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WATER USE and MANAGEMENT PROJECT

MID PROJECT REVIEW

The Water Use and Management project (263-0017) in Egypt is an AID-financed, applied research program. It was initiated in FY 76 with the signing of the grant agreement in June of that year. The project, however, never got fully underway until early 1978 when a full contract team was placed in the field. The project was designed to run 5 years and with extensions the contract is now scheduled to terminate on July 30, 1982.

The project plan, as well as the contract, calls for an in-depth evaluation at mid-point in the project. Dr. Itil Asmon, private consultant, and Dr. Gilbert Corey, Water Management Specialist, DS/AGR-AID/W were asked by USAID/Cairo to comprehensively review the project's past performance and future plans. The evaluation plan required that each reviewer prepare a separate report, after which the two would be combined to form the evaluation report. This is Dr. Corey's report.

The team spent 3 weeks in Egypt working together. Dr. Asmon will spend an extra week in combining the reports into the draft evaluation report. The project is rather large and complicated and it was necessary to divide the work load so that each reviewer could cover specific aspects thoroughly. Therefore, the two report system seemed expeditious.

The Team reviewed all project background material (Project Paper, Contract, Work Plans, past evaluations). Some 70 publications, articles, staff papers, and reports were read to determine output and stage of development. The field sites at Kafr El Sheikh, Giza (Monsouria), and El Minya were visited with project staff. And finally, discussions were held with officials from the Ministries of Irrigation and Agriculture, with GOE and contractor project personnel, and USAID.

PROJECT DESCRIPTION

The project was developed in early 1976 and the grant agreement with GOE was signed in September 1976. The contract to provide the technical assistance, however, was not signed until May 1977. The Consortium for International Development (CID) was selected as the contractor. The first team members did not arrive in Egypt until October 1977 and a full contract team was not available until January 1978. Thus, the project essentially started either 16 or 8 months behind schedule depending on which date one considers as project initiation. This is not especially unusual. Ordinarily AID does not find contractors who can field large teams immediately after contracts are signed nor should it be expected. At any rate, the contract is now scheduled to terminate on July 30, 1982, or approximately 5 years after the technical assistance contract was signed.

The purpose of the project as stated in the Project Paper, is to (1) develop and demonstrate replicable improved irrigation water management and associated practices that increase agricultural production and (2) increase institutional capacity to develop and

sustain an improved on-farm water management capacity. In summary, the project is to develop and implement an applied research and management program for the improvement of management of irrigation water.

The project is being conducted by the Water Research Center in the Ministry of Irrigation. There is close cooperation with the Agricultural Research Center. In fact, agricultural scientists from that Center are assigned to the project. The contract with CID provides for procurement of necessary professional services, equipment, and commodities for the project.

There is an Egyptian Project Director who is assisted by a U.S. Technical Project Director. The principal project activities are carried out in three pilot areas in Monsouria, Kafr El Sheikh, and Minya. The U.S. team consists of 5 professionals in the main office and one each at the field sites for a total of eight U.S. technicians stationed in Egypt.

The contract between AID and CID presents the clearest description of the project concept and its implementation methodology. The following description is summarized from that document.

The final product, from the project, will be an action program, tested and proven as to technical applicability, farmer acceptability, and organizational replicability that could be expanded to regional and/or national programs. An applied research and extension program is to be conducted with farmers in 3 pilot areas to:

1. Identify major constraints to improved on-farm water management and optimal water delivery system operation.
2. Determine and establish the use of optimal irrigation practices at the farm level in pilot areas.
3. Establish improved water control practices for the water delivery and drainage systems in project areas.
4. Develop plans for organization and implementation of expanded future programs based on results in the project areas.

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

In each of the pilot areas, project activities are to be implemented in 3 overlapping and interrelated components, which are:

A. On-farm surveys—designed to improve the data base concerning existing farm production and to determine the type of additional research required.

B. Develop and improve a similar data base concerning quality and quantity of water entering and leaving each irrigation area.

C. Conduct studies in 2 stages where:

Stage (1) involves an on-farm research program based on components A & B and on results from other agricultural research in Egypt. Research on improvement of farm application systems. Develop optimum combinations of such factors as flow rate, field configuration, infiltration, field leveling, all of which will lead to higher efficiencies. Studies also to be done on replenishment of soil moisture and control of waterlogging and salinity.

Stage (2) Design and implement a pilot program in each of the 3 areas. To test the acceptability and rate of adoption by farmers of improved practices. Of equal importance will be the determination of the most efficient organizational approach or approaches, the technical competence of personnel required and the costs and benefits involved for successful conduct of such programs.

