suit the implement. The spacing of shanks is related to the efficiency of breaking up the soil; theoretically, a closer spacing of tines should provide more soil breakup or shattering at shallow depths, and a wider spacing should be effective at deeper depths. The spacing of the shanks is also directly related to the power inputs as depth increases. The frequency of tillage operations should be measured against crop yield and tillage costs. The recommended frequencies are a) after each crop; b) bi-annually; c) annually. The tillage operations should be carried out at a moisture content giving maximum soil break-up at a particular depth (or at a standard penetrometer value at a specific depth). To establish the optimum conditions to carry out tillage, observations of cross sections of the tilled profile and measuring bulk density before and after tillage are used.

Secondary soil factors can be measured and studied during the course of these trials, such as soil compaction, soil aeration, and changing infiltration rates.

The use of a standard implement and power unit is necessary since it is difficult to measure tractor power under varying field conditions without proper monitoring equipment such as a three-point linkage dynometer and continuous engine operation recording devices. By rating a "standard" implement and tractor under controlled conditions at the Research and Development Station, power factors, fuel consumption and speed could be measured to provide data for comparative cost estimates.

Effects of Machinery Traffic and Tillage Operations on Soil Compaction

Compaction of the soil is the result of bulk loading, when the soil particles move closer, increasing bulk density and thereby reducing porosity and decreasing water and air movement through the soil. Compaction restricts root development. The chemical status of the soil contributes to the rate of compaction; "calcium" soils and soils high in organic matter are the most resistant to compaction, while "saline" soils are least.

Compaction also affects yields in other ways, from seedling emergence and nutrient uptake rates to drainage and irrigation. The ability of the soil to resist compaction is related to "soil strength," which is defined as the amount of energy required per unit volume of strain. This relates resistance to boht volumetric compression and linear deformation. The factors involved in compaction are particle size distribution, cation species and concentrations, kind of clay, and moisture content.

There is some evidence that movement of tractors over saturated clays may have some effect on deep drains, causing them to settle. Moving the soil to and fro by tillage activity may cause formation or illuviation of fine particles into an impervious layer or "hardpan," particularly under saline conditions. Also, the movement of a smooth bottomed implement over the soil surface at the same depth will form a "plow sole" or a compacted hardpan.

It is hard to believe that Nile Valley soils, which exhibit deep-cracking, would be compacted uner "normal" conditions, alhtough with increased salinity this might occur. Therefore, a series of trials will be developed to meausre the activity of tractors and implements on compacting soils under various conditions. These will be field trials and will be combined with the other trials.

Soil factors such as soil strength, bulk density, chemical properties and moisture content will be analyzed in the usual manner and do not require further elaboration.

Additional trials include operating a "standard" tractor of known weight, drawing an implement such as a chisel plow, over a wet soil at successive time intervals, such as 48 hours after irrigation, 72 hours, 96 hours, etc. This would be repeated until no further observable change occurs in the various soil types. These trials would provide insight as to optimum tillage conditions (this will de dealt with further in a working paper).

Organic Matter Content and Tillage of Heavy Clays

The reduction of organic matter from crop residues and manure must have a detrimental effect on soil conditions apart from the nutritional status of the soil. Rice straw, cotton stalks and other residues can be used for this purpose, but they are commonly removed and sold for cash. There may be economic factors that preclude the use of crop residues or the growing of green manure cover crops. Economical mechanical methods of incorporating crop residues must be investigated. The effect of various levels of organic matter on tillage, measured in terms of soil aggregation and soil strength, as well as the implements best suited to incorporate these residues, must be examined.

Optimum Depths of Gypsum Application, Methods of Application and Incorporation

The quantity of gypsum applied per unit area is directly related to the amount of sodium that must be replaced on the clay complex at a specific depth such as the plow layer, 250-300mm deep. Gypsum must be evenly distributed over the field surface and incorporated to a uniform depth subject to the following considerations: since gypsum is not very mobile in the soil and cannot be "flushed" into the soil to displace sodium, the best result is obtained when the ameliorant is brought into close contact with the soil peds through even distribution and mixing so that there is a greater contact area with the soil particles.

Proper application and incorporation of gypsum may not be possible for the small farmer and the cost effectiveness of gypsum at the small farm level will have to be studied.

Various methods of mechanical incorporation will be investigated. A heavy duty offset disk, fitted with gypsum hoppers, will be tried first, followed by alternative methods.

Mole Drain Installation

Mole drains are an adjunct to subsurface drainage. They should find application in areas where subsurface drains are spaced too far apart and in soils that may require rapid leaching. The installation of mole drains is not a simple matter of drawing a subsoiler-type of implement through the soil, but a skilled operation to be carried out by experienced technicians.

Work in the Zawiya area of the Delta by the National Institute of Agricultural Engineering U.K. personnel has shown that special consideration has to be given to various problems concerned with installing mole drains:

a) If the soil surface is not properly sealed over the drains, irrigation water will rush down the vertical slot over the mole cavity causing it to collapse.

b) Mole drain outlets must be protected with a short length of piping.

c) The mole drains should be drawn when the soil moisture content in the soil profile is at the correct level.

d) A proper beam-type mole plow must be used to draw the mole drains; a modified subsoiler is not suitable.

At this stage, mole drain trials will not be proposed as in-house research, but it will be recommended that a short term consultant, namely the person responsible for the Zawiya project, should be appointed to perform trials in selected areas and train selected key personnel in mole drainage.(44,45) These investigations would also include selection of the most appropriate equipment for mole drainage in the Nile Valley.

Effects of Tillage Practices on Soil Structure

Presently, the following should be considered in examining effects of tillage on soil structure:

1. The breakdown and improvement of soil structure using various ameliorants or by changing the ion status of the soil;

2. The effects of tillage and mechanical operations on the soils where a rice/cotton rotation is used (type of rotovators, chisel plows, disk type implements and inversion implements);

3. The stability of structure and aggregation under tillage on both non-saline and saline soils.

These are among the most pressing concerns at present.

Testing of Implements and Equipment under Controlled Conditions

A great deal of work specifically related to the selection of implements and tractors ideally suited to tilling these soils will have to be conducted under carefully controlled and managed conditions. Specially trained and experienced personnel will normally be available at the research centers who are normally engaged in testing equipment other than that used by the Land Improvement Authority.

The Authority should develop a comprehensive research program in collaboration with the Research and Development Center, a component of the Mechanization project, to test equipment, implements and tractors deemed suitable for the land improvement operations. Collaborating with the Research and Development program of the Project would save resources, and by allocating a few specialist personnel to work on the research program, valuable experience would be gained.

The testing recommended deals specifically with the selection of various kinds of implements and fittings that would provide optimum effects from the various operations and "bench test" cost efficiencies. It will be assumed that the materials of construction will be tested or at least will comply with approved and accepted standards and that the construction is satisfactory. Such decisions will be expected from the testing center. The data required in the immediate future is discussed here, though no doubt other testing requests and requirements will arise later.

1. Chisel plow: There are a number of implements of this kind on the market and in use by the EALIP. The manufacturer's claims will have to be tested under local conditions, especially in heavy clay soils, in order to determine the proper cost effective power inputs for these implements. Besides power input, the shpae and configuration of the shanks and the type of tine or point giving the best soil shattering effects, and shank spacing for optimum soil breakup for least power input will be investigated.

2. Offset disk harrow: Disk harrows may provide the best means of distributing and incorporating gypsum, but they seem to be little used in Egypt, probably because of the high power input required. It will be necessary to a) design a gypsum hopper and feed system for the disk harrow; b) determine the best combination of gang angle and spacings for maximum depth, and c) determine the most suitable blade configuration (spherical or conic) for deep penetration and mixing of the gypsum.

3. Tractor tyre configuration: From recent observations, it appears that large diameter, narrow tracked tyres are sidely used, with emphasis on using tractors of increasingly greater power output to do the same kind of field operations that lower powered tractors do elsewhere. Amongst other factors, the choice of tyre size seems to be inappropriate for the prevailing conditions and specific measurements must be made to ascertain what the best tyre combination is to perform various operations, such as a) "normal" tyre sizes, those currently fitted to tractors in use; b) single, small radius, wide tread tyres; c) double rear radius types; e) double rear front four wheel drive.

Tests will be carried out on tractors drawing implements of various kinds, the power output matched to the size of the implement. Various parameters will be measured such as slip, power output, fuel consumption, speed of operation, rolling resistance, etc. The ASAE sepcifications, EP391 and S404T, may be used as guidelines to estimate these factors.

There are indications that weights and tyre ballast is not commonly used, which increase traction, but also increases tyre wear and fuel consumption. These tests are the most pressing over the short term; additional tests will be presented in future working papers.

Drainage Factor Research Proposals

The drainage problems on Nile Valley soils have been discussed in Part I. In view of the fact that the conditions prevailing in the Nile Valley are not unique, the technology dealing with drainage is extensive and complicated and the parameters needed to solve the drainage equation are detailed and exacting. Therefore, it will be necessary to study and analyze existing data dealing with soil analyses, salinity levels and similar parameters. These data will then be used in an objective measurement to determine temporal and spatial distribution of salinity to derive a comprehensive reclamation program. Such reclamation processes will center around proper technically conceived drainage systems and effective water management procedures.

In accordance with the EALIP research objectives, in which drainage and attendant factors such as salinity, reclamation, and water management are addressed, "water management" includes improved irrigation methods and the extension program work that goes along with these methods. Extension will be considered elsewhere. The following proposals are intended to assess existing drainage systems by means of field investigations and subsequent calculations of the efficiency and efficacy of controlling the water table below the root zone and to maintain

an equable salt balance for sustained crop production. Simulation models will be used to make the calculations (see section on Simulation Analysis).

The drainage program will center around three activities: 1) salinity: whether salts in the soils are due to irrigation water or groundwater and the effects on crop yields, in order to determine drainage costs (including older and current data); 2) the reclaiming of saline and saline/alkaline soils and preventing productive soils from becoming saline, i.e., determining the basis of the reclamation process; 3) drainage systems: the role of open and subsurface drainage in land improvement, the "drainage equation" here meaning a global approach to drainage.

Drainage can be divided into two systems: a horizontal system typified by open drains and tube drains, and vertical drains typified by vertical wells. The use of horizontal drains is well known and tube drains have been installed for many years.[47,48] However, this drainage work now seems to be inefficient and additional, or adjunct drainage procedures such as mole plowing may be required to improve the efficiency of drains already installed. Therefore, mole draining will be investigated in the context of improving existing drainage efficiency rather than as a sole means of drainage improvement. It will be necessary to establish a time-sensitive means of estimating drain efficiency. Noramlly these measurements are very time consuming, but there are computer-based models[49] that can predict the behavior of the water table, making use of the soil parameters obtained in the Soil Factors research part of this program.

A vertical drainage system has not been in favor in the Nile Valley although comparative costs of horizontal and vertical drainage may weigh in favor of horizontal drainage. A properly detialed technical and economic assessment does not appear to have been made, though some assessment may be possible when existing data are surveyed. Assuming that technical considerations are not totally contrary to practical application of a vertical drainage system, it has some very strong points in its favor, notably in simplicity of installation and maintenance. This requires "soft drilling," or jetting. Extensive subsurface investigation is required before this system can be used, but a limited number of trials should be considered.

In considering the three drainage factors, neither an equalbe salt balance nor a reclamation procedure can be achieved without both a proper drainage system or consideration of the economic salt-balance threshold limits. Consequently, the research thrust should be directed toward the most cost effective method for developing a realistic salt balance system, rather than an extensive drainage system.

The design of drainage systems, depths, spacings, etc. has been addressed in the EALIP research program but the objectives of such drainage research are obscure.

It must be clearly understood that waterlogging and progressive salinity in the Nile Valley is the result of improvident irrigation practices--the excessive application of irrigation water, antiquated and poorly maintained channels and structures, resulting in leakage and inaccurate water deliveries. Worldwide experience indicates that drainage is required on all irrigation systems and greater drainage intensity is needed as the climate becomes more arid. This fact has to be recognized in the Nile Valley where the aim of maintaining soil productivity will depend on improving soil management, improving water management and improving salt balance procedures by means of drainage systems.

The approach considered here would appear to be in concert with the terms of references for land improvement and should not be in conflict with other institutional activities.

Furthermore, research activities should be directed to establishing broad-based criteria for maintaining equable salt levels, for continued crop production, and to a lesser extent for maintaining the water table below the "apparent" root zone. Although it would be necessary under non-irrigated conditions to maintain a steady state condition, with the periodic applications of irrigation, a transient state exists here and designs must comply with this situation.

It must be pointed out that such matters concerned with drain materials, envelope materials and conditions, installation methods and techniques have not been addressed in the foregoing research proposals. This will arise in the course of the research, but emphasis should be placed on examining those factors concerned with the principles of soil-water behavior leading to development of proper criteria. The research should follow these lines:

1. Survey of existing data and alternative data sources; analysis of the relevant data pertaining to soil, salinity and drainage;
2. Use of existing techniques, or development of specific simulation techniques and procedures, to test drainage and irrigation parameters;
3. Development of field procedures to test hypotheses;
4. Finalizing the analysis and preparation of the required design of field installations.

The above program will require time, but there is no purpose in attempting to base costly field works on incomplete studies of the basic parameters needed for design.

The Salinity Problem

Much of this background has been discussed in the foregoing sections, but a brief outline of particular research follows.

1. Survey of Groundwater Hydrology: Although it may not be within the scope of the Authority to investigate groundwater hydrological conditions over extensive areas of the Nile Valley, this can be considered the macro-situation and it is of prime importance to know what the groundwater hydrological conditions

are in any large area such as within a district and on down to the village level. Such infomration is required for proper drain design, operating and maintenance, and monitoring. A search for such data, maps and other works should be instituted. In the micro-situation, at the field level, a search is needed of existing data from current drainage trials, and for collating data for analysis and simulation studies. These studies should include: a) phreatic fluctuations in the root zone from irrigation applications; b) salt balance in the root zone during irrigation application; c) capillary transport of salt from the groundwater into the root zone and to the surface.

2. Salt balance: Maintaining an equable salt balance is the prime objective of drainage and of reclamation.

a) Crop salt tolerance: Comprehensive studies of crop tolerance to salt have been conducted over many years, in many kinds of soils, and in many climatic environments. These values can be used for a first approximation for comparison with Nile Valley conditions, and such data can be used for threshold levels for leaching studies.

b) Salt status: Determinations will be required to establish the procedures whereby an equable salt balance can be maintained in the root zone of crops grown in heavy clays. Evaluating the salt storage levels for the vertisols and other soils will be necessary.

c) Leaching equation: The common approach to determining the leaching required to maintain an optimum salt balance is based on achieving a steady-state condition. Salt profiles in the root zone of an irrigated soil tend to be sigmoidal. Using this configuration, both the leaching rate and drainage intensity can be reduced. This approach should be investigated with reference to conditions in heavy clays.

Under an irrigation system, the frequent wetting and drying cycles should provide an adequate leaching profile, but in heavy soils the degree and depth of drying have important bearing on the transfer of salt. It will be important to investigate whether or not the solutes do leach the salts beyond the root zone with the present irrigation regimes.

Underlying this set of investigations are two sets of basic parameters: 1) salt distribution in the soil profile: a careful search of the data may reveal that such investigations have been performed, but if not, such data can be rapidly determined using the soil column techniques. 2) Leaching efficiency in the presence of other salts: the presence of other salts influences the solubility and exchange basis of absorbed sodium which may inhibit the leaching process; this factor must be ascertained using soil column techniques and field investigations.

Once the various soil parameters have been determined, analytical and simulation techniques can be used to test alternative procedures to obtain the required leaching procedures to maintain a salt balance and to establish proper drainage criteria, ie., of spacing and depth, bearing in mind that the discharge/hydraulic head ratio largely determines these two design parameters. Once the "paper" analysis has been completed

the parameters can be measured either by installing new trials or using existing layouts.

