A.I.D. EVALUATION SUMMARY - PART I PD-ABA-171 64

1 BEFORE FILLING OUT THIS FORM, READ THE ATTACHED INSTRUCTIONS
2 USE LETTER QUALITY TYPE, NOT "DOT MATRIX" TYPE

IDENTIFICATION DATA

A. Reporting A.I.D. Unit
Mission or AID/W Office USAID/Islamabad
(ES# 89/3)

B. Was Evaluation Scheduled in Current FY Annual Evaluation Plan?
Yes ☐ Slipped ☐ Ad Hoc ☒
Evaluation Plan Submission Date FY 89

C. Evaluation Timing
Interim ☒ Final ☐
Ex Post ☐ Other ☐

D. Activity or Activities Evaluated (List the following information for project(s) or program(s) evaluated, if not applicable, list title and date of the evaluation report.)

Project No.	Project /Program Title	First PROAG or Equivalent (FY)	Most Recent PACD (Mo/Yr)	Planned LOP Cost (000)	Amount Obligated to Date (000)
391-0467	Irrigation Systems Management (Research and Policy Implementation component)	June 5, 1983	June 4, 1993	$ 205 million (25.1 million for the component)	$96.3 million ($15.7 million for the component)

ACTIONS

E. Action Decisions Approved By Mission or AID/W Office Director

Action(s) Required	Name of Officer Responsible for Action	Date Action to be Completed
1. USAID to continue support to WAPDA (Water and Power Development Authority), PCRWR (Pakistan Council of Research in Water Resources), and PARC (Pakistan Agricultural Research Council) for water management research. All recommendations of the evaluation have been considered, and USAID to work with research organizations to get most of the research recommendations of the evaluation team incorporated in the research project revisions of GOP PC-1s and other planning and redesign documents.	J.U.Ahmad, ARD F. H. Usmani, GOP	Dec.,1989
2. USAID to work with Federal and Provincial officials of agriculture and irrigation departments and research organizations to create inter-linking of research activities and information exchange between action and research agencies. Research program will be integrated with PIDs (Provincial Irrigation Departments), On-Farm Water Management Directorates and Command Water Management entities. A detailed action plan will be prepared for implementation.	J. U. Ahmad & A. P. Newman A.R.D. Asif Kazi, GOP	Dec.,1989
3. USAID to work with the University of Idaho (UOI) to develop proposals for a two year extension of technical assistance contract.	J. U.Ahmad,ARD	Dec., 1989

(Attach extra sheet if necessary)

APPROVALS

F. Date Of Mission Or AID/W Office Review Of Evaluation: (Month) April (Day) 17 (Year) 1989

G. Approvals of Evaluation Summary And Action Decisions:

	Project/Program Officer	Representative of Borrower/Grantee	Evaluation Officer (A)	Mission or AID/W Office Director
Name (Typed)	Jalil U. Ahmad	Asif H. Kazi	Tanveer A. Khan	James A. Norris
Signature				
Date	23 JULY 89	31/7/89	Sept. 19, 1989	Sept. 25, 1989

A.I.D. EVALUATION SUMMARY - PART I

1. BEFORE FILLING OUT THIS FORM, READ THE ATTACHED INSTRUCTIONS
2. USE LETTER QUALITY TYPE, NOT "DOT MATRIX" TYPE

IDENTIFICATION DATA

A. Reporting A.I.D. Unit

Mission or AID/W Office _____

(ES# _____)

B. Was Evaluation Scheduled in Current FY Annual Evaluation Plan?

Yes ☐ Slipped ☐ Ad Hoc ☐

Evaluation Plan Submission Date FY 90

C. Evaluation Timing

Interim ☐ Final ☐

Ex Post ☐ Other ☐

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Project No.	Project /Program Title	First PROAG or Equivalent (FY)	Most Recent PACD (Mo/Yr)	Planned LOP Cost (000)	Amount Obligated to Date (000)

ACTIONS

E. Action Decisions Approved By Mission or AID/W Office Director

Action(s) Required	Name of Officer Responsible for Action	Date Action to be Completed
4. Senior research scientists will be invited in annual review meetings to make presentation of research results.	J.U. Ahmad,ARD COP, UOI	On-going
5. Constitutions' of PCRWR, DRIP and NADLIN will be reviewed to improve effectiveness of these organizations.	Asif H.. Kazi GOP	Dec.,1989
6. An action plan will be developed to better coordinate research activities of WAPDA, PCRWR, DRIP and PARC.	J.U. Ahmad,ARD Asif H. Kazi, GOP	Oct., 1989
7. Competitive Grants Program to be evaluated for its pay off.	J.U. Ahmad,ARD	Dec.,1990

(Attach extra sheet if necessary)

APPROVALS

F. Date Of Mission Or AID/W Office Review Of Evaluation: (Month) (Day) (Year)

G. Approvals of Evaluation Summary And Action Decisions:

	Project/Program Officer	Representative of Borrower/Grantee	Evaluation Officer	Mission or AID/W Office Director
Name (Typed)				
Signature				
Date				

2

ABSTRACT

H. Evaluation Abstract (Reproduced in the space provided)

The Irrigation Systems Management Research(ISM/R) Project aims to assist the GOP to carry out a series of specific research projects focussed on major water management needs and to develop the capacity of GOP research institutions so that a well organized and managed integrated research program for irrigation management is established and sustained. This project is being implemented in all four Provinces by WAPDA, PCRWR and PARC. Designed in 1984, its implementation was begun in April 1985. Institution building activities include development of research management skills, establishing a Competitive Grants Program, setting up a Library Documentation and Information Net-Work (NADLIN), and training of staff. Initially designed as a four year period, the current ending date is June, 1990. Due to initial (start up) delays the review/evaluation has been conducted mid-way through project implementation.

The purpose of this review was to evaluate design concepts, objectives, basic assumptions and progress todate and recommend future courses of action. The evaluation was based on: 1) review of data, reports and other documents, 2) interviews with USAID, contractors, GOP, WAPDA, PCRWR, and PARC officials, the Principal Investigators (PIs), Co-PIs, and other concerned scientists, 3) visits to the PIs offices and research sites, and 4) interviews with a farmer groups.

The report notes that in addition to a delayed start there were number of problems in start-up and implementation, but the project has now entered a very productive phase. Some studies were found to be behind schedule, and some have deviated from the original plan, but on the whole the Project is moving in the right direction. There have been some significant accomplishments which warrant its further continuation.

The evaluation identified positive indicators of: 1) significant progress in institution building activities, 2) contractor's staffing of long term positions has been inadequate contributing to slow progress, 3) research management has generally been good, 4) coordination of different research units has been successful and development of an annual research plan has been well organized, 5) in-country training has been productive but progress on overseas training was far behind schedule, partly due to use of training funds by other components of the ISM project, 6) the Competitive Grants Program, though established, needs to be evaluated for its long term pay-off. Suggestions have been made for incorporation in the project redesign and a recommendation that the project be extended two year.

COSTS

I. Evaluation Costs

1. Evaluation Team Name	Affiliation	Contract Number OR TDY Person Days	Contract Cost OR TDY Cost (U.S. $)	Source of F
1. Dr. W. Doral Kemper (Soil Scientist)	Agricultural Research Service U.S.D.A.	78	45000 (Appr.)	Project Funds
2. Dr. Marshall J. English (Agricultural Engineer)	Oregan State University			
3. Mr. Mohiuddin Khan (Civil Engineer)	Consulting Engineer			

2. Mission/Office Professional Staff Person-Days (Estimate)	3. Borrower/Grantee Professional Staff Person-Days (Estimate)
12	25

A.I.D. EVALUATION SUMMARY - PART II

SUMMARY

J. Summary of Evaluation Findings, Conclusions and Recommendations (Try not to exceed the three (3) pages provided)
Address the following items:

- Purpose of evaluation and methodology used
- Purpose of activity(ies) evaluated
- Findings and conclusions (relate to questions)
- Principal recommendations
- Lessons learned

Mission or Office:	Date This Summary Prepared:	Title And Date Of Full Evaluation Report:
USAID/Islamabad	June 20, 1989	Project Review/Technical Evaluation Irrigation Systems Management (ISM/R) April 17, 1989.

The Irrigation Systems Management (ISM) Project aims primarily at improvements in productivity of irrigated agriculture by development of Federal and Provincial institutions for planning, design, operation and maintenance of irrigation system, and by equitable and reliable water delivery, and efficient water management. It has 4 discrete but inter-related components;

1. Rehabilitation works
2. Institutional strengthening
3. Research and policy implementation
4. Command Water Management

The project was initiated in 1983. The first phase of the first two components co-funded with the World Bank were completed in June 1987. Its evaluation was done in later part of 1988 which has been separately summarized in an A.I.D. Evaluation Summary dated September 1988. Based on the evaluation findings, the first two components have been redesigned and an amendment to ISM Project has been authorized. The Command Water Management component, also co-funded with the World Bank, was begun in 1985, and its interim evaluation has been separately carried out. This evaluation covers only the Research and Policy Implementation component. Commonly known as ISM/R i.e. Irrigation Systems Management Research.

The purpose of this component is to assist the GOP to carry out a series of specific research projects focussed on major water management research needs of the country and develop research capacity so that a well organized, well managed and integrated research program for irrigation management is established and sustained. The ISM/Research Component was designed in 1984 for initially a four year time slice. Its implementation was begun in 1985. The Component is implemented by WAPDA (Water and Power Development Authority), PCRWR (Pakistan Council of Research in Water Resources), and PARC (Pakistan Agricultural Research Council). DRIP (Drainage and Reclamation Institute of Pakistan) - a semi-autonomous organization in the Ministry of Science and Technology - is also a collaborator. The Component covers different areas of research, which altogether include 8 research projects as follows;

- Farm Water and Water Course Management.

  1. Farm Water Management
  2. Beyond Watercourse Improvement
  3. Encouraging Water User Involvement in Better Water Management

- Water supply and delivery system.

  1. Irrigation Systems Outside the Indus Basin
  2. Integrated Watercourse Management

4

Salinity Control, Drainage and Conjucture use of surface and ground water

1. Surface Drainage and Water Table Control
2. Development of Groundwater - Surface Water Models
3. Public and Private Tubewell Performance

The Component has been under-way for more than 2 years with part of the technical assistance team in Pakistan for its design before its implementation was begun. According to design the research projects should terminate in July 1990 while the technical assistance contract in April 1990. A major focus of this Component is to develop technical expertise and research management skills so that a foundation of well organized, well managed and integrated research program in irrigation management is firmly established and sustained. It is expected that the concept of the project will continue long after this particular phase terminates. The evaluation was, therefore, called to technically evaluate project's design concepts, objectives, basic assumptions and progress todate, and review whether the Component objectivies have been or are being met or the strategy should be modified to achieve the objectives. The evaluation team was therefore to recommend actions to be taken to remove implementation constraints and changes that could improve its implementation and design. The team was also mandated to provide specific recommendations regarding directions for future research studies after June 1990. Primary information sources for this evaluation included visits to research sites, meeting with USAID and GOP Officers, visit to offices of WAPDA, PCRWR and PARC, interviews with Principal Investigators (PIs), contractors' team members, and USAID officials, and review of reports, data and documents related to ISM/Research Component. In addition interviews with a group of farmers were also conducted and a series of background reports were provided.

The team found that this project has had a delayed start and a number of problems in start up and implementation, now it has entered in a very productive phase. The team noted a few significant accomplishments in a few on-going research studies and recommended that the Project/Component be extended by two years i.e. upto June 1992.

The team found that the Component is approximately one year behind the schedule, in particular the following activities/research studies being significantly behind schedule;

a) Building the data base for the 'Beyond water course management' subproject.
b) Literature review for the "Outside Indus" subproject.
c) Research on causes of tubewell deterioration
d) Hands on training with ground water models
e) Evaluation of economics and farmer acceptance of techniques considered in "Integrated Water Management" and management techniques for high water table conditions
f) Evaluation of economics and farmer acceptance of techniques for reclamation of sodic soils
g) Social science studies for "Encouragement of Water Users" subproject
h) Training of PCRWR staff on administration of grants for item (g) above.

Some departures from the original plan were also noted by the team in the following cases, however, the team found that the departures from plan in three cases are consistant with project goals.

a) No significant involvement of local professionals in the "Out of Indus" subproject.

b) Monitoring of Private tubewells will not be done by SCARP Monitoring and Evaluation.

c) Development and testing of furrow and portable sprinkler irrigation techniques is not being done.

d) Development of a tubewell maintenance staff will not be done.

e) Development of implements for forming furrows and beds will not be done.

f) The work to be done on "Encouraging Water Users" will be handled by subcontracts/grants rather than being done in house by PCRWR.

The team found that the Competitive Grants Program has been organized and has now gone through two rounds of grant awards, although late to start and plagued by management problems initially, it now appears to be running smoothly.

The team found that good progress has been achieved in equipment procurement, however, procurement of a few additional equipment is still needed and a few equipment still needs to be made operative.

The team noted that rapport between GOP personnel and long term advisors has been good, but contractors' staffing of the long term positions has been inadequate, which has partly contributed to slow progress of the research activities. The team recommended that technical assistance contract be extended until April 1992. The team found that research management has generally been good, coordination of different research units has generally been successful, and development of annual research plan has been well organized.

The team found that overseas training of scientists and researchers has been lagging behind schedule due to over spending of training funds by other components of the ISM Project, therefore, there will not be any direct benefit of training on the on-going research studies. However the in-country training has been very productve and contributed significantly to the research program.

The team also made recommendations regarding research studies that need to be continued and a few institutional changes that may create a better research environment.

On the whole, the team found that although the Component had a slow start and had problems in its start-up and, initial implementation, it has now entered in a very productive phase and interim accomplishments on some of the research studies justify continuation of the Project beyond June 1990 to at least until June 1992.

A. General Recommendations

1. The project should be continued and extended at least until 1992.

2. A Pakistani should be recruited as a Deputy Chief of Party until such time as he is ready to take over the Chief of Party position at which time the American Chief of Party would resume a technical advisory role.

B. Research Recommendations

1. The Competetive Grants Program should be reviewed at the completion of the project to decide how well it has served the ISM/R program and what its appropriate long range function is.

2. Steps should be taken to involve participating social scientists with engineers and physical scientists in efforts to develop acceptable solutions to the problems that are being studied.

3. Specific approaches for improving karez systems are proposed. Additional efforts to make more effective use of karez water are needed. Interaction between karezes and tube wells must be analyzed.

4. Additional studies involving a greater range of water use is needed for the research on the interaction between water use and nitrogen leaching.

5. Studies of the use of brackish water should be continued and should incude tests of brackish water for early season irrigations.

6. Redesign and use of the tubewell sampler (a sampling device to take tubewell casing and gravel pack samples) should begin immediately and the diagnosis of tubewell deterioration should be carried out.

7. The concept of installing drain tile as a form of skimming well should be evaluated for economic feasibility and acceptability to farmers.

8. The feasibility and effectiveness of shallow, low cost drains, which a farmer would be capable of installing without special machinery and which would not require pumping, should be explored.

9. Development of midcourse water storage that would provide flexibility in water delivery in order to eliminate night irrigations should be considered.

10. Research on farmers' willingness to pay for watercourse lining and how their investment in canal lining might influence their practices should be started.

11. A study of possible reductions in the abiana for farms which do a good job of maintaining water courses. This system could be structured in such a way that it would provide a direct incentive for a higher level of maintenance without reducing total revenues to the irrigation department.

C. Institutional Recommendations

1. ISM/R annual project meetings should be expanded to include all senior research officers and they should be given a major role in presentation of research results.

2. An aggressive effort should be made to establish links to action agencies of one kind or another, including provincial agriculture departments, irrigation departments, the extension unit at MONA, the On-Farm Water Management and Command Water Management programs and regular extension people. These institutions should be actively participating in definition of research needs.