Supposedly the project is now at the beginning of stage 2 or is ready to initiate pilot programs. The evaluation, for which this report is a part, was designed to be conducted at this time to provide USAID and the contractor an independent assessment of the elements and organizational arrangements required for the pilot demonstration/production activities to be conducted during the last two project years.

PROGRESS TO DATE

Much progress has been made on the project during the initial three year period. Certain key elements are lagging others, however, and now that the pilot stage is emminent a careful review of current status is in order.

The project activities A, B, and C, above, represent a well planned and comprehensive approach to improvement of any irrigation system anywhere. All activities are essential to success. Activities A and B are necessary to build a reliable on-farm testing program, C stage 1. All three, in turn, are essential before entering, C stage 2, the implementation of the pilot program.

Activity A, the on-farm surveys, has been developed and is functioning well. The data from these surveys are excellent and will be especially valuable not only to future programs in irrigation, but also any other agricultural development program. Much information regarding the existing farmer practices, his constraints, and how he copes with them are revealed in these analyses. They should definitely be continued on into the pilot phase and beyond, if expansion programs finally develop from this project.

Activity B, the monitoring of the water situation, is not as well established. This could be due to a variety of reasons, the most important of which is undoubtedly the degree of difficulty encountered in accomplishing it. It is, however, essential to success in water management improvement programs to know how the water is presently being managed and where the water goes. This activity is especially difficult under Egyptian conditions because so much of the delivery system is below land surface and is essentially connected with the underground water system which lies just below the surface on most of the agricultural land.

A good program of water budgeting for the overall pilot areas is now in progress and must be continued. The present deficiency in the water analysis system is a program to learn about and monitor the management of water along the meska. In other words, it is not sufficient to know the gross water balance; one must also understand and monitor how the water is used and moved from farm to farm, and on the farm. This can only be done by developing a system of water

measurement and observation on meskas as the water is used. This requires a great deal of dedication and certainly overtime because farmers might be irrigating at any time throughout the day or night.

This activity should definitely be initiated early in the pilot programs. In fact, water use among, or between meskas should also be monitored. This could probably be done by establishing several adjacent meska turnouts as gaging stations with recorders. The water management along the meska need only be accomplished on representative meskas much in the same manner as the farm survey data are gathered. Some of this information has been accomplished especially at Monsouria, but much more needs to be done.

Activity C, the on-farm research and the pilot testing, has been ~~accomplished~~ planned. The design of the pilot programs has been fairly thorough; however, one wonders if the lack of data regarding water distribution among farms and fields along the meska hasn't created a bias that could lead to misguided programs. This will be analyzed further after reviewing the status of inputs, outputs, and end-of-project status.

Inputs

Insufficiency of inputs has not constrained progress on the project. In fact, in some cases, it appears that over-abundance of inputs has caused diversion from priority problems. Specifically the unusual amount of TDY technical assistance must at times surely hamper production of resident staff. Also there seems to be either an excess of equipment or a mismanagement of it. At least some of the equipment does not seem to fit into the program plans or plans were changed before it was effectively used; laboratory trailers are one example.

There was an initial delay in getting a full contract team in the field. This is not abnormal, however, and should have been programmed into work plans. It is noted that the contractor does not have a full five years, after fielding a team, to complete the 5-year project. This must be recognized when evaluating progress and making future plans.

The level of technical assistance advisors is exactly as contracted with a full contingent of eight persons on the field team. They are stationed as called for and have the required disciplines. The field team is of exceptional quality with everyone highly motivated and interested in making the project a success. The Egyptian counterpart team also is at full strength and there appears to be good motivation. The training program has been exceptional in building enthusiasm and a team spirit among the host team. They also have an outstanding grasp of the totality of irrigation water management in all its social, economic, institutional, and technical aspects. This is unusual and must be credited to the training program.

In the almost 3 years since the project started there has been a total of approximately 8 person years of short term assistance provided under the contract. Six person years have been provided in the technical areas; the other two in administration and training. It is questionable that such a large quantity of short term help can be efficient and effective, especially when it is provided through a total of 54 persons. One wonders if the resident staff does not spend a significant amount of time programming and providing for the short term assistance. It is noted that the engineering discipline accounts for more than one-half of the short term technical assistance; yet it is apparent that this discipline

lags the others in accomplishments (see details presented later in this report).

Financial inputs appear to be sufficient and on schedule. Overall the input situation is as planned.