The Drainage Equation

Drainage can be accomplished by horizontal drains (subsurface or open drains) or by vertical drains (pumping water from the groundwater table). There seems to have been little work directed toward the possibility of using vertical drains in the Nile Valley; this aspect will be briefly outlined.

1. Horizontal drainage of heavy clays: The drainage of heavy clays, with low hydraulic conductivity rates that are influenced by electrolytic activity (salt concentrations in the groundwater) can be drained conventionally by using highly developed drainage theory. But a comprehensive knowledge of the nature and properties of the soil is required and the behavior of the phreatic system and irrigation regime must be understood. The important factors are: a) the hydraulic conductivity within the respective layers of the profile, rates and distribution; b) the effect of drain depth on the flow regime about the drain, and c) the ratio of discharge (or drainage coefficient, which is equal to the leaching rate plus the excess irrigation water), and the hydraulic head, or height of the water table above the drain level.

2. Drain spacings and depths: There is an intermittent relationship between spacing and depth: the deeper the drain, the wider the spacing, all other things being equal. However, a cost relationship is involved as deep drains are more expensive than shallow drains. Once these parameters are determined leading to optimum design conditions for maintenance of a proper salt balance (including adequate farmer management), the cost effectiveness of design can be ascertained by means of analytical or simulated methods before conducting field trials.

3. Vertical drainage: With the exception of some deep-well observations in the northern Delta, no work has been done in the NIle malley on the groundwater configuration nor on the feasibility of using shallow vertical wells for groundwater control. The disadvantage of vertical wells is the energy requirement to drive pumps and their constant supervision. Pumping from shallow wells should not be too costly, as the depth of sediments is generally considered to be 8-10 meters. The general concept is that shallow wells may have to be closely spaced to be effective, depending on the conductivity of the aquifer. The misconception, that horizontal drainage operating under gravity requires little or no maintenance, is equally misleading, because horizontal drains to not work if there is the least degree of hydraulic imbalance, i.e., raising of water surfaces due to clogged drains.

A preliminary investigation should begin by determining effective spacing of wells, their drawdown characteristics, well size, and power requirements. Operating and maintenance costs can then be compared to a horizontal drainage system. Once such a feasibility assessment is made, field trials can be conducted in selected areas.

4. The reclamation process: The reclamation of adverse soil conditions must precede any land improvement activities. Except for improper soil management e.g., poor tillage practices, inadequate fertilizer application, etc., salinity is the most important yield inhibitor under Nile farming conditions. The only way to control salinity is to leach salts from the soil, and to do this, adequate drainage is required. The following, while not necessarily research subjects, will certainly form part of any subsequent operation and implementation programs:

a) Salt balance management: The methodology for maintaining a salt balance in the root zone will involve the following:

i) Water management: The improvement in irrigation methodology will depend on an even soil surface to effectively distribute the water, thereby improving water application and reducing excess water in the phreatic zone. This objective requires land leveling. Once the land surface is in a suitable condition, irrigation application systems can be designed to apply water more efficiently in terms of water-use and labor.

ii) Soil amelioration: It is inevitable that all irrigation water contains salts of various kinds and in varying quantities. In some circumstances the soils become alkaline as a result of leaching sodium together with the calcium, out of the soil. Such soil can be reclaimed only by lowering the pH toward the value of 7 by using ameliorants, such as by applying calcium in the form of gypsum. However, the application has to be repeated at intervals to counteract the constant addition of salts and to compensate for calcium's movement out of the profile by leaching. It must therefore be determined to what depth gypsum must be incorporated and the frequency, to balance salt additions from irrigation water, subsurface (phreatic) contributions, and the leaching of such salts.

iii) Soil management: Again, ignoring the various factors concerned with fertility and cultural practices, tillage practices must be adopted that will contribute to maintaining soil structure. This will involve close attention to subsoiling practices that may inadvertently contribute to salt redistribution into the root zone.

b) Groundwater management: Groundwater management does not appear to be a function of any organization at present. The farmers appear to be ignorant of this important problem, and it may have to become a function of the extension service to propagate information that draws the farmers' attention to groundwater maangement:

i) Optimum groundwater levels: The level of groundwater, or water table, will depend on drainage conditions and irrigation application. The farmer has the facility to control rises in the groundwater level and he should be instructed in observing rises in the water table. This can be done by the simple expedient of placing pipes in the ground at strategic localities and measuring the water level in the pipe. The use of this

simple technique rests, however, on three assumptions: (a) that the land has been leveled; (b) the irrigation system has been renovated and improved, and (c) the drainage system works.

ii) Monitoring groundwater levels: Though (i) above is a farm-level monitoring system, a more extensive system is needed to monitor groundwater over a larger area and another approach may be considered: on a district basis, have farmers report back water table information and direct it to a specific authority that has an established analytical system to process the data immediately.

iii) Regional monitoring of groundwater and salinity: The least costly method of monitoring large areas of land is use of spectral analysis. The use of inexpensive infrared false-color photography with 35mm or 60mm film should be investigated. Extensive field surveys are costly, requiring many people and extensive laboratory facilties, while photographic techniques can be used to pinpoint problem areas for detailed land investigation.

c) Cost comparisons of alternative drainage methods: The acceptance of alternative systems or procedures can be based logically only on their cost effectivenes. Cost effectiveness not only implies the system with the least or lowest cost, but also the lowest cost required to achieve the optimum objective of the operation. This is not based on the usual cost-benefit analysis, which tends to yield misleading or even spurious conclusions. Alternative procedures, based on linear programming, may be used to assess the situation.

Simulation Analysis

Simulation modeling has been made possible by the development of computers, especially the minicomputers. This technique offers the research worker, soil scientist and engineer a powerful tool to clarify research objectives and to apply knowledge in a practical context for various field activities such as water management, systems analysis, irrigation design, leaching procedures for proper salt balance, drainage design and economic and financial analysis to obtain cost-effective procedures. A great deal of analytical work of this kind was not done in the past due to sheer numbers and the amount of time required. With the advent of microcomputers, such of this work can be done in a short time by relatively inexperienced people. The most exacting task involved is gathering the necessary data. Also, creation of oomputer software, or programs, requires professional programmers with a clear understanding of the research problem and solutions needed. There are many small computer programs avialable from many sources.

A survey has shown that there are at least five such programs that can be used for the research work involved here, though they will have to be translated from their language (machine or assembly language in most cases) to the language of the computer being used, a relatively simple but time consuming operation. It will be recommended that an experienced programmer

be hired to prepare and translate these programs, as well as create other programs needed for research and field operations. This person will also be needed to train a nucleus of programmers and operators within EALIP.

1. Soil and water program: the programs available for research use are: a) simulation of the transport process in soils; b) simulation of salt accumulation and leaching in soils; c) simulation of water balance of arable lands and pastures; d) simulation of field water use and crop yield; e) matching cropping systems to water supply using an integrative model.

These are some of the most useful and available programs, though a more comprehensive search of the literature will certainly reveal others that may be used.

2. Implement and machinery simulation programs: A number of suitable simulation programs have been compiled for the study of machinery and implement capacity and costs and most of these can be obtained at low cost or free of charge. However, they must be adapted to local conditions before being used for research purposes. One of the most useful of these programs is a Fortran program for multicrop farms for determing operation schedules, field machinery requirements and costs (Dept. of Agricultural Economics, Michigan State University) which might form the basis of a basin or village level analysis of mechanization needs.

3. Irrigation and water management: A very suitable program is available from the Water Management Research Project in Pakistan, "Matching Cropping Systems to Water Supply Using an Integrative Model." This program could be adapted to Nile Valley conditions without difficulty and could be used to simulate basin problems and solutions.

4. Computer hardware: The small desktop microcomputer can deal with most of the simulation programs mentioned. Though most are written in Fortran, they can be translated into BASIC by computer translators at a time-effective cost in comparison with their great use in research. The computer hardware to be recommended for use by EALIP will be a multi-user computer capable of measurement and control of laboratory devices, controlling and testing equipment, data acquisition and daily work on simulation studies, survey work and general business and research procedures.

5. Operators and programmers: The computer work, and all persons involved, should be combined with the central information and data-gathering section in the Authority, to perform primarily the laboratory work and also the field-data gathering work/ programming need[illegible] above. Two or three operators should be trai[illegible] arrangements made to provide adequate incentives to maintain their services--to keep these trained people. A specialist programmer should be appointed to adapt or develop programs for the unit. These people should also receive training in information/data gathering and processing skills, os as to better understand the field staff's work. A short term specialist in "informatics" and computer programming should be appoijted to develop a suitable system and to train the nucleus personnel of the Authority's center.

Information and Data Base

If suffices to say here that a proper information and data base must be established in order to develop an efficient research system--there is certainly no need to "reinvent the wheel." With the development in recent years of specific research programs in extensive irrigation projects, improved crop varieties, intensive agricultural production, etc., greater scientific effort has been devoted to the soils of the tropics and arid regions. It is from this data source that research systems and methodology could be drawn. These data can be gathered from scientific institutions, international organizations, universities and data collection organizations. A list of these sources, and how to contact them, will be submitted under separate cover.

The information center envisaged will not require extensive premises or expensive equipment, but can be designed as a simple retrieval system. Equipment such as microfiche and microfilm readers will be required, in addition to filing cabinets and shelves to store publications.

Acquisition and Storage of Technical Literature: There are four types of technical literature from which the researchers can obtain information and data:

1. Textbooks, or reference books: carefully selected to form the core of a reference library, and replaced periodically to include ever more current publications.

2. Technical and scientific journals: providing the most up to date information and current developments on pertinent subjects. These are expensive and unless actually read and used, may only repressent a great capital outlay.

3. Technical and scientific abstracts: providing the least costly means of keeping track of current events and developments in a wide spectrum of subjects across region types and countries.

4. Journal indexes: indexes of selected journals provide the least-cost method of following progress in a chosen subject area, as long as the reader "knows how" to read article titles. Individual offprints can be obtained at low cost but with the individual effort of the researcher in choosing and sending for the material.

5. Project reports: These provide a "track record" of work done and "good" (i.e., well prepared) reports based on valuable local data.

Location and staff

The laboratory work will be conducted at the existing central laboratories located in the EALIP central buildings. There are ten separate rooms comprising the central laboratory. The laboratories are well equipped with modern apparatus for the various soil parameter studies required for reclamation.

There is a competent staff of qualified personnel and technical personnel skilled in the routine work of soil analysis. From these, the specialist staff will be drawn for special research programs. The field work involved in the research program will draw on personnel of the operations section of the EALIP. Details of staff allocations are given in Appendix I.

EGYPTIAN AGRICULTURAL
MECHANIZATION PROJECT

SOIL IMPROVEMENT SUBPROJECT

WORKING PAPER NO. 2

OPERATIONAL ANALYSIS OF LASER PLANE CONTROLLED LAND LEVELING OPERATIONS OF THE DELTA SUGAR COMPANY

July 1982

Prepared by J.A. McClung
and Eng. A. El Fayoumi,
with Dr. A. Orabi

I. Outline

The purpose of this operational analysis of the land leveling activities of the Delta Sugar Company will be to develop data on the time, direct operating cost, power requirements and earthwork volumes for a laser plane based land leveling program in Egypt. The investigative portion of the analysis will be divided into two different types of data gathering activities:

1) Topographic surveys before and after land leveling operations take place, and

2) Data collection related directly to time, direct operating cost and power requirements of the operation.

The data gathered will be analyzed to determine:

1) The volume of earth that can be moved by an operating unit in a given period of time, and

2) The direct operating cost of the machinery unit used.

The methodology to be used is set out in this paper. The operational analysis will be used for:

1) Selection of appropriate equipment to be used in widespread land leveling programs;

2) Development of a management and operating program for similar work elsewhere in Egypt (see Working Paper No. 3);

3) Preparation of a budget for precision land leveling programs

4) The data base for further investigations into cost effective methods of precision land leveling.

Justifications

The justification for this operational analysis is based on the following premises. Although precision land leveling has been demonstrated in several experimental areas to increase crop yields through the resulting improved water management, no systematic treatment of the time, cost and power factors involved in moving specific volumes of earth is available. Furthermore, little if any commercial land leveling operations are taking place to provide guidelines, based on empirical data, for determining the time required to do the work needed, the equipment and the costs and earthwork volume that can be moved with relation to the swelling clays of the Nile Valley. In some land reclamation areas, where however soil conditions are different, there are several commercial operators active.

Although the improved water management aspects of land leveling operations have been demonstrated by the EWUP,[1] work, there is a second major benefit of land leveling which is the provision

of optimal conditions for the operation of machinery and land leveling thus is an important component of the mechanization project.

Third, this study is undertaken by the Agricultural Mechanization Project with the objective of optimizing a mechanized operation while at the same time improving both water management and the mechanization of crop production.

Location of Survey

The operational survey will analyze and study precision land leveling activities of the Delta Sugar Company (DSC) in the Baltim area. The DSC is one of the few areas in which a major land leveling program is taking place. Due to the fact that the DSC has undertaken laser plane controlled precision land leveling for several years and is expected to continue these operations for several years, the areas in which it is currently operating can be used to provide data as a basis for similar operations in other parts of the Nile Valley, where similar heavy swelling clays occur. The key to this analysis is the development of actual operational data as opposed to purely experimental data.

Brief Description: Land Leveling Operations of the DSC

Some general information has been gathered by Project personnel through visits to the DSC operating areas in Baltim and through interviews with involved personnel and equipment suppliers in Cairo.[2] A brief description of their operations is presented in the following paragraphs.

The DSC is using laser plane controlled operating units to zero level fields for sugarbeet production. The basic unit with which the DSC is working is an area of 25 meters by 250 meters. This area has been chosen as it suits both drainage and allows mechanization of farming operations. Under existing conditions, the DSC operating team consists of:

2 assistant engineers
1 assistant engineer for topographical analysis
1 assistant for topographical analysis
1 laser equipment manager
Miscellaneous drivers and laborers depending on the size of the operating unit.

The DSC currently has two such teams on its staff that are supervised by a soils engineer. The equipment inventory of the DSC is currently:

1	120 hp tractor, with subsoiler attachment
24	98 hp tractors with wheel mounted drag scrapers (model Renault 981, scrapers 3-meter Beheira type)
8	65 hp tractors mounted with chisel plows
3	laser transmitting units
3	laser level rods
20	laser receiving uits

The DSC divides this equipment into three groups: two operating units, and equipment on standby or under repair.

It is understood that 19 of the laser receiving units are currently mounted on the scrapers pulled by the Renault 981 tractors. The remaining laser unit will be mounted in the future. Each operating unit is thus composed of:

8	Renault 981 tractors with Beheira-type drag scrapers mounted with a laser receiving/control unit
2	Renault 981 tractors mounted with drag scrapers
3-4	Renault tractors mounted with chisel plows
1	laser transmitting mast

Two laser mounted scrapers are held on standby, on a rotating basis, to replace units that require repair.

The operating units may work as two separate units or as an integrated unit depending on the area worked in.

The general operating procedure is as follows: A preliminary topographic survey is carried out by the topography specialists using the third laser unit. This survey is carried out on a grid used to determine approximate cuts and fills and to determine balance lines, accomplished by calculating the average elevation. This information is used in the construction process. The tractors mounted with chisel plows next deep-plow the areas. In some cases this step is bypassed, for example, where areas have previously been leveled. (Originally, this step was omitted, until it was determined that impermeable layers were likely to develop if this operation was ommitted.) Following plowing, if the topographic survey indicated large undulations, scraper mounted tractors without laser units undertook rough leveling by eye. Next, the 8 laser-mounted units operate off one laser transmitter. When construction has been completed a check survey is run by the topographic specialists.

Many of the above operations may take place at the same time, under the general direction of the two engineers. For example, surveying may be taking place while plowing and leveling are taking place in other fields.

The DSC units keep their equipment in the field and refueling and lubrication are provided in the field. The working hours of the field personnel range between 9 and 15 hours per day. When the staff camps in the field, higher working hours result. The rotating equipment maintenance schedule ensures that the units are generally able to operate at full strength in the field. The number of tractors may in a unit may vary depending on the total equipment inventory and the size of the area the unit is working in.

Estimate of Time for Survey

An estimate of the time required to carry out the investigations and perform subsequent analysis is 8 man-weeks over a 4-week period. Actual field work would take a one-week period of study

that may be repeated if desired. It is expected that all transport and professional personnel will be provided directly by the Agricultural Mechanization Project.

II Procedures

The investigation program will be divided into three areas of activity:

1) An initial data collection and study design phase;

2) Topographic survey activities, and

3) Data collection on working time and operating cost.

Each area of activity is described as follows:

1. Preliminary Investigations: A team of Project personnel will meet with the personnel of the DSC. This team will set up the necessary arrangements to undertake the study, including identifying the times, the area, and the equipment to be used for the study. Additionally, the team will gather basic information about the operations of the DSC, including:

   a) the basic specifications of the tractors, drag scrapers and laser plance equipment used;
   b) The general field operating procedures, i.e., number of tractors operating off a lser mast, etc;
   c) the exact undertaken in a given time period;
   d) operations that take place in conjunction with leveling, i.e., ditching, ditch cleaning, etc.

It should be noted that a general description of the above is presented in the foregoing section of this paper; this activity aims at gathering the details of this information.

The preliminary investigation will take place a short time in advance of the actual investigations, in order to ensure that the field team collects all necessary data when conducting the actual study.

In addition to the preliminary study, final arrangements will be made when the field team arrives at the site, including:

   a) identification of equipment and drivers participating;
   b) configuration of the fields on which the study will be carried out;
   c) arrangements for accomodation of the personnel.

2. Topographic Surveys: The "before and after" topographic surveys (done on a grid basis) are the standard tool and the only accurate way of designing precision field leveling and calculating earthwork volumes.

   Methodology: The method of surveying proposed will use an electronic laser-emitting control device and a receiver rod. In the event this equipment is not available in time, an

optical level and standard differential leveling procedure can be used. Where an optical level is used, a graduated rod is held at each grid point, the rod is sighted through the level and the elevation is read off the rod and entered into a field book. Where a lser device is used, the procedures are similar, but the need for sighting through the level is eliminated as the laser device emits a continuous revolving beam of light which is received by a photo cell in the special rod. Receiving the beam fifteen times, the photo cell emits a beep and is locked into place and the data entered in a field book.

The advantage of this survey method is that it reduces the number of field workers, the amount of time required, and increases the accuracy of the survey.

Field Work

a) The survey grid: The grid points will be located on a 10-meter grid as shown in Figure 1. The baseline will be set out along the longest (120 meter) side of individual fields. The baseline will be set at 10 meters from the field border in order that grid points fall on the edges and middle of individual fields and so that the baseline stakes may remain in place when construction takes place.

Then the lines of stakes will be set out a right angles to the baseline at 10-meter intervals. The right angle is obtained by setting a measured tape 14.14 meters along the diagonal from adjacent 10-meter stakes and ten meters from the grid point. The grid line can then be set out using ranging rods in a straight line at 10m intervals.

b) Laser equipment: The laser equipment shall be used according to the manufacturer's instructions.

The rod reading shall be taken along the grid lines starting with A_1, to A_2, then B_{20} , B_{19}, etc.. This procedure is shown in Figure 2, and is designed to eliminate recording errors.

c) Datum reference: The datum reference point will be established and carefully demarcated on the ground. Either an existing structure of some permanence or a long steel stake driven into the ground will be used. The elevation value and location will be carefully recorded in the field book.

As the DSC regularly conducts surveys for areas it works in, it is proposed that the project hire the DSC to provide grid point elevations for random land areas it works in, in the future. This data can be used to develop continuing statistics on the volumes of earth moved per unit area. This should be an item for discussion with the DSC during the course of the study and appropriate arrangements should be made.

Previous Page Blank

3. During this portion of the survey data will be collected for 4 laser mast mounted tractors on:

a) fuel consumption;
b) time taken to complete each field;
c) number of runs to complete each field;
d) tractor cost records.

The methodology for collecting the above information is as follows:

Fuel consumption: In order to determine actual fuel consumption in liters per hour, data on fuel consumed per tractor will be recorded. At the beginning of the study each tractor will be topped up to a mark that is readily seen when refueling. When the tractors are refueled for the first time the actual volume of fuel required to fill to the mark will be recorded (see Form No. 1). Upon each refueling the data will be recorded in a similar way.

Time required: The time required to undertake individual activities will be recorded, including:

a) transport times (to and from field);
b) length of run (time required for individual runs when the tractor is under load or spreading);
c) turning times (the length of time the scraper is raised while the scraper is turning), and
d) refueling and break-times (amount of time the tractors are in the field but not operating).

This data will be accumulated on Form No. 2.

Standard wrist-watches will be used for each of the three tractors. One person will be assigned to monitor each tractor. In the event that the time taken per run is very small, stopwatches should be available.

The number of runs will be calculated directly from the data tabulated on time requirements.

Tractor cost records: The team will collect tractor cost records from the DSC and elsewhere. These records should include the following categories of information:

a) capital costs;
b) annual operating costs;
c) annual fuel consumption in liters;
d) annual cost of fuel;
e) annual lubricant costs;
f) annual maintenance costs;
g) annual costs of operating labor.

This data may then be used to calculate economic and financial costs.

III Data Analysis

The data analysis will be divided into two separate parts, consisting of a) a determination of the volume of earth that can be moved by the given equipment unit in a given amount of time, and b) the operating cost of the machinery units, including direct operating cost and later including capital, economic and financial costs.

The following pages outline the input that will be required for each analysis, the methodology to be used, and the output expected of each analysis.

Volume of Earthwork: This analysis will determine the Machine Unit Day (MUD) and will also be used to develop volume of earthworks per run data for the tractors being used by DSC.

Input: The input for this analysis will be volume of earth determined by the "before and after" topographic surveys and the time taken to move that volume of earth.

Methodology: The data will be analyzed to determine a Machine Unit Day (MUD). M-U-D is defined for this study as the volume in cubic meters moved in a defined time period by the machine unit used in this case by the DSC.

Earthwork volume will be determined by using the actual cuts and fills made by the unit. As a check, and for comparative purposes, a computer program[3] will be used to determine:

1) the optimum cut and fill using the "before and after" topographic survey data and
2) the cut and fill after the field has been leveled.

Actual cut and fill will be determined by subtracting the measured elevation of each point after leveling from the elevation of each point before leveling. Using the four-point equations below (1 & 2) the volume of earth actually moved will be determined. The equations used[4] are:

Equation 1:

$$V_c = \frac{L^2}{K} \left(\frac{C^2}{(C + F)}\right)$$

Where:

V_c = volume of cut

L = length of a grid square

C = cut

F = fill

K = a dimensional constant

Equation 2:

$$V_F = \frac{L^2}{K} \left(\frac{F^2}{(C + F)}\right)$$

Where:

the variables are the same as those in Equation 1.

K is a dimensional constant equal to 4 in the metric system and C and F in meters.

Previous Page Blank

Calculation of the time factor will be determined for:

1) the actual amount of time the tractors are in the field;
2) the total amount of time spent including transportation from and to the field, refueling, etc. It is intended that the first calculation give a theoretical M-U-D, whereas the second will give a figure that can be used for planning field operations.

The working unit will be defined as consisting of vehicles directly engaged in leveling, both laser plane mounted vehicles and vehicles used for rough leveling.

Using the data defined above, M-U-D will be determined for the DSC working unit by the equation:

$$M\text{-}U\text{-}D = V/T/M$$

Where:

$M\text{-}U\text{-}D = m^3/hr/tractors$

V = volume of earthwork

T = hours in a working day

M = machinery unit

The time factor will be varied for the two cases previously described (time operating, time idle).

The average volume moved per run and for the length of run can be calculated. The actual amount of time the tractors have been hauling and spreading earth will be calculated by adding up the second column of Form 2.

Similarly, the number of runs can be made for the individual tractors by assuming an equal volume of earth is moved by each tractor. An average for the machinery unit can be calculated. It should be noted that this number will be high, as it will not account for rough leveling in the turning areas that is done by non-laser mounted vehicles. For planning purposes, however, the accuracy should be sufficient. The equation used is:

$$VPR_{t_1} = V_{T_1} / N_R / T_{T_1}$$

Where:

VPR_t = volume per run per unit time

V_{T_1} = estimated volume per tractor

N_R = number of runs

T_{T_1} = time of runs per tractor

It may be possible to determine, using this data, the power requirements and power utilized. At present, it seems best to proceed using the methodology outlined above for planning purposes. If necessary, additional analysis could be undertaken to collect additional information.

Output: The output of this analysis will be a tabular array of data presenting the Machinery Unit Day data and average volume per run in time. This data will be used as input in implementing the proposed land leveling program in Upper Egypt.

Cost of Operations: The data collected and tractor cost records will be used to determine the economic and financial operating costs of the DSC operations.

Input: The input for this analysis will include the tractor cost records of the DSC, the fuel consumption of tractors, the equipment manufacturers' specifications and the labor costs.

Methodology: The proposed method of analysis* prorates annual fixed costs over an assumed tractor useful life of 8000 hours and calculates variable costs on an hourly basis.

For the Economic analysis:

a) Variable costs (LE/hour)

i) Fuel: $= \frac{IP}{138.32} \times F \times H \times C$

Where:

IF = international price of crude oil in US$/bbl

138.32 = constant, liters of refined diesel fuel/bbl crude oil

F = parallel market rate of exchange, LE/$US

H = rated horsepower

C = fuel consumption in liters/hp-hour

ii) Lubricants: $= C_1 \times F$

Where:

C_1 = coefficient of lubricant consumption as a percent of fuel costs

iii) Repair and Maintenance: $= K \times C_2 / U_L$

Where:

K = capital cost

C_2 = coefficient of maintenance costs as a percentage of capital cost

U_L = useful life of tractors in hours

---

* Ref: Planning and Evaluation Subproject

b) Fixed costs/hour:

i) Interest & depreciation:

$$\frac{\left[\left(\frac{i\,(1+i)^n}{(1+i)^n-1}\right) \times (K-S) + (S \times i)\right]}{A_n}$$

Where:

i = opportunity cost of capital

n = years useful life (life in hrs/A_H)

S = recoverable salvage value at end of n

K = capital cost

ii) Miscellaneous costs: = (V x F) x .05

Where:

V = variable costs

F = fixed costs

.05 = coefficient of miscellaneous costs as a percentage of variable and fixed costs

(The miscellaneous costs include insurance, garage fees, guard services, etc.)

For the Financial Analysis:

a) Variable costs (LE/hour)

All formulae used are identical to those used in the economic analysis except for the fuel costs, where prevailing local market prices of LE 0.025/liter for 1977-1980 and LE 0.03/liter thereafter were used as data inputs.

b) Fixed costs (LE/hour)

i) Depreciation: = (K-S) / U_L

ii) Interest: = [(K+S)] x A_h

iii) Miscellaneous costs: same as in economic analysis

During the first iteration an operating cost per hour will will be developed using the equations presented and the tractor cost records collected. The total area leveled over the period that the tractor cost records cover will be used with the operating costs to determine a cost per feddan. This information will be of only marginal use for planning purposes as it does not contain a measurement of earthwork volumes. However, if the DSC is willing to

collect topographic data for given areas as outlined in the data collection section of this paper, statistics may be generated from a representative sample on the median, 25-quantile and 75-quantile of the volume of earth moved for a given area. This data can, in turn, be used to develop the probable cost per unit volume of earth.

A second iteration will be performed using the actual fuel consumption which was recorded on the day(s) of the survey. This data will be combined with the earthwork volume for the day(s) of the survey to determine a cost per volume for that day. This figure may serve as an order of magnitude value for planning, until such time as additional data is accumulated.

Output: The output of this data analysis will be a report on:

(1) the tractor operating costs of the DSC;

(2) the cost per feddan of the land that the DSC has leveled to date;

(3) the tractor operating cost for the tractors observed on the day(s) of the study;

(4) the cost per unit volume on the day(s) of the study.

Additionally, this data will serve as the first iteration of the data analysis. If and when the DSC collects topographic survey information, and earthwork volume statistics have been developed, a second iteration will take place. These reports will address both economic and financial operating costs.

IV Conclusion

The reports generated by this Working Paper will be of use in developing a land leveling program for Upper Egypt. This is especially true as the survey will be carried out on a commercial operation. Additionally, the results may be used to assist in the privitization of such an enterprise. It is proposed that the reports be distributed to the DSC and to the ECC for their use, as well as to interested Project staff.

REFERENCES

1. Egyptian Water Use and Management Project, Report No. 54. Ministry of Irrigation, ARE.

2. a) Personal communications of E.D. Coles with DSC personnel, October 1982.

   b) Memorandum on Land Leveling Operations of the Delta Sugar Company, Dr. A. Orabi and Dr. El Araby. Agricultural Mechanization Project. June 1982.

   c) Personal communication, Mr. J. McClung with personnel of laser plane suppliers (Egyptian Computers Company, ECC) to the DSC.

3. Land Leveling Design System. Software for use with Apple II Computers: Laserplane.

4.

5. Agricultural Cooperative Tractor Cost Survey in Beheira and Gharbia Governorates. Planning and Evaluation Subproject, Agricultural Mechanization Project. April 1982.

EGYPTIAN AGRICULTURAL MECHANIZATION PROJECT

SOIL IMPROVEMENT SUBPROJECT

WORKING PAPER NO. 1

BASIN SURVEYS: MINIA GOVERNORATE

April 1982

CONTENTS

1.0 Outline

2.0 Survey Procedures

2.1 Phase I

2.2 Phase II

2.2.1 Topographic Survey
2.2.2 Soil Survey
2.2.3 Sociological Survey

2.0 Operational Planning

3.1 Basin Configuration

3.2 Earthwork Volume

3.3 Equipment Capacity

3.4 The Time Factor

3.5 Equipment Selection

3.6 Analytical Procedure

4.0 The Topographic Survey

4.1 A Representational Survey

a. Basin Selection
b. Basin Configuration

4.2 Survey Methodology

4.3 Fieldwork

a. The Survey Grid
b. Laser Levelling
c. Recording Rod Readings
d. The EPROM

4.4 Computer Printouts

4.5 Data Analysis

5.0 Equipment Schedule and Costs

6.0 Cost Estimates

7.0 Technical Pamphlets

Working Paper No. 1

THE BASIN SURVEY: MINIA GOVERNORATE

1.0 Outline

The purpose of the Basin Survey will be to determine the extent of the land improvement work in Minia Governorate. They survey will be divided into two phases: the preliminary data gathering survey and the topographic, soil and sociological surveys of selected basins.

The data obtained from the Phase I surveys will be used to determine the number of basins for topographic surveying, soil surveying and sociological survey.

The results of these surveys will be used for an operational analysis to determine the kind, size and number of equipments needed to carry out the land improvement program within the allowable annual time frame; the organization required to manage the program; the cost of procuring the equipment, and the cost of operating the equipment.

In addition to the above, data obtained from the village agricultural officers on problem areas within the village areas, salinity, high groundwater, and alkalinity will be used to draw up an overall operational plan.

The justification for these surveys is based on the following premises. In the case of the Phase I survey, there had been no clear statement on the extent of the areas in which to plan the land improvement operations, including land levelling, subsoiling and soil amelioration. The Phase I survey requires few resources and costs very little.