3. PCRWR, DRIP and NADLIN should be incorporated into the Ministry of Water and Power and seminars and other meetings used to better coordinate their activities.

4. An officer in the Federal Government should be empowered to expedite processing of nominations of foreign advisors and candidates for overseas training. Whenever an advisor is to be nominated (TDY or long term) direct communications between the contractor and the key decision makers in the GOP should take place to expedite the selection process.

5. Local officers should be given more discretion in handling of minor purchases.

6. Research officers should be allowed promotion in place rather than promotion only when transferred.

7. Hardship pay for research workers assigned to outlying stations should be sanctioned.

8. The USAID Project Officer and the contractor's Chief of Party should undertake a few field trips to research sites to develop a better understanding of their jobs and points of view.

9. USAID should permit as many long term advisors as possible to remain in country until the end of 1990.

10. More detailed planning of TDY visits should be implemented and fewer TDY people should be used for more repeat visits to the extent that it is practical to do so.

ATTACHMENTS

K. Attachments (List attachments submitted with this Evaluation Summary; always attach copy of full evaluation report; attach studies, surveys, etc., from "on-going" evaluation, if relevant to the evaluation report.)

K. Attachments: Final report dated April 17, 1989 titl

"Project Review/Technical Evaluation
Irrigation Systems Management Research (ISM/R).

COMMENTS

L. Comments By Mission, AID/W Office and Borrower/Grantee On Full Report

The Irrigation Systems Management/Research Component has bee underway for more than two years with part of the technical assistar team being in Pakistan for its design. A review/technical evaluatic the Component was conducted by a three person team during M April 1989 to review the design, progress, and implementation constr with the objective of recommending, where possible, adjustments in t on-going programs, and in the design of follow-on activities.

Specific findings and recommendations drawn from this review/technic evaluation will be used in redesign of the Project activities for a year extension. As per ISM II amendment, the current PACD of the IS Project, of which ISM Research is a component, is June 4, 1993. Therefore, no separate A.I.D. document is required for the proposed year extension of ISM/Research activities. The recommendations of t evaluation will be incorporated in the appropriate GOP documents and concurrence will be given through Project Implementation letters (PI

FINAL REPORT

PROJECT REVIEW/TECHNICAL EVALUATION
IRRIGATION SYSTEMS MANAGEMENT RESEARCH
(ISM/R)

(A component of Irrigation Systems Management(ISM) Project)

APRIL 17, 1989

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April 17, 1989.

PREFACE

The ISM/R Project/Technical Evaluation Team was composed of the following members:-

1. Dr. W. Doral Kemper — Leader
   Agricultural Research Service
   U.S. Department of Agriculture
   U.S.A.

2. Dr. Marshall J. English — Member
   Department of Agricultural Engineering
   Oegan State University
   U.S.A.

3. Mr. Mohiuddin Khan — Member
   General Manager(Planning)WAPDA(Rtd.)
   Pakistan.

Dr. Kemper arrived from USA on March 20th, Mr. Mohuddin arrived in Islamabad on March 21, 1989 on which date work was started. Dr. English joined the team on March 26, 1989. The report was completed on April 17, 1989.

The team is thankful to USAID for the excellent facilities provided. It is also grateful of Mr. Khadim Hussain and Mr. S. M. Ajmal, Secretaries, for the hard work put in by them in completing the report during Ramazan.

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CONTENTS

I. EXECUTIVE SUMMARY AND SIGNIFICANCE OF ACCOMPLISHMENTS TO DATE.

EXECUTIVE SUMMARY

During the period March 21 to April 7 the evaluation team met with approximately 75 individuals in Islamabad, Lahore, Faisalabad, Bahlwal, Karachi, Hyderabad, Tando Adam, Quetta and research sites in the vicinity of these cities. Included were researchers and administrators involved in the project, grant recipients, representatives of irrigation departments and other institutions with a natural interest in ISM/R, and farmers.

The overall assessment of this project is that it has had a delayed start and a number of problems in implementation, some of which must still be addressed, but that it has now entered a very productive phase. The project should be contiued and extended at least until 1992. A Pakistani should be recruited as a Deputy Chief of Party and should be trained by the current Chief of Party until such time as he is ready to take over the position, at which time the American Chief of Party would resume a technical advisory role.

With regard to progress on the ISM/R project:

1. The project is approximately one year behind the schedule that was planned in 1985.

2. In particulaer the following tasks associated with the eight research subprojects are significantly behind schedule:

   a) Building the data base for the 'Beyond water course management'subproject.

   b) Literature review for the "Outside Indus" subproject
   c) Research on causes of tubewell deterioration
   d) Hands on training with ground water models
   e) Evaluation of economics and farmer acceptance of techniques considered in "Integrated Water Course Management" and management techniques for high water table conditions
   f) Evaluation of economics and farmer acceptance of techniques for reclamation of sodic soils
   g) Social science studies for "Encouragement of Water Users" subproject
   h) Training of PCRWR staff on administration of grants for item (g) above

   All of these have been initiated and work is continuing on them. We anticipate some progress in each of these before the contract ending date.

3. The following departures from the original plans for this project were noted:

a) No significant involvement of local professionals in the "Out of Indus" subproject.

b) Monitoring of private tubewells will not be done by SCARP Monitoring and Evaluation.
c) Development and testing of furrow and portable sprinkler irrigation techniques is not being done.
d) Development of a tubewell maintenance staff will not be done.
e) Development of implements for forming furrows and beds will not be done.
f) The work to be done on "Encouraging Water Users" will be handled by subcontracts/grants rather than being done in house by PCRWR.

We regard the last three items as appropriate departures from plan that are not inconsistent with project goals.

4. The competetive grants program has been organized and has now gone through two rounds of grant awards. Although late to start and plagued by management problems initially, it now appears to be running smoothly.

5. In-country training has progressed well. US training is far behind schedule. The original projection for US training was 122 individuals. Currently 35 have gone to the US. An additional 72 are planned and awaiting final approval which probably will be forthcoming before project completion date.

6. Procurement and delivery of some equipment is still being held up in a number of cases.

7. To overcome shortage of funds a revolving fund, preferably separately for each implementing agency viz WAPDA, PCRWR and PARC may be created. Such revolving fund has already been created by IBRD and ADB fundings of Pakistani projects.

With regard to the performance of the contractor

1. Rapport between GOP personnel and the long term advisors has been very good. TDY advisors who have made repeat visits have also been well thought of. Two of them have functioned almost as long term advisors. TDY personnel who have visited only once have not been as effective.

2. Contractor staffing of the long term positions has been inadequate. At present 57% of the original allocation of man-months has been utilized. It now appears that by the end of the contract the total utilization could be as low as 64%. These low staffing levels have slowed the progress of the project. Aggressive efforts should

be made to fill key positions for the last year of the project, in particular the data management specialist position.

3. Research management has generally been good. Coordination of different research units has generally been successful, development of annual research plans has been well organized and the quarterly and annual meetings are regarded as quite useful. However it would be appropriate for senior research officers to make presentations at the annual meetings.

Research recommnedations:

1. The competetive grants program should be reviewed at the completion of the project to decide how well it has served the ISM/R program and what its appropriate long range function is.

2. Steps should be taken to involve participating social scientists with engineers and physical scientists in efforts to develop acceptable solutions to the problems that are being studied.

3. Specific approaches for improving karez systems are proposed. Additional efforts to make more effective use of karez water are needed. Interaction between karezes and tube wells must be analyzed.

4. Additional studies involving a greater range of water use is needed for the research on the interaction between water use and nitrogen leaching.

5. Studies of the use of brackish water should be continued and should include tests of brackish water for early season irrigations.

6. Redesign and use of the tubewell sampler (a sampling device to take tubewell casing and gravel pack samples) should begin immediately and the diagnosis of tubewell deterioration should be carried out.

7. The concept of installing drain tile as a form of skimming well should be evaluated for economic feasibility and acceptability to farmers.

8. The feasibility and effectiveness of shallow, low cost drains which a farmer would be capable of installing without special machinery and which would not require pumping should be explored.

9. Development of midcourse water storage that would provide flexibility in water delivery in order to eliminate night irrigations should be considered.

10. Research on farmers' willingness to pay for watercourse lining and how their investment in canal lining might influence their practices.

11. A study of possible reductions in the abiana for farms which do a good job of maintaining water courses. This system could be structured in such a way that it would provide a direct incentive for a higher level of maintenance without reducing total revenues to the irrigation department..

Institutional Recommendations

1. ISM/R annual project meetings should be expanded to include all senior research officers and they should be given a major role in presentation of research results.

2. An aggressive effort should be made to establish links to action agencies of one kind or another, including provincial agriculture departments, irrigation departments, the extension unit at MONA, the On-farm Water Management and Command Water Management programs and regular extension people. These institutions should be actively participating in definition of research needs.

3. PCRWR, DRIP and NADLIN should be incorporated into the Ministry of Water and Power and seminars and other meetings used to better coordinate their activities.

4. An officer in the Federal Government should be empowered to expedite processing of nominations of foreign advisors and candidates for overseas training. Whenever an advisor is to be nominated (TDY or long term) direct communications between the contractor and the key decision makers in the GOP should take place to expedite the selection process.

5. Local officers should be given more discretion in handling of minor purchases.

6. Research officers should be allowed promotion in place rather than promotion only when transferred.

7. Hardship pay for research workers assigned to outlying stations should be sanctioned.

8. The USAID Project Officer and the contractor's Chief of Party should undertake a few field trips to research sites to develop a better understanding of their jobs and points of view.

9. USAID should permit as many long term advisors as possible to remain in country until the end of 1990.

10. More detailed planning of TDY visits should be implemented and fewer TDY people should be used for more repeat visits to the extent that it is practical to do so.

Significance of Accomplishments to Date

Some of the USAID ARD staff raised the question of whether results obtained to date on this project justified its extension, or whether it should be terminated for lack of progress. We submit the following list of accomplishments along with our evaluation of their significance as a evidence for extension.

1. Findings that cotton and wheat can be irrigated with brackish water (2000 to 4000 ppm salt) and good yields can be obtained.

Significance: Over 10,000,000 acres of land in the Pakistan lie over water which is brackish. Much of this land is only cultivated about 60% of the time because of lack of irrigation water and some of it is completely out of production. Finding that this water is useable identifies a new resource that could facilitate feeding millions of people. The only information still needed to make this pay off is whether there are techniques for seed varieties which will provide good germination and seedling emergence in soil irrigated with these waters.

2. Finding that wheat can yield reasonably well when the water table is shallow (about 0.6 M) and if properly irrigated, can obtain over half of its water from the watertable.

Significance: This is particularly good news to farmers on the tail ends of watercourses where the water table is often shallow because the surface is low and where the water supply is often limited because of watercourse losses. Having had many crop failures from over, or underirrigation on these areas, the farmers have abandoned many of them and at least a million acres of them lie idle while Pakistan imports wheat. Guidelines for the prescribed irrigation which are understandable by farmers will need to be prepared.

3. Properly placed gabion dams to recharge groundwater and piping water out of the karez through low cost polyethylane tubing have resulted in 4 fold increases in flow.

Significance: Thirty percent of the area irrigated and most of the farmers with small water shares in the highlands of Baluchistan are served by karezes. Many of these karezes ceasing to flow. Studies by ISM/R financed sociologists at the University of Quetta indicate that in many cases lack of maintenance rather than a dropping water table is the primary cause. The larger and more affluent shareholders in these karezes have been moved by the promise of quick returns on tubewells and invested their funds in new wells, leaving the remaining smaller shareholders with insufficient funds to clean the karezes. The successful karez technology developed by this project to date has encouraged karez owners to consider other means of improving the efficiency of karezes, such as piping them as outlined in the review report. This could save cleaning costs of over Rs.100,000/year and quickly pay for the pipe. Karezes require no power to get the water to the surface and consequently are ideal for most of Baluchistan's isolated areas where power is unavailable and diesel fuel is expensive.

Socio-economic analysis should be conducted regarding these ancient systems after they have been given the benefit of a few years of research and modern technology.

4. A tool has been developed by WAPDA Scarp Monitoring Organization and their advisors which will take samples of the PVC or fiber glass well screen and the gravel packs behind them from abandoned wells. This allows "postemortem" determination of what went wrong with the well. This instrument coupled with records of specific capacity decline of all SCARP wells should tell us why the wells failed and provide guidelines for well construction and operation that will result in higher water yields and longer life.

Significance: As an indication of the potential value of the findings of this study, it is estimated the replacement cost of the wells in the Indus basin is near a billion dollar. In addition the extra cost of pumping from wells whose specific capacity has decreased amounts to crores of rupees each year. Lives of wells now average less than 20 years.

5. Irrigating in furrows between cropped beds has reduced the water required to grow raw crops and wheat by from 20 to 50 percent.

Significance: Utilization of this type of cultivation could put a major portion of Pakistan's idle land back into production. Economical ways of making the furrows and careful irrigation are still needed to achieve this potential.

There are only a few of the most identifiable results of the ISM/R research program. Most of the payoffs are still "incubating" and are more difficult to predict. However, the entire cost of this project could probably be justified on the basis of these 5 items - especially if they are continued to their optimum pay off point.

Based on this type of analysis and the probable pay off of several other components of the ISM/R project, the review team has recommended its extension through June 1992. Some of the leads uncovered by this project appear extremely promising and may warrant further investment after that time. The major pay off will probably be in the development of a better coordinated group of more effective research organizations who will fill the research needs of action agencies. That pay off is difficult at this point in time to predict, but it will be substantial.

II. Project Evaluation

General Evaluation

The ISM/R is an ambitious project. The concept is sound, to strengthen research institutions in Pakistan and to foster coordination of interdisciplinary and cooperative research between Pakistani institutions. A US contractor can be effective in such a program because the contractor comes on the scene as a new and impartial player with no objectives beyond the stated one of strengthening the research system. The contractor is not and will not be a participant in the competition that often complicates relationships between different agencies. It is our impression that the concept was valid and that the program has been fundamentally successful.

Evaluation of this project is a challenge. The scope is very broad and a large number of individuals and institutions are involved. The ultimate contributions to the effort that have been made by the Pakistani institutions involved are not easliy measured. The contractor has functioned as a catalyst rather than as an action agency. The long range impacts of research experience gained under this project, computer training, the building of professional relationships between researchers, US country training, and the development of new roles and new committments by the Pakistani institutions involved are virtually impossible to assess. The review team has taken its primary responsibilities to be (1) determination of whether reasonable progress is being made, (2) identification of problems needing attention, and (3) recommendations for future research. We have ried to evaluate the level of effort, the quality of research and the implications of institutional arrangements that have developed under the umbrella of this project. But a final measure of the program itself is beyond our abilities. An anecdote will illustrate the point: At the Annual Project Review in Quetta (April, 1989) a group of social Scientists who had been studying karez systems encountered a research engineer who had been trying to improve these systems. These individuals discovered that each had valuable information to share with the other, and they began to formulate a coordinated research project. We can only speculate on what they will learn from each other and how it will affect karez systems.

Evaluation of progress

This project had a difficult begining, with delays and interruptions in funding and delays in approvals of the PC-1s. Staffing problems plagued the contractor and caused problems for the Pakistani institutions as well. As a consequence the overall project is perhaps one year behind schedule at this time. Also as a result of these problems there have been some departures from original project plans.