Outputs

Project outputs include: (1) identification of major constraints to on-farm water management; (2) establishment of optimal water management practices in pilot areas; (3) improved water control practices established; (4) plans developed for organization and implementation of future program expansion; and (5) experienced scientists and technicians in place.

None of these outputs have been fully achieved. Nor should they be. The program to date has focused on creating the situation and atmosphere where the output production can take place. An experienced Egyptian staff is in place and well trained in the various interdisciplinary aspects of on-farm water management. However, until they go through the experience of pilot testing and developing national plans for expansion their training will only be academic.

There has been a reasonable identification of constraints to on-farm water management (output 1). However, one should never consider this phase completed. As technologies are developed to remove constraints new factors become important. Then, the problem identification phase really becomes a methodology whereby government/farmer relations are built and the operation of the irrigation system is monitored.

In summary, the project should not be evaluated at the present stage on the basis of the planned outputs. These ~~will all~~ can only occur during the final phase into which the project is now scheduled to enter.

End-of-Project Status (EOPS)

The End-of-Project Status is worth reviewing at this stage because a cursory review might lead one to conclude that most EOPS have been met and the project is already successful. This is certainly not the case especially in light of the fact that most outputs are yet to be developed. The EOPS remaining to be accomplished are vitally important to project success and it would be misleading to assume that the overall project is a success without at least a degree of completion of EOPS 1 b and c. A brief review of all EOPS follows:

1 a. Three pilot areas established--The sites have been established with working teams assigned and functioning. Soil and farming practice surveys and area water balances have delineated many boundary conditions. The degree to which operation of the farm water management system is known within each area varies considerably. Much more is known in this regard about the Monsouria site than the other two.

1 b. Farmers are practicing recommendations derived from the Project--Farmers appear especially cooperative and work well with project staff. However, farmer acceptance can only be fairly evaluated at project termination since pilot testing of recommendations will then be complete.

1 c. Yields have increased significantly over non-Project areas--Some significant yield increases have been achieved experimentally from agronomic practices. Yield increases strictly

from water management changes have not yet been demonstrated. Evaluation of this must also await project termination.

2 a. Government approval exists for program expansion--The Government of Egypt views the program with great anticipation. Once viable programs for expansion can be demonstrated not only with a delineation of the technology but also the means to implement it, the government will respons. Both the Ministries of Agriculture and Irrigation look to this project to provide guidance on design of programs to increase agricultural production.

2 b. Farm problem feedback mechanism exists--The farm survey mechanism provides excellent feedback on agronomic social and economic status. These surveys should be continued throughout the life of the project. Feedback from the irrigation system operation is weak. The overall water budget for each entire area is good but the manipulation of the water within the system is not sufficiently monitored. In fact, it is not yet well known.

2 c. An evaluation program exists for the research--Here again the farm survey mechanism provides an excellent tool to monitor changes caused by research. It is undoubtedly sufficient unless the sole objective of a specific item of research should turn to saving water, developing procedures or anything other than increasing farm production or farmer income.

2 d. Inter ministry and interdisciplinary approach accepted--Without question this condition has been fully met.

2 e. Farmers' views understood and incorporated in planning—Undoubtedly this has been accomplished to a great degree. Certainly his views have been sought and research programs have been molded to fit his views. However, it is not readily apparent that his views are completely understood regarding operation of the irrigation system along the tertiary distribution channel (meska) or among the meskas along the branch canals. His perceptions and suggestions regarding farmer organization also needs further attention.

Pilot Project Plans

Tentative plans have been made for the pilot testing phase at each of the field sites. These are outlined below. Plans have been made describing how each activity will be implemented.

Monsouria—There are several specific pilot program ideas scheduled. Basically they include (1) development of an advisory service to assist farmers with irrigation scheduling, distribution system maintenance and crop husbandry; (2) development of farmer organizations to facilitate scheduling of water, ditch maintenance, and other community efforts; (3) elevation of one meska in an open ditch; (4) putting one meska under pipe line, and (5) development of a land leveling program.

Kafr El Sheikh—(1) development of a farmer advisory service; (2) provision of a land leveling program; and (3) organization of farmers to improve meska and field ditch design, operation and maintenance.

El Minya—(1) Raise one meska and provide water under gravity, (2) provide an advisory service; (3) develop a land leveling program; and (4) develop farmer organizations.

In addition to the pilot testing described above, project personnel have listed 7 items still needing further problem identification and research. These include:

1. Field drains at Kafr El Sheikh
2. Plant population density
3. Sweet corn production
4. Farmer acceptance of new technology
5. Irrigation law
6. Relationship between farmers and support institutions
7. Role of livestock in agriculture

ASSESSMENT and ANALYSIS

The project concept and design is exceptionally good. The process of learning how the present system functions before testing or implementing solutions is sound and logical. Too often one finds, in development projects, solutions to non-problems or assumed problems being implemented without the vaguest notion of how to be successful. This is true especially in irrigation system improvement which is a complicated mix of society, water, land, and cropping systems. And the Egyptian water delivery system is so complex that it is virtually impossible to understand it without systematic data collection.

This project provides time for that difficult and time consuming phase of data collection to understand the system and identify the problems. The project is undoubtedly providing the best farm agricultural data available in Egypt. These data are needed by several ministries in the Government of Egypt and by donor agencies involved with assistance to them. It is noted that the recent scope report on the

"Nile River System - Redesign, Rehabilitation and Improvement Program" suggest that the following alternatives should be investigated in developing the feasibility for a command area irrigation project:

- installation of a gravity system on an entire area
- change from a rotation to a demand system of water delivery
- reduce the size of the meska command area
- develop operation and maintenance plans
- develop conjunctive use of water
- investigate land leveling and use of fill to raise meskas

The feasibility of each of these alternatives cannot be honestly assessed without a great deal of basic information and research. The Water Use and Management Project, in its final phase, should provide exactly the type of information needed on all of these technologies.

The project, then, is timely. Its output is needed now. Among government officials one feels a sense of anticipation and expectancy for the information that will define a workable large scale program to increase agricultural production. It is especially important that the project now focus full attention on the pilot programs to provide this needed information.

The project is at a stage where the pilot testing phase is essential. There is no reason for not launching it now. However, implementation plans and target outputs need to be very clear to all participants. To date they are not. The present plans are too diffuse and non-specific. It is not apparent that an analysis of timing and

technician constraints was made before deciding on the scope of the pilot studies. These need to be narrowed to technologies which have a high probability of being useful to Egypt in the near term. They also need to be focused because the technologies not only need to be applied and tested but the implementation must be monitored with sufficient care so that a development plan can be designed from the pilot tests. This means that the reasons for successes and failures must be quantified. The implementation and operation of each pilot program must also be accomplished in a manner such that the institutional requirements for its establishment are quantified and delineated. This always means more time than if project staff accomplish the entire process by themselves. Egypt cannot improve its irrigation system through a research project. EWUP can only develop an economically and technically feasible plan for such improvement. The remainder of the project life should be devoted solely to that purpose.

The pilot program will consist of several elements related to farm water management. Implementation of programs involving these elements are usually site-specific, therefore an analysis of the major ones is worthwhile. The following brief review is based on observations and research to date:

1. Water management among and on farms—The Egyptian irrigation system is unique. The principal reason for this is the delivery of water to each farmer in a channel which is below the land surface. Most irrigation systems involve government management of the system down to a tertiary system which is managed by the farmers. In Egypt, the tertiary system is

the meskas and it is true that the farmers manage the water beyond the meska outlet. However, the Egyptian system offers another major difference. Just as the farmers on a meska are mutually concerned about the water in that channel, so are the farmers related among the meskas on a branch canal. There are no control gates on the meskas so there not only must be a division of water along the meska but also there is a division among the adjacent meskas. This added dimension greatly complicates the water use pattern among farmers as well as the organization required. It certainly cannot be ignored, however, in any program dealing with improved farm water management.

2. Water delivery by gravity—The Egyptian irrigation system is designed to provide an abundant quantity of water to each irrigated acre. Usually the supply is reduced or cut off in the branch canals during the nighttime hours and it is supplied in a conveyance system that is below the land surface. Each farmer must therefore lift his water from 1 to 2 feet to get it on his crops. He does this by various hand, animal, and mechanical powered pumps. Such a system acts as a long reservoir where water is essentially stored before use. With such a system the farmer has some flexibility on when he irrigates. In other words, the water will not run off if it is not immediately used. The branch canals and all meskas connected to them have a rather large storage capacity.

Now, when this system is placed above ground a different situation exists. The water will flow by gravity and it is much more important to develop a rotational system of use among farmers. When the system is flowing it must be used or spilled into a drainageway. This is not to say that the tertiary system should not be elevated. In the interest of energy savings alone it is surely worth testing. This is to point out that there are some advantages to the below ground systems. It is probable that one can come nearer to scheduling water strictly according to crop demand with this below-ground system. It should also be noted that a below-ground system can only be successfully operated where water is especially abundant.

3. The drainage problem--Because of the flat delta terrain, its low elevation, and the abundance of water in the irrigation system throughout most of the year, there is a relatively high water table under most of Egypt's agricultural land. The irrigation water supply has a very low salt content and to date the salinity problems have been minimal and most of the ground water is not especially saline. In fact, most of it is usable as irrigation water.

   One logically could predict that the present situation cannot continue without serious detrimental effects being created by the high water table and salt condition. After all, the post Aswan irrigation system is not really old. This is undoubtedly the reason the government has implemented a tile drainage

program as well as a program of open drain lines in the lower delta agricultural lands.

Certainly any water management improvement program must take into consideration the drainage problem and the effects of alterations in the irrigation system must be carefully monitored. Where drainage and ground water is relatively salt free a program of conjunctive use might prove especially valuable in maintaining a lower water table. The open drains merely act as skimming wells and would be an excellent source of water should water use efficiency become a serious concern of the government.

4. Land leveling—There are data to indicate that application efficiencies could be improved if the irrigation basins were made more precisely level. There is not information, however, to indicate that land leveling would increase yields. There are many problems associated with land leveling in Egypt. The irrigation units are exceptionally small as are the farms themselves. Therefore it is difficult to manouver the relatively large machines within the small fields. Access to fields is also a problem since practically all agricultural operations are carried out either by human or animal power. The severest constraint to development of a land leveling program is undoubtedly the fact that cropping intensities are so high as to preclude the land being idle for more than a few days each year.

Land leveling is, however, important if more efficient use is to be made of the irrigation water. Even if the farmers

maintained the small irrigation units, they would operate better from having been leveled.

5. Farmer organizations—As with water management in any irrigation system, the Egyptian farmer would benefit from a water user organization. It is apparent that the formation of such institutions will be difficult in Egypt simply because there is not a real shortage of water.

   If farmer organizations are to be successful there will have to be a function around which to rally. Perhaps the operation of a meska by gravity (elimination of the work involved in pumping) will do it. It does not seem likely that farmers would organize any more formally than at present around the possibility of irrigating on demand. Most of them probably would argue that they are doing that already.

SUMMARY and RECOMMENDATIONS

The project is scheduled to enter the pilot test phase. It is important that this phase be carefully planned to insure that information derived from it will not only be useful to the GOE but will also be in a form usable by them.

It will be especially important to manage personnel and time carefully; otherwise the program can become fragmented and unfocused resulting in the loss of the true purpose and the production of something other than planned. This cannot be overemphasized. The very nature of the program results in a rather thorough understanding of the on-farm agricultural situation. Armed with such knowledge,

project personnel will think of many possibilities for further study and research which are outside the project bounds. Most of them could be viable and worthwhile endeavors; however, with limited time the project must remain focused on specific purposes. Otherwise it will continue indefinitely on the brink of producing something useful for operational agencies but never quite getting it all together. This is a common failing among agricultural researchers. It is much more attractive and easier to pursue unknowns than it is to develop an implementation methodology for an improvement technology that has been identified. Yet, the pilot program must do exactly that or the entire program will have failed. This is a challenge project leadership must constantly deal with.

There is evidence that there has been such a lack of concentration on focus during the problem identification and research phases. Some aspects were thoroughly and well done, yet other rather obvious problem situations have not been researched in depth, if at all. For example, there appears to be a tail-ender problem along the irrigation distribution system. Neither the nature of the problem nor how the farmers cope with it has been completely explained and documented to date.

The training program has been highly successful. The host country scientists and engineers who have received the training are exceptionally well versed in the fundamentals of farm water management. However, it may have been so successful that Egyptian and American participants have been lulled into believing that the

problems were all identified once the training course was completed. On the contrary, that should be the beginning of a process of irrigation and farming system monitoring that goes on continually. This systematic gathering of data and information is not apparent in the water distribution system yet it is highly visible and well done in the farm practices surveys. This should be corrected during the pilot phase.

Following are several specific suggestions which, granted, are based only on a two-week look at the project but hopefully all will be worthy of discussion and some worthy of consideration.

General

1. There should be a redefinition of project goal to emphasize conditions other than strictly agricultural production. Perhaps equally important to Egypt are conservation of energy and water. Important to the farmer are increased income and reduction in labor. All of these should logically result from improvement in water management, while it is not readily apparent that agricultural yields can be increased very much through water management alone unless one expresses them as yields per unit of water used.
2. The project should focus more directly on water management. The original project design called for a focus on the water but recognized that "other factors" were important and should not be excluded. The previous evaluation (October 1979) noted that these "other areas" were proceeding in advance of the water use work. This condition seems to still prevail and is also evidenced in the pilot testing and further research planning.

3. Develop clear, specific, and focused plans for the final project phase and maintain the focus. Decide on the remaining work by analyzing the time and resources available. Develop achievable purposes and maintain the focus. Once a technology is decided on for testing do not give up on it too soon. Carry out tests until an implementation plan is developed or a logical explanation of why it didn't work is made.

4. Orient program efforts to the field during the final phase. The time for theory and sophisticated research is finished. The pilot stage occurs in the field. Go there and show the farmers that the project is serious about helping them. Transfer some central office personnel to the field.

5. Give Egyptian counterparts more responsibility and focus short term advisors specifically on field jobs. The emphasis in the pilot stage must be on getting the job done. The importance of maintaining discipline balance is not important. After the pilot programs have been carefully planned, all effort must be toward execution of the plan. The product will be a program which Egypt can adopt and implement. No other products are as important now. Remaining focused on this will require dedication and unselfishness.

6. Get project publications into the hands of the people who can use them. A high level agricultural official commented that he had read both publications. The review team had available some 70 printed articles and documents which had been produced by the project. If the publications are not useful to

Egyptian irrigation and agricultural planners and scientists they are not worthy of publication.

Additional Research

7. Build additional research needed into the pilot programs. Do not pursue further research not specifically related to pilot programs. Effort must be given to change the project emphasis from research to pilot testing. This cannot be done by continuing research as usual and adding the pilot program on. It will be best to consider the research phase completed and devote full attention to pilot testing. The needed research can very effectively be done within the framework of the pilot studies.

8. The disposition of water on farms and among farms must be better quantified and monitored. Questions such as: how much water does each farmer get; how much does he lose; how long does he have the water; the flow rate per feddan; etc. must be answered. Of course, data will have to be gathered on a sample basis. Since this must be done to verify effects of some of the pilot programs it should not be an extra burden.

9. Consideration should be given to moving further upstream and further downstream for the water budgeting. This suggestion is certainly debatable as it would require considerable effort. Perhaps it would be sufficient to look into the problem in sufficient depth to understand what would be required to carry out such a program. If Egypt launches a program of water management improvement on large command areas then such studies

would be essential. A preliminary look at the problem by this project would probably be efficient and effective use of time in the long run.

10. Additional research is needed to quantify the following.
    i) what is the nature and extent of the tail-ender problem?
    ii) what are the benefits from increased efficiency of water use?
    iii) what is the effect of various water management practices on waterlogging, salinity and alkalinity problems?
    iv) what can be done with the water saved through better water management?
    v) to what extent are the farmers already organized to apportion water among themselves?
    vi) what is the significance of intake and intake opportunity for the heavy delta soils given the fact that basins are small?

    All of these should be pursued within the pilot program.

Pilot Testing

11. The pilot studies must involve methods that can be built into long-range and large-scale programs. The project should not furnish all inputs or if it does it must analyze and recommend how they would be made when the program goes full scale on a national basis. A significant element of the pilot program is the determination of how to implement the expansion program.
12. The product of a successful pilot study is an implementation plan for some technology. This requires at least some pre-feasibility studies, an evaluation of the benefits to be

gained and the expected costs and an analysis of the conditions under which the program will succeed.

13. The experiences involved in designing, implementing, and conducting the pilot tests should be documented. This is important whether or not the particular test succeeds or fails. Either way one must know the reasons for success or failure; otherwise too much is left to chance during replication of the program on a large scale.

14. Make pilot test plans as specific as possible. Try to visualize what the expansion program would look like if the pilot is a success.

15. Assign specific people to specific pilot programs. There is insufficient time to have all technicians and advisors working on all pilot tests. Responsibilities must be assigned and authority given so that the work progresses expeditiously.

16. Keep the number of pilot tests to a minimum. It will be far better to complete one program well than partially do several. The output from pilot programs is not useful unless it reaches a point of adoption or rejection.

17. A suggested set of pilot tests might include:

    i) A land leveling program at Kafr El Sheikh or Minya.

    ii) The Hammambi canal and meska in pipe.

    iii) Conjunctive use of water at Kafr El Sheikh and Monsouria.

    iv) Farmer advisory service at all sites.

    v) Development of farmer organizations.

These suggested 5 programs would include all important factors presently under study. They permit focusing on targets and should be

amenable to making specific assignments among the various specialists and disciplines. There are 3 that should be the responsibility of engineers, one the responsibility of agronomists, and one the sociologists. Obviously economists should be involved with all.

The land leveling program will be difficult to pilot test; therefore the suggestion that it be concentrated at only one site. There are so many factors needing test that someone should be placed full time on the program. The study needs to determine the best method of irrigation after leveling, the best time for leveling, the best method to accomplish the earthwork, and the appropriate field size after leveling. Undoubtedly the program should work with private tractor owners who presently contract to prepare seed beds. If the program is to finally be worthwhile, private contractors would be preferred over government operators for the machine work. The surveying and calculations could probably be handled by technicians under an engineer's supervision. Either the Kafr El Sheikh or El Minya sites appear suitable for this program where the earthwork could be combined with raising meska banks in the one case and removing or rebuilding open drains in the other.

The Hammambi branch canal pipe installation will provide an ideal pilot test site. It is also one in which the Ministry of Irrigation is very much interested. The entire branch canal needs to be looked at as the test area. There are many things that will need to be monitored including water use, irrigation efficiencies, total demand for water, farmer impressions, costs, benefits, and problems

with construction and operation. Undoubtedly some information will need to be gathered on adjacent branch canals for comparison.

Conjunctive use of water appears to be a natural technology if production increase per unit of water is important. Without doubt many farmers practice it now. The open drains are natural skimming wells and where water quality is suitable there is no reason to not use the water. Certainly the Egyptian farmer knows how to lift water. One assumes that if this is not important now it surely will be in the near future. Egypt cannot continue to develop desert land indefinitely without being concerned with water waste on the delta. This study could be done on one or two meskas where attempts should be made to irrigate according to crop needs while using as little water as possible from the canal system. In connection with this study, the elimination of some of the open drains in the lower delta should be studied.

The farmer advisory service will definitely be needed if any national program in the future is to deal with water management. The farmer will certainly need to be shown the benefits of better water management before he will accept it. Along with the water management practices all other agricultural inputs can be incorporated into the program. Undoubtedly this program should work with the Agricultural Department or perhaps the Agricultural Cooperatives. At least, it will have to be institutionalized in some way. Perhaps the Irrigation Departments need also to be involved in development of water management extension specialists. Training will undoubtedly be necessary in this study. Certainly the study should be carried out at all sites in conjunction with the other pilot programs.

The farmer organization development needs also to be studied at all sites. This will also need to be done in conjunction with the other programs; otherwise there will be no reason for the farmers to organize. As the advisory service and the other technology developments begin to function and show progress, then the farmer organization development might have a possibility of success.

18. Two additional years will not be sufficient to adequately complete pilot testing. This type of study always takes longer than planners anticipate. Good pilot concepts should not be killed because insufficient time was given for them to mature. The Hammambi canal pipe system is not yet designed so it is unlikely that it will be operating for yet another year. If only two more years remain for the project it is suggested that the pilot studies be reduced even further to less than five. The herein suggested program could need at least three years to complete in a sensible manner. Adding more inputs would not reduce the time frame. Management development programs with small farmers takes time; usually more than governments and donor agencies are willing to give.

DISCUSSION OF SPECIFIC QUESTIONS

USAID asked the evaluation team to address several specific questions. Although some answers are contained within the body of the report, following are specific comments on some of the questions.

1. Is the interdisciplinary approach feasible during implementation of a larger project?

The interdisciplinary approach is often overplayed. Certainly it is necessary to consider all constraints and assess all resources available to remove constraints in any improvement project. However, it is not necessary and may not be wise to disaggregate constraints by discipline. It is much more important to explain why the system operates as it does through an interdisciplinary approach. The engineering approach to inefficient use of water on farms has traditionally been to accept it and either provide more water to the farmer or drain off excess water or both. This approach has been the pattern in Egypt. But to actually understand the true reasons for inefficient water use on the farm one must use the interdisciplinary approach. This is now being recognized worldwide.

The interdisciplinary approach is essential to understanding the operation of the irrigation and the farming systems. Problem identification or constraint analysis must recognize that social, economic, political, institutional, biological, and physical aspects all play important roles in defining any management system. It is equally important to consider all of them in deciding on technologies to remove constraints.

Once a program of testing solutions is underway, however, the interdisciplinary approach is needed only to insure that the system is properly monitored. In other words, implementation of major programs which have been carefully and properly designed through an interdisciplinary approach do not need to be accomplished in an interdisciplinary manner.

2. The comprehensiveness of project research directed at on-farm water use and the impact on yields and income of various alternatives regarding quantity and timing of water use.

Several studies have been made which relate to the water use problem. Examples are the use of water by crops from the ground water, the economics of pumping by various methods, the economics of water shortages, conveyance losses along the distribution system, and the various studies which describe the on-farm water management system at specific sites.

All of these studies are important to solutions which may finally adopted. Much of the water management "research", however, must await the pilot trials. The tough questions can only be answered by working with a sufficiently large portion of the irrigation system to be able to quantify effects and establish causes.

There are some aspects that should have been researched in more detail. For example, the extent and nature of the tail-ender problem both on a particular meska and among the meskas on a branch canal is not well known. This should be established before pilot studies alter the situation. The quantification of benefits from

increased efficiency of water use have not been specified. The effect of present water management practices on the waterlogging, salinity, and alkalinity problems has not been adequately researched. Finally, the factors which determine the height of water in the channel at the farm could be studied; for instance what effect does cleaning the meska have on water elevation at the tail-end?

Most of these and other studies can be accomplished during the pilot testing stage. That program should not be delayed in order to do further research.

3. The appropriateness of considering on-farm water management apart from off-farm water management and other on-farm practices as well as the need to address policy decisions at higher levels.

On-farm management should not be considered apart from off-farm water management. The project has not done this. Certainly some studies have been totally on-farm as they should be; but project personnel are well aware of the intricate connection between on-farm, off-farm and policy. In Egypt, this is especially important because the farms are small, water is delivered at below grade, there are no control gates on the tertiary channels, the secondary channels are regulated twice daily, and there is a high water table throughout most of the country. Obviously one cannot isolate water management on farms in such a system. The water management system in Egypt is undoubtedly the most complicated one in the world. This need not be discouraging because it also undoubtedly has the possibility of being one of the best managed large systems in the world. It has not yet approached that potential, however.

4. Criteria employed in developing suggested solutions including consideration of acceptability to farmers, complexity of organization or cooperation required, government support needed and extension effort necessary.

Insufficient attention has been paid to this aspect, however, it is difficult if not impossible to develop final solutions without pilot testing. Perhaps it is a mistake to develop solutions and implementation plans in any significant detail because the pilot program must be flexible enough to accept change imposed by farmer and institutional implementation capabilities.

The plans developed thus far have the appearance that they are to be thrust on the system by the project. This cannot be allowed because it would show nothing other than what is possible without government and farmer cooperation. Just the opposite is what is needed.

5. What new practices have been developed or applied which have the greatest potential for large-scale replication?

The practices that appear attractive to farmers and have good potential for large-scale replication are (1) raising the water elevation in the meska by some means and (2) land leveling to decrease labor and water needed to cover fields. The government should be attracted to (3) irrigation scheduling (irrigation according to crop needs) combined with conjunctive use of water because it potentially could reduce irrigation water requirements by one-fourth to one-half.

These practices are not yet ready to implement on a large-scale. Implementation methods must be worked out through the pilot testing program. There should be considerable concentration on these three technologies during the pilot phase.

6. The interaction of techniques being developed and the steps needed to implement them.

This must be determined during the pilot phase. Viable farmer organizations should not be required for all the technologies being tested. The pipe line, raised meskas, land leveling, and conjunctive use of water should not require a tightly organized farmer group. On the other hand, some of the assistance provided through the advisory service such as irrigation scheduling, channel maintenance, etc. will require a farmer organization and a co-operative effort with some governmental institution.

7. The adequacy and content of plans for the pilot area phase.

In some respects the plans are too detailed; yet in other cases they aren't specific enought. There is an expectation that events will occur on a pre-planned schedule and that they will occur quite rapidly in the early stages of development. This probably is over optimistic.

The implementation plan lists responsibilities for Egyptian staff but says nothing regarding American project staff. A successful pilot program will require concerted effort on both staffs and specific assignments and responsibilities should be made for everyone.

One of the activities apparently involves making recommendations to farmers on (1) better on-farm water management, (2) use of water by gravity; and (3) promotion of good water management. These statements sound all right but are difficult to carry out. What is meant by "good water management?" What is an improved level basin? These activities are too vague and must be made specific before they can be implemented. Undoubtedly it is impossible, at present, to precisely define farmer recommendations. If so, then the pilot program must determine them before attempting to tell the farmer to do a better job. He will need specifics.

When the water is presented to the farmer under a gravity system and he has always had to pump it before, he will probably be wasteful of it at the outset. Extra effort will have to be made to assist him with this new and quite changed technology.

The pilot evaluation plans are quite good. However, the engineers should monitor more than the position of the water table. Where and when the water moves within meskas and on farms is especially important also. This should be done quite thoroughly on a macro (area) scale and by sampling on a micro (meska) scale.