The second phase is concerned with measuring the physical components of the work area. In order to carry out engineering planning, maps are required at scales allowing accurate measurements to be made. Maps and air photographs at scales of 1:2500 or 1:5000 with contour intervals of 0.25 meters are required. Attempts to purchase such maps failed. Inquiries to obtain such maps from other sources are also unsuccessful. Hence the recommendation to carry out the second phase of the survey.

The second phase will provide new methodology for future survey procedures which the land improvement organization may use for detailed surveys.

The time taken to gather the Phase I data was about one month, or about 1.5 months and with extraction and collation of data will total 2 man-months (four persons working one month).

An estimate of the time for completing Phase II is four months, but an accurate estimate will be possible only when the first phase is completed. Each laser survey unit can do from 600 to 800 feddans in a six-day week, working 6 hours per day. Assuming half these values, 36,000 to 48,000 feddans can be surveyed in the four month period.

Transport, professional personnel and labourers will be provided by the Land Improvement Organization.

2.0 Survey Procedures

The survey will be divided into two phases.

2.1 Phase I

The first phase of the survey will consist of gathering data from each of the village areas. This data is given on map sheets at a scale of 1:10,000, showing the basin areas, location of roads, canals and drains.

The village agricultural officer was requested to demarcate on each map the following subjective assessments of those factors depressing optimum crop production. The pro forma for collating the data from the maps in shown in the attached forms.

These data will be extracted and tabulated for analysis. The results of the analysis will be used to determine:

a. the total number of basins;
b. the size distribution of the basins;
c. the approximate area, in each markaz, of the subjective assessment of factors (a) and (b) above;
d. the area of field crops and orchards (or non-productive land), roads, canals, etc., village area;
e. the area of cultivated land that is out of production because of salinity, high groundwater, or other reason.

From this data analysis a number of basins will be sampled. The sampling may be randomly drawn, selected on a stratified basis, or a combination of both. This can only be decided once the data has been exmained in detail and the selected sites examined on the ground.

The number of sites to be selected will be based on a simple statistical procedure. For example, the coefficient of variation between the surveyed areas and the total area chould not exceed 10 percent, but because of the size of the whole area a longer variation may have to be accepted. The standard error of the surveyed areas should not exceed 5% with a confidence level of not less than 95%.

2.2 Phase II

The selected basins will be surveyed using the following procedure.

2.2.1 Topographic Survey

The topographic survey uses a laser levelling instrument and records of the field data on a recording device to be directly translated into the Hewlett Packard 85 minicomputer. The computer will be programmed to print out the following data:

a. three levelling configurations:
   1) stepped or terraced;
   2) sloping, or
   3) level (zero levelled);
b. the volume of earth to be moved;
c. the cut-and-fill at each nodal point or stake location.

2.2.2 Soil Survey

The soil survey should be carried out at a reconnaissance level. What is required is a simple, rapid assessment of the essential soil factors of salinity, aklalinity, and groundwater level, and a subjective description of the soil conditions. The object of this procedure is to reduce the amount of time and personnel required to produce the desired results and to complete the work in as short a time as possible. The data required are:

a. salinity, expressed as the decisiemens, obtained from soil paste measurements;
b. alkalinity, expressed in pH, obtained colorometrically or by means of an electrode cell;
c. groundwater measured in the augur hole;
d. soil description from the augur hole.

The soil should be sampled at .15, .30, .90 and 1.20 m.

2.2.3 Sociological Survey

A sociological survey should be conducted in each of the basins surveyed in order to obtain a clear view of the farmers' reaction to their requirements and reactions to improving the land situation in the basin.

The survey details will not be described here but some of the salient features that should be discussed with the farmers are:

a. that survey and design of the basin will be completed a year ahead of construction so that the designs can be considered by the farmers, allowing them to plan ahead their crops, and to provide feedback to the designers;

b. that the relevant improvements will include some or all of the following:

1) land area to be leveled and the amount of leveling, such as volume of earthworks and cut-and-fill;
2) canal realignment and structure renovations;
3) access and "in-basin" roads;
4) amelioration and subsoiling (gypsum application and incorporation);
5) drainage, surface drains, subsurface drains and drainage improvement (mole drainage).

c. establihs cropping patterns for the respective basins and estimate effects of the construction on future cropping patterns and income.

These are amongst the most important items that are required for creating an organization to conduct the land improvement operation and for future operational planning.

Inegrating farmer participation into the planning process is essential for the success of an operation of this kind.

3.0 Operational Planning

The purpose of the proposed surveys is to obtain basic information needed for the planning of the future land improvement program, and to provide the crucial data needed to plan the financial costs of the operation.

3.1 Basin Configuration

The dimensions of the basin, shape, length and breadth, will influence the size and kind of equipment to be selected for levelling operations and other operations.

The time that equipment takes to traverse the length of a basin and the turning time proivdes the rate of operation per unit time. Small or uneven shaped basins require more time to complete than even-shaped or longer basins. Further, equipment with greater capacity can be used in longer basins. Thus, basin configuration significantly influences operational costs.

3.2 Earthwork Volumes

The vertical configuration of the land will indicate the amount of earth to be moved. The shaping of the land also indicates how much earth must be moved.

Considering that this land improvement activity is required in order to improve distribution of water, the goal is to aid water management by providing more efficient irrigation methods, i.e., using less water to influence groundwater levels and incidently reduce salinity.

Shaping the land may fall into one of three categories:

a. Primary levelling, where large volumes of earth may be moved and terracing the land may be needed to provide an ideal irrigation surface;
b. Secondary levelling where undulations and uneven land surface are cut down to provide a graded or level surface for the even distribution of water;
c. Tertiary levelling, required to smooth farm fields after plowing, this operation usually to be carried out by the farmer.

The volume of earth to be moved in primary and secondary levelling depends on the overall land form of the region; hence, estimates can only be obtained once an extensive topographic survey has been completed.

3.3 Equipment Capacity

The capacity of the equipment, scrapers and tractors, will depend upon the volume of earth to be moved, as well as the distance of movement. Axiomatically, a large number of small machines would be required to move the same volume of earth over short distances with many turn-arounds, whilst a few longer capacity machines would be required to move the same volume over long distances with few turn-arounds. But this choice requires a cost analysis and a linear programming solution. The survey will provide the data for this solution.

3.4 The Time Factor

The fact that any construction operations within the farming area will be dependent upon fitting such operations into the cropping pattern provides a constraint upon the amount of time available to do the construction work.

The best estimate available appears to range from 90 to 150 days per year. To have a large capital investment in machinery and large complement of idle personnel for a greater part of the year is inefficient; nor will it be possible to move the equipment to other regions, as the cropping patterns are similar in other regions growing field crops. Land improvement work in the sugar growing areas and in lands requiring rehabilitation may be possible.

There is both an economic and a management problem: from the economic point of view equipment can be "moth-balled" or depreciated over a longer period of time; as long as it is not used, it does not incur operating costs, yet still represents idle capital. This can be written off against social or state cost to the agricultural sector. But idle personnel is another matter, and alternative employment would have to be found for the trained personnel.

3.5 Equipment Selection

From the foregoing it can be seen that selecting the equipment is going to be more complex than envisaged. There appear to be two alternatives:

a. existing available equipment may be pressed into service and used at sub-optimal levels;
b. new equipment procurements will be based on optimal requirements suited to the field conditions.

At this stage the problem not only concerns what equipment is available but how many items are required to do the amount of work in the given time frame.

3.6 Analytical Procedure

An optimal solution to the selection of equipment and to the "modus operandi" of the land improvement operation will be solved by means of a linear program technique.

The two constraints apparent at this stage seem to be unit size and time available to complete the construction. However, other constriants may come to light during the course of these surveys and a more objective assessment can be made of the analytical methodology.

The capacity of the tractors and scrapers can be calculated using the equations and methodology given in such publications as the American Society of Agricultural Engineers Yearbook, Hunt's "Farm Power and Machinery Management" (Iowa University). But a more realistic method will be to measure the actual field operations. The Delta Sugar Co. is using the equipment that is advocated for the land improvement operation. It is stressed here that the "conditions" are of no consequence; the measurements concern the power and time needed to move volumes of earth. The "conditions" include the density and moisture content of the earth to be moved. The tractor configuration will be similar to the other tractors in use in power, weight and time-size. These details will be given in Working Paper No. 2.

The problme presented here is ideally solved by means of the linear programming techniques with a straightforward matrix array and the two constraints of basin shape and time. Other, more refined methodology may be used at a later stage. The RPM network can be used to formulate and solve mathematical programming problems in an iterative procedure with a graphic representation of the complex mathematics, increasing the usefulness of this technique.

4.0 The Topographic Survey

A topographic survey is a basic requirement for any engineering construction operation. Such a survey provides the data to determine the extent of operation, the kind and

size of equipment, time needed to complete the operation and the organization to run such an operation, and cost of carrying out the construction work..

4.1 A Representational Survey

This topographic survey is proposed because no pre-planning maps or aerial photography is available for determining the preliminary estimates of earthwork volumes and land an cadastral configuration. In the usual circumstances maps at scales of 1:2500 and 1:5000 ore rectified aerial photographs at similar scales are available. The following procedures are recommended.

There is not time to carry out detailed topographic surveys of all the governorates; the other three will be dealth with by selecting a representative sample of the basins. The first governorate to be surveyed is Minia.

a. Basins will be selected randomly from three categories based on size. The number of basins from each category shall be selected statistically allowing for specific variation with a limited standard error at a confidence limit of not less than 95%. The number of basins in each markaz will be obtained from the data gathered in Phase I of this survey.

b. Basin configuration data can be obtained from the topographic survey or from the rough field maps.

4.2 Survey Methodology

This method of surveying does not use optical surveying techniques. The levelling procedure uses an electronic controlled laser device and receiver rod. Where an optical level is used, the graduated rod, held by a rodman, is sighted through the level and the elevation is read off the rod and the nodal point or grid number and elevation entered into the fieldbook.

This procedure is repeated for each nodal point until the area surveyed is completed. The laser level works in a different manner. The laser transmitting device is mounted on a tripod, transmitting the laser beam in a horizontal circular plane, at a given height above a datum level (ground level at the laser station, for example). A graduated rod with a light sensitive detector is set over the nodal point and the rod reading is read off, giving the elevation of that point. This reading can be enetered into a fieldbook in the conventional method. The fieldbook entries are then entered into the computer. The method advocated here will be to enter the field observations into an electronic recorder which then transfers the data to a cassette tape, which is then translated and transfers the data into the micro-computer. The computer program processes the data, computes the earthwork volume, the nodal cuts-and-fills, and prints out the data.

The purpose for suggesting this procedure is that:

a. it reduces the amount of time for the fieldwork and uses a minimum number of field workers;
b. accuracy of the observations are increased (a relative accuracy of 1 in 500 to tacheometric vertical measurements and 1 in 15000 for the electronic vertical measurement;
c. errors in fieldbook entries are eliminated;
d. the arduous and time consuming mechanical cut-and-fill calculations are eliminated; doing these calculations for a number of surface configuration options (terraced, sloped or zero levelled) would take much time and occasion many errors; the computer will eliminate error and reduce the time required.

The time to complete the work and the accuracy of this work is an essential part of the survey.

4.3 Field Work

a. The Survey Grid: The nodal points will be located at 10 meter intervals, as shown in Figure 1.

The baseline will be set out along the longest side of the area to be surveyed and stakes driven into the ground at 10 meter intervals. Each stake should be clearly marked, alphabetically.

Then, lines of stakes are set out at right angles to the baseline, at 10 meter intervals. The right angle is obtained by setting a measured tape 14.14 meters along the diagonal from an adjacent 10 metre stake. The grid line can then be set out by ranging rods, to maintain a straight line, at 10 meter intervals. The survey grid is shown in Figure 1.

Pacing along grid lines will not be acceptable.

b. Laser Levelling: The laser levelling equipment shall be used according to the manufacturer's instructions. The rod readings will be taken along the grid lines starting from A_1 to A_2, then grid line B_1, B_2, etc., to avoid recording errors. Random observations along grid lines, as pacing along grid lines, would produce errors.

c. Datum Reference: The datum or reference point must be established and carefully demarcated on the ground. Either a long steel peg is driven into the ground, or a concrete beacon is placed in the ground. The elevation value and location will be carefully recorded in the fieldbooking system (fieldbook or polycorder).

The reference plane for levelling and irrigated field or basin must be referred to the full supply level of the supply canal ("menwa" canal). A head

differential of 0.10 or 0.15 m is allowed so that water can flow from the supply canal onto the field.

d. Recording Rod Readings: The rod readings will be recorded on a Polycorder, an instrument that looks like a hand-held calculator. The reading is pressed in the following manner: Nodal points, A_1 ; B_6, Rod Readings, 2.39 ; 3.43, etc.

e. Cassette Recording: The Polycorder is connected to the cassette recorder and data transferred to the cassette. The cassettes are then set into the central office where the data is processed in the computer. The cassettes are filed and the data retained for future reference.

4.4 Computer Printouts

The cassettes containing the field data are "played" into the translator and data is translated into computer language. The recorded computer program then computes the required data and a printout of the data is obtained.

At this stage a very suitable program is available for this work, but the program may be altered to provide additional information is required, at a later stage.

4.5 Data Analysis

Four sets of information will be obtained from the survey of each basin:

a. earthwork volumes;
b. land form configuration;
c. cut-and-fill at the nodes;
d. basin dimension.

A suitable equation is available to compute the power required to move earth over given distances at optimum speeds. This equation will be tested against measurement that will be made of levelling work done by the Delta Sugar Co. (see Working Paper No. 2). While conditions differ between areas, it is not the conditions that are being measured: the rate that volumes of earth of a given density are moved over a given distance in a given time using a prime mover (tractor) of specific configuration (time, size, power rating) with a specific implement, is measured to obtain the parameters and variables used in "localizing" the equation.

This data will then be put into a linear program matrix and the solution obtained by means of the computer. The details of the analysis are given in the section on operational planning (Section 3).

5.0 Equipment Schedule and Costs

The laser equipment, consisting of the laser level, tripod and detector rods, can be purchased locally. The Polycorder and peripherals will have to be purchased from U.S. manufacturers.

The equipment is described in detail in the attached photocopies of the technical literature.

Transport and personnel will be provided by the Land Improvement Organization.

EQUIPMENT SCHEDULE

Item 1: Hire Items

Hiring of laser equipment from E.C.C. as per proforma invoice, consisting of the items described in the attached quotation submitted by E.C.C. at LE 1380 for 4 months: LE 5520.0

Item 2: Computer Software

Provide for purchase of computer software for land levelling program for computing levelling configuration of area (terraced, sloped, or level) earth volumes and stake line cut-and-fill values. Estimate in $: $ 2500.0

(Note: Whether the program is purchased or developed in Egypt, the cost is the same.) --------

Item 3: Offshore Purchases

1. Model 516 Polycorder 24,000 digit data storage capacity, one offer @ $3360	$ 3360.0
2. Model 535N Nickel-cadmium rechargeable batteries. Replacement set of six AA size and one 9-volt, 1 set @ $45	45.0
3. Model te7R AC wall mounted replacement battery charger, one offer @ $25	25.0
4. Model 520L field carrying case, complete; one offer @ $55	55.0
5. Model 544S. RS-232 cable with socket, adapted to Hewlett Packard 85 inlet, one offer @ $45	45.0
6. Model 550A Audio Cassette connector cable, one offer @ $45	45.0
7. Model 217CD Cassette Reader, one offer @ $1690	1690.0

8. Model SC254 pin RS-232-C connector cable, one offer @ $45	45.0
9. Model 551B Audio Cassette to reader connector cable, one offer @ $15	15.0
10. Supply of suitable audio cassette recorder, one offer @ $250	250.0
11. Package and freight	350.0
TOTAL:	$ 5925.0

Item 4: Local Purchases

1. Metallic tapes, 30 meters on reel, 4 @ LE 100 each	LE 400.0
2. Ranging rods, 2 meters long, with .25m red, white and black bands, 6 @ LE20 each	120.0
3. Audio tape cassettes, 90-min. high fidelity quality, 40 @ LE1.50 each	60.0

Item 5: Transport, Personnel

1. Transport: 4-WD vehicle, 4 months	1000.0
2. 7 labourers, 4 months @ LE1.50/day for 120 man-days	180.0
3. One professional team leader @ LE4/day for 120 man days	480.0
4. 2 professionals, 1 instrument operator and staffman/recorder, @ LE2.74/day for 120 man days	330.0
5. One driver @ LE 1.50/day, 120 days	180.0
6. Computer operators @ LE3.50/day for 150 days	525.0
7. Laboratory staff @ LE1.50/man, 250 days	360.0
8. Travelling allowance, approx.	3000.0
9. Contingencies	605.0

Total in LE: 12,760

Total in $$: 8,020

TECHNICAL SPECIFICATIONS

SURVEYING SYSTEM (GRADE SETTING)

MODEL	DESCRIPTION
945 U	**MODEL 945U UNIVERSAL LASER** 3-axis electronic self-levelling rotating laser 14 mm diameter sport at laser. Plane of laser light can be tilted on slopes up to 10%. Has ± 6° self-levelling range. Early Warning System, variable speed beam rotation, 0-300-600 rpm, regulated, self-levelling or manual mode selection, power cable, battery clips, fiberglass carrying case, and instruction manual.
970-2	**LASER ROD 2.2 m** Automatic grade rod has rapid scan sensor, sliding cursor and moving calibrated tape for differential (cut and fill) or direct elevation measurements, side scales for standard grade readings, lock-on and constant tracking modes, audible lock-on indication. Complete with eight "C" cell batteries, carrying bag and instruction manual.
851	**HEAVEY DUTY ALUMINUM TRIPOD** Heavey duty extension leg tripod with elevator column for fine height adjustment and male 3½ x 8 mounting threads. Extends from 0.9 to 1.9 m.

sd.

ECC | Egyptian Electronics & Computers Co.

sole distributers for
Spectra - Physics
U. S. A. — W. G. — U. K.

Quotation No. SP. 8/82.

Date: April 28th, 1982.

FOR LEASE OF SPECTRA-PHYSICS
LASER SURVEY SYSTEM.

Customer: Egyptian Agriculture Mechanization Project
Ministry of Agriculture
Dokky-Giza,
Egypt.

I. SYSTEM DISCRIPTION AND LEASE RATES

ITEM	MODEL	DESCRIPTION	QTY	MONTHLY LEASE RATES IN EGYPTIAN POUNDS. PER UNIT	AMOUNT
1	445000-01	Laser level, universal (complete with carry case and power cable).	1	960.000	960.000
2	851	Heavey duty aluminuim tripod.	1	60.000	60.000
3	970-2	Automatic laser rod (with carry bag).	2	180.000	360.000
			TOTAL ONE MONTH LEASE CHARGE .....L.E		1380,000 ========

Shawky

II. TERMS AND CONDITIONS

1. Minimum lease period for the above system and rates is four complete months.

2. Above lease rates are valid for a leasing period of six months, if the lease is exctended beyond six months the lease rates will be reduced by 10% (ten) starting the seventh month and if extended to more that one year will be reduced by another 10% (ten) from the original rates starting the begining of the second year.

3. Payment of lease charges for the first four months will be paid in full and in advance upon delivery of the leased equipment.
   If the lease period is extended for any longer period the monthly lease charges will be paid in advance at the begining of each month.

4. Lease rates include all maintenance, repair and caliberation work required for the proper operation of the leased equipment, these rates also include adequate training for customers personnel for three days upon delivery of the equipment.
   However, they do not include any repair work necessary in case any damages occur to the equipment due to missuse or physical distruction or any other hazards, and in such cases the customer will be responsible for any cost of repair to make the damaged units servicable, or its complete value if it couldnt be properly returned to its original condition.

Sf.

../..2

5. Any break-doun of any of the leased unit will be repared by us and put back to service within a maximum period of 48 hours, otherwise we will replace such unit by a similar one untill the original unit is repaired.

6. The customer can chose to lease the equipment for only four months period after which the equipment will be returned to us, or he can chose an open lease period for more than four months, and in the latter case, the lease will be monthly basis starting the fifth month and the lease will be considered extended monthly exept we receive from the customer written notice of termination of the lease one month prior to termination date.
In all cases, if the equipment are not returned to us at the end of the lease period, a daily lease charge wil be due from customer for each day calculated on basis of monthly rate devided by 30 days.

7. Delivery of leased equipment to customer will be within 45 days from receipt of written acceptance of this offer from customer.

8. This offer is valid for 30 days from its date.

Utility

"We had been looking for years for a self-leveling laser that we could use for both general construction and sewer construction. Then we found the 945U. It is totally automatic and works great on *all* of our jobs."

Plumb Target—Allows you to plumb over the laser beam accurately when setting up for sewer construction.

Carrying Handle—Makes it easy to carry and nt this compact, lightweight laser. And you can set the grade direction quickly and easily by sighting along the handle.

945U LaserLevel™

Housing—Rugged castings and extrusions rotect the fully-enclosed self-leveling system to nsure reliability and total waterproofness. Slim profile makes it easy to set up in curved, pre-cast inverts.

wer—Waterproof power connector is keyed to allow fast, sure attachment of the power cable. he LaserLevel's low power draw means longer battery life for greater convenience.

Grade Window—Lets you clearly see the de-setting shown on the digital counter. Grade can be set accurately to 0.01% over the ±10% grade range.

ser Windows—Precision, optical glass ures accurate transmission of the beam in all positions while also ensuring that the laser is a completely sealed, waterproof unit.

rivet—Basic trivet plate provided with ery 945U has 3 adjustable footscrews low fast rough-leveling of the laser for fast set-ups.

Laser Beam—Small, bright, perfectly round spot ensures accurate work by your men. And it comes on only when the beam is level or on grade to protect you from costly mistakes.

Early Warning System—Shuts off the laser beam if it is knocked off level or off grade. Turns it back on only when it has automatically releveled itself to within ±1/8 inch at 100 feet (±3 mm in 30 m).

Base—3-1/2-8 threaded ring allows the 945U to be securely mounted to any of the support accessories available.

Bullseye Level—Use it to rough level the laser if you are using the Plumb Target for setting up on line.

Wide Self-Leveling Range—±6° self-leveling range means fast, easy set-ups in any situation. Electronic self-leveling is a proven concept that provides more versatility.

Rotor Control—With the Rotor Mode Switch in the up position, the Rotor Control lets you set the laser beam on grade quickly and accurately. With the Rotor Mode Switch in the down position, the Rotor Control lets you point the beam and adjust the rotation speed of the laser beam to any setting between 0 and 600 rpm. At 300 rpm and 600 rpm, the speed is regulated, for top-notch performance from any of our machine control systems being used within.

Vertical Plane Bullseye Level—Used for rough leveling the laser when setting up for vertical plane applications. Laser will self-plumb automatically over ±6° range to give fast set-ups.

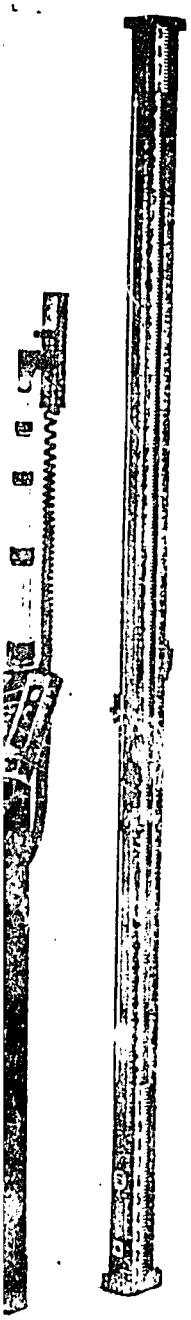
Automatic/Manual Mode Switch—Down puts the laser in the automatic, self-leveling mode. Up puts it in the manual or non-self leveling mode. Lets you turn off the automatic self-leveling system when you need to rake in grades beyond the ±10% range.

Self-Leveling Indicator—In the automatic mode, green light goes on and off with the laser beam so you know when the laser has self-leveled itself. In the manual mode, this light stays off. You can be sure that the laser beam is level or on grade and in the self-leveling mode when both the laser beam and the green light are on!

Remote Line Control
When attached to the power cable, the remote line control lets you point the laser beam, to set or adjust line quickly and accurately, without going back down into the manhole or trench. One man set-ups become simple.

Accessories

"The accessories for the LaserLevel have obviously been designed with the user in mind. They make a good system even better."



Mounting Systems

A comolete line of tripods, trivet plates, and mounting accessories are available to meet every need and job-site application. All are designed to be rugged and easy to use.

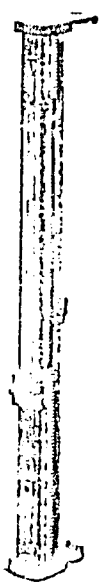
Detectors– The most technologically advanced detectors available in the world today make the 945U even easier to use in the rotating mode for general construction.

Laser-Rod® Detector

Automatically finds the laser beam over an elevation range of 5.5 feet (1.7 m) elevation and as far as 1,000 feet (300 m) away from the laser. Takes 16 readings on each shot to average atmospheric effects for unequaled accuracy. Four models available to read "cuts and fills", "direct elevations," and "standard grade readings" in feet and tenths, feet and inches and metric.

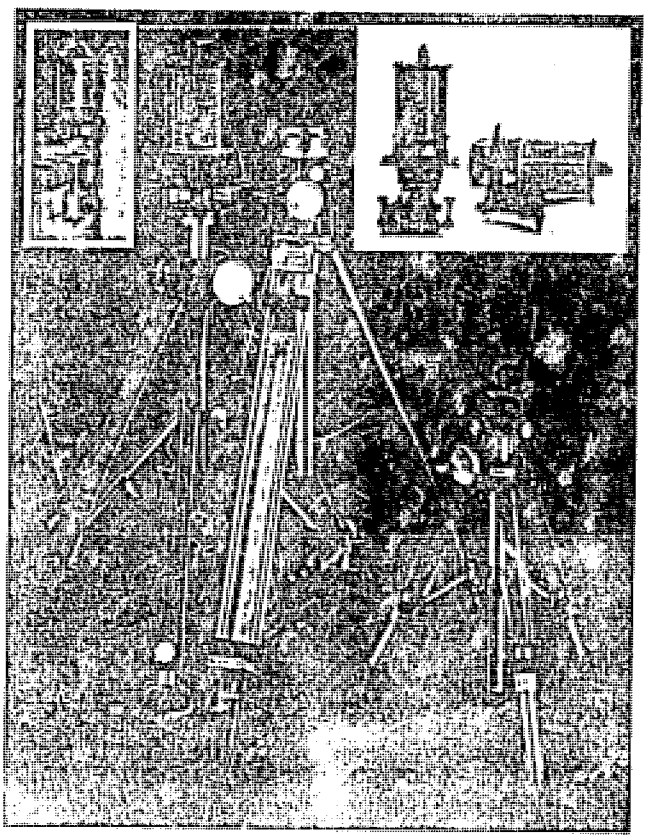
Shorter models also available with 1.5 foot (0.5 m) search range.

Specifically designed for use around building construction.

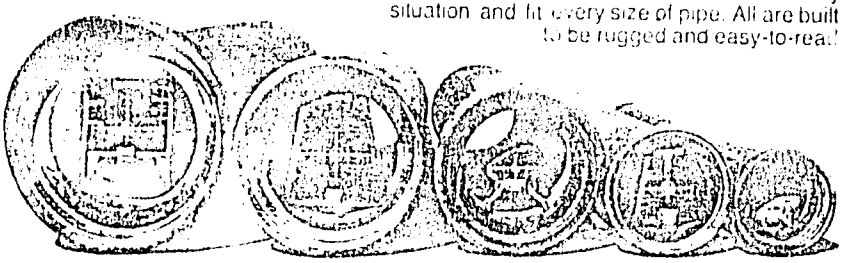


LaserEye® Detector

The best hand-held detector available for setting screeds or marking walls, forms, and floors. You can separate the sensor and readout, select the sensitivity by flicking a switch, and use the special marking notches to ensure accuracy. Can also be used on a direct elevation reading rod or telescoping grade rod.



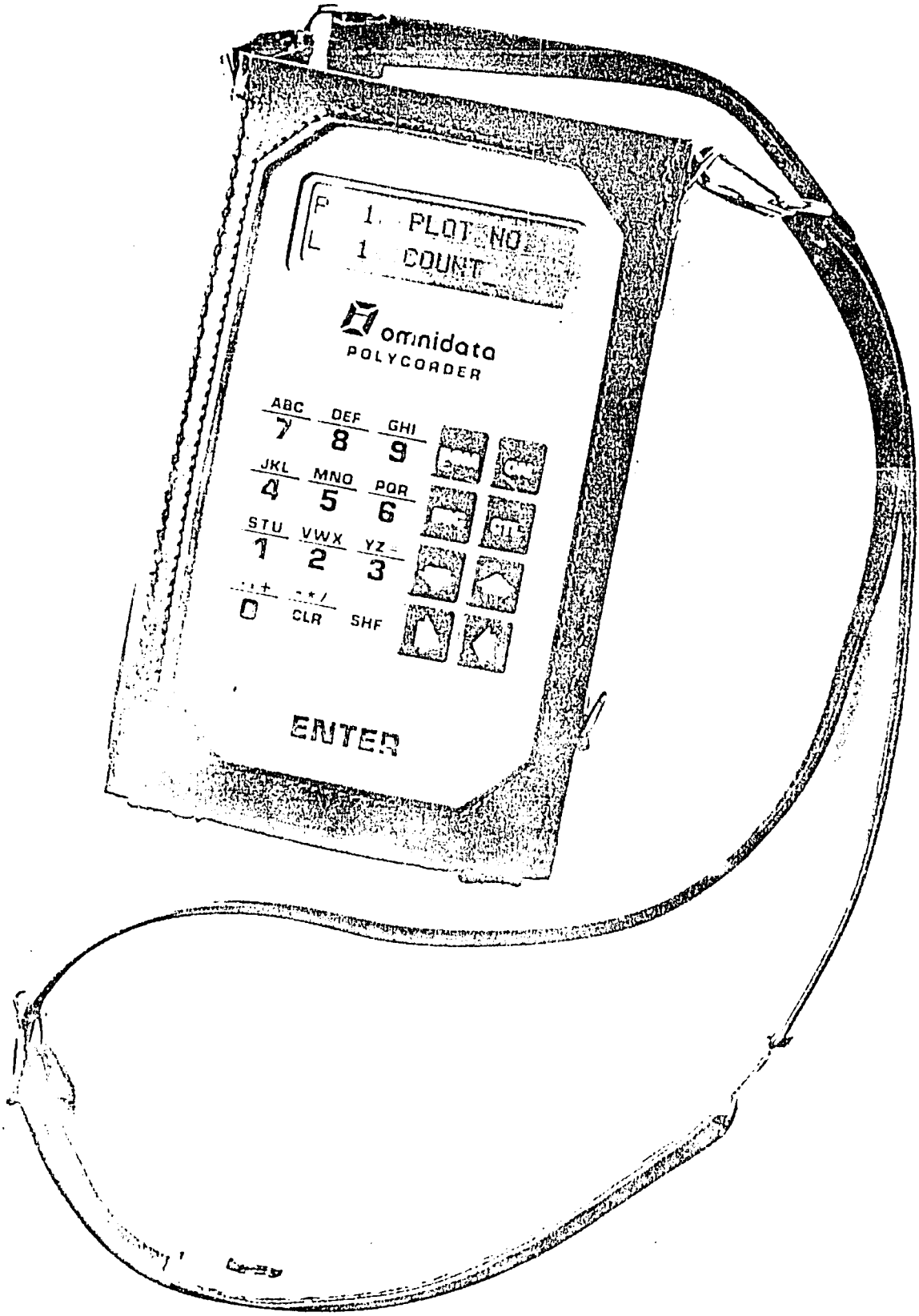
Targets: Different targets are available to meet every situation and fit every size of pipe. All are built to be rugged and easy-to-read.



Adjustable Large Pipe Target: Designed to give the user maximum flexibility. Calibrated to self-center pipes from 15" to 30" or 400mm to 800mm in diameter. Two levels allow it to be leveled both right side up and upside down. Locking screw and design of feet allow it to be easily attached securely to a 2 × 4 for use in very large pipe.

Adjustable Small Pipe Target: Also designed to give the user maximum flexibility. Calibrated to self-center in pipes from 6" (150mm) to 12" (300mm) in diameter. Level vial allows it to be leveled when the bullseye is not at the center line.

Clip-in Targets: Three different types designed to clip in and self-center in 6" (150mm), 10" (250mm) and 12" (300mm) diameter pipe.


P 1 PLOT NO
L 1 COUNT
omnidata
POLYCORDER
ABC DEF GHI
7 8 9
JKL MNO PQR
4 5 6
STU VWX YZ
1 2 3
0 CLR SHF
ENTER

MODEL 516 POLYCORDER

INTRODUCTION

Modern field research generates large amounts of data, derived from both visual observations and instrument readings. The rising cost of labor and the proliferation of inexpensive minicomputers and time-share terminals have combined to make computer compatible data logging the most cost effective means of handling data. Error reduction and rapid data analysis are benefits beyond cost savings.

The Omnidata Model 516 Polycorder is the easiest to use, yet most sophisticated portable data collection system available. It accepts both keyboard entry of visually observed data and electronic entry of voltages and digital signals. Its highly visible display, long battery life and sealed case and keyboard make the Polycorder the ideal field instrument.

Data stored in the Polycorder can be recalled to the display for editing or transmitted directly to a computer for report generation. Stored data can also be dumped to an audio or digital cassette recorder for archiving.

TYPICAL POLYCORDER APPLICATIONS

KEYBOARD DATA ENTRY

Visually observed data is normally recorded using a pencil and a notebook. Notebooks contain pages that can be partitioned into lines and columns, and data is entered into the columns. The Polycorder was designed to mimic a notebook so that notebook users would feel comfortable with it. Almost any data that is normally taken with a pencil and paper can be taken faster and easier with the Polycorder.

Both numeric and alphabetic data can be entered from the sealed keyboard. The dot matrix LCD display shows the page number and line number into which data is being entered. It also displays a user-programmed "prompt" for each column to remind you what data to enter into the column.

ELECTRONIC DATA ENTRY

Many researchers are finding that they need sensor and instrument readings in addition to visually observed data. The Polycorder has 10 high resolution analog inputs, a BCD input, and an RS-232 input. It can read the output directly from sensors such as:

Neutron Probes	Steady State Porometers
Digital Scales	Load Cells
Temperature Sensors	Infrared Radiometers
Water Level Transducers	Multi-band Radiometers

COMBINED KEYBOARD AND ELECTRONIC DATA ENTRY

Often you will want to store both keyboard and electronically entered data. The Polycorder can accept both types of inputs mixed or matched in any order. For example, before reading the output of a pressure transducer you might want to key in a sensor ID number.

USING THE POLYCORDER

Before you can take data with the Polycorder, you must program it for your application. The following series of steps is normally followed when setting up the instrument.

1. Write any necessary User Programs using Mode 15.
2. Set a volume active using Mode 9.
3. Format the volume using Mode 4.
4. Assign memory to the volume using Mode 6.

The Polycorder is now programmed and ready to take data in the field using the following steps.

1. Plug in the sensors if any are required.
2. Turn the Polycorder on by pressing the ON button.
3. Press the ENTER bar to begin data collection. The prompts that you programmed into the Polycorder will appear on the display to remind you what data should be entered.

When you are finished recording data, you can play it back directly to your computer using the following steps.

1. Plug the Polycorder into your computer.
2. Use Mode 2 to transmit the stored data to the computer.
3. Your computer will then massage the data and print it out.
4. Optionally, the Polycorder can drive a printer directly.

KEYBOARD DATA ENTRY

The following example will illustrate the keyboard data entry procedure. Assume that you are measuring the height of two trees and wish to record both the individual heights of each tree and the average of the two. If you were to do this in a notebook, the page might look like this:

PAGE 1

	TREE 1	TREE 2	AVE HEIGHT
LINE 1	42	32	37
LINE 2			
LINE 3			
LINE 4			

By entering the following program into the Polycorder you can program it to accept the two tree heights and then automatically compute and display the average height. Operational Mode 15 is used to write programs into the Polycorder.

SAMPLE PROGRAM TO STORE TWO NUMBERS AND THEIR AVERAGE

LINE	INST	OPCODE	PARAMETER	COMMENTS
1	HKY	40		STORE TREE 1 HEIGHT
2	RCC	53		PUT IT IN REGISTER A
3	ICP	65		POINT TO NEXT TREE
4	HKY	40		STORE TREE 2 HEIGHT
5	RCC	53		PUT IT IN REGISTER A
6	ICP	65		POINT TO AVERAGE
7	ADD	31		ADD THE TWO TREE HEIGHTS
8	CON	22	2	ENTER A 2

BECOMING FAMILIAR WITH THE POLYCORDER

The purpose of this brochure is to give you a brief view of what the Polycorder is and how it works. The Polycorder was designed to be very simple and easy to use in the field and only a few minutes are required to teach someone how to record data with it. Before you can record data, however, the Polycorder must be programmed for your application. The programming procedure is not complicated and you do not need to know a programming language.

VOLUMES, PAGES, LINES, AND COLUMNS

As we have mentioned, the Polycorder simulates a notebook that is partitioned into pages, lines, and columns. To allow more flexability, the Polycorder is organized as a library that can hold up to 15 notebooks. Each notebook can store different types and amounts of data.

The notebooks in the Polycorder are called VOLUMES rather than books. Only one volume can be used at a time, and the volume currently being used is called the ACTIVE VOLUME. The page, line, and column in the active volume are called the ACTIVE PAGE, ACTIVE LINE, and ACTIVE COLUMN.

OPERATIONAL MODES, ATTRIBUTES, FORMATS, AND POLYCODE INSTRUCTIONS

The next few sections briefly cover Operational Modes, Attributes, Formats, and Polycode Instructions. After reading through them you should have a rough idea of the Polycorder's capabilities. Don't be concerned if you find a few of the concepts a bit hazy. For the sake of brevity, this technical manual does not go into the detail that the Polycorder instruction manual does. We mainly want you to get a feel for the potential of the instrument.

OPERATIONAL MODES

When you turn the Polycorder on, the word MODE will appear on the display, in response to which you should key in one of the 20 Operational Mode numbers listed below. Each Operational Mode performs a different function. There is an Operational Mode Description at the back of this manual that explains each Mode in detail.

NO.	NAME	OPERATIONAL MODE
0	EXECUTE	Execute the active volume
1	EDIT	Edit the active volume
2	SERIAL XMT	Transmit the active volume to the Serial I/O
3	TAPE XMT	Transmit the active volume to cassette
4	FORMAT	Format the active volume
5	DELETE	Delete the active volume
6	ASGN MEM	Assign memory for the active volume
7	RLS MEM	Release memory for the active volume
8	TEST EXEC	Test execution of the active volume
9	CHANGE VOL	Change to a new volume
10	USER LIB	User-written program library
11	POLY LIB	Polycode program library
12	MODE LIB	Operational Mode Library
13	SENSOR TEST	Analog sensor input test

EGYPTIAN AGRICULTURAL

MECHANIZATION PROJECT

LAND IMPROVEMENT SUBPROJECT

WORKING PAPER NO. 3

LAND IMPROVEMENT DEMONSTRATION BASIN CONSTRUCTION PROGRAM

June 1982

CONTENTS

1.0 Introduction

2.0 Selection of Basins

3.0 Survey Methodology

3.1. Socio-technical Survey
3.2. Topographic Survey
3.3. Soil Survey
3.4. Irrigation System and Water Management Study

4.0 Basin Rehabilitation Design

4.1. Time Factor
4.2. Land Leveling
4.3. Soil Amelioration
4.4. Drainage
4.5. Canal Realignment
4.6. Roads
4.7. Irrigation Improvements

5.0 Long-term Planning and Cost Estimates

6.0 Equipment Requirements and Operating Costs

6.1. Land Leveling Equipment
6.2. Open Drains and Canals
6.3. Soil Amelioration

7.0 Implementation of Demonstration Basin Construction

7.1. Time Frame
7.2. Staffing
7.3. Equipment for Construction
7.4. Equipment Schedule

Enclosures:

1. Figure 1: Mole Plow
2. Operation Schedule
3. Check Lists for Diagnostic Surveys

LAND IMPROVEMENT DEMONSTRATION BASINS PROGRAM*

1.0 Introduction

In order to implement the land improvement demonstration program, basins will be selected in each governorate to demonstrate the proposed basin design and construction methodology to the farmers, to develop the methodology and to demonstrate and train E.A.L.I.P. personnel.

The first basin to be developed, in Minia, will be selected from the present project villages. Thereafter, the Project Evaluation Advisor will assist in selecting basins in the other three governorates (Beni Suef, Assiut, Fayoum). Once the demonstration basins have been completed in each of the four governorates, basins in each of the markaz will then be chosen. The basins in the respective markaz will be selected from the initial basins surveyed in the sample survey (see Working Paper No. 1). The construction work will follow in a similar manner to the first demonstration basins, in Minia, with the added advantage of the specific experience gained from the first round of construction work. Specific local characteristics of each locality will then be included in subsequent design and in construction.

The initial methodology described in this working paper and in Working Paper No. 1, Basin Surveys, will be used in the course of the survey, design, organization and construction of each basin.

Initially, training will be provided for key personnel in various aspects of the work. They will then assist in training the field personnel. Detials of this training program will be provided in a subsequent working paper.

2.0 Selection of Basins

Initially, a single basin will be selected from the villages in Minia governorate. The only criteria to be used for selecting the basin at this stage is that the basin should be within the size range used for the selection of basins for the basin surveys described in Working Paper No. 1: first, an area not more than 80 feddans and not less than 60 feddans, or average 70 feddans.

Secondly, the actual area of land used for cultivation--that is, the agricultural area--should be not less than 90% of the gross area, and third, that a multi-crop rotation is practiced. Other factors inhibiting crop production will only complicate the selection process and the objectives of the demonstration are to investigate such inhibitory factors as part of the program.

---

*See Working Paper No. 1, Basin Surveys: Minia Governorate, June 1982.

The selection of demonstration basins in Beni Suef will follow similar procedures for Minia, where the basin will be selected from the initial basin survey within the size limits stated and in an area practicing multi-crop rotation.

Basin selection in Assiut governorate will conform to the size limits but the initial basin should be planted to sugar cane.

The Fayoum areapresents some specific problems. Land leveling methods and other soil improvement activities may have to be modified or even changed to deal with the specific conditions of this area. A field survey of the area will be conducted prior to finalizing the methodolgoy or selecting the demonstration basins. The field survey will be conducted by selected authorities on the Fayoum area, E.A.L.I.P. and Project personnel.

Summary of basin selection:

1. Minia: Selected from the Project villages
   Size of basin within the range 60-80 feddans with 90% of the area with multi-crop rotation

2. Beni Suef: Selection of a basin at random within the same size limit as for Minia and with a multi-crop rotation

3. Assiut: Selection of a basin at random within same size limit as for Minia, but planted to sugar cane

4. Fayoum: Selection of basins will be decided after conducting a field survey (in mid-June)

3.0 Survey Methodology

The survey methodology will be based on the procedures described herein; the methodologies are well known but may have to be altered or adapted to suit prevailing conditions. Such modifications can be made in the course of the survey of the demonstration basins.

The survey will be carried out in the field by a team consisting of the Soil Improvement Subproject personnel, Project Evaluation Subproject, and personnel from E.A.L.I.P. research and implementation sections.

3.1 Socio-technical Survey

The socio-technical survey will consist of a diagnostic analysis of the conditions in the basin to identify problems other than those associated with soils and irrigation methods.

The objectives of this survey should be:

a) to obtain some understanding of the farmer organization, ownership, farm size and related water use and management factors influencing decisions in water use (i.e., to provide a systematic approach for understanding farm irrigation systems)

b) to identify constraints that inhibit agricultural production, such as water supplies, marketing and farm access;

c) to identify constraints that may impede the development of the basin as a unit for land improvement activities.

The diagnostic analysis should focus on the role that the farmer organization plays, or shall play, in the initial development of the basin, particularly with respect to adapting new irrigation methods and water management concepts, and then in the continuation of new practices.

3.2 Topographic Survey

The procedure for carrying out the topographic survey has been described in Working Paper No. 1. It is summaraized here:

a) A grid at 10m intervals will be set out over the whole of the basin.

b) The elevation of all the nodal points will be measured by a laser level or an optical level.

c) Other salient features of the basin will be recorded, such as canal gradients, water levels, roads, drains, etc., and mapped.

d) The topographic data will be processed by computer and this data used to design the land improvement system... land leveling, drainage, etc.

3.3 Soil Survey

A detailed soil survey will be carried out in the basin to determine the extent of soil amelioration: leaching, intensified drainage including mole plowing, etc.

The soil observations should be placed at 40m intervals (at every fifth nodal point). This will give a density of 2.6 locations per feddan.

Sampling can be done efficiently from augur borings rather than from test pits. The usual, routine methods of sampling and analysis will be used.

3.4 Irrigation System and Water Management Survey

T he existing irrigation system and water management will be assessed to obtain the following data:

a) the total water entitlement;

b) the method of diverting water from secondary or tertiary canal into the quaternary canal or "meska", by sakia, pump, tambour (archimedian screw), or gravity, measuring sizes and capacities;

c) the capacity and condition of canals, gradients of such canals within the basin (capacity may be measured by flumes or other methods);

d) condition and location of turnouts, regulators, bridges, culverts, and other structures;

e) condition of drainage system, both open and subsurface, including the main drains in the vicinity of the basin.

A sketch map of the whole basin will be made showing the location of the relevant data. Also, a comprehensive questionnaire and check list will be compiled for performing all the tasks involved. The completion of the questionnaire will be combined with careful discussions with the farmer(s) and with field observations. The relevant check lists are attached.

It should be realized that this is a first-time basin survey and that the documentation and methodology may have to be altered to suit specific conditions.

4.0 Basin Rehabilitation Design

The design of the rehabilitation of the basin will consist of a number of activities. The need for and extent of the rehabilitation of a basin will be based on the topographic survey, the soil survey, the diagnostic socio-technical survey and the assessment of the irrigation and drainage system. Details of the topographic survey analysis are given elsewhere.

4.1 Time Factors

The number and type of equipment and personnel required to compelte the rehabilitation of a basin within the time limits imposed by crop rotations may be analyzed by means of PERT computer programming. (It should be noted that a PERT programming will be used for planning the annual basin operation programs at least a year in advance.) In addition to providing a time frame to complete a program of work, PERT programming indicates minor activities that may inhibit execution of the main activities.

To implement t he PERT program, the variables pertaining to each activity must be measured during the course of the work. Initially, simple estimates of the variables may be used, but more accurate variables will be obtained with experience.

4.2 Land Leveling

The primary activity will be leveling of the basin. The land leveling activity may include primary, secondary or tertiary leveling, and the analysis of the topographic survey will define the areas of the basin for each category of land leveling, the volume of earth to be moved based on the balance of cut and fill, and the cut or fill at each nodal point, giving the direction of earth moving and cut and fill pattern. The selection of the

type and number of tractors and implements will be based on these data.

4.3 Soil Amelioration

The soil amelioration will be based on the results of the soil assessment field work and soil samples collected. Three factors are involved:

a) Salinity, based on electrical condictivity in desi-siemens, and the cations Na, Ca and Mg;

b) Alkalinity, based on the pH, electric conductivity and alkaline carbonate content;

c) Impervious layer, determined from examination of the soil profile.

These three sets of data should provide adequate information for deciding the need for leaching, gypsum application, and subsoiling.

The amelioration of saline soils can only be achieved by leaching with an effective drainage system or a porous, permeable soil system with a deep phreatic level. Leaching can be carried out by ponding the surface or frequent applications of water during irrigation. To obtain efficient leaching, the soil surface should be leveled, without minor unevenness more than 50-75mm.

Alkaline soils can only be reclaimed by the use of soil ameliorants, or improvers, such as gypsum or acid-based ameliorants on high carbonate soils. The incorporation of ameoliorants to a depth of 250-300mm is desirable for faximum effect. Deep ploughing, using moleboard plows or disc harrows, will be required to effectively incorporate the ameliorants. This kind of equipment is beyond the capability of the farmer to own or hire at the present time and the work will have to be done for him by subsidy or by contractor.

An impervious layer can be broken up by mechanical action, i.e., deep tillage, or dissipated by chemical amelioration. The impervious layer appears to occur between 250 and 300 mm and the use of either chisel tines on a toolbar penetrating to 400mm or more, or the use of a heavy duty subsoiler penetrating to more than 400 mm (750-1000mm) may be used.

4.4 Drainage

Two aspects of drainage will have to be considered:

a) Surface drainage is used to remove surplus irrigation water from the small basin or furrow systems. The surplus water application is used to spread water over an uneven land surface. Surface drains are also used to demarcate farm boundaries, and drains take up to 15% of the land surface. Land leveling would dispense with the need for most of the surface drains by improving

water application, except for reentrant land surfaces or other specific conditions.

b) Subsurface drains may not be functioning properly because of blocked collectors and blocked main drains. The designed spacing may be too great, the depth to spacing ratio unsatisfactory, causing the mid-point water level to rise up into the root zone, or the slow dissipation of the water table after irrigation.

In this case, mole drainage may be the preferred method to improve drainage; alternatively an additonal drain may be installed between two existing drains, halving the spacing. This alternative may be more costly, yet permanent.

4.5 Meska Canal Realignment

If it is conceded that land leveling is for improving irrigation water distribution, it would be inappropriate not to rehabilitate the "meska" or tertiary canals, most of which are in a very poor state of repair. The rehabilitation of these canals should consist of:

a) filling in the existing channel, providing the correct center line, bed gradient and cross sections consistent with capacity;

b) locate check and drop structures (to control full supply water surface and the bed gradient);

c) provide gated outlets to gruops of farms long the canal.

This aspect of basin improvement has been carefully studied by the E.W.U.P. project* in Minia and they have found that farmers will excavate the canal if it is filled in, compacted and the canal alignment indicated. The farmers are also constructing the outlet structures at their own expense, following the designs for these structures provided by the Ministry of Irrigation.

4.6 Roads

Access to and from farms within a basin have been completely neglected by project invovlement to date. If the basin is taken out of production, the opportunity should be taken to improve access roads to the farms. The new road alignment will follow existing donkey tracks, unless relocation is otherwise indicated. The width should not exceed that required for a small pickup truck--not less than 2 meters. (Experience elsewhere has shown that the total area taken up with services in tertiary units--the equivalent of basins--does not exceed 7% of the gross land area. In Egypt, EWUP Report No. 57 states that up to 15% of the land area is used for services, mainly in open field drains.

Normally, such farm roads are not constructed more than 350 to 500 mm above ground level. The width should not be less than 2 m but 2.5 m would be more convenient. Applying a compacted

*Egyptian Water Use and Management Project, Ministry of Irrigation

layer for this class or road is not normally needed. Compacting the local fill material is sufficient. The cost of construction is directly related to earth fill volume and compaction costs.

4.7 Irrigation Improvements

The irrigation methods used at present--the small basin method--is actually very efficient in terms of water application efficiency, but construction is time consuming, and diverting water into the basins takes a great deal of time. These small basins inhibit proper mechanization of crop production operations such as sowing, interrow tillage, pest control and harvesting.

Two methods of applying water may be used:

a) long basins, either level or sloped, suitable for fodder crops (berseem), wheat, rice, possibly beans;

b) long furrows, either level or sloped, used for row crops, cotton, beans, maize and vegetables. Curcubits (melons, cucumbers, pumpkins) may be grown on beds which are two ridges combined.

The length of the basin or furrow may be arbitrarily chosen depending on the length of the farm or the space between obstacles such as drains, roads, terraces or canals. However, there is a constant ratio of length and the discharge into the basin or furrow.* For a given discharge, the length should not exceed this ratio. The ratio depends on the intake rate, discharge, and length. Most of the published parameters for this technology are based on non-swelling clay soils. The parameters may vary radically for the swelling clays predominating in the study area. Thus, it will be necessary to measure intake rates to determine the initial filling of cracks, and the final intake once the cracks have closed. Once the cracks have closed the intake rate is very slow: intake rates of 0.003 mm/hour have been measured on similar soils.**

The indications are that large discharges will be required for a short period of time, but this discharge should be able to reach the end of the basin or furrow in time to fill the cracks rapidly before being shut off. Some field trials will be needed to determine this relationship.

Diverting water from the lead furrow into the basins or row furrows can be accomplished by using syphon pipes or spile pipes.***

---

* Peri, B. and G.V. Skogerboe. 1980. Analysis of Basin-Furrow Irrigation. Reprot 61. Consortium for International Development. Colorado State University.

** Annual Report, 1980/81. Chemistry and Soil Research Institute. Salisbury, Zimbabwe.

*** Lecture notes on Irrigation Methods for Extension Workers. Sakha Training Center, Egypt. May 1982.

The use of either allows the correct volume of water to be metered (measured) into each basin or furrow. The problem of obtaining P.V.C. syphon pipes bent to the correct shape may arise. Spile pipes made of plastic or scrap metal pipes or cans open at both ends, even bamboo joints, may be used. However, getting the farmers to adapt these methods will require considerable extension effort by means of field demonstrations.

The objectives at this stage of the survey will be to establish the magnitude of the potential for improved farm irrigation methods, the variants of the methods proposed, and to measure the various design parameters and design demonstration systems. The discussions above indicate the practical issues involved in irrigation improvement and the technical experience brought to bear upon specific, local conditions.

Although these recommended improvements in irrigation methodology will largely fulfill the physical aspects of improved water management, little will be achieved without institutional change--improving or creating a farmer water-user organization to manage the new methods and technology. The creation of farmer institutions are not part of this Project nor are included in this survey, but little will be achieved without institutionalized farmer interaction.

5.0 Long-term Planning and Cost Estimates

One of the purposes of this survey is to establish the long-term planning objectives and short-term cost estimates to initiate the land improvement implementation program. To determine both these objectives it will be necessary to estimate the kind, size and number of equipments required to do the work.

In order to compile a long-term paln it will be necessary to knwo the extent and location of the work areas, the materials handling requirements, the total number of operating units (tractors, implements, service trucks, personnel carriers) and the logistic factors (e.g., fuel supply, servicing facilities, stores, field personnel movement). Once this data has been assembled, activity planning cna proceed using various methodologies such as CPM, PERT or RPM (resource planning and management, a combined CPM type network procedure and linear programming method) to test planning alternatives.

Once a long-term plan has been established the short-term cost estimates can be made for successive annual budget estimates. The budgeting methodology will be described in a technical paper to be prepared.

---

* Keui-Lin Chen and R.B. Wensink. 1976. Resource Planning and Management in Agricultural Systems Analysis. Paper No. 76-5540. American Society of Agricultural Engineers (ASAE).

6.0 Equipment Requirements and Operating Costs

A prerequisite to long-term planning and estimating costs will be the kind, size and numbers of equipment--tractors and scrapers for leveling, tractors for deep tillage, ditch cleaning, and possibly mole plowing.

Determining the required capacity of such equipment for conditions in Egypt, particularly for use on swelling clays (vertisols) cannot be based on simplistic methods or those developed for non-swelling clay conditions, though such methodology can be used as guidelines for further investigation. Precise data must be obtained from careful field measurements and observation of similar kinds of equipment that may be used in this project.

6.1 Land Leveling Equipment

A simple conceptual model will indicate the complexity of calculating scraper capacity, the time and the power required to complete a unit area. Estimating these factors depends upon:

a) the land form--the topographic configuration, determining the volume of earth to be moved;

b) the soil properties such as texture, bulk density, degree of dispersion (degree of dispersion varies with ionic concentration and with pH), and cone penetration index (cone penetration values may be misleading particularly at the dry end of the scale where soil peds shatter along interstitial cracks);

c) the shape of the area, and size of units: the leveling implement has to cover the whole area efficiently--excavating into odd corners and have a short running radius due to small field size (e.g., the manoeuverable trailing wheel hitched 2-3m Beheira scraper is better suited than the 10m land plane).

6.2 Open Drains and Canals

The choice of implements for digging open drains lies between a rotary cutter-type ditcher or a back-action differ. The rotary ditcher is a heavy power consumer on a tractor so its cost may be very high per unit length of channel excavated. It is also restricted to a given size and depth of channel.

The use of a semi-mounted digger would provide a more versatile implement for both digging new channels and for cleaning existing channels. Though slower than the rotary ditchdigger, back-acting diggers are not so "heavy" on a tractor. Further, the back-actor can be used for maintenance work in the off season while the tractor is used for other work during the construction season.

It will be necessary to determine the magnitude of drain construction and maintenance work and possible canal rehabilitation before the choice of one or the other, or both, can be made.

The costs can be determined only when the capacity and power size of the tractors are known. The total or annual costs will be based on the extent of construction work.

6.3 Soil Amelioration

Soil amelioration means applying and incorporating a chemical ameliorant, mainly gypsum. Gypsum should be mixed in, or incorporated, into the root zone of the crop, 200-300mm deep, for best effect.

A heavy off-set disc harrow may do the job efficiently; moleboard plows can do th job but a "plow sole" may develop (impervious layer);unless moisture content is at optimum level, a moleboard plow will plow up large clods. Specialized "double-digging" plows may prove useful in eliminating a cloddy surface.

The size of a disc harrow is determined by the working depth required and the power is related to the number of discs per gang (or axle), length of the gang and spacing of the discs along the gang. The ability of the discs to penetrate depends on the soil moisture content and shape of the discs--too wet, a soil will clog up the discs, and too dry, will cause the harrow to "ride" over the soil surface. Spherically shaped disc blades are ideally suited to lighter soils while conic blades work better in heavy, hard-to-penetrate soils.

Excess use of a disc harrow will also create a plow sole. Moleboard plows inherently run this rish, and also require high power inputs.

A balance must be struck between efficient ameliorant incorporation, the frequency of application, and the most efficient implement. The operating costs will be directly related to the size of the implement and the power rating of the tractor, measured under field conditions.

Two heavy-duty offset disc harrow, with different disc blade configurations, are included in the first bid order.

Soil can be mechanically "ameliorated" or improved by normal tillage (up to 400mm) or by deep tillage (greater than 400mm), breaking up impervious layers and aerating the deeper layers of the profile. The efficiency of breaking up the soil depends on the optimum spacing of tines and soil moisture content. The tines break up soil in the form of an inverted triangle, the apical angle ranging 80-45 degrees depending on the dryness of the soil. The tines should be spaced to obtain an overlap of the triangles: too close a spacing requires more time (passes) to complete a unit area and too far apart fails to break up the soil effectively. At the same time, the deeper the tines work, the further apart the spacing of the tines, depending on the characteristics of the foot piece, the shank of the tine, and the nature of the soil.

A mole plow used for drawing mole drains should not be confused with a soiling implement fitted with a moling plug. The illustration in Figure 1 shows a typical mole-plow. Details of the mole plow and its use will be described elsewhere.

The costs in the first case will be greater because of the time taken to complete a unit area and possibly a larger power unit will be required. On the other hand, crop growth will be affected with inefficient soil breakup.

Costing of these operations can only really be based on careful field measurements. Costing tabulations will be compiled for each phase of the work.

7.0 Implementation of Demonstration Basin Construction

Prior to the construction of the basin a number of activities will be performed and these must be fitted into a time frame. Such a time frame is tied into the cropping rotation in order to do the field construction work when the fields are free of crops. Therefore, some degree of latitude will be required in time frame for construction of the demonstration basin. Furthermore, timely completion of field surveys and designs will be required to inform the farmers of the impending work plan. The ordering or lining of the equipment for the work will be fixed.

7.1 Time Frame

Essential details of the time frame are shown on the bar chart in Figure 2. The times shown are estimates of the time needed to complete each activity. However, the purpose of this program will be to measure the actual time taken to do each phase of the operation.

7.2 Staffing

The work on this initial demonstration basin will be done by each member of the project team, each being invovled in his specific activity. As previously stated, this exercise will provide a "training exercise" for each member of the team.

Apart from the Project team, personnel from the relative EALIP organization departments who will ultimately be concerned with this work should be included in the team.

The Project team includes:

1. Dr. Adel Orabi, Administration
2. Dr. Achmad Abary, Technical Coordination
3. Eng. Ahmed El Fayoumi, Irrigation and Water Management
4. Eng. Hassan El Banna Osman, System Training
5. Eng. Amr Marie, Field Operations; Organization and Management

7.3 Equipment for Construction

The tractors and scrapers including the laser regulating equipment, and servicing facilities, may be hired from the EALIP, though this may be costly and used only as a "stop-gap" measure for the initial operation.

A schedule of equipment required for the construction work and the time the equipment will be used is attached.

EQUIPMENT SCHEDULE

1.	Tractors, 45 kw (pto) and 5/7 tine chisel plow	2
2.	Tractors, 65/70 kw (pto) and 3m Beheira scraper, all fitted with laser plane leveling control system	7
3.	Tractors, 65/70 kw (pto) and 3m Beheira scraper (without laser plane control)	2
4.	Tractors, 95/100 kw (pto) fitted with single or double tine subsoiler penetrating to 750mm	2
5.	Fuel bowser and service unit (including spares)	1
6.	Transport for drivers and service personnel	1

ANNEX D

MANAGEMENT SYSTEM FOR PROJECT DEMONSTRATION/TRAINING EQUIPMENT

AGRICULTURAL MECHANIZATION PROJECT

MANAGEMENT SYSTEM FOR PROJECT DEMONSTRATION/TRAINING EQUIPMENT

INTRODUCTION

In the past four months considerable effort has been put forth in processing funds and developing specifications for badly needed project demonstration/training equipment. Now that the funds are available, specifications completed and the first group of equipment selected, a system of management for this equipment is required in order to ensure that the equipment is effectively utilized, properly serviced and effectively cared for. The equipment will last only as long as the system is adhered to since improperly maintained equipment will soon be inoperable without it.

SYSTEM REQUIREMENTS

1. Equipment Responsibility. A person should be made directly responsible for the equipment before it is placed in the field. The logical person would be the project's mechanization specialists if a set of equipment is placed in villages as planned. The regional coordinators should assist the specialists in picking up and transporting their equipment sets to designated locations according to the Village Program plans being developed for each area..
   Before any equipment is purchased, it should be loged in a Project Commodities book . This book should be maintained by a full time official from the Ministry of Agriculture working with project management. The log book should include w.e where the equipment is located; its condition, etc. and periodic spot checks should be made to ensure proper use and care of the equipment.
2. Storage Facilities. A store or shop should be made available for each set of the equipment. If the location of the equipment is in a village then a local storekeeper with a lock and key should be appointed to care for the equipment when it is out of operation. He should maintain daily equipment use records and report directly to the area's project mechaniza-

tion specialists who should assume full responsibility over the equipment in his area.

3. Training : Selection/Training of key equipment personnel. Before the equipment is put into operation careful selection/training should be done of the key personnel who will be supervising/operating/maintaining the demonstration- training equipment. The project's technical training specialist or other person(s) from the project's technical department should test, select, orient and train as necessary the equipment's store keeper, operator/mechanic and other persons as assisting with maintaining the project's equipment.

4. Equipment Operator/Mechanic. Each set of equipment should have an operator/mechanic assigned to it who is sufficiently trained to properly operate and maintain the equipment. Two persons may be required(one operator,one mechanic) if a large number of equipment is assigned to a particular area. Although this person will be in charge of the equipment while he is using or repairing it, the mechanization specialist should still be responsible for supervising the equipment's operations.

5. Support Equipment and Materials. Each set of equipment should have the following equipment and materials to support its operations.

   a). Tool Box with a complete set of tools required to service the equipment.

   b) Fuel and Lubricants available as necessary to carry out planned field operations and storage needs.

   c. Available workshop within 20 klms of the area of operation to perform any major repairs. This will be especially critical when the equipment is planting or harvesting and requires immediate repairs.

   d). Spare parts. For the equipment, especially fast moving items like fan belts, radiator, hoses, tires, etc. must be available. A list should be made for each piece of equipment supplier and/or identified in surrounding parts houses for future reference.

6. Operating Funds. In order to be effective in demonstrating to and training farmers on the project equipment, all mechaniza-

tion Specialists will require operating funds to finance the demonstration/training activities. These funds will be of two sorts.

(a). Demonstration and training sessions funds and

(b). Equipment servicing and repair funds.

In (a) the activities will clearly be for project goals for which funds are available in the In-country Training Funds' line items approved by USAID.

However, in (b) funds will be required for servicing the equipment between demonstrations and for repairing the equipment when it breaks down. The source of these funds need to be determined before field operations can begin.

CONCLUSION

The foregoing management system for project demonstration/training equipment, will if followed closely, provide the necessary support for project field implementation equipment.

Since much of the equipment to be used has not yet had sufficient research inputs to determine if the equipment selected for demonstration/training is the most appropriate, the necessity of closely adhering to a system of operation becomes even more important. It will keep the equipment operable for a longer period of time which will allow the mechanization specialists to field their equipment in a variety of conditions over the next few years. This should not only help solve the present labor shortage problem but will also provide considerable information to all concerned as to the appropriatness and durability of the equipment selected

for use in the project villages at this time.

ANNEX E

VILLAGE PROGRAMS WORKPLAN OF THE MACHINERY MANAGEMENT EXTENSION AND EXTENSION TRAINING PLAN

AGRICULTURAL MECHANIZATION PROJECT
VILLAGE PROGRAMS WORKPLAN OF THE MACHINERY MANAGEMENT EXTENSION AND EXTENSION TRAINING PLAN

INTRODUCTION

In 1981 the Program Plan for the Machinery Managment Extension subunit was completed and approved by both the Ministry of Agriculture and USAID. This plan established a framework and program activity schedule by which governorate level, district level and village level mechanization specialists and advisors would be trained and placed in each of the five governorates. There they would begin to develop and implement appropriate local mechanization programs with assistance from the project and MOA extension personnel. These programs were to be educationally oriented and would include machinery introduction as well as irrigation and cultural practices inputs in order to accelerate the mechanization process in Egypt.

Now that the mechanization specialists and advisors are completing their orientation and training activities as scheduled, an organized and intense effort from the project and extension personnel is required to assist these individuals in developing and implementing effective local (village) level machinery management programs to effect mechanization extension activities. In order to provide the necessary support to the developing of these programs, the following Village Programs Workplan is presented. It is designed so that it can be presented to the specialists as they are completing their final training at the Sakha Training Center prior to returning to the project areas. The Workplan is composed of a Machinery Management Extension and Extension Training Chart and a Staffing Organization Chart which integrates both the Machinery Management Extension Subunit and Training Subunit personnel into one funtioning group. This is necessary since the majority of the extension specialists and advisors activities will be training(educationaly) oriented.

MACHINERY MANAGEMENT EXTENSION AND EXTENSION TRAINING PLANNING CHART

The MMEETP chart will be maintained in the Cairo project office. It will be updated during the weekly meetings which will be held to plan ongoing activities as well as evaluate and revise and necessary present activities.

The chart is divided into four major sections as follows:

1. Geographical Areas/Project Staff

The project areas and assigned staff are listed in this section. Additional spaces have been provided in order to accomodate subsequent areas and staff as the project dictates.

2. PHASE I

The first phase to be completed for each of the project villages will be to develop individual machinery management programs(e.g. Desya Village- Machinery Management Program , etc.). These will be completed initially by the Village and District Mechanization Specialists with assistance from the governorate mechanization specialist(when assigned) and the Regional Mechanization Extension Coordinator who will, in turn, be assisted by the project's Machinery Management Extension Director and Advisor Counterpart. Included in the programs will be (a) an overview of the target area,(b) a survey of key farmers and (c) equipment,(d) a listing of outstanding Mechanization related problems facing farmers,(e) a set of objectives(and time frame) which can realistically be implemented and(f) a time sequenced program plan(listing available resources) to carry out these plans. The target dates for each of the steps in phase one are listed on the MMEET chart and will be updated as necessary

3. PHASE II

The second phase to be completed will be the actual implementation of the Various Machinery Management Programs developed by the mechanization specialists in phase I. Included will be extension activities such as field days, mechanized crop planting, research/trial demonstrations, machinery introduction, etc. as well as extension training activities such as equipment training(locally) on farm tractors, backhoe operation, tractor and water pump preventative maintenance, etc. and training center activities such as tractor operation, etc. The planned implementation target dates will be listed and updated according to the actual conditions.

4. PHASE III

The third phase to be completed which will be carried out to some degree on a continuing basis will be the evaluation and revision

exercises necessary before the following annual programs are developed.

STAFF ORGANIZATION

The staff organization chart which shows the positions and relationships between positions in order to effectively carryout the Village Programs Plan is found in Appendix A.

Their roles are defined as follows:

1. Training and Extension Coordinator

The primary responsibility of the Training and Extension Coordinator and his counterpart will be to coordinate and direct the integrated activities of the Machinery Management Extension and Training Subproject activities. Other duties will include:

a. Conducting weekly planning meetings(thursday) attended by the directors and advisors from the MM Extension and Training Subunits as well as the Extension's Regional Coordinators.

b. Finalizing and presenting to the Project Director quarterly cash need statements in order to obtain USAID funds to carry out the workplan's activities.

2. Training Subunit Director

The Training Subunit Director will prepare, implement and evaluate the extension training activities according to the workplan requirements requested by the Machinery Management Extension Director. As the training Director also has four other subprojects who will be requesting training activities, his time will be divided accordingly .

3. Machinery Management Extension Subunit Director

The MME Subunit Director's primary role will be to direct the activities of the Regional Mechanization Extension Coordinators who will be located in the north, central and southern part of Egypt as shown in Appendix B.

It is through these coordinators that the project will direct the development of village mechanization programs.

4. Advisors

The Advisor's role will be to advise and assist their counterparts as necessary to produce effective and efficient village mechanization programs. As the efforts require both planning and implementing extension and extension training programs, the responsibility will be divided accordingly as follows:

a. Extension and Training Coordinator and Counterpart will need to spend at least 70% of their time, coordinating, planning

and evaluating the village programs as they are developed.

b. The Machinery Management Extension Advisor, together with the Director will need to spend at least 70% of their time in the field where the programs are being developed and will require professional assistance and advice. Their input to the overall planning will be done during the weekly planning meetings when all concerned will be present.

In order to cover the three regions they will need to divide their time between the three areas which could be done on a weekly basis. If one week each month was spent in each region with the Regional Coordinator. The last week could be used to coordinate in a particular area as necessary. This system combined with attending the weekly meetings(Thursdays) will allow all areas to be covered as well as enable all concerned to share the progress, problems and plans in each region.

5. Regional Mechanization Extension Coordinators

The most critical participants in effecting the workplan are the Regional Mechanization Extension Coordinators. Working through the established extension system, they will be the link between the project's technical expertise, and the village-level mechanization advisors who will actually develop the programs.

As shown in Appendix B, three regional coordinators are proposed who will have the following responsibilities:

a. Coordinates with the directors (as necessary) the activities of the governorate, district and village mechanization Specialists and Advisors as per directions given by the MME Subunit director and advisor.

b. Provides the MME Subunit director with village program information as it is developed in the field.

c. Attends weekly planning meetings to plan and update the village programs workplan.

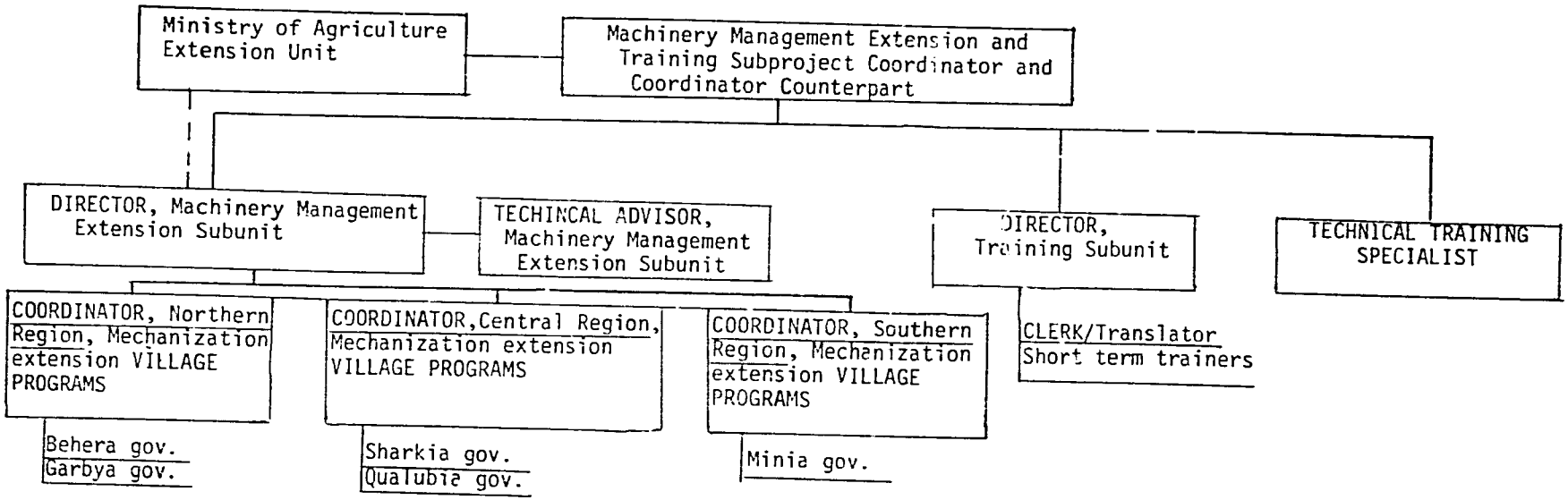
SUMMARY

In summary, the foregoing design of the Village Programs Workplan has been completed in order to carry out a primary project goal of establishing in each of the 23 target villages machinery management programs which can be used as examples for surrounding villages and districts in their efforts to mechanize exisiting agricultural practices. Of equal of perhaps of more important is that the Plan's design attempts to integrate both the Ministry of Agriculture's extension and training department personnel with that of the project 's staff who have been assigned to establish the mechanization programs at the village level. It is

only through an effective extension staff that the mechanization effort will be ultimately adopted by the farming community which by all indications are ready, or willing to start and in need of mechanized agriculture practices.

AGRICULTURAL MECHANIZATION PROJECT

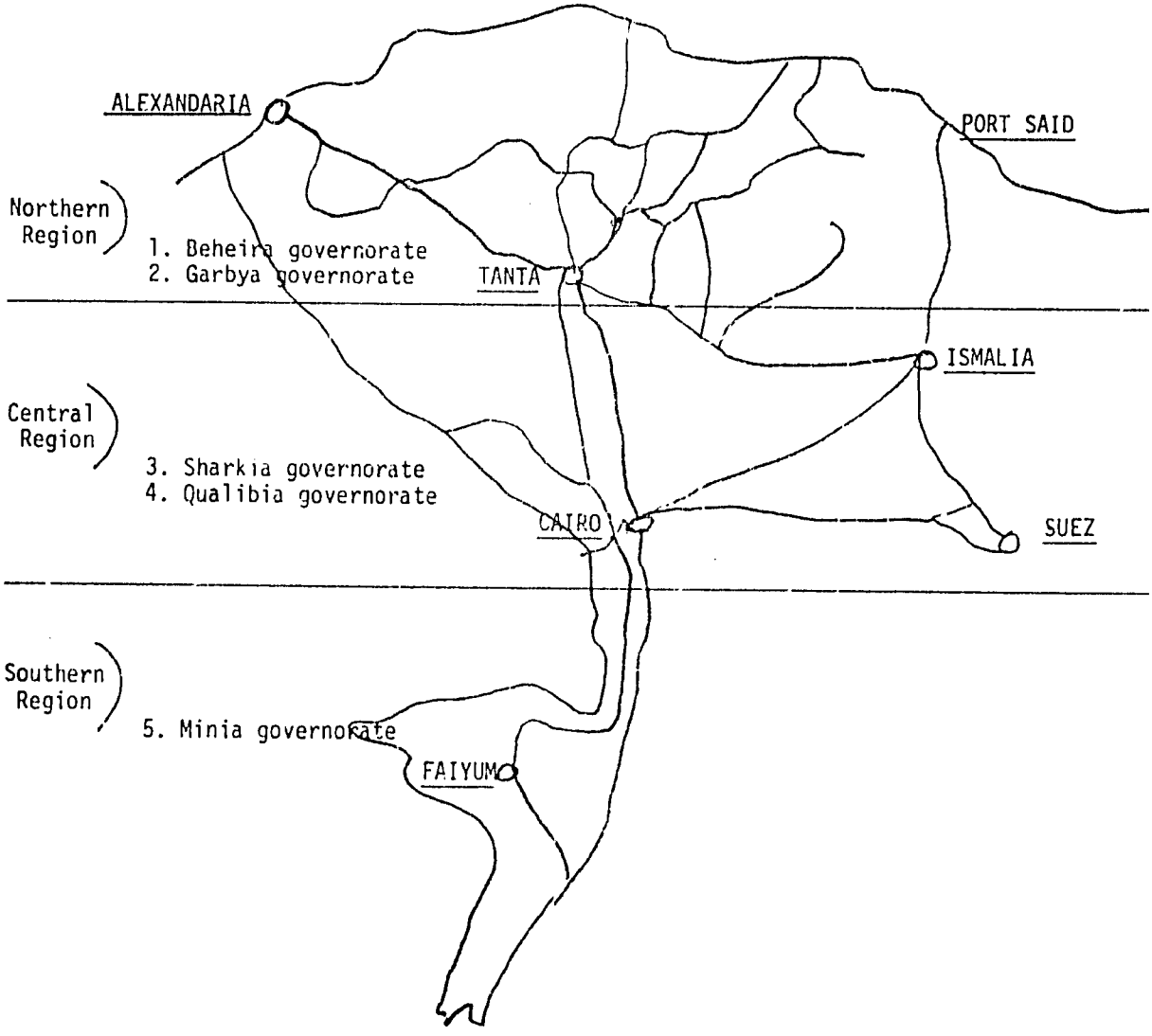
Staff Organization Chart for the VILLAGE PROGRAMS PLAN



APPENDIX A

AGRICULTURAL MECHANIZATION PROJECT

Regions of the VILLAGE PROGRAMS PLAN of the Extension and Extension Training Activities



APPENDIX B