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**FINAL REPORT**

**ON THE**

**COOPERATIVE AGREEMENT NO. 391-0467-A-00-1818-00**  
**IRRIGATION RESEARCH**

**PART I: IRRIGATION SYSTEMS MANAGEMENT**  
**RESEARCH PROJECT**

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## EXECUTIVE SUMMARY

### INTRODUCTION

An important component of the USAID and World Bank financed GOP Irrigation Systems Management Project is the irrigation systems management research (ISM/R) which was designed to identify opportunities to increase the effective use of water and enhance the skills and capacity of scientists and institutions to conduct irrigation research. The ISM/R project component was implemented initially with the help of the University of Idaho (UOI) for a 4-year period ending in June 1990, but which was decided later to be extended for selected activities. However, with the UOI's departure in end December 1990, the International Irrigation Management Institute (IIMI)-Pakistan with its international network was requested to provide technical oversight to selected on-going research activities in three federal ministries, namely, the Water and Power Development Authority (WAPDA) under the Ministry of Water and Power; the Pakistan Agricultural Research Council (PARC) under the Ministry of Food and Agriculture; and the Pakistan Council of Research in Water Resources (PCRWR) under the Ministry of Science and Technology. The Directorate of Hydrology and Research of the Sindh Irrigation Department (SID) was added only during the last two years of the Project.

The ISM/R Project was implemented through a Cooperative Agreement (CA) with USAID. Specifically, IIMI's role was to provide technical assistance in conducting irrigation research to the following GOP organizations : (1) WAPDA's Water Wing (Planning and Investigations), Mona Reclamation Experimental Project (Mona), Lower Indus Water Management and Reclamation Research Project (LIM), Planning Directorate South (PDS), Watercourse Monitoring and Evaluation Directorate (WMED) and SCARPs Monitoring Organization (SMO); (2) PARC thru its Water Resources Research Institute (WRRRI) of the National Agricultural Research Centre (NARC), agricultural research stations and collaborating Universities such as the Agricultural University at Faisalabad (UAF), University of Agriculture and University of Engineering and Technology at Peshawar, Sindh Agricultural University at Tando Jam; (3) PCRWR and its affiliated organizations like Drainage and Reclamation Institute of Pakistan (DRIP); and (4) SID thru the Directorate of Hydrology and Research in connection with the upgrading of the Soil Mechanics and Hydraulics Laboratories at Hyderabad and Karachi. Moreover, while working with the research institutions, IIMI tried to encourage the definition of priorities for future irrigation management research in Pakistan which became a topic for discussion in a special session during a symposium held upon completion of the project.

## **IMPLEMENTING PROCEDURES**

Implementing procedures were established to deal with the criteria for the selection of research activities, the review and selection process, the documentation into workplans as integral parts of sub-grant Memoranda of Understanding (MOU) between IIMI and the collaborating institutions for approval by the USAID Project Officer, and the formation of a CA Planning and Review Committee.

IIMI agreed to assign one of its international staff to act as project coordinator. IIMI staff, including the project coordinator provided technical assistance through frequent short term interactions with staff of the concerned research institutions.

To facilitate the dissemination of research findings, IIMI agreed to convene biannual meetings of principal investigators and organize a final workshop to report and receive feedback on the research findings.

IIMI also agreed to submit project activities reports to the USAID at the end of each quarter describing the progress and problems of activities underway, including recommendations on future work to be undertaken, and a final report upon completion of the Project.

## **PROJECT ACTIVITIES**

### **Technical Assistance Provision**

The provision of technical assistance was in the nature of advising the staff of participating institutions in preparing more focussed workplans, reviewing required research equipment, research data collection and analysis, and writing of results and reports for each study. Assistance in organizing and conducting short training courses, although not earlier envisioned, also became a substantial part of the technical assistance effort.

### **Biannual Progress and Review Meetings**

Two biannual ISM/R Progress Review Meetings were held, the first on 24 September 1992 at the Pearl Continental, and the second on 25 January 1993 at the Avari Hotel, both in Lahore. The two meetings followed a similar format of allotting 20-30 minutes for each subproject. This included an overview by the subproject leader and individual presentations by the principal investigators and senior and junior research officers. For each study, a brief statement was given on the objectives, findings, conclusions, current status of data collection and analysis, paper and report writing, and future plans.

## **Symposium**

An end-of-project Symposium was held on 11-13 April 1992 at the Government Engineering Academy Punjab, Niaz Beg, Lahore, to report on the findings of studies conducted under the Project. About 105 participants from WAPDA, PARC, PCRWR, SID, agricultural universities, USAID and IIMI participated.