The most significant problems at this time are (1) delays in delivery of equipment (2) delays in the US training program to the point where the training will have little immediate effect on project research, and (3) understaffing of the technical advisory positions. These problems are slowing the progress of the project, causing various components of the project to deviate from the origianl plans and reducing the impact which this project could have had. The delays and deviations from plan notwithstanding, this review team feels that the project has made substantial progress toward its fundamental objective of strengthening the research program for irrigation management in Pakistan. Most of the major impediments have been overcome and we believe that most remaining problems are now being resolved effectively. It is our feeling that the project should be continued for two years beyond the contract ending date in order to realize the benefits which are just now begining to materialize. It is our understanding that this could be done without additional funding because the early delays in the project have preserved part of the original funding and the Rupee value of the dollar has increased.

The remainder of this section focuses on the eight research subprojects and the issue of training.

Review of Research Subprojects

The eight subprojects were reviewed to determine what progress had been made, what the prospects are for successful completion and whether the work being done was in conformity with the original plans. The 1984 Final Report of the project planning team was used as the basis for this evaluation because the project contract simply referred back to that Final Report and the Master Plan written in 1985 was phrased in terms that were too general for our purposes. The Final Report enumerated a set of outputs which, were to be produced by the project. In the case of some of the subprojects we identified additional outputs which, though not listed as such were clearly implied by subproject objectives.

The following comments include a blend of advice solicited from researchers and administrators and from the Technical Assistance Team, as well as our own observations. Our intent is not to criticize but to take this opportunity to renew and perhaps refine the objectives of the ISM/R Project based on that hindsight.

General Assessment

A number of planned activities are behind schedule and there have been some apparent departures from plans as the project has progressed. Some of these are summarized below and are discussed in greater detail in the following sections:

a) Significantly behind schedule;

(i) Building of the data base in the 'Beyond Watercourse Management' subproject.

(ii) Literature review in the 'Outside Indus Basin' subjproject

(iii) Research on physical causes of well deterioration

(iv) Hands on training with ground water models ('Ground and Surface Water Models' subproject).

(v) Evaluation of the economics and farmer acceptance of techniques for reclamation of sodic soils.

(vi) Economic evaluations of the techniques being studied under the Integrated Water Management subproject and the task on management of irrigation in the presence of a high water table.

(vii) Social Science grants relating to Encouragement of Water Users.

(viii) Training of PCRWR staff in administration of Social Science grants.

All of these tasks have been initiated and there is good reason to expect significant progress by the end of the contract.

b) Departures from original plan;

(i) No significant involvement of local professionals in the 'Outside Indus Basin' subproject.

(ii) Full scale monitoring of private tubewells will not be done by the staff originally designated for the job but may be done by an outside contractor.

(iii) Development of a tubewell maintenance staff will not be done.

(iv) Development of alternative methods for irrigation to control water table levels (furrow and portable sprinkler) is not being done except as an incidental part of FWM-1.

(v) Development of bullock and tractor drawn implements for furrow and bed preparation will not be done.

(vi) A program of subcontracts for studies relating to Encouragement of Water Users has been substituted for the original plan which called for case histories to be conducted by PCRWR staff.

There have been no studies of riverine systems in the 'Outside Indus Basin' subproject. Such studies were not part of the project design but had been planned by the PC-1 to be done in conjunction with that subproject.

The review team feels that the departures from plan in items iii, v and vi above are appropriate changes that are consistent with project objectives.

One shortcoming which we observed in several of the subprojects, and which was commented on repeatedly in the 1988 Mid-Term Evaluation report, involved the timeliness and intensity of data analysis. Although data collection has usually been well planned and executed there were several instances where the resulting data had not been scrutinized carefully and critically. Often a first season of data collection provides early insights that suggest needed changes in the experimental plan. Such insights depend upon not only tabulating the data but studying the implications of the data as well.

Review of the individual subprojects follows:

a) Integrated Watercourse Management

> This project views the water course as a subsystem which includes the canal network supplying the watercourse, the water course itself, and the farms, fields, farmers and institutions involved.

This subproject is designed to study these various components as a system. The outputs expected from this effort include:

(i) monitoring and evaluating the operation of a distributary,

(ii) guidelines for cropping patterns,

(iii) a set of reports on alternative warabundi operating procedures and other alternatives in watercourse operations,

(iv) guidelines for tubewells operated in conjunction with canal water,

(v) an evaluation of mechanized water course construction, and maintenance, and

(vi) an evaluation of buried pipelines for water conveyance.

This large subproject is to be led by MONA with inputs, collaboration and cooperation from all other institutions in the ISM/R project. MONA's program has been consolidated into the following specific studies:

a) Development of technologies for machine forming of earthen water courses.

b) Installation and evaluation of the performance of a buried pipeline operating from a tubewell in an area that has no access to canal water.

c) A study of the potential for matching cropping patterns to water suppllies.

d) Monitoring of water flows in a distributary.

e) A study of actual water distribution in a water course command.

f) Division of a water course with a large supply into two water courses with more easily managed water supplies and a study of the physical and social consequences of such a change.

With respect to the first study, a mechanized system has been developed and used to construct five sections of water courses. Conveyance efficiency averages 55% in two sections of 600 and 1200 meters. A preliminary assessment indicates that construction costs are moderate and cleaning costs are quite low. A question remains whether the useful life will justify the initial cost, but the system shows promise. The system as now designed is limited to a maximum installed canal capacity of 2.5 cusecs because the ditcher and tractor are of medium size.

The pipeline/tubewell system has been installed and is operating successfully. It is serving an area of 454 acres through two loops with a total pipeline length of 8000 meters. Primary advantages are that it virtually eliminates losses and provides precise control of water.

Monitoring of water deliveries in a distributary with a command area of 5000 acres has been carried out for one year. This has produced a large volume of data which remain to be analyzed in detail. Preliminary analysis indicated that the farms were receiving an average of 15% more water than they were authorized.

The analysis for matching cropping patterns to water supplies has made some progress. Three cooperating farms have been selected for study. Actual water use and estimated water requirements are being compared. Ultimately a yield model will be used to study alternatives of cropping for those three farms.

A large amount of data are being collected under this subproject. The data analysis and economic evaluations that are an essential part of the subproject are lagging the field work to some extent. According to the senior economist with MONA there is a need for more intensive training in statistical analysis and operations research, requirements which will be met to some degree at least by a ten week short course scheduled for the summer of 1989 at the University of Idaho which he expects to attend. It is our assessment that the field research described above will be completed by the contract ending date. However the systems involved will need a few years of operational analysis to arrive at realistic estimates of costs of operation, useful life of system components, maintenance needs and so on, and then to utilize this information

in analyses of the economic merits of the systems under study. This process should extend for at least two years beyond the nominal project ending date. The study of the split warabundi has not been implemented because of legal complications. There are indications of prorgress on the legal question at this writing.

b) Beyond Watercourse Improvement

This subproject is intended to assess the socio-economic impacts of public investment and private contributions in water management. In broad terms the outputs were to include;

training of WAPDA staff in data management and analysis, development of a comprehensive data base and a series of socio-economic studies based on these data. The special studies and training are proceeding well, however the data base development is well behind schedule.

The data base is planned to include all related data collected by WAPDA Monitoring and Evaluation Directorate. The data are a diverse collection of surveys that encompass baseline surveys of irrigation projects, monitoring of water use in irrigation projects, special purpose irrigation studies and watercourse data from 61 watercourses. These data sets are derived primarily from evaluation of development projects for USAID and the World Bank. The specific data include water use, application efficiencies, weather data, cropping patterns, cultural practices, yields and institutional data. The data are to be encoded in d-Base III. The data base development task was originally intended to begin in April of 1986. However the computers for this work were not received until one year later. Further delays occured in 1987 and 1988 due to a shortage of research staff and delays in replacing the Social Scientist technical advisor. At this time the data are only partially encoded. Field data collection and special studies are proceeding on schedule but analysis of data from the larger data base from past studies has not progressed significantly.

Training of WAPDA staff is apparently proceeding well. Initial training of the M & E staff began with fundamental training in utilization of computers and has since moved on to training in d-Base III. The full power of the data base will not be utilized however until the M & E staff have received additional training in statistical analysis. The Directorate is anticipating six months of training and assistance from a data management specialist during the coming year. By the end of the project there will be at least additional three degree trained staff and other staff with internship experience.

Special studies now in progress include the effects of under-irrigation and over-irrigation on crop yields, physical characteristics of selected water courses and a comparison of actual and design discharges in three locales. These are proceeding smoothly.

c) Irrigation Systems Outside the Indus Basin

A great deal has been accomplished under this task. However the study has departed substantially from the original plans, and the achievements to date may not be of an enduring nature unless the original plans are implemented. In the 1984 Final Report it was observed that past work in the Baluchistan area has emphasized demonstration projects and pilot practice implementation rather than research. The work done to date under the ISM/R project is research, but that work has begun taking on the form of demonstration projects.

Broadly speaking the original intent of this project was to use a research program as a vehicle to develop expertise and prepare guidelines relating to karez and sailaba irrigation methods. One important resource for that work was to be the farmers themselves who have accumulated literally thousands of years of experience with these systems. The original project design called for involving Baluchi researchers in the project as a way of capturing and institutionalizing that experience locally.

The work done to date has involved improvements in selected sailaba and karez systems for the purpose of increasing effective yields of water. Considerable short term help has been used in this effort. This work has undoubtedly developed a useful base of experience for those participating in it, but the work now needs to be expanded to other karezes and sailabas and the experience gained should be incorporated into more general analyses. Furthermore that experience should be institutionalized in line with the original objectives; specificaly the emphasis in this subproject should now be the following:

(i) Involvement of Baluchi professionals in the research team must receive more attention. It is difficult to find qualified people in the province, but local people should be involved at any levels they can be. It is our understanding that the Baluchistan government wants local people to be used, and people from outside Baluchistan will often not have as clear an understanding of the language and culture.

(ii) That team should be utilized for broader research on karez and sailaba characteristics. It might be especially fruitful to search out and study marginal and failed karezes. This broader research should be coordinated with the Social Science research being done in Baluchistan by the Encouraging Water Users subproject.

(iii) Research which has been done on improving water yields has been quite promising and should be continued, but should now be generalized by extending to a wider range of karezes and sailabas. The continuing research should be more concerned with efficient use of the irrigation water produced by these systems, conjunctive use of flood and ground water, possible improvements in crop selection, agronomic practices and spillway design for sailaba bunds.

(iv) Preparation of guidelines for sailaba design and utilization should be delayed for one or two years until the above work has been done. Preparation of a long term research plan should likewise be delayed.

In the 1988 Mid-Term Status Report by the Technical Advisory Team it was observed that the major emphasis on sailaba and karez methods in Baluchistan was not in conformity with the PC-1 because the PC-1 had encompassed the Northwest Frontier Province and had included studies of riverine systems. The research that has been done has been concentrated on karezes and sailabas apparently because they are unique to this area and no other research is being done to deal with their unique problems. The 1984 Final Report does in fact emphasize Baluchistan and the karez and sailaba techniques there, so this effort is not inconsistent with the project plan.

The Mid-Term Status Report also observes that very little has been done to review the existing literature on these methods. A literature search was carried out in the U.S. and reprints were supplied to WAPDA.. We have not determined whether those reprints have had a thorough review.

The specific work done on karezes includes the following work on the Abdul Hakim Karez in the Mastung valley of Baluchistan.

1. Construction of a gabion weir upstream of the mother wells to increase recharge of the aquifer.

2. Capping the wells of the karez to eliminate entry of runoff from rainfall and to determine whether erosion associated with that runoff is a major cause of soil and rock in the channel the cleaning of which costs up to Rs. 100,000 per year.

3. Fixing of piezometers to monitor the water table and assess the contribution of the water held behind the gabion dam to recharge of the acquifer.

4. Lining the leaking portion of the underground channel with polyethylyne lay-flat tubing to determine how much water can be saved and delivered to the daylight point of the karez.

5. Construction of a tank to store and measure the surplus water accumulated during the night when farmers prefer not to irrigate.

6. Pumping the water through pipes to irrigate an orchard close to the tank.

These measures have increased the water table height by up to 1.5 feet following a runoff event and have increased discharge of the karez from 0.1 to 0.8 cusec.

The farmers have not yet developed cropping areas to use the entire flow of water. The discharge has increased so much that it more than fills the tank during the night. Consequently an escape channel has been constructed which diverts the water away from irrigated fields.

d) Private and Public Tubewell Performance.

Outputs called for in this subproject include (i) technical reports on tubewell life and causes of deterioration, (ii) a well trained staff for tubewell maintenance and (iii) a statistical data base and analyses for better design, construction and management of tubewells.

A substantial statistical data base has been developed for SCARP wells, and a survey of deterioration of wells in various regions has been conducted. This survey has developed a useful statistical profile of regional variations in tubewell deterioration which should serve as a useful guide to a more in-depth study of the root causes of well deterioration. At present the physical or chemical causes of well deterioration have not been analyzed. A device for measuring local inflows at different depths and taking well casing cores and samples of the surrounding gravel pack has been designed for this subproject and used to take one sample in a single well. The device suffered a mechanical failure, but the technique appeared feasible. It is the intention of the suproject management to redesign the sampler and use a number of them to conduct a rapid, full scale survey of the characteristics of failed wells.

The PC-1 called for similar work on private tubewells. At present it appears that the Monitoring and Evaluation Directorate will not be able to accomplish this task by the end of the ISM/R Project. Management of the Directorate is considering contracting out the job of data collection on private wells. While this is inconsistent with the original objective of training M & E personnel there appears to be no alternative. In the opinion of the Hydrologist who has been associated with this project the private tubewell study would double the workload and there are not sufficient qualified staff at the Directorate to deal with that workload. In as much as the causes of well deterioration are unknown, research on treatment to prolong useful life has not yet begun.

Development of a staff for maintenance of tubewells is not anticipated, and is beyond the originally intended scope of the project.

e) Development of Ground and Surface Models.

Outputs planned for this project included (i) selection, testing and calibration of ground water models for use in Pakistan, and (ii) documentation and staff training on software and modeling techniques.

This project has made reasonable progress towards its objectives. A substantial

library of computer codes for ground water modeling has been assembled. Training in the use of computers and implementation of ground water models on microcomputers have been accomplished. The models have been applied to specific studies in-country, including the CRBC study, a study of ground water in the MONA project and digital modeling of the SCARP IV aquifer in the vicinity of Allahabad to evaluate saline water intrusion and the consequences of pumping from skimming wells.

Because of the complexity of groundwater models it can take a great deal of time for users to develop a full understanding of the intrinsic strengths, weaknesses and potential uses of such models. The primary weakness of the ground water modeling subproject at this point is that the GOP users have not had sufficient training to develop a full understanding of these factors. Because of the departure of the long term consultant associated with this work this essential training may be slowed considerably. As an alternative, US training for selected individuals would serve to compensate for the loss of the consultant and would be profitable to Pakistan in the long run, though it could reduce the productivity of this subproject in the near term. The training would be in the form of internships with organizations which are using ground water models. The participants in such internships should be selected with due consideration for the advice of the Technical Assistance Team, since not all of the project research team are sufficiently well trained in ground water modeling at this point to profit from such an internship.

f) Farm Water Mangement.

The four components of the Farm Water Management subproject are discussed seperately below:

1. FWM-1:
Water Management Strategies for Areas with Poor Drainage and Shallow Water Table Conditions

The anticipated outputs from this project included recommendations on irrigation frequency and agronomic practices in the presence of poor drainage or shallow water table conditions, and reccomendations for development of bullock or tractor drawn implements for land formation. It was apparently intended that alternative methods of application (furrow or portable sprinklers) be tested as well. (The intention to conduct such tests is implied by the project objectives.). This line of research will be of critical importance to irrigation management in much of Pakistan because it represents a low cost way to minimize waterlogging and the associated damage to crops. Work on this project has been conducted at MONA and LIM. Crops were planted in wide beds and furrow irrigation was carried out at fixed levels of soil moisture depletion in the top 30 cm. These studies have been productive. Furrow irrigation in wide beds seems to have resulted in substantial reductions in water use and increased yields when compared with traditional basin flooding. The third season of this effort will be under way this year.

Three suggestions have been made for modifications of the experimental work for the coming season; first, that the experiment be constructed in a way that will permit differentiating between the effects of reduced water and the effects of furrow irrigation; second, that the experimental treatments include even greater reductions in applied water; third, that an ET model be used to estimate the crop

consumptive use during the experiment in order to estimate the amount of water supplied by the water table. Key elements of the original plan have not yet been dealt with. Social and economic considerations have not yet been addressed, alternate methods of irrigation have not been studied explicitly and reccomendations to implement designs have not been developed. In the 1988 Mid-Term Status Report the Technical Assistance Team argued that the design of implements is not properly part of this research. This review team concurs. At this point the analysis should determine whether sprinklers or furrows should be used, what furrow configurations might be economical and acceptable to the farmers and what bed forming techniques would be most appropriate.

2. FWM-2: Use of Brackish Ground Water for Crop Production.

The basic objectives of this task are (i) to develop reccomendations for use of brackish water for irrigation, and (ii) analysis of long term impacts on soil salinity.

Research has been underway for two years at MONA and LIM and the third season is now underway. There is some diversity in the methods being tested at the two stations. Brackish water is being used either as an exclusive source or in combination with fresh water. The combinations include alternating irrigations with fresh water or mixing with fresh water. Early season irrigations have used fresh water in all cases. Both furrow and basin plantings are being tested. Soil salinity is being monitored but at this stage there has been no definitive analysis of long range effects. Experiments are being run on cooperating farms. It would be premature to make reccomendations for use of brackish water at this stage, but clearly the capacity to make such reccomendations is being developed.

These studies have made considerable progress and are consistent with the objectives of the project. Good yields have been realized, though sometimes at greater expense (more frequent irrigation) than with fresh water. The study shows considerable promise and should be continued beyond the end of the ISM/R program and perhaps expanded to include other crops and to test the use of moderately brackish water for germination irrigations.

3. FWM-3: Irrigation and Nitrogen Fertilizer Mangement

The objectives are to determine the effects of over-irrigation and the timing and amount of fertilizer use on nitrogen utilization and leaching. Various forms of Nitrogen fertilizers are to be used. The end product is to be a set of reccomendations concerning use of water and fertilizers and testing of these reccomended practices on farmers fields.

Two years of research have been conducted. Several research institutions are involved, including UAF, MONA, NARC and SAU. The work is being done both in field plots and greenhouses. The research groups have been coordinating the design of their experimental protocols with the exception of NARC which has not been irrigating. Results from the irrigated plots for the first two seasons have shown only minor interaction between water use, the source of N, the timing of fertilizer use and Nitrogen movement in the soil.

The study has progressed well since its inception and has been consistent with the objectives of the ISM/R program. Improvements in experimental design are planned for the third season. The tentative changes include a wider range of applied water and the use of tensiometers or lysimeters at some sites to determine leaching rates.

The various institutions are basing their water applications on calculated ET in order that the results from differing locations can be compared. However at least two different ET models are being used and such models can give widely differing estimates.

Development of recommendations for water and Nitrogen use would be premature at this time but with the rate of progress of this study we anticipate that useful reccomendations will be forthcoming by the end of the project.

4. FWM-4: Biotic and Chemical Reclamation of Sodic Soils.

The intent of this study is to develop improved reclamation techniques. The original objectives also emphasized the participation of extension personnel in Sindh and Punjab in the planning and evaluation of such techniques. One additional required output of the study, which is implied by the objectives, is an economic evaluation of the alternatives and a search for low cost methods of reclamation.

Work on this task began in the 1986-87 season. Several institutions are involved, including MONA, UAF, The Land Reclamation Directorate at Lahore and the University of Karachi. The scope of the research has been broad, including the use of greenhouse and lysimeter studies, gypsum and acids and the screening of plants for salt tolerance, forage production and soil reclamation potential. This diversity of institutions and research approaches is a significant strength of the research program. Some success has been achieved by these research efforts, particularly with reclamation of the top 10 to 30 cm of sodic soils.

These studies are not yet ready to support conclusive reccomendations on appropriate techniques for reclamation. Additional experimentation is needed and an economic evaluation of the various alternatives must be carried out. Some of the methods tried to date have involved significant costs for chemicals, mechanical mixing of soils and irrigation. Economic evaluation of low cost methods has not received much attention. The lowest cost methods appear to be those which use a crop to help replace the sodium while leaching water is applied. However additional research is essential to define the long term consequences and rates of reclamation.
It is not clear to what degree extension personnel have been brought into the planning of the experiments. However most of the studies have ben carried out on working farms, which is a major step in that direction. The economic evaluation phase in particular should involve significant participation of extension people and farmers.

While this component of the Farm Water Management subproject is making progress and is in conformity with its objectives, the primary goals have not yet been reached.

g) Surface Drainage and Water Table Control.

The primary outputs from this subproject are to include development of a microcomputer based ground water model, development of appropriate techniques for drainage on individual farms and testing of those techniques on cooperating farms.

The subproject has made a great deal of headway. Develpment of the computer model has progressed very well. Conventional drainage is being installed on cooperating farms in Sindh and data from those installations are being used to calibrate and test the model. A drainage installation at MONA has been designed and installation began in 1988 but was interrupted by monsoon rains. It is imperative that the MONA installation be finished before the 1989 monsoon season begins.

The principal task remaining is develcpment of low cost techniques for farm drainage. A suggested approach to this task is to test the feasibility of shallow drains that can be hand dug. This allows the farmers to use their own labor if they so desire, and way eliminate the need for pumping.

h) Encouraging Water User Involvement in Irrigation Management.

The intent of this portion of ISM/R has apparently shifted during the course of the project. The change is consistent with the basic objectives of the ISM/R program. The Outputs listed in the Final Report for the ISM/R Design in 1984 call for a set of case studies, evaluations and reccommendations concerning water user organizations, as well as staff training in this subject. However the 1988 Mid-Term Status Report emphasizes development of a subcontract administration program involving subcontracts for studies in Social Science to be awarded to educational institutions in Pakistan. As such, this study has evolved into a set of university research projects administered by PCRWR but still designed to deal with the original questions posed in 1984. The change implies a greater emphasis on institution building. It is not clear how or when this shift in expectations of the study occurred. The benefits to PCRWR will be training in grant administration rather than in evaluation of social factors in irrigation.

The project was delayed considerably in implementation. The original plan was to begin in January of 1986 but the grants to universities were not awarded until June of 1988. Nine grants have now been awarded, each for two years. Completion of these grants will coincide with the expiration of the original ISM/R program in June of 1990 (the ending date for the original PC-1's). All nine grantees were recruited specifically for these studies. The Review Team was able to meet with only three of the grantees. The titles of the projects suggest that these nine studies should serve the project objectives, but how well they do so will depend to some extent upon the ability of the program manager to focus the efforts of the grantees on the relevant questions and to develop linkages

between the grantees and the other research institutions which need the insights and suggestions of these grantees. The Project Director is a capable individual who should be able to accomplish these objectives, but it is unlikely that the results of these studies will be fully utilized before the presently scheduled ending date of the ISM/R project.

The assessment of the review team is that, with the exception of the director of the study, the professionals in PCRWR who are to administer these grants were not fully staffed at the initiation of the nine grants and did not have the background to administer the projects without outside assistance. Substantial in-country training of PCRWR staff and increased contact between the various institutions involved was recommended and is planned for the remaining year of the project.

Training

Training of Pakistani professionals in the US has deviated substatnially from the original project design. The 1984 Final Report estimated that at least 8 doctoral students and 32 MS students would receive degree training in the US, and that another 42 would receive non-degree university training and other custom training. About half of the degree training participants were to be utilized in ISM/R research projects in Pakistan before the end of the project.

The training program that has now evolved inludes 9 doctoral and 24 MS students will receive US training. An additional 46 participants are identified for internships short courses and study tours. This level of training will be somewhat less than originally projected. Nevertheless we feel that it will be one of the major, enduring benefits of the ISM/R program.

Even this truncated training program is lagging behind schedule however. At this time there are 4 Ph.D students and 3 MS students at U.S. universities and 28 others who have participated or are awaiting final approval of their nominations or for training funds, including 5 prospective doctoral students and 21 prospective MS students. The review team has been advised that most of the issues which have delayed these participants have been resolved.

The problems which have been encountered were largely procedural delays in the processing of nominees through the various agencies, provincial and federal offices of the Pakistan Government, the Academy for Educational Development and USAID, process that could take more than one year. The delays were then aggravated by the fact that training funds for degree programs were temporarily exhausted in 1988. All training under the broader umbrella of ISM, of which ISM/R is one component, was handled by a single administrative unit seperate from ISM/R. All ISM training funds were pooled and training slots were allocated from that pool without regard for the original training budgets. As a result of delays in processing of nominations and an unexpected increase in requests for training a number of training slots originally budgeted for ISM/R were used for training of people in other programs. The result was exhaustion of funds before scheduled ISM/R training needs had been met. (Funds for internships and other custom programs are still available). Since then additional funding has been made available which will allow the program to resume after an interruption of about 5 months.

The long delays and reallocation of funds to other programs has had a serious impact on ISM/R. Assuming that the balance of anticipated training is implemented, total training will still be less than originally planned, confidence in the contractor has been diminished and the contributions of the participants to research in Pakistan has been delayed.

Competetive Grants

The Competetive Grants Program (CGP) is managed by PCRWR. Its purpose is to expand the pool of competent researchers in irrigation management in Pakistan. The vehicle for this process is a system of grant offerings which provide researchers experience in writing grants, managing projects, conducting research and reporting on the results.

The procedures are as follows: A set of priority interest areas is defined and a call for preproposals is published. The preproposals are screened and a subset selected for further consideration. The researchers are instructed to submit full proposals and these are then submitted to panels of experts for critical evaluation. The evaluation criteria are based on criteria used by similar granting agencies in the US, Australia and elsewhere. A separate panel is selected for each proposal, the members being drawn from a pool of 51 cooperating reviewers according to the content of the proposal. Upon approval the proposals are then submitted to the Project Implementation Committee for final selection.

The CGP is now in its second round of grants. In spite of a slow start it appears to have been successfully instituted and has made considerable progress in line with the original ISM/R objectives. Ten grants have been awarded to-date.

Part of the CGP has been a series of workshops to assist grant applicants with development of proposals and to train grant recipients in management of research projects. These have been conducted successfully, but have been dependent on TDY consultants. It is not yet clear that CGP has the in-house expertise to conduct these workshops in the future. Training of CGP personnel for that purpose is needed.

Once a project gets under way CGP monitors its technical and financial progress. Based on our assessment of two grantees we feel it essential that this technical monitoring be done by staff who are capable of dealing with technical matters, not only to insure that the work is done but also to insure that as the work progresses the goals of the research remain in line with the fundamental ISM/R goals. CGP may not have sufficient technical staff for this function at present.

Early in the project there were difficulties and some confusion on reporting and financial procedures that caused problems for some researchers. Indications are that these have been cleared up at this time. One remaining potential problem is the lag time required between first quarter reporting and release of second quarter funds. It appears that CGP is aware of this problem and may be taking steps to correct it.

III. Evaluation of Contractor

The contractor's responsibilities encompass staffing. Management, procurement, research projects and institution building. It is difficult to divorce the performance of the contractor from the progress made in the research projects and training. These have been discussed above. The issue of procurement is discussed in another section of this report. This section therefore evaluates the contractor's performance in staffing and in the broader area of institution building.

Staffing

The ISM/R project has had mixed success with staffing of long term positions. The people who have filled these positions have been of high caliber and have been well thought of by those who have worked with them. However at times the contractor has been unable to fill key, long-term advisor positions in a timely manner. Because of this the long term staffing has been inadequate at times, and during the remaining year of the contract the long term staff may be seriously undermanned. The understaffing of the long term positions has been offset to some extent by short term consultants and short term people may be used in lieu of long term people during the last year as well.

The reasons for the delays in filling positions are a matter of debate between the parties involved. A number of nominations for these positions have been put forth and rejected. The contractor has felt that the reasons for the nominations have not been adequately understood by the individuals who rejected them. USAID has felt that the contractor should have been more willing to accept the decisions. This conflict has created a situation in which at least one position has remained vacant for 16 months. A reasonable resolution of this problem would be that the primary decision makers involved in each position should be identified immediately when a nomination is needed. Those people should then meet and decide between them what qualifications are needed for the position in question, and should continue to meet until an individual has been selected. Approximately 60% of the contracted man-months of both long and short term consultants have been utilized at this time. The project was originally contracted as a 54 month effort. Because of delays discussed above it has been in full operation for about three years. The 60% level of effort has therefore not been unreasonably low. The nature of the understaffing problems have been the lack of continuity in the past and the prospects of severe understaffing in the remaining year.

Long Term Technical Staff

The ISM/R contract called for a team of five long term advisors, one of whom was to serve as the Chief of Party. The Chief of Party position was of necessity a largely administrative position and his effectiveness as a technical advisor would be limited by his administrative responsibilities, which include planning, supervision of contractor staff, technical assistance team and short term consultants, preparation of training plans for US training, budgeting, procurement and interfacing with the GOP officies. These responsibilities would seem to require a full time effort without the added responsibility of serving as a technical advisor. It appears then that most of the technical advisory services would need to be handled by the remaining four team members. The table below indicates the distribution of man-months originally contracted for and the number expended as of April, 1989.

	Original Contract	Utilized	Amended Contract	Remaining
Chief of Party	48	48	60	12
Social Scientist	46	25	50	25
Research Program Specialist	36	6	24	18
Hydrologist	40	30	37	7
Irrigation Agronomist	36	30	37	7

The original contract called for 158 man-months for those four. At this writing, with 12 months remaining in the contract, 91 man-months have been utilized, 58% of the total allowed by the contract. A portion of the work that was anticipated for long term specialists has been covered by short term TDY consutants intead (see below). However the number of man-months of short term consultants utilized to date has been roughly in the same proportion as the long term advisory staff (59%).

The contract for man-months of technical advisors in all positions was amended in May, 1988. The revised contract increased the number man-months for the Chief-of Party to 60, the Social Scientist Position was increased to 50 man-months and the Irrigation Agronomist was increased by 1. Most of these increases were made up by a reduction for the Research Program Specialist (reduced by 12 man months).

The general perception of the institutions and individuals working with them is that the Technical Assistance Team has functioned well up to this point. The technical advisors have consistently been described in favorable terms for their responsiveness and for the technical help they provided.

At this time the Social Scientist, Research Program Specialist and Hydrologist positions are vacant. It has been proposed that the Social Scientist position be converted to a a data management specialist. However standard AID practice prohibits family status for individuals who spend less than one year in country. That may make it very difficult to recruit a person for any long term positions for the last year of the project. This is likely to leave the long term advisor team with only the Chief of Party and Irrigation Agronomist positions filled for the final project year.

Short Term Advisors

Thirty-three people had visited Pakistan for a total of 64 man-months as short term advisors as of April 1. A balance of 41 man-months remain unused at this time. (This review team will be utilizing three man-months of that allocation.).

Two of the short term advisors, Bondurant and King, have accounted for approximately one-fourth ofthe total TDY man-months. Bondurant visited the country 8 times for a total of 8 months, while King visited 6 times, also for a total of 8 months.

Both had areas of particular responsibility: Bondurant for the Outside Indus subproject and King for drainage related work. With this level of effort, their focus on particular areas and the continuity that was possible with so many visits, these two people have functioned as long term advisors.

Four other individuals visited the country either 2 or 3 times.

The remaining 27 TDY consultants visited the country only once. In line with the project goals of institution building, their responsibility was generally to advise, review and train local professionals rather than to actually carry out any of the tasks. A review of their tour reports indicates that while they were often working very closely with Pakistani they did generally follow the basic guidelines laid down for consultants.

Institution Building

The institution building activities of the contractor which were examined include project management, training, information dissemination and competetive grants.

Project management

The key elements of project management which are not considered elsewhere in this report primarily involve research coordination, reviews and reporting. Our observation has been that where several institutions have been involved in a project, there has been an effort to coordinate their research. Examples include the coordination of several units on the FWM-3 research and the apparent coordination of LIM and MONA on FWM-1. At the same time, in the case of FWM-4 a broad range of complementary research has been organized involving several institutions.

Research reviews have been dealt with in two ways. Quarterly meetings of all participants have been conducted at the Project Offices in Lahore. The function of these meetings has been primarily for the purpose of surfacing any problems and coordination of research. The plan is that they should be attended by the Project Directors and by all Senior Research Officers. Additionaly there has been an annual meeting at various locations for the purpose of developing the Annual Work Plan for the coming year. These have ususally been attended primarily by the Project Directors, management of the GOP institutions and the contractor staff.

One shortcoming of the annual meetings is that they are used as the forum for formal presentation of research findings, and the presentations are made by the Project Directors. The Senior Research Officers who have had responsiblity for the actual conduct of the research are usually not in attendance. In discussions with two of the SROs they indicated a strong interest in attending these meetings, and it would seem appropriate for them to attend and to make the presentations on their research. This would give them a better understanding of the other research programs, some of which they are trying to coordinate with. It would also serve a training function and would develop a sense of mission in them. Such a program would necessarily be longer and more costly but would go a long way toward strengthening the institutions involved.

The question of reporting is of some concern. The schedule of required reports is adequate, but the quality of reporting has not been uniformly good. In some cases the reports are quite difficult to understand and interpret. Without greater precision in writing and more detailed presentation it is possible that valuable information which has been obtained at great effort and expense will be obscured by the reports that are generated.

IV. Evaluation of Equipment Needs, Procurement and Utilization

As indicated in the fifth semi-annual report (Jan '89 University of Idaho) all equipment that has been approved for purchase has been procured and received in Pakistan. As of December 31, 1988 only one item remained to be delivered to the receiving of institution. The distribution of the equipment is summarized in the following table:

Equipment Procured and Delivered under ISM/Research Project

Mona	186,549	
LIM	36,996	
Planning Directorate South	74,838	
Watercourse M&E	67,000	
WAPDA		724,895
PARC		232,076
PCRWR		264,003
Total delivered		1,220,974
University of Idaho inventory		197,711
On hand to be delivered		401
Grand total as of Dec 31, 88		1.419,086

The above statement shows that good progress has been achieved. However, GOP participants at some locations do not feel that all the equipment which has been approved has been delivered and "installed" the reason for this misunderstanading appears to be the time required in the tripple checking procdure for purchase approval. First the equipment item is supposed tobe listed in the PC-1, then the researcher and contractor are supposed to make sure it is needed. Then the contractor submits a list of equipment to USAID. USAID submits this list to the GOP which approves it and sends it back to USAID. USAID then approves the list and gives it back to the contractor. Then the contractor can order the equipment. This process is necessary because the GOP does not allow some purchases (e.g. vehicles must be kept to the most reasonable in cost).

The contractor expresses his equipment procurement performance in terms of what has been approves by USAID and GOP for purchase. The contractor does not accept deliquency charges on items being held for approval by USAID or GOP. The federal ISM/R Coordinator and some of the researchers do not understand this process and feel that the contractor is not getting the equipment ordered in a timely fashion.

Equipment orders are still "in the mill" on many items (e.g. for DRIP and NADLIN) and additional items will be needed for research which we are proposing in this review. To help get the orders to the users as soon as possible it is suggested that where possible the item be purchased in Pakistan from vendors who provide after sales service. It is proposed that the GOP be asked if they would give blanket approval to meet research equipment, excluding items such as automobiles and any thing else that they wish to control. Apparently this could enable USAID to allow the contractor to order the equipment

directly and save two or three months. It is also suggested that when equipment is ordered in the U.S. that a reprsentative of the contracator should check the equipment and verify its satisfactory condition before it leaves so that if there are defects they can be corrected by the supplier.

Research related equipment has become sophisticated. It is new for Pakistani scientists and maintenance and operation requires considerable training input. The latest semi-annual report states that this training is being arranged by the technical assistance contractor. The review team received several positive reports on this training. Particularly good reports were given on the computer training that has been provided. Comments by the former Chief of Party in his end of tour report need to be considered. The following are abstracted below:

"The procurement law requiring U.S. manufacture places a serious time constraint when procuring sophisticated equipment because much foreign made equipment is superior to U.S. made and often the foreign supplier it is the only manufacturer of specific equipment. Regardless, time consuming waivers are required.

The quality of the product received is less than standard perhaps because the seller knows that it will take a long time in delivery and its destination is a long way away. The condition in which some equipment arrives leads one to conclude that manufacturers and dealers knowingly take little or no care and some may send inferior products. Many items arrived with 110 volt input requirement when specifications clearly indicated 220. Some items were suspect of being used. Others with parts missing and several electrical items arrived without connecting power cords. All this can and has been corrected but only with further delay.

The procurement process takes much longer than the contractor anticipated. Where equipment is required for a project, implementation of activities should be postponed for at least one year if the equipment is procured in USA.

Many sophisticated items of equipment require maintenance contracts for proper care. Often there are dealers in Pakistan for the particular item of equipment. In most cases however the local dealer does not want to handle the maintenance contracts because the purchase was not made through them or their company. Reluctance of local firms to handle maintenance contracts on products coming from the United States apparently stems from suspicious that the product is not genuine or may be a used product."

The above comments by the former Chief of Party who has a thorough knowledge of projects in Pakistan warrants serious consideration to determine whether the facts discussed can be used to obtain waivers to rules which will facilitate more timely and effective procurement.

The 5th semi-annual progress report (1989) states that the contractor will also procure equipment for the Punjab Irrigation Research Institute (IRI). This equipment was identified under the ISRP project

but was listed in the ISM/R, WAPDA PC-1. Specifications have been prepared and procurement is under way through the University of Idaho contract.

During the discussions with research workers from the University of Karachi the review team was informed that their gas chromatograph was not operable on the quality of hydrogen available in Pakistan. A Hydrogen generator costing about $8000 will be necessary if they are to use that chromatograph in their study of reclamation of chemical and biotic methods of soil reclamation.

Neutron probes which have been supplied to measure moisture stress in soil are expensive. Infrared sensors which simultaneously measure vapour pressure deficit and air temperature have been developed to estimate water stress in plants. These may be more suitable in the long run and should be investigated.

V. Implementation Problems that are Constraining Progress

Complexity of Project and funding delays

The ISM research project is designed to be implemented by three ministries, Water and Power, Agriculture, Science and Technology. The work is coordinated by the federal coordinator in the Ministry of Water and Power. Chief Engineering Advisor in the Ministry of Water and Power is the Chairman Advisory/Coordination Committee. All heads of research divisions, WAPDA and provincial irrigation departments are represented in this committee. The federal coordinator is also under the chairman of this committee. It has taken an average of 87 days to get quarterly budget allocations through the office of the coordinator and the ministry of water and power. An examination of the record shows that the coordinator's office took an average of 9 days to process these papers. This indicates reasonably rapid handling of these budgetory matters by the federal coordinators office. The other 78 days (on the average) are spent in circulation between other ministerial offices. The financial advisor in each ministry have a say in the release of funds. This is the standard procedure for routing all funds in the federal government and is generally subject to delays.

The problem of funds being needed before this long process is concluded was discussed in the advisory/coordination committee meeting on January 22, 1989. One suggestion was that the permission required to set up a revolving fund for each implementing agency viz, WAPDA, PCRWR, and PARC. Since IBRD and ADB are doing this with projects with which they are working in Pakistan, it must be possible. The review team recommends that the advisory committee request to set up these revolving funds.

Coordination of water management research.

Water management research has been handled by the ministry of water and power because the research is generally of the applied type and used primarily by water and power. Integration of PCRWR (including DRIP and NADLIN) back into the ministry of water and power would substantially increase the opportunities for effective coordination of the PCRWR research with that of other water resources agencies. DRIP should be more closely coordinated with irrigation departments and WAPDA since the primary users of DRIP research are these departments. For example DRIP is evaluating cost and effects of tile drainage along Jamroa west canal to drain adjacent land and lower the water table. An alternative solution which should be considered is lining the Jamroa west canal which would logically be an activity of WAPDA or the Sind irrigation department. Please see Appendix 1 for justification of transfer of PCRWR and DRIP to the ministary of water and power.

Coordination between the ministry of water and power and agriculture is occuring at the federal and provincial levels in the command water management and with research stations like MONA and LIM.

Lack of full strength of contractor's resident team.

The contractors long term advisory team has never been up to the full strength of 5 persons and is now down to 2. GOP project leaders have expressed that long term, a recurring advisors have been their most effective advisors and conversely that limitations on such help was constraining progress. Persons for the advisory team being at less than full strength have included failure by the contractor to allow enough time to get the names cleared by the GOP, rejection of the GOP of two proposed team members and family health problems which cancelled one candidate's eligibility.

Reluctance by the contractor to accept the GOP rejection of their first nominee and come back within reasonable time with another candidate delayed the process till it was too late to obtain another candidate. That reluctance was based on the contractor's hope that they could convince, or had convinced, their GOP cooperators that their proposed nominee was the man needed for the job, and that a change decision by the GOP might come about. Past experience indicates that the GOP does not change its decisions on such matters. To avoid future misapprehensions of the type the contractor should discuss advisory needs of the GOP with their working counter parts and make sure that there is meeting of minds with the working counter parts and that those counter parts have consulted with their immediate supervisors on this matter. From what we have been told we gather that this is the contractor's opportunity to increase the probability of GOP approval. Second chances rarely if ever, occur, and once the GOP issues a turn down on a proposed advisor, the contractor should take immediate steps to propose another.

Training

There is confusion in overseas training of candidates which was largely take an out of the hands of Idaho. In the subsequent confusion candidates selected have been dropped and new ones nominated and sent in their place who had no connection with ISM/R or even ISM. Qualified candidates for Ph.D have been dropped on the basis that their age is above 40 years.

In-country training has been strongly praised and appreciated by the recipients and their advisors. A mojor portion of this has been on computer use. It has had one major draw back in that once the individuals become proficient in computer use, this skill is highly marketable. NADLIN reports losing several of their computer trained staff to other agencies or the private sector.

One constraint for principal research investigators of universities is they do not have enough powers for local purchase of materials which are not available in the caentral store. Their power is limited to Rs. 200 whereas the powers of a senior engineer in WAPDA are Rs.1500. University recognize that their rules are outdated and should be enouraged to revise their rules and allow their researchers purchase powers of at least Rs.1500.

More than two years back, the federal and provincial budget provided incentives for academic qualifications special pay was sanctioned for officers with a Ph.D. We were informed that ISM/R workers are not getting this special pay.

VI. Recommendations Regarding Completeness of the Program
A. Areas Not Covered that Should be Covered

Regarding Competitive Grants

One of the primary arguments for distribution of research funds through competitive grants is to increase opportunities for creative scientists to obtain funding for their best research ideas. One of the major arguments against use of competitive grants is, that unless the criteria for selection are narrowly defined and the review and selection panels are carefully instructed, a broad array of subject matter is included in the proposals approved and much of the investment misses the target for which the funds were appropriated. Incorporation of research needs of Irrigation Systems Management action agencies in selecting the areas of research and reviewing specific proposals can help keep the competitive grants research focussed on Irrigation Systems Management.

Evaluation criteria should be developed to determine at the end of this project whether competitive grants are an effective means of obtaining a good return for the country on its investment in research. It should not just be assumed that distribution of funding through competitive grants is a good investment. Development of such criteria should include consideration of how much basic and long term pay off research the country is willing and able to support and the competing needs for targetted research which has a higher probability for earlier economic return. In short, the use of competitive grants is itself an experiment and it should be properly analyzed.

The technical committee of ISM/R should appoint a group, as soon as possible, to develop the evaluation criteria for the competitive grants program. That same group should plan to evaluate this program near the end of the ISM/R project period.

NADLIN

The National Documentation Center, Library and Information Network (NADLIN)

This library and documentation center for water resources information will fill a vital need and provide a continuing base for orderly and informed research on water management in Pakistan. NADLIN was directed by the Ministry of Science and Technology to expand its subject area to additional natural resources areas and to expand its clientel beyond the borders of Pakistan. The contractor and USAID felt that this would dilute their effort so the original objectives of the PC-1 regarding irrigation management would not be achieved. Consequently they insisted on a return to the objectives of the original PC-1. Negotiations went on for one year before PCRWR and the Ministry agreed to implement the activity as initially planned. Transfer of vehicles, equipment and funding were delayed as a result.

NADLIN has the largest budget (as per PC-I) of Rs. 2,28,96,269 out of PCRWR budget of Rs. 6,23,40,906. Out of a total NADLIN budget of Rs.22 million the funds required for new building are Rs. 7.7. million. The USAID, ISM component, is Rs. 97,70,294 in foreign exchange which is to be spent by 1990. Land has been allotted to NADLIN by CDA near the WAPDA grid station and building will start as soon as the funds are available.

It is stated in the annual plan document that the focal point of irrigation and hydrology is to be developed at NCDC Lahore and a focal point for water resources reclamation and environmental science is to be at Islamabad. Having the main center in Lahore which has the largest number of organizations dealing with irrigation and hydrology makes good sense. Recently NADLIN proposed developing a "focal point for water resources, reclamation and environmental science." This sounded like another move to expand the subject areas to some of the ISM/R Advisory Committee members. Based on that reaction and other factors, NADLIN has given up that idea and is proposing a "focal point for Water Resources" which could be at Karachi. Baluchistans needs could be better filled from Karachi.

The Director General was frank about NADLINS problems including the lack of clientel in Islamabad.

Other constraints have included the sudden departure of the expatriate advisor, difficulty in obtaining trained computer operators and late arrival of equipment like the microfiche printer and a vehicle. Steps could be taken to increase the clientele and also use the center as a training center for refresher courses for librarians and other workshops and training coursesin water resources subject. There is a need to put NADLIN in touchwith international organizations so that it can be sustained after expiry f ISM/R. Their holdings of research journals are still extremely limited and advertisements in the US by the contractor should be considered to obtain sets of journals that might be donated in the wills of scientists and engineers to this worthy cause.

Regarding Research Designed to Encourage Water Users (EWU)

These projects are interesting and their probable results appear to have some potential for application. However, identifying the action agencies or decision making bodies that will use those results and getting inputs from those agencies or bodies to the planning and design of the research will improve the focus of the research and increase the probability that the results will be used.

Possibilities for these socio-economic scientists to cooperate across agency lines with physical scientists and engineers to achieve common research goals should be thoroughly examined. For instance, during the annual meeting when some of the university social scientists working on karezes came and talked to the Project Director, who is in- charge of WAPDA research to improve karezes, it quickly became obvious that they had common goals and that working together could be highly productive.

However, if the Director of the EWU program had not made the special effort to invite the University social scientists to discuss their program with the review team and the Project Director in-charge of Karez Improvement had not left the ongoing session of the annual meeting to meet the University scientists, and invite them to come on his field day tour, this potential for productive cooperation may not have been recognized. Further efforts by the Director of the EWU program and the short term advisor to bring these EWU scientists together with physical scientists, engineers, action agencies and decision makers to discuss common goals of the research could increase the effectiveness and relevancy of the EWU research.