The Symposium had eight technical sessions. Thirty-two papers were presented and discussed. These were documented in an 8-volume proceedings which were distributed before the symposium. The volume titles are listed below:

- \* Vol. I Integrated Watercourse Management
- \* Vol. II Farm Water Management
- \* Vol. III Role of Water Users in Irrigation Management
- \* Vol. IV Drainage and Water Table Control
- \* Vol. V Groundwater and Physical Hydraulic Modeling
- \* Vol. VI Use of Database and Public Tubewell Performance
- \* Vol. VII Improving On-farm Water Use and Application
- \* Vol. VIII Irrigation Systems Outside the Indus Basin

A final volume, Volume IX, was prepared and distributed after the symposium. It documents the highlights of the discussions in the 8 technical sessions and the views expressed on a future ISM research agenda for Pakistan. The addresses during the inaugural session as well as the comments during the closing session are also featured.

## **Project Activities Reporting**

IIMI submitted a total of six quarterly activities reports. Each report described the progress and problems of activities underway and included recommendations on future work for the following quarter. An added feature in the report is an attached chronology of interaction visits and meetings between IIMI staff and researchers of participating institutions.

This report constitutes the final report on all Project activities with emphasis on the ISM/R Symposium, and the final technical reports for each study.

## **ACCOMPLISHMENTS**

The fact that an end-of project symposium was held to report on the research findings was cited by the Chief Guest during the Symposium as proof that the ISM/R Project has been able to attain its basic objective of assisting GOP research organizations in enhancing their research capacity and in disseminating key research findings. Worth

mentioning also is the development of working relationships in the conduct of research which transcended ministerial, provincial and departmental boundaries.

Some of the more tangible accomplishments of the Project in the last two years are the preparation of the following documents:

- \* Consolidated workplans for each of the studies under the different subprojects (Annexure 1)
- \* Equipment lists, specifications, cost estimates and suppliers for research commodities required by PARC and the Directorate of Hydrology and Research in Sindh in their respective subprojects (Annexure 2)
- \* Six quarterly activities project reports submitted to USAID
- \* Nine volumes of the 11-13 April 1993 Symposium proceedings (Annexures 2 and 3)
- \* Final technical reports submitted by research investigators for each study (Annexure 4)
- \* Final project report (this report ) to USAID

The Project was able to organize the following meetings:

- \* Four policy and review meetings involving the membership of the CA Planning and Review Committee to discuss the scope of the project and implementation procedures, and to sort out funding issues
- \* Two Biannual Progress Review meetings to provide opportunities for the researchers to present the research results obtained thus far and exchange experiences
- \* End-of-project ISM/R Symposium to present, disseminate and discuss research findings with a wider audience, including the target end users of research results and recommendations

The Project encouraged and supported the following training activities:

- \* Training course on border irrigation design and evaluation jointly organized by PARC, UAF and IIMI at the UAF campus
- \* Two-week training course on design and operation of sprinkler and trickle irrigation at the NARC Training Institute in Islamabad



- \* One-week training course on surface irrigation at the NARC Training Institute in Islamabad
- \* Training of five staff of the Directorate of Hydrology and Research in Sindh: two staff in Hydraulic Modeling at the Irrigation Research Institute, Lahore; two staff in Hydraulic Monitoring at the Alluvial Channel Observation Program (ACOP)-WAPDA, Lahore; and one staff in Water Quality Testing at the Directorate of Land Reclamation, Punjab, Lahore
- \* An expanded version of the on-job training course on surface irrigation held on 17-22 April 1993 at the NARC Training Institute in Islamabad.

Some key issues that emerged from the Symposium for consideration in developing an immediate research agenda to build on the Project are the following:

- Policies and accompanying procedures to update databases through a continuing monitoring program and make them more useful and user friendly such as those for public tubewells, watercourse performance evaluation, water quality, etc.;
- More effective approaches to be developed to encourage water user associations to undertake organized activities such as tile drainage installation and maintenance, mechanized watercourse construction and maintenance, conjunctive use of groundwater with canal water, watercourse and water distributary delivery management;
- Ways to reduce the cost of tile drainage installation, buried irrigation pipeline, trickle and sprinkler irrigation;
- Further demonstration and determination of the technical and socioeconomic viability of high efficiency water application systems such as trickle, bubbler, raingun sprinkler and modified furrow system for orchards and other high value crops in water scarce areas as in Balochistan;
- Use of computer simulation models to match crop water requirements with water supply for possible irrigation advisory services, tile drainage and skimming well design, and groundwater movement prediction; as a decision support tool to improve equity of water delivery to outlets along a distributary and to optimize the effect of desilting for more equitable water distribution;
- Further use of physical hydraulic modeling for designing silt excluders/ejectors not only for channels but also for structures like delay dams recommended for recharging karezes; and

- Development of improved machinery with equipment manufacturers and dealers for forming broad beds and furrows found essential under shallow watertable conditions and for mechanized watercourse construction and maintenance.

## **LESSONS LEARNED**

The ISM/R Project as initially conceived in 1984 had two objectives which were to enhance the research capacity of collaborating GOP institutions (institution building) and to assist in priority research programs. Both objectives were pursued simultaneously. Research organizations like WAPDA, MONA, DRIP and LIM have been strengthened or supported by this project. Monitoring organizations like SMO, WAPDA, WMED, and planning organizations, especially Planning Directorate (South), have been helped to do research work for planning purposes. As emphasis was also given to strengthen organizations for research coordination and information sharing, two committees were set up: research advisory committee and technical coordination committee. To fill the gap of information sharing, an institution called National Documentation Center, Library and Information Network (NADLIN) was established. However, as was pointed out by several speakers during the Symposium, while individual scientists can do very good work, either the results are not shared by others or there is a lack of coordination among different research organizations.

Organizations that have coordination role are PCRWR, PARC, P&I Organization (WAPDA) and IWASRI. Under the ISM/R Project, the University of Idaho and later, IIMI provided day-to-day research coordination among these organizations while policy questions were referred to the advisory/technical/review committee(s) for resolution. A need for a similar coordination set-up has been expressed to enable the concerned institutions to continue to work together effectively after completion of the project. Moreover, it was recognized during the Symposium that efforts should be pursued aggressively to establish links to action agencies like provincial agriculture and irrigation departments, the On-Farm Water Management and Command Water Management Programs, regular extension staff, progressive farmers and private sector representatives. These agencies/persons should not only be recipients of the products of research but should actively participate in the definition of research needs and in their execution.

Since IIMI got involved only towards the end of the Project, it can neither take full credit nor full responsibility for shortfalls in the Project, if any. IIMI has found the assignment both challenging and rewarding. The opportunity to work with and support national institutions was particularly satisfying. Being accepted as a sincere and impartial convenor of meetings that brought together competing and rival organizations was an added bonus to IIMI. It is encouraged to continue and even enhance the working and trusting relationships that it has established under the project.

## RECOMMENDATIONS

During the Symposium, various speakers gave well-considered assessments of irrigated agriculture in Pakistan - its current state, problems and potential, what needs to be done, and the critical role of research.

In the welcome address, it was stated that Pakistan's land and water resources are rapidly degrading, and thus threatening its sustainable productivity. The heart of the effort required to reverse this adverse trends in the country's irrigated agriculture, is research and capacity building - the very same effort that the ISM/R tried to promote and build up.

A similar assessment was made in the keynote address in which the value of research in irrigated agriculture was underlined as an investment for the very survival of the country. However, unless a holistic approach to problems is adopted which includes prominently management issues as are now being addressed by IIMI, the temptation would be to opt for capital intensive solutions. It was suggested to bring the issues more often to public attention and to the political leadership. It was observed that the coordination needed for such a concerted effort has been shown, proved and documented as part of the ISM/R Project.

A consensus emerged during the Symposium that such coordination should be continued and strengthened. A coordinating committee could be formed, building on the one set up under the ISM/R Project, with a rotating chairman among members from the Ministry of Water and Power, PARC, PCRWR, WAPDA, four provincial irrigation and agricultural departments, Water and Agriculture Divisions of the Planning Department, the private sector, and IIMI. The possible role of IIMI was highlighted in the address of the USAID representative which stated that with IIMI firmly established in Pakistan, it can synthesize and adapt regional experiences to Pakistani conditions while collaborating with national organizations. One of the first activities of the coordinating committee could be to deliberate on the views presented on an irrigation management research agenda for Pakistan. Incidentally, a similar committee is the Consultative Committee of IIMI-Pakistan which only lacks a representative from PCRWR.

Considering the importance of water resources and agriculture to Pakistan's economy, the PCRWR view is that the research agenda should pass the following tests:

- \* It should be a doable program within a given time frame.
- \* The benefits of a research program should be quantifiable.
- \* Research should be end-user oriented and collaborative.

- \* End-users should be identified and involved at the planning stage of an R and D program.
- \* Environmental impacts of a development program should be properly looked into and the research project should highlight the measures to overcome the consequent environmental degradation vectors.

Several speakers emphasized the importance of funding research. An indication of adequate funding for this purpose is at the level of 2.5-3.0 percent of the development outlays.