Karez Irrigation System Research by WAPDA and Quetta University

In the highlands of Baluchistan the primary source of irrigation is groundwater. As shown in the following table:-

Area in acres irrigated by different groundwater sources in Baluchistan.

Sl. No.	Irrigation source	Quetta Div.	Sibi Div	Kalat Div	Makran Div.	Total	
1.	Tube wells	39,700	3850	45,170	4360		93,080
2.	Karezes	35,500	6300	15,000	2000		58,800
3.	Dug Wells	6,600	2280	3,650	6000		18,530
	Grand Total:					170,410	

About 30% of the ground water extracted is by the ancient method of Karezes. Tubewell technology has been developed by many research institutions in the world, so in spite of their high use of energy tubewell use has overtaken that of Karezes. Research is needed to help the large number of people depending on these ancient systems in Baluchistan. Consequently, additional emphasis on Karez systems is recommended as follows:

1. The reservoir behind the gabion weir, in the system being studied, is silting rapidly and may only function for 5 or 10 years. One suggested solution is to have a sediment excluder in the body of the weir. Another question is why the fertile bed of the Nallah upstream from the gabion weir is not being farmed. The farmers feel that since water remains in this recharge reservoir for about a week following run off events most planted crops would be damaged. Another possibility is to practice some variation of sailaba cultivation on the silted area, with areas engineered to hold only the amount of water which could infiltrate into the soil within one day. Other productive uses for this rich soil area might provide revenue for construction of another gabion dam.

2. Capping the wells is no doubt helpful in excluding wind blown soil and preventing run off and erosion from inside the cone of spoil that normally surrounds these wells. However further research is needed to: (a) determine how much of the cleaning can be avoided by having such caps and (b) develop economical caps with proper vents for the warm humid air. The farmers are concerned that if the humidity in these shafts remains high the walls may become moist, soft and fall in the well.

3. Piping the water through imported polyethylene lay flat tubing has been successful in saving water normally lost in this permeable section above the water table. However damage to this thin walled tubing from falling dabris is likely to occur and repair or replacement may be difficult. Economics of using corrugated PVC piping (of the type used for tile drainage but without perforations) should be studied. This would be more durable as soil can be piled on it to prevent it from damage.

   Piping the Karez, with perforated pipe and a gravel pack in the section below the water table (near the mother wells) and blind pipe (surrounded by soil near the transition) in the section above the water table could eliminate the need for cleaning the Kareze. Placing a valve on this pipe at the daylight point could allow conservation of water inside the hill when it is not needed for irrigation. While piping would be expensive its benefits also appear to be large.

4. The pakka tank for storage on the Hakim Karez was expensive and lower cost tanks should be designed and evaluated. One of the additional benefits of piping and valving a Karez could be elimination of the need for a tank.

5. The pump to irrigate the orchard, with garden type hoses is heavy on running cost as it is run on diesel oil as there is no electric power in the area. A "bubbler" type of irrigation system could perform under the 3 feet of gravity head available, eliminate need for the pump and provide efficient modified trickle irrigation. This bubbler system should be tried at this location.

6. Future Karez studies should be conducted cooperatively by WAPDA research staff and the social scientists, economists and geologists at the University of Quetta who are funded under two of the EWU projects. These University Scientists are personally acquanited with many Karezes and reported knowing of several where cleaning has been delayed so long that water is no longer flowing from them, even though water is standing in the mother wells. The University Scientists should identify several of these dead Karezes and then should get together with the owners and WAPDA personnel to negotiate cost shared improvements on

these Kareze systems which could reactivate the flow and provide data bases to determine the physical, economic and social feasibility of piping and valving, retention dams for aquifer recharge and other factors whose feasibilities are being raised by the Hakim Karez study and the University EWU surveys.

7. An important aspect of future research on Karezes is the interference of open wells and tubewells near the Kareze. Certain minimum approach distances have been laid down in the water laws of Baluchistan for new wells but additional data are needed to confirm or refine the fairness of these laws. One common assumption is that even tubewells do not interfere with a Karez if they are kept at a reasonable distance apart since the tubewell draws water from lower aquifers and the Karez draw from upper aquifers which are often not appreciably connected. Since open wells draw from the upper aquifers they are often considered to be more damaging to Karezes. These assumptions need to be verified by monitoring water table heights and flow rates on other Karezes which are near wells during and between times when the wells are being pumped.

PARC and WAPDA Studies on Irrigation, Nitrogen Use and Crop Production

These studies, conducted at several locations, have considerable overlap. However, this overlap appears justified because nitrogen is a relatively high cost component of the farmers production system and nitrate is so easily leached from root zones by percolating water. Original thinking was that if farmers do not manage their water efficiently, because they do not recognize its real cost which is paid largely by the government, they might be convinced to manage water more efficiently if we could show them that over irrigation leaches out nitrogen and decreases yields. Results to date have been surprising and consistent in showing that little yield reduction occurs as a result of irrigation up to 1.5 times evapotranspiration (ET), except perhaps in soils with shallow root zones because of high water tables. One study has been conducted with even higher rates of over irrigation. More studies including irrigation rates up to 2 ET or even possibly 3 ET will be necessary to determine the irrigation level which causes reduced yields and yellowed leaves in wheat and corn. Reduced yields and nitrogen deficiency symptoms are commonly observed in crops in low areas of basin irrigated fields in Pakistan where wheat or corn in other portions of the field are green and healthy. The results of such excess irrigation studies including variation in leaf color associated with excess water are needed to help farmers realized that in some areas they are applying more than twice as much water as needed. Such information would help them understand the benefits that can be derived from improved leveling in terms of additional area that they could be irrigating.

The PARC and WAPDA Studies on Use of Saline Water (2000 to 4000 ppm)

These studies are helping identify this water as a resource for Pakistan. In most of these studies, non-saline canal water is used for the rauni and first irrigation on all treatments. If non-saline water is essential for the rauni and first irrigation the value of these findings would be limited since at the time of rauni and first irrigation there is a strong demand for irrigation water.

In areas not under a canal command where tubewell water is saline, it would be impossible to obtain the salt free water. Consequently, it is essential to develop ways to ensure adequate germination of the seedlings in soil irrigated with the available saline water, to achieve the practical potential for utilizing Pakistan's saline water resources. Such germination and emergence studies; inlcluding salinity levels in the irrigationwater and seeds of promising crop species and varieties; could be conducted in pot or small lysimeter studies.

PARC and WAPDA managed studies on how to reclaim and use saline sodic soils have obvious application in this irrigation system and should be continued.

Factors Affecting Decline in Specific Capacity of Tubewells

Tubewells are a continuing necessity for controlling waterlogging and salinity and for utilizing groundwater for supplemental irrigation. Costs of drilling, casing and screening these wells are high. Their capacities to produce water often decline rapidly, with rates of this decline ranging from 0 to 8% per year according to data taken by the SCARP Monitoring Organization (SMO). Rate of decline is strongly related to the specific SCARP in which the wells have been drilled, developed and used which could be related to water quality, installation methods or operational practices. The SCARP Monitoring Organization (SMO) unit and their ISM/R advisors have developed a new tool which has great potential for determining the causes of degradation in wells that have gone out of production that have fiberglass or PVC screen sections.

This tool has been inserted in wells to the desired depth and has taken a core of the well screen and the gravel pack. Information gained from these cores coupled with inflow data at different depths could provide positive identification of factors affecting well degradation. This is probably the most important break through in tubewell research in decades. If they are not successful in removing this tool from where it is currently stuck in a well, and if an agreement for payment for this sampler cannot be reached between WAPDA and the Workshop which built the machine, to get this important research moving again USAID should authorize the contractor (ISM/R-Idaho) to pay for the machine which was constructed with several successive designs for improvement under advise of countractor team members. USAID would undoubtedly recognize this as a wise investment of funds and reimburse the contractor.

The Irrigation Research Institute of the Punjab Irrigation Department has an ongoing but underfunded program on methods to reduce encrustation and corrosion on well screens, and remove encrustations from some types of screens. The WAPDA SMO project and the Irrigation Department project should be coordinated and supported. As a first step, the Irrigation Research Institute should be encouraged to submit a proposal for research on maintenance and rehabilitation of well screens for the next round of Competitive Grant funds. Seminars or other information exchange sessions should be held at least a couple of times a year with American advisors attending if they are incountry. At appropriate intervals the two groups should issue manuals on the construction and maintenance of wells to maximize their specific capacity and longevity.

Extraction from Aquifers of Non-Saline Water Which Overlies Saline Water

Skimming Wells to control the watertable and to obtain fresh water for irrigation are needed in many areas where a layer of fresh water overlies saline water. The primary mechanism applied to date to reduce salinity intake and upconing of deeper saline waters has been to reduce the depth of the wells and reduce the rate of pumping on each well. At Mona, two, small shallow wells have been joined together to a single centrifugal pump to provide adequate supply while keeping rate per well at a low level.

However, these techniques cause some degree of upconing and mixing of the deeper saline water with the less saline water that lies above them. Considerable research has been done at several locations in the past in Pakistan which confirmed theory developed at Colorado State University by McWhorter, Zuberi et al, which predicted that upconing of the underlying saline water was positively related to the pumping rate and proximity of the screened section of the well to the saline water layer.

Experiments at Mona also demonstrated that two wells, bored within 20 feet of each other with the screen of one being in the saline zone and the screen of the other in the fresh water zone, could be pumped at rates which could stabilize the freshwater-saline water boundary. This avoided mixing of saline and fresh water but was expensive and required a place to put the saline water.

The ideal skimming well to obtain best quality water for an area underlain with saline water will generally be an interceptor drain along a canal or distributary. The drain should be deep enough to collect water even during the dry season. This means they will have to be installed by a machine which can lay the perforated plastic pipe below the water table. The tile should not be so close to the distributory as to significantly increase the rate of loss from the distributory.

Feasibility of using tile laying machinery already in the country to install such drains, should be determined. Proper slit size to avoid excessive sediment intake in soils of different texture should be determined, along with development of means to flush accumulated sediment from the tile lines. Lengths of tile lines needed to accumulate adequate amounts of water to justify pumping for irrigation purposes should be determined. This work could be best done cooperatively by DRIP, WAPDA, some of the drainage installation projects (i.e. near Faisalabad and perhaps the UAF). Farmers who could be benefitted by such an installation should be involved in planning this project so they would understand its drainage cum water supply purpose, assist in its constuction on their land (build the pump house, water distribution system, etc.) and pay for operation of the pump.

Shallow Low Cost Drains Which Can be Installed by Farmers

Work at LIM has shown that good crops of wheat and cotton can be grown on land where the water table depth varies between 0.5 and 1.0 meter during the growing season. Irrigation required for the best wheat crops was less than 20 cm because a major part of the water needed was taken from the water table. A major portion of the land is out of cultivation at the bottom ends of many watercourses due to lack of irrigation water and salt accumulating on the surface resulting from evaporation above shallow water tables. Present drainage methods lower the water table to where crops may not be able to draw a major portion of their water from the water table, so more irrigation water will be needed. The relatively high costs of installing and pumping deep drain systems are preventing many farmers from investing in drainage who might derive substantial benefits from shallow tile drainage using crops which can benefit from the resulting water regime.

Research on shallow drains should not diminish the excellent and essential research being done by the DRIP on deep drains (1.5 to 3 M) or that being started at Mona on drains of intermediate depths (1.0 to 1.5). Information on crop production from the water regime resulting from those studies will provide criteria for installation of drains to optimize crop production.

The purpose of the additional drainage studies proposed here would be to determine whether the increment of improved drainage achievable by farmers with small investment can provide them with a profit. This will depend on whether shallow drain outfalls are available and will probably be limited to crops which are tolerant of high water tables and can make good use of water from intermediate water tables containing moderate amounts of salinity. In areas subject to substantial amounts of monsoon rain, where areas around the shallow open drains are often inundated Kharif rice crops followed by wheat or berseem would be possible rotations.

A possible place to start such research would be in the lower reaches, next to the drain, of the area commanded by tubewelll MN 78 at Mona where most of the land is out of cultivation. The Mona extension wing could confer with owners of land in this or similar areas concerning their interest in drainage and reclamation when farmers sufficiently interested to install the shallow drains (0.5 to 1.0 M) are found, they could be provided with the drain tubing and help to make sure this is installed on grade.

Evaluating benefits and costs would be a major objective of this study so low cost materials should be obtained where possible. According to the Director General of DRIP, the current cost of 4" dia PVC drain pipe is about Rs.27 per meter. Assuming tiles at 50 M spacing,
drainage would require 200 M of tile drain per hectare meter or Rs.5,400 of pipe per hectare or about Rs.2,200/acre.

Where gravel is costly, low cost substitutes such as rice straw or rice hulls should be evaluated as substitutes for envelope materials. Choice of crops adapted to shallow water table conditions will be vital to achieving good production. The extension agent will need to provide the farmer with appropriate advice and counsel and help him measure his yields, water table heights and changes in soil salinity to fully assess the benefits and costs. If the benefits appreciably exceed the costs, cooperative case history studies should be conducted with successive farmers to develop criteria for defining where such drains will be a good investment. The end goal will be drainage improvement which can proceed without GOP inputs other than alignment assistance.

Midcourse Storage to Eliminate Night Irrigation and Improve Supplies to Users on Bottom Halves of Water Courses

Benefits derived from day rather than night irrigations include easier monitoring and earlier repair of bank ruptures, more timely changes from field to field and in some areas increased safety of the irrigators. Cost associated with such benefits could include loss of production from the land used for a storage reservoir, seepage losses from the reservoir, costs of construction and cleaning the reservoir, possible pumping of water out of a storage reservoir, and possible increases of opportunities for dispute in the warabundi.

It is possible that these costs can be minimized by:

(1) Finding a watercourse with sufficient grade and designing it so 30 to 60 cm of water could be added to a midcourse reservoir by gravity flow during the night hours.

(2) Finding a farmer who owns an acre or two of land on which such a reservoir could be built who could be interested in using the reservoir for fish production and getting information for him on fish farming.

(3) Sealing the reservoir to reduce seepage loss.

(4) Comprehensive discussions with the farmers and concerned Irrigation Department Personnel to define a revised warabundi and flow control devices on the reservoir outlet which would provide equitable distribution to these lower end farmers.

For experimental installations the owner of the land containing the pond could be reimbursed by an amount equal to the value of the vegetative crop formerly grown there minus the value of his fish produced.

An additional cost that might be borne by the research project would be the cost of 75% of the materials needed to provide pacca lining for the watercourse from the mogha to the reservoir under arrangements similar to those used in the On Farm Water Management Program. Reduced roughness and increased cross section that could be designed into such a pacca watercourse could help gain the head needed to raise the level in the reservoir during the night storage period. If this watercourse section has negligible loss and seepage from the pond is small, the tail end farmers could receive more water than before. Farmers in all reaches would be able to irrigate during daylight rather than night hours.

A group of 16 leading farmers from the Mona project area were exposed to this concept and they felt that it had potential for water management improvement that should be investigated.

A variant of this system would be to run the night water supply into existing (or improved) village ponds, and use an efficient low lift pump to lift water back into the water course during day light hours. Costs of operating this pump could be shared by all water users in return for elimination of night irrigation turns.

Benefits costs and problems of these and other variants should be monitored and solutions to the problems could be developed.

B. Is Dissemination of Results Treated Satisfactorily

All research units contacted seemed to understand the importance of writing reports and research papers on their results. The annual research meetings are helping project leaders find out what is being done at other locations.

The annual meeting provides a forum for presentation of research results to respected administrators and peers. Project directors and especially those at isolated locations, look forward to these meetings and the meetings are a positive incentive to get some good research done and prepare it for presentation. Presentations and discussions have improved significantly since the first meeting. The personnel brought together at this meeting are limited primarily to project directors and administrators at higher levels.

The investigators could also benefit from such sessions by learning what is being done at other locations and partaking of the professional motivation that comes from presenting ones research results to ones peers and defending ideas and conclusions in debate.

The Mona project has a small extension unit involving a Senior Research Officer, about 4 Junior Research Officers and about twenty Field Assistants who disseminate research findings of the project. The Project Director insists on 3 seasons of field data to gain a reasonable estimate of climate interactions before clearing a new agronomic practice for implementation. This extension unit is also used to gain insight into farmers practices and attitudes to make surveys before and after improvement programs and to identify farmers who are interested in cooperative research and in other ways is not a typical extension unit. It is not used to convey water management technology to farmers under conditions similar to those by the Agriculture Departments extension agents.

A program has been underway for over 10 years to improve farm water management, through the Provincial Agriculture Departments. This program has been particularly vigorous in the Punjab under the On-Farm Water Management Directorate. This Directorate has an active and internationally recognized Water Management Training Institute at Lahore which trains teams to help farmers improve their water management. These provincial programs are still in need of improved water management technology.

A Major organizational deficiency which is detracting from the effectiveness of ISM/R programs is the lack of coordination with action agencies and extension. In the original design of the Irrigation Systems Management project, research (ISM/R) and development (ISM/CWM) phases were separated partly on the basis of how these phases were to be funded. The original separation is probably the major factor: lack of coordination.

Having had no input to the development of the objectives and priorities of ISM/R program the On Farm Water Management and Commmand Water Management program leaders feel that the ISM/R program is not focussed to provide answers to their specific needs and identify potentials for improvement of their action programs.

The ISM project paper (p.61, item ii) authorized Command Water Management to "develop water management techniques and program...." Consequently CWM is tending to do its own "action research needed to solve problems and improve their development programs. However, the PC-1s developed by the GOP agencies did not include a research component. While most of the coordination and cooperation needed is on the working person to person level it should be initiated at administrative levels. For instance the ISM/R technical committee could invite a technical member of the On Farm Water Management program to become a member of that committee. His specific responsibilities could include preparation of prioritized list of research needs of the action agency and its associated training centers.

The ISM/R technical committee could then utilize this information in guiding the ISM/R program to obtain the most vitally needed solutions. The competitive Grants Program could use this list as a guide to help determine and prioritize subject areas in which proposals should be invited.

In general, the input of action agencies should be incorporated in research programs to the point where they feel that at least a major part of this research is filling their needs. Having played a significant role in directing this research to their needs they will feel it is their own and will likely implement findings in their program.

Barriers to having action agencies base their program evaluation on research agencies data and conclusions include inherent tendencies of agencies to "protect their turf" and mistrust data and conclusions from other agencies.

The type of research done can determine the credibility of both agencies. For instance if farmers fail to make the good investment in cleaning and maintenance of earthen sections of the watercourse or don't use saved water effectively following an improvement, a research agency program which just documents failure of the farmers to make use of those opportunities is of little value and can be counterproductive. Cooperative research between the action and research agency is needed to find out how to help farmers recognize their potentials for improvement and motivate them to achieve those potentials. Trust in each other generally results from working together to achieve vital common goals when each agency has a well defined contribution to make to the research. For instance action agency personnel report seeing differences in responses of farmers on different watercourse command areas. Having quotas to fill they generally don't have time to study and identify reasons for the differences observed, but they may be able to direct research agency personnel to groups of water users where answers may be identified and introduce the researchers to farmers who have thought through parts of the problems.

There are many opportunities and vital needs for development of such cooperative research-action agency efforts to achieve worthwhile goals. Unless use is made of such opportunities, understanding and trust between these agencies is not likely to grow and the nation's investment in research and development to improve water management may fail to provide a good return. It is recommended that the Technical Committee of ISM/R take the lead in identifying and promoting these relationships.

Farmers Willingness and Ability to Make and Pay for Watercourse Improvements.

Benefits of improved water courses which accrue directly to the farmers include ease of handling the water and increased delivery to the field.

When the improvement includes pakka lining the increase in delivery to the fields is more permanent, maintenance costs are reduced and sediment is moved more completely to the fields where it serves to improve fertility and is not a problem.

Farmers in the Mona Project areas and on land served by watercourses improved by the On Farm Water Management Program participants have been particularly enthused about the pakka nature of the outlets, check structures and lined sections. While the water savings are often not as large as farmers perceive them to be, other factors probable contribute to the farmers positive attitude toward Pakka improvements. These include increased order and stabililty on the water course. While many farmers might take a few strokes of a kassie to steal water from a down steam user, hardly any farmer would destroy a section of pakka channel, which he has helped build and pay for, to extract such water.

Farmers also report that it is easier to obtain participation from less cooperative members of their groups in major improvement programs than to get them to participate in simple but recurring maintenance and cleaning of earthen channels.

It has been assumed by many of us that the relatively high cost of pakka lining was more than most farmers could, or would pay and that consequently such improvement would have to be paid for largely by the Government. However, limitations on Government funding and the growing enthusiasm of farmers for pakka lining indicate a need to reassess that assumption. Current watercourse improvement programs of the On Farm Water Management Program require the farmers to furnish the labor and 25% of the materials costs, with the Government furnishing the other 75% of the materials cost and providing technical guidance.

In some cases arrangements have been made to allow the farmers to pay their share of the materials cost through increased abiana (seasonal irrigation charges). While this highly subsidized Government program is in place it will be difficult to get economically rational farmers to agree to pay a higher percentage of watercourse improvement.

However, the On Farm Water Management Program will probably face recesses in some areas and might be restructed in some areas (e.g. Command Water Management Projects) to allow farmers to pakka line as much of their water course as they wished, provided that they furnish all the labor and the materials.

If the Government wanted to continue some subsidy it might provide them with technical assistance and an interest free loan to be repaid within a fixed time (i.e. 10 years) through increased abiana charges. A prerequisite to starting the project could be signature by all farmers to the increased abiana charges. If the Government furnishes the interest free loan it would actually be paying for a substantial amount (about 1/3) of the materials cost. This could be considered as an effort by the Government to abide by Islamic financing principles.

The Government would gain respect and positive benefits from the program including decreased tube well pumping costs, increased cropping intensity and associated abiana, and increased food and fiber supplies for the nation and for export. Water course lining and associated reductions in seepage should reduce the need for tubewell operation which will reduce the long term commitment of the nations limited energy supplies to water management and decrease mixing of deep saline waters with less saline upper aquifer waters. This relative improvement of upper aquifer waters will generally allow water tables to come nearer to the surface, where crops can draw a significant portion of their needed water from the ground water, without salinizing the soil surface. If the farmers make this investment in watercourse improvement, major new factors which could help improve water management will be the sense of ownership by the farmers of the watercourse and the increased value that the water will have in the minds of the farmers who will probably be paying abianas of about Rs. 70/ acre/season.

Researchable issues could include the following;

1. Whether farmers see enough advantage in pakka lining to pay for most of it themselves.

2. Whether the farmers might choose lower cost lining when they are paying for it.

3. Whether their greater investment results in more consciousness of waters value and more careful use thereof.

4. How much less time will be spent by the farmers in maintenance after the improvement.

Motivating Farmers to Clean and Maintain Watercourses.

According to monitoring records and other research studies, one of the best investments that farmers can make is to clean and maintain their watercourse. In spite of that fact, few water courses are adequately cleaned and maintained and much water is needlessly lost. Finding ways to motivate farmers to make this investment is an objective worth continuing effort. The following course of motivation was proposed to us by Rehmat Ali of WAPDA. The team discussed this concept with Secretary, of Irrigation and Power, Punjab, who was intrigued by the idea and said that the Irrigation Department would be pleased to cooperate on testing the idea. The concept was also discussed with Mushtaq Gill and Ashraf of the On Farm Water Management Directorate who suggested some refinements based on their experience. The review team concurs with these experienced water managers that this idea has merit and should be evaluated.

Farmers served by a distributory would be told that their watercourses would be evaluated toward the end of the canal closure period and graded as A, B, and C depending on whether they were properly cleaned and maintained.

They could be given a small brochure with pictures or drawings which described what constituted (A) good, (B) fair and (C) poor maintenance and cleaning. The brochure could also state how much water is lost from watercourses in different conditions. The A, B or C designation would be painted prominently on the Mogha. Farmers served by A grade watercourses would be allowed a decrease (e.g. 10%) in their abiana for that season. Farmers whose watercourse cleaning and maintenance merited a B grade would be allowed half that decrease and farmers whose lack of effort merited C grade would pay full abiana. At first this might look like another give away program, but according to the records, good cleaning and maintenance programs can provide the farmers with more than 10% added water to their fields. In most areas farmers have bare land each season and getting more water to their fields would allow them to irrigate more acres. This would raise their cropped acreage which would probably compensate for the reduced payment per acre.

Actually this progaram would in essence remove the disincentive for cleaning and maintenance which is inherent in the current abiana system.

That is, if farmers served by a watercourse do such a poor job of cleaning that they they lose most of their water, their planted acreage decreases and they pay less water charge in spite of the fact that the Irrigation Department continues to provide them with the same amount of water through their Mogha.

Judging teams could be composed of On Farm Water Management, Irrigation Deparment, Extension University or MONA personnel, who could also help farmers in other ways such as measuring their flow rates with flumes to determine whether that might be a better way to evaluate water course cleaning and maintenance. They could also work with farmers leaders to decide how to deal with persons on a watercourse who would not do their part.

Researchable issues include the following:

How many of the farmers would react to this type of incentive.

What informational materials would help motivate the farmers to make this good investment?

Would any of the farmers group be interested in having the irrigation department or agriculure department "judges" help them organize and supervise "A grade" cleaning and maintenance.

How rapidly do the benefits derived from cleaning dissipate? How many cleanings per year are economically justified.

What degree of training or supervision is needed to assure that all watercourses do not get " regardless of their condition?

Do the farmers with "A grade watercourses get more water to their fields? Do they make good use of it? If not, what are their constraints?

VII. Changes Within the Following Entities that Could Improve Implementation, of the Research Program

In the Government of Pakistan:

1. Coordination of planning and implementation of research on water management would be substantially improved if PCRWR, DRIP and NADLIN were under the Ministry of Water and Power along with WAPDA and other water resources research groups.

2. To get funds to projects in time to get the research done, revolving funds should be set up at the WAPDA, PCRWR and PARC levels which would allow disbursement of funds to the projects which are progressing satisfactorily while the respective ministries are processing the paper work. Permission to set up these revolving funds should be sought from the relevant authorities citing the ADB and IBRD projects as precedents and indicating that USAID is willing to play a similar role as guarantor of funding.

3. An Officer in the Federal Government could be made responsible for quick processing of cases of foreign advisors and candidates for overseas training rather than channeling these cases through routine ministerial staff who commonly delay cases for foreign training.

In GOP Research Organizations:

1. There should be more coordination of planning and exchange of information between research organizations dealing with water management. Seminars should be held on important subjects. If PCRWR, NADLIN and DRIP were in the Ministry of Water and Power more coordinated planning, modelling and implementation of research would take place.

2. The powers of Principal Investigators should be studied particularly with regard to local purchase of stores. As a first step the purchasing powers could be increased to correspond to those exercised by Senior Engineers in WAPDA.

3. Research Officers should be allowed promotions in place rather than being promoted only when they are transferred to a new location. The common practice of transfer after 3 years prevents the assembly of experienced staff at research locations.

4. Some years back a proposal was made to sanction special pay to research workers on the same lines as is sanctioned for planning, design and generation Officers in WAPDA when they work at dam sites and other isolated locations. This was not sanctioned for research workers but should be reconsidered because many of the research stations are located in areas away from towns where good schools and other necessary facilities are often not available. This hardship, coupled with the hard dedicated work needs to be compensated.

On April 14, 1989, the review team was informed by USAID that long term expatriate slots could not be reserved for the ISM/R contractors team past April of 1990. For this and associated reasons we recommend the following:

1. The contractor begin recruiting for a Deputy Chief of Party who can work with the current chief of Party for as much as possible of the coming year. That deputy COP should have experience in administrating water management research, must be a Pakistani and should be available till April of 1992. It is recommended that he be chosen from among retired persons to avoid depletion of the ranks of the ISM/R participants. The current Chief of Party, the contractors campus support staff and USAID should instruct him on the responsibilities of Chief of Party and should have him take over as Chief of Party as soon as he is ready to do so. This would relieve the current chief of Party to provide advisory assistance in areas where it is vitually needed for the remainder of the year.

2. Open and frank communication regarding each proposed TDY advisor should be initiated with the individuals who will be working with the advisor and their supervisor to make sure three is agreement concerning their needs.

3. As soon as a TDY advisor is approved a tentative schedule for him and the GOP researchers should be developed including timing of support materials and personnel to be in place.

4. TDY advisors who will be teachig as all or part of their assignment should plan to leave manuals with each trainee covering the material taught so the trainee can refer to it when the advisor has gone, and so he can pass this information onto his successor if he is transferred to another post.

5. Extending or repeating TDYs should be arranged whenever possible to reduce the portion of the time of advisors and GOP scientists that is spent in orientation.

6. The long and short term advisors in Pakistan should work with the Idaho University and Washigton State University (WSU) Campus support members and the GOP agencies, who are sending trainees to the US on degree programs, to identify thesis projects for each of those trainees which will prepare the trainee to fill a specific need in the agency. To the extent possible these research projects should use data from Pakistan and be conducted in Pakistan. Where possible, campus advisors of these students should be persons who have been working in Pakistan or can be used in Pakistan as advisors to the ISM/Research Projects.

In the USAID

1. A primary constraint on the orderly and effective completion of this project is the extreme limitation on number of long term advisers who will be allowed to stay in Pakistan. Most of the scientists whom we contacted expressed the opinion that the longer an adviser stay in Pakistan, the more valuable that adviser becomes to them because the adviser learns to know their needs, becomes better able to communicate with them and becomes more dedicated to helping them. Short term advisers can transfer some types of technology but long term advisers are more effective in helping them solve problems and helping them become problem solvers. If there is any way in which USAID can remove their constraints on number of long term advisors, the review team recommends that they do so and then allow the GOP and the contractor to determine what mix of long and short term advisors is needed to attain the objectives of this project.

2. There were stronger expressions of desire by Pakistani Scientists and Engineers to keep the advisers in Pakistan expression of desire by the Contractors team to stay.

   The contractors team feels that USAID does not want them to stay. Our assessment is that the contractor has shown a reasonably good level of effort in helping GOP agencies identify needs for technical help and supplying advisers who have been able to provide that help. The contractor allowed us to read their correspondence files and it become apparent that the USAID Project Officer is well trained and knowledgeable concerning water management. He has insisted on changes in budget, etc. which at times appeared inconsequential and counter productive to the Contractors Chief of Party. However, on further investigation it becomes apparent that many of the suggested changes were designed to save the contractor from being in violation of USAID policies, which are not always designed primarily to help contractors do their jobs.

   The review team finds both the Project Officer and the Chief of Party to be dedicated hard working, competent individuals and recommends that they get together on a field trip related to the project where they will have time to know and understand each others jobs and points of view.

In the Contractors Team

How this team can and should act to remove constraints and improve implementation depends on how many long term personnel they are allowed to keep in Pakistan and whether their contract is to be extended post April of 1990. It was the opinion of most of the GOP cooperators that the contractor team had performed well and should be retain as long as possible because " it takes time to educate advisers to Pakistans' needs". There will also be several items concerning training, equipment purchase and procurement of advisors which will need their support. For these and related reasons, the review team recommends that the Idaho contract be extended to April of 1992. There appear to be adequate unused funds to fund the extension.

The review team feels that responsibility for delays experienced in this project are about equally shared by all parties (i.e. the contractor, USAID, GOP, and GOP research agencies). Moreover we do not feel that the delays have decreased the potential productivity of this project. The institution building objectives of the project cannot be imposed overnight. Many of them require development of initiative from within the institutions which could have been disrupted if the contractor had pushed items such as the budget through the ministries.

There were allegations that lack of numbers of the contractors team was the major factor responsive for the relatively long time taken to get the PC-1s written and approved. Given the availability of the detailed ISM/R design report, the availability of the Chief of Party and Sociologist to advise on these PC-1s and the fact that PC-1s are GOP documents expected to be prepared primarily by GOP researchers and their administrators, we see little if any justification for this allegation.

Assuming the continued presence of two long term advisers till April of 1990 and a Chief of Party with 4 or 5 Pakistani Scientists and Engineers from April 1990 to April 1992 the following suggestions for removing constraints and improving implementation are recommended.

1. Open and frank communication regarding each proposed TDY adviser should be initiated with the individuals who will be working with the adviser and their superviser to make sure there is agreement concerning their needs.

2. As soon as a TDY adviser is approved a tentative schedule for him and the GOP researchers should be developed including timing of support materials and personnel to be in place.

3. TDY advisers who will be teaching as all or part of their assignment should plan to leave a manuals with each trainee covering the material taught so the trainee can refer to it when the adviser has gone, and so he can pass this information onto his successor if he is transferred to another post.

4. Extending or repeating TDYs should be arranged whenever possible to reduce the portion of the time of advisers and GOP scientists that is spent in orientation.

VIII. ITINERARY

Date	Persons Contacted	Titles and Places
3/21	Jalil U. Ahmad	Project Officer, ISM/R - USAID, Islamabad.
-"-	Alvin P. Newman	Chief, Water Resources USAID Islamabad.
3/22	James A. Norris	Director, USAID Mission to Pakistan.
-"-	Hans P. Peterson,	Chief, Agriculture and Rural Development.
-"-	N. M. Awan,	Chairman, Pakistan Council of Research in Water Resources (PCRWR).
3/23	Asif H. Kazi	Chief Engineering Adviser, Ministry of Watr & Power, Islamabad.
-"-	F. H. Usmani	Federal Coordinator for ISM/Project, Ministry of Water and Power, Islamabad.
-"-	Zahid Hussain	Director of Land and Water Resources, PARC, Islamabad.
3/25	Rehmat Ali	Director, Watercourse Monitoring and Evaluation, WAPDA, Lahore.
-"-	Saddiq Cheema	Director General, Punjab On Farm Water Management Program Lahore.
3/26	E. J. Doering	Chief of Party, UOI, Lahore.
-"-	Ahmad Masud	Director General, Aluvial Channels Observation Project, WAPDA, Lahore.
-"-	Tariq Masood,	Director, ACOP, WAPDA, Lahore.
-"-	F. A. Zubairi	Director General of International Waterlogging and Salinity Research Institute (IWASRI) 20-E/1 Gulberg III Lahore. 54660
-"-	Hayat ullah Khan	Agricultural Engineer, ISM/R, Lahore.
-"-	Mian Moh'd. Ashraf	General Manager, WAPDA (Rtd.) also former Chief Engineer,P&I Lahore

3/27	Gary Johnson	Hydrologist, ISM/R, Lahore.
-"-	Khalid Mohtadullah,	General Manager, Planning Division, WAPDA, Lahore.
-"-	Atta Ur Rehman	Acting Chief Engineer, SCARP Monitoring Organizations, WAPDA, Lahore.
-"-	Mohammad Iqbal Ahmad	Ground Water Modeler(SRO) SCARP Monitoring Organizations WAPDA Lahore
-"-	Mian Saeed Hussain	Well Rehabilitation Senior Geologist,SMO
-"-	John Baxter	ISM/R Lahore.
3/28	Mohammad Munir	Chief Engineer, Planning and Investigations WAPDA, Lahore.
-"-	Abdul Shakoor	Chief Engineer, SCARP Monitoring Organizations, WAPDA, Lahore.
-"-	Shah Mohammad	Chairman, Soils Department, University of Agriculture Faisalabad.
3/29	S. A. Qureshi	Wheat Breeder , Punjab Agriculture Department. Retired. Currently working on Sugar Cane with Private Industry.
3/30		20 Farmers of MONA project. The leading farmers as below:
-"-		1. Rao Faizullah (oldest farmer with largest land holding)
-"-		2.& 3. Malik Nawaz his brother Malik Mohammad Aslam.
-"-		4. Malik Yaqoob, former Chairman Union Council
-"-		5. Ch. Mohammad Ashraf
-"-		6. Chanduwana.Bashir

3/30 & 3/31	Bashir Ahmad	Project Director, MONA, P & I WAPDA.
-"-	Abdul Hamid,	Xen.Engineer MONA, P&I WAPDA
-"-	Barkat Ali	Economist, MONA, P&I WAPDA.
-"-	Mohammad Ramzan	Soil Scientist " " "
-"-	Iqbal,	Agronomist " " "
4/1	Mushtaq Gill	Director of Training, On Farm Water Management Program, Punjab Government.
-"-	Ch. Mohammad Ashraf	Project Director, Command Water Management Project, Tohar Niaz Beg Lahore.
-"-	E. J. Doering	Chief of Party, ISM/R, Lahore.
-"-	Robert Haggerty,	ISM/R, Lahore - Short Term Training Specialist.
-"-	James Bondurant	Agricultural Engineer, ISM/R on TDY at Lahore.
-"-	Edward Wiser,	Hydrologist, ISM/R on TDY at Lahore.
4/2	Muzammil Qureshi,	Secretary of Irrigation for the Sind, Karachi.
-"-	Abdullah Khan,	Project Director, LIM, Hyderabad.
-"-	Umar Khan	Soil Scientist, LIM, Hyderabad.
-"-	Afzal Javaid	Agronomist, LIM, Hyderabad.
4/3	Bashir A. Chandio	Director General, Drainage Research Institute of Pakistan.

4/4	Mohammad Aslam	D.G.(retired of PCSIR)receipient of one of the competitive grants.
-"-	Sadrul Hassan Rizvi,	Director, PCSIR and cooperator and competitive grants project.
-"-	Rafiq Ahmad	University of Karachi(Emeritus)
-"-	Shoaib Ishmael	University of Karachi.
4/5	Ijaz Humayun,	Project Director of Planning South WAPDA.
4/6	Shukurullah	Prof. Head of the Economics Department, Baluchistan University (P.I.) on EWU study.
-"-	Syed Mohammad Arif	Economist - Univesity of Baluchistan. Co-Principal Investigator. on EWU.
-"-	Fazal Karim Khan	Head of the Geography Department, Baluchistan University (P.I. on EWU)
-"-	Ghulam Nabi Achakzai	Prof. of Sociology, Baluchistan University (P.I. on EWU study).
4/7	Farmers of Abdul Hakim Kareze	Panj Pai Research Site Mastung Valley Baluchistan.
4/16	M. A. Goheer	Director General, NADLIN, Islamabad.

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APPENDIX-1

Justification for transferring PCRWR to Ministry of Water and Power from Ministry of Science and Technology.

1. PCRWR with its former name Irrigation Drainage and Flood Control Research Council was created by the ministry of water and power and it was functioning very well in that ministry as this ministry is the end user of all research for these subjects science and technology has little use for it. Besides all research organimzations dealing with water resources such as MONA, LIM, SRO, IWASRI and ACOP are in WAPDA and seperation of PCRWR from the ministry has starved it from the feed back necessary for full research

2. DRIP which is n:ow part of PCRWR was also conceived by the ministry of water and power as this institute was required for planning and design of vast drainage system being undertaken by this ministry through WAPDA. One of the largest drainage systems in the world viz left bank out fall drain (LBOD) is being constructed by WAPDA in Sind. DRIP could serve this project in many ways as it is located near Hyderabad where the General Manager south of WAPDA who is incharge of LBOD is also stationed. DRIP has felt the isolation and there are problems of control of DRIP from Islamabad. The right place for this organization is WAPDA. It will not only get the necessary feed back from various organizations like LIM but could be technically controlled by IWASRI which shall have international experts even after ISM/R project is completed.

3. NADLIN also deals entirely with water resources topics and as such rightly belongs to the ministry of water and power.

4. Continuation of PCRWR in the ministry of science and technology does not serve any useful purpose for water management research in Pakistan as it has got islolated from the mainstream of researches being donducted by the ministry of water and power. An important point to be considered in this connection is that the day to day problems faced by the water and power ministry need action research. These are possible of solution only when there is close administrative relationship between the implementing agencies and the research institutes.

APPENDIX 2

International Irrigation Management Institute (IIMI)

The review team visited IIMI offices and met with the Director, Earnest Schultze on March 23. We explored at length the question of what interests the ISM/R project and IIMI might have in common.

IIMI has been doing collaborative research with the Irrigation Research Institute of the Punjab Irrigation District and has been working to develop cooperative research programs with other irrigation related institutions in Pakistan (e.g. Sindh Irrigation Department). IIMI has asked the GOP to provide Pakistani staff who would work with IIMI to develop more effective cooperation on research, put without success to date.

IIMI apparently takes a leadership role in the research in which it is involved. The research projects are initiated, directed and analyzed by IIMI senior staff which are a mix of foreign nationals and Pakistanis.

The central question from the perspective of the ISM/R program is the nature of the IIMI research. Both organizations are studying irrigation systems. IIMI's approach is operational analysis, an input-output approach in which insights are derived by observation and statistical analysis. The basis question asked is "what inputs produce what outputs"? This is a useful first step in a research program the perspective it can provide. ISM/R is following a scientific approach in which the basis question is "how do the inputs produce the outputs?" This line of research provides the basis for restructuring or redesign of systems.

The difference can be illustrated by the research being done on water courses. IIMI did a study of inequities in distribution in a water course and observed that one consequence of unequal distribution is that farmers choose different crop rotations in different parts of the distributary because of the difference in water supply. This provides a better understanding of the problem but tells us nothing about how to redesign the water course. ISM/R is studying loss rates, lining, cleaning and other facets of water course performance. This approach will eventually provide a basis for redesign of the water courses.

To the extent that IIMI continues the operational research it has been doing it can provide ISM/R with insights and questions that can be helpful during formulation of the ISM/R research programs. However, it is our understanding from the discussion with Schultze that IIMI is shifting its research program to the area of management science. He sees IIMI dealing not with the physical systems but with the management systems. Rather than being concerned with physical conditions, physical activities and physical results, the focus will be on management conditions, management activities and management results. The parameters of interests are such things as goals, feed-back, the qualilty of people involved, the availability of information, organizational structure and so on. In that event the people involved in social science work for ISM/R could be interested in what IIMI does in the future.

Regardless of the direction IIMI's research eventually takes the research done there will probably complement the ISM/R program. Close contact should be maintained between the two organizations.

Appendix 3

International Waterlogging and Salinity Research Institute (IWASRI)

The institute as originally conceived was a national institute under the Ministery of Water and Power with its own laboratory and field research stations but the scope of the institute was changed later due to financial constraints to an institute which can only get research done through existing research organizations on contract, it is not to undertake any research itself. For about a year Mona and LIM were part of this research institute, now they are again with Chief Engineer, P&I of WAPDA.

At present the institute is headed by Acting Director General with three directors for engineering, soils and planning and coordination. Each director is assisted by one or two senior or junior officer. Only one expatriate advisor from United Nations is helping the institute provision exists for three advisors out of which one shall be permanent.

The highiest priority of research for this institute is drainage. The area of research includes ground water drainage surface drainage tubewell drainage, soil management and water management. At present the institute is busy in preparing a national research Agenda for research specislists have been asked to present papers on the national agenda. In order to get a wider response 57 organizations covering federal and provincial departments, ministries, eminent scientists, farmers, associations and progressive farmers in the country were asked to send proposals out of these 25 organizations have responded so far.

Following the formulation of research Agenda IWASRI would have to develop specific research programs. After this the work would be assigned to various research institutes or undertaken under the foreign bilaterial technical assistance. Although the formulation of the technical research proposals would be undertaken by the principal investigators of the research institutes, they would be assisted by IWASRI in this important task through the specialists both foreign and local whose services would be arranged by IWASRI. During the research study IWARSI would, watch the progress, there methodology etc. An evaluation of the work would be done after completion. IWASRI would provide the finances, arrange supply of equipment and materials and provide technical assistance and training. It can take up collaborative research projects through foreign research institutes when foreign donors are involved. IWASRI is preparing a new PC I for the ISM(R) as at present its functions are governed by a PC-1 independent of ISM(R).

APPENDIX 4

LIM

The LIM organization was begun in 1977. The first field studies attributable to this organization were conducted by Umar Khan in 1980. Full scale development of facilities and staff began in 1987. It is developing a research program which concentrates on water management and crop production under high water table conditions and with brackish water. At the moment LIM consists of three senior research scientists and six junior research staff. The staff are enthusiastic and seem to share a sense of mission regarding their work. There are two research positions vacant, an On-Farm Water Management position and an Economist. LIM has derived a substantial share of its budget from AID support outside the ISM/R program, including approximately 50% of its budget in the four years which will end in June of 1989.

The research activities at LIM should be viewed against the reality of farm water distribution practices in the Sindh. It is our understanding that while water distribution is organized in Warabundis, the actual allotments to the farmers are often made only in response to a surcharge which the farmer must pay to the individuals who control releases. Within that system the most powerful farmers receive a disproportionate share of the water and some farms may receive none at all. The arbitrary nature of farm water deliveries has important implications for the resarch program at LIM. It changes the nature of farm water availability and it complicates the work of the LIM staff who must themselves depend upon this Warabundi water for research.

It is the LIM policy that field research will be conducted on land provided by cooperating farms. In fact LIM has no land of its own for field trials. This policy has two significant advantages; it begins the process of involving the farmers in the research and it gives the research staff an opportunity to better understand farm practices. There are disadvantages also, notably that the farmer may take actions which constrain or sabotage the research. It is our feeling that the benefits of working with cooperating farms should outweigh the disadvantages in the long run. However it might be appropriate for LIM to establish a small set of experimental fields for work which a farmer would not allow on his farm.

ISM/R related research at LIM has been devoted to FWM-1 and FWM-2. The conduct of these experiments seems to have been competent, but further work on interpretation of experimental results is needed and additional experimentation needs to be done after some revision of experimental protocols. The data collected from the FWM-1 study indicate that yields are increased in the presence of a high water table by reducing water use through wide-bed furrow irrigation. However it is possible that:

(1) water use could have been further reduced by an irrigation schedule designed to induce the crop to draw more water from the water table,

(2) some of the observed water savings were attributable to the use of furrow irrigation in lieu of basin irrigation. LIM research staff believe that farmers will not adopt furrow methods in general, hence a similar study based on basin irrigation is needed. Research staff have in fact recognized these problems and redesigned the FWM-1 study for the coming season. With regard to the FWM-2 study it was suggested that the initial irrigations be done with brackish water as well. However the increased sensitivity of germination and seedling establishment to salinity could jeopordize yields more than would be acceptable to the cooperating farmer.

As noted above, LIM is understaffed, so it may be some time before the data already collected are fully utilized for engineering and economic analyses. The absence of these staff may also impact planning for upcoming research activities.

LIM staff felt that the visits of ISM/R staff and TDY personnel have been reasonably frequent and were very beneficial. However they expressed considerable frustration at the ISM/R training program. Virtually all of their major nominations for training have been left on hold or lapsed when the training dates passed. They specifically cited six nominations which have been active for 18 months with no definite resolution. They did mention two in-country training courses dealing with computers and drainage to which they have sent people and which they considered productive. With regard to ISM/R financing the Project Director observed that while there are delays in receiving funding they are 'normal' delays which he can deal with.