## FINAL REPORT

### PART I

#### IRRIGATION SYSTEMS MANAGEMENT RESEARCH PROJECT

##### INTRODUCTION

With financial assistance from the USAID and the World Bank, the Government of Pakistan (GOP) has been engaged in the Irrigation Systems Management Project, a comprehensive project designed to upgrade major portions of Pakistan's irrigation systems and to strengthen the capacity of the organizations charged with operation and maintenance of these systems. An important component in this effort is the irrigation systems management research (ISM/R) that was designed to identify opportunities to increase the effective use of water and to enhance the skills and capacity of scientists and institutions to conduct irrigation research. The ISM/R project component which was designed for a 4-year period ending in June 1990 was implemented with the help of the University of Idaho (UOI). Due to a late start and several positive indicators during the mid-term review, it was decided to continue selected activities beyond June 1990. However, with the departure of the UOI in end December 1990, a series of discussions between the GOP, USAID and the International Irrigation Management Institute (IIMI)-Pakistan were held to have the latter, with its international network, provide technical oversight to selected on-going research activities started earlier in three federal ministries. The research organizations originally involved were the Water and Power Development Authority (WAPDA) under the Ministry of Water and Power, the Pakistan Agricultural Research Council (PARC) under the Ministry of Food and Agriculture, and the Pakistan Council of Research in Water Resources (PCRWR) under the Ministry of Science and Technology. The Directorate of Hydrology and Research of the Sindh Irrigation Department (SID) was added only in the last two years of the Project.

Specifically, under this project which was implemented through a Cooperative Agreement (CA) with USAID, IIMI's role was to provide coordinated technical assistance to several research institutions mostly engaged in the final phase of completing a variety of irrigation research activities with a view of enhancing the institutions' research capacity. Exceptions were the newly initiated PARC subproject on improving of on-farm water use and application, Phase II of the PCRWR subproject in encouraging water user associations for better water management, and the SID studies on physical hydraulic modeling. In its collaboration with research coordinating organizations such as the International Waterlogging and Salinity Research Institute (IWASRI), PCRWR, and PARC, IIMI aimed to raise the research management skills and capabilities of some permanent staff through "hands on" experience in planning, monitoring, and evaluation of irrigation and drainage-related research. Moreover, while working with the research institutions, IIMI tried to encourage the definition of key

elements and priorities for future irrigation management research in Pakistan as discussed in the end-of project symposium by representatives of key irrigation management research organizations in the country.

## **PROJECT SCOPE AND OBJECTIVES**

The CA was signed on 18 September 1991 but was made effective from 1 August 1991 to 31 May 1993. The stated objectives of the CA are:

- a. Assist Government of Pakistan (GOP) research organizations in selected priority research programs in enhancing their research capacity and in the dissemination of research findings.
- b. Conduct research in collaboration with the Provincial Irrigation Departments (PIDs), addressing critical issues related to management of operation and maintenance that would improve equity and reliability of irrigation water distribution.

This report (Part I: Irrigation Systems Management Research (ISM/R) Project) covers only the first objective; the second objective will be covered by a separate report of IIMI's own research on "Management Decision Support for Canal Operations and Maintenance.

In meeting the first objective, IIMI provided technical assistance in conducting selected research projects started by GOP organizations under the ISM/R as follows: (1) WAPDA's Water Wing (Planning and Investigations), Mona Reclamation Experimental Project (Mona), Lower Indus Water Management and Reclamation Research Project (LIM), Planning Directorate South (PDS), Watercourse Monitoring and Evaluation Directorate (WMED) and SCARPs Monitoring Organization (SMO); (2) PARC thru its Water Resources Research Institute (WRRI) of the National Agricultural Research Centre (NARC), agricultural research stations and collaborating Universities such as the Agricultural University at Faisalabad (UAF), University of Agriculture and University of Engineering and Technology at Peshawar, Sindh Agricultural University at Tando Jam; (3) PCRWR and its affiliated organizations like Drainage and Reclamation Institute of Pakistan (DRIP); and (4) SID thru the Directorate of Hydrology and Research in connection with the upgrading of the Soil Mechanics and Hydraulics Laboratories at Hyderabad and Karachi.

## **AGREED IMPLEMENTING PROCEDURES**

Although the Cooperative Agreement was made effective only as of 1 August 1991, aspects of the implementing procedures were discussed and agreed upon on 28 July 1991 in a meeting convened by Mr. F.H. Usmani to implement the decisions reached in an earlier meeting held on 22 May 1991 in the office of the Additional Secretary

(Water) of the Ministry of Water and Power. In consideration of the limited funding and time (only up to 31 May 1991) available, the following were some of the implementing procedures that emerged from the meeting:

- On the selection of research activities, the following criteria were agreed upon: expectation of useful results emerging from the activity before 1993, increased orientation to testing of research hypothesis under actual field conditions, and attention to management rather than merely technical issues.
- In the review and selection process, IIMI staff would sit with concerned staff of the implementing research institutions or with the project coordinators in the case of PARC and PCRWR. The process would entail also the identification of required technical assistance and the need for research equipment.
- The outcome of the discussions in the review and selection process would be documented in Sub-grant Memoranda of Understanding (MOU) between IIMI and the implementing institutions/research coordinators. The MOU would specify the research activities being supported, the rupee budget, and which expenditures were reimbursable. The MOU would be approved by the USAID Project Officer.
- The Sub-grant MOUs would form the bases for a Consolidated Work Plan.
- A Planning and Review Committee would have the following role and composition:

Task:

- a. To coordinate and periodically review the progress of the various research studies carried out in the implementing Institutions. The Committee would do so on the basis of IIMI's report to the Committee on the progress of the research in comparison with what was agreed upon in the Memoranda of Understanding.

Committee Composition:

General Manager Planning (Water), WAPDA, Chairman  
Project Officer USAID  
Director, IIMI-Pakistan  
Project Manager, IIMI-Pakistan  
Representative PARC  
Representative PCRWR  
Chief Engineer (P&I), WAPDA

Ex officio: Chief Water Resources Division, USAID  
Federal Coordinator

Observer: IWASRI Representative

- To facilitate the procurement of equipment, the participating Institutions would prepare lists of required equipment in order of priority, with specifications as complete as possible, including suggestions on where the equipment might be ordered. The proposals for the purchase of equipment would be considered in light of the agreed research activities and with respect to the development of research capacity for the future. IIMI would submit the list of recommended equipment for purchase by USAID or through a mechanism to be agreed upon by the GOP, USAID and IIMI.

Moreover, the CA specified the following:

- The procedure for reimbursement to the GOP research institutions would be decided with the consent of the GOP.
- IIMI would assign one of its international staff to act as project manager in coordinating the participation of research institutions and the provision of technical assistance to various research projects according to the staff member's area specialty and in conducting research directly related to the CA. IIMI would furnish short term technical assistance through its long term staff by frequent short term interactions with the staff of the research institutions responsible for the sub-projects.

To facilitate the dissemination of research findings, IIMI would convene biannual meetings of principal investigators and would organize a final workshop to report and receive feedback on the implications of the research findings.

IIMI would submit a Project Activities Report to USAID at the end of each quarter by describing the progress and problems of activities underway, including recommendations on future work to be undertaken. No later than 30 calendar days after the CA completion date, IIMI would submit a final report on all its activities to the USAID. Likewise, required financial reports would be submitted to the USAID.

## **ACTUAL IMPLEMENTATION PROCESS**

### **Technical Assistance Provision**

The provision of technical assistance was in the nature of advising the staff of participating institutions in the preparation of a more focussed workplans, reviewing research equipment required, research data collection and analysis, and writing of



results and reports for each study. Technical assistance also took the form of training research staff through the interaction process to enhance their capabilities in doing research and in disseminating research findings. Although not earlier envisioned, assistance in the preparation, organization and conduct of short training courses became a substantial part of the technical assistance effort.

Workplan formulation. Based on the agreement reached during the 28 July 1991 meeting, IIMI staff continued the process started as early as 4 June 1991 of reviewing and selecting research activities by meeting with concerned staff of the different participating GOP institutions and with the project coordinators in the case of PARC and PCRWR. This has meant reviewing the institutions' original annual workplans and the progress achieved so far in their research activities. It was explained during the meetings that a revision of their individual workplans would become necessary because of the funding and time constraints and that the expected outcome of the review process would include the identification of selected activities, research commodities, and the technical assistance required. Moreover, it was also intimated that the outcome of the review would form the basis of separate Sub-grant Memorandum of Understanding between IIMI and individual participating institutions.

During the interactions with the various institutions, it became apparent that there was great concern about their need to be reimbursed for expenditures incurred by them between 1 January 1991 until 31 July 1991. This concern prompted the convening of a meeting, this time, by the General Manager Planning (Water) as Chairman of the Planning and Review Committee, in his WAPDA office on 28 October 1991. This matter and other outstanding issues related to the implementation of the CA were taken up. IIMI used the opportunity provided by the meeting in presenting an indicative work plan it prepared in implementing the first component of the CA. It presented a table (Attachment A) indicating teams and lead persons from IIMI who would be providing technical assistance to the various research activities. In the discussions that ensued, it was made clear that the CA would cover expenses incurred beginning 1 August 1991. Accordingly, it was agreed to advise the various research institutions to revise their corresponding workplans with IIMI. Schedules for these working meetings with IIMI were set. As a pleasant consequence of the 28 October 1991 meeting, the pace of the preparation of revised work plans was accelerated. IIMI received the revised consolidated work plan of WAPDA on 24 November 1991. The revised work plans of PARC, PCRWR, and an indicative one from SID were reviewed on 8 January, 27 April, and 12 May 1992, respectively. The final workplans have been consolidated into a separate volume entitled ISM/R Work Plans for 1991-93 (Annexure 1).

Subgrant Memorandum of Understanding. The sub-grant MOUs were formulated and subsequently signed between IIMI and PARC, WAPDA, PCRWR, and SID on 14 January, 18 March, 16 May and 10 August 1992, respectively. A supplementary Sub-grant MOU with the SID was approved by USAID on 16 May 1993.

Equipment lists and specifications. On equipment procurement, only the lists submitted by PARC and the SID were reviewed and endorsed to USAID for purchase by its Commodities Division. WAPDA and PCRWR opted not to acquire additional research equipment. All the documentation related to technical specifications, cost estimates and possible suppliers needed for each piece of equipment/commodity to be purchased abroad or locally were submitted to USAID in September 1992. The documentation was treated as an important integral part of the ISM/R workplans (Annexure 1).

Technical assistance interaction. Some of the technical assistance teams could develop more regular interaction modalities than the others as in the case with WAPDA organizations. Weekly 2 to 3 hour tutorial meetings went on with SMO with respect to the subproject on "Ground Water Models Development." Several meetings of the same duration were initially held with concerned staff of the WMED regarding the study on "Existing Flows in Watercourses as Compared to Design Discharges." This was followed by a joint visit to one of the 8 distributary sites to observe and refine the field data collection. Very intensive interactions were maintained with the PD (S) on the Directorate's preparation of the report on "Plan, Rehabilitation and Improvement of Karezes in Baluchistan." However, a trip in early May 1992 to Quetta to visit various karez, sailaba, bubbler and drip irrigation research sites of the Directorate had to be cut short due to political unrest in the area. The first visit to the Mona Experimental Project was in early June 1991. A two-day visit of the technical assistance team of IIMI to Mona in mid-February 1992 enabled the formalization of the interaction mode with Mona staff. A subsequent two-day visit during the third week of April 1992 to Mona made it possible for essentially the whole team of IIMI to meet with the Project Director and the remaining members of the depleted Project staff. The separate simultaneous discussion-meetings enabled the team to review current activities including the reports that had been prepared and were being prepared for the different studies being conducted under the subprojects on "Integrated Watercourse Management" and "Farm Water Management." During a joint visit of an IIMI team with the USAID Project Officer to the LIM in late February 1992, a review of the studies being carried out and a meeting with the research staff regarding IIMI's provision of technical assistance was taken up. In the case of the meetings with the new staff of the SMO, the actual progress made on the analysis of tubewell deterioration and on the database part of the subproject on Public Tubewell Performance was critically examined and fresh analytical approaches were explored.

Visits to the cooperating organizations of PARC provided an excellent opportunity to review the progress of the subproject on "Improving Efficiency on On-Farm Water Use and Application." As a consequence of these initial visits, it was agreed as desirable, in facilitating the comparison and eventual dissemination of results on the border irrigation procedures across the five locations representing different soils and environments, to hold a four-day training course at the University of Agriculture at

Faisalabad in mid-June 1992. Just like what happened during the trip to Quetta as mentioned earlier, the trip to Gilgit with the PARC Coordinator to review the studies being conducted at the KARINA research site had to be aborted half-way due to a serious religious conflict that suddenly erupted in Gilgit. However, in mid-August 1992 an IIMI team in the company of the USAID ISM/R Project Officer and the PARC subproject coordinator and his associates finally could visit the KARINA research studies in Juglote, Gilgit. The Institute is one of the cooperating institutions conducting studies on trickle, sprinkler and border irrigation. Before visiting the current and proposed field research sites, the Director briefed the group about the work of his Institute and its relevance to irrigated agriculture in the Northern Areas. On 14 November 1992, the PARC coordinator convened a meeting of Principal Investigators involved with the subproject at NARC in Islamabad. The status of the various research studies, the writing of papers for the April Symposium, the preparation for the two-week training on sprinkler and trickle irrigation, and the overseas and local procurement of research equipment by the Commodities Division of USAID were all taken up during the meeting.

The interactions with PCRWR were more in the nature of coming up with a highly focussed workplan considering the realities of the very limited budget available under the CA. This resulted in the decision to utilize the available funding only for continuing and completing the subproject on "Surface Drainage and Water Table Control" and to prepare a Phase II proposal for the subproject on "Encouraging Water User Associations (WUAs) for Better Water Management" to be submitted to USAID for a separate PIL. Despite the military operations going on in late July 1992 in the Sindh province, a joint visit was organized by the Chairman of the PCRWR with his colleagues from the DRIP, and staff of USAID and IIMI to the current and proposed pilot tile drainage sites in the Shikarpur area. The impact of the tile drainage installed was already visible in the older sites where a mixed of cereals, vegetables, sugar cane and fruit trees was being grown. The aspect of economic and social viability was requested to be included in the future reporting of the results in the pilot sites to complement the promising technical findings being obtained. In the case of Phase II of the "Encouraging WUAs for Better Water Management," it was agreed that the emphasis would be in the synthesis of the results of studies conducted in Phase I to evolve a strategy for strengthening WUAs, and the conduct of action research to study in detail the processes of forming or strengthening existing WUAs and the mechanisms of cooperation at the watercourse level for the physical and technological interventions in the two field locations chosen.

With regards to the SID, once it became clear that funds would be provided by USAID with its issuance of PIL 303 for the rehabilitation of the infrastructure component of the subproject on the "Upgradation of the Soil Mechanics and Hydraulics Laboratories at Karachi and Hyderabad," the preparation of a revised workplan and the corresponding equipment list for the two laboratories was attended to in earnest. This necessitated a more careful scrutiny of the proposed equipment list by comparing the

items with those currently being used by the Hydraulics Research Station of the Punjab IRI at Nandipur. The equipment list was also examined by considering the requirements of the proposed physical modeling and monitoring of water quality studies to be conducted. In assessing the staff to be made available to conduct the studies, further hands on training of the junior staff became evident and this was organized in three institutions based in Lahore.

During the quarter preceding the end-of-project Symposium date, the significant interactions between IIMI staff and research staff of collaborating Pakistani institutions were mostly on the preparation of draft Symposium papers and final reports. The interactions consisted mainly of reviewing format, content, outline, initial draft, advanced draft and final version of papers preliminary to printing. After the symposium, the interactions concentrated in encouraging and assisting the different researchers in completing their final reports for each individual studies. A list of the studies is given in Attachment B.

Related to the technical assistance was the more administrative type of interactions needed to sort out issues as they arose on periodic expense reimbursement requests received from the concerned organizations thru the Federal Coordinator prior to the certification by IIMI for reimbursement from the USAID/IIMI Cooperative Agreement. The interactions also included discussions on submission of quarterly and financial reports to IIMI by the collaborating institutions and on some of their staffing and other funding concerns.

Training. Most of the actual training provided in developing research capacity of GOP researchers was thru the various modes of technical assistance interaction of IIMI staff with the researchers. Although the formal training component of the original ISM/R Project involving higher degree education, short term training, internships, study tours, etc. was not included in the CA, it did not take long for the IIMI team to realize that there was a big clamor for short training courses related to some subprojects.

A training course on "Border Irrigation Design and Evaluation" jointly organized by PARC, the UAF, and IIMI was held at the UAF campus on 16-18 June 1992. The training was primarily for the staff of the collaborating institutions (i.e. University of Engineering and Technology, Peshawar; Sindh Agricultural University, Tandojam (SAUT); UAF; KARINA, Gilgit; and Mona Project, Bhalwal) involved in the study on "Improving efficiency of on-farm water use through effective and efficient border irrigation procedures" (see Attachment C). Attendance was good even though the training was scheduled immediately after the Eid holidays. Unfortunately, participants from the SAUT could not come due to special conditions prevailing in the Sindh province. However, seven field staff members including a Deputy Director of the On-Farm Water Management, Punjab, and seven staff members of UAF, in addition to the Principal Investigator, took part in the training. The training provided the participants

an excellent opportunity to discuss key problems associated with surface irrigation methods under Pakistani conditions. Lectures combined with discussions enabled them to have a frank exchange on the merits and demerits of various "basin" and "level" border design and evaluation procedures. Two computer models, "VOLBAL" and "BASCAD," were used to demonstrate their usefulness in the design and evaluation of border irrigation. A one day field demonstration of border irrigation and the required data collection were done at the Post Graduate Agricultural Research Station. The participants' active involvement in the demonstration contributed towards developing their confidence in continuing with the study.

IIMI staff also arranged with the Irrigation Research Institute, Lahore the training of two officers of the Directorate of Hydrology and Research in Sindh on hydraulic modeling; with ACOP-WAPDA the training of two officials on hydraulic monitoring; and with the Land Reclamation Directorate, Punjab, the training of one official on water quality testing. All five officers received their certificates of completion on 14 February 1993 at the ACOP-WAPDA office (Attachment D).

IIMI assisted in formulating a 2-week training on the design and operation of sprinkler and trickle irrigation held on 8 to 21 January 1993 at the NARC Training Institute in Islamabad. Participation was not restricted to ISM/R collaborators only. The forty participants came from various agencies which are currently engaged in sprinkler and trickle research and development such as the On Farm Water Management (OFWM) project, university and NGO staff, and some farmers (Attachment E).

IIMI also provided assistance in developing an expanded version of the on-job training course on surface irrigation which was held at the University of Agriculture, Faisalabad, in June, 1992. The new course was designed to reach a wider audience to meet the great demand. The one-week course was held at the NARC training facilities on 17-22 April 1993 with 43 participants (Attachment F).

### **Biannual Progress and Review Meetings**

Due to the longer time needed to finalize the work plans of PCRWR and SID, only two instead of three Biannual ISM/R Progress Review meetings could be held. The first was held on 24 September 1992 at the Pearl Continental and the second on 25 January 1993 at the Avari Hotel, both in Lahore. The two meetings had a similar format with 20- 30 minutes allotted to each subproject. This included an overview by the subproject leader and individual presentations by the principal investigators and senior and junior research officers. For each study, a brief statement was given on the objectives, findings, conclusions, current status of data collection and analysis, paper and report writing, and future plans. The order of presenting the studies was as follows:

- . Integrated watercourse management
- . Farm water management
- . Beyond watercourse improvement
- . Irrigation systems outside the Indus Basin
- . Development of ground and surface water models
- . Public and private tubewell performance
- . Improving efficiency of on-farm water use and application
- . Encouraging water users associations
- . Surface drainage and water table control program
- . Research studies related to the upgradation of the Hydraulics and Soil Mechanics Laboratories in Hyderabad and Karachi.

In both meetings, the preparations for the end-of-project ISM/R Symposium in mid-April 1993 were taken up. In the second meeting, the group went over the tentative program on such items as the venue, dates, timing, titles of papers, authors, etc., and the list of participants. Any change in title/author(s), deletion/addition of papers was requested to be submitted or communicated before participants left the meeting venue. It was also agreed to hold a technical session on "Irrigation Management Research Agenda of Pakistan for the Future" to precede the closing session. Paper presenters would include Dr. Bashir Chandio who would present the view from PCRWR; from WAPDA, Mr. Muhammad Munir; from PARC, Dr. Shahid Ahmad; and from IIMI for the global view, Dr. Jacob Kijne. In the same meeting, the absolute deadline for receiving the final drafts of papers by IIMI was set on 14 February 1993 so that the papers could be edited, printed and bound to be ready for distribution before the symposium date.

### **Symposium**

As agreed by all concerned parties, the end-of-project symposium to report on the research findings was held as scheduled on 11 to 13 April 1993 at the Government Engineering Academy Punjab, Niaz Beg, Lahore. About 105 participants from WAPDA, PARC, PCRWR, SID, agricultural universities, USAID and IIMI participated. (The symposium program and the participants' list are given in Attachments G and H, respectively).

In his welcome speech during the inaugural session, Mr. Khalid Mohtadullah, Deputy Director General of IIMI, former General Manager for Planning (Water), WAPDA, and also former Chairman of the Technical Advisory Committee of the ISM/R Project, promised IIMI's full support to Pakistan's efforts to do research on environmental and sustainability issues of irrigated agriculture. He highlighted recent IIMI work which points to rapid secondary salinization as threatening the sustainability of the system. Mr. Shams ul Mulk, Member (Water), WAPDA, in his off-the-cuff keynote address, also emphasized the sustainability issues as underpinning the very survival of the country. He exhorted researchers to openly discuss important issues with the political leadership so that the magnitude of the problem is appreciated and necessary support given by the government. He focused on political leadership, political will, political commitment in driving home his views. He encouraged the scientists to provide credible evidence of their work so that it would influence decision making at all levels. Mr. Arnold Radi, Chief, Agriculture and Rural Development, USAID, said that he was happy to see that the ISM/R Project had provided useful results but suggested that these should not be allowed to remain on paper but put to use in the field. He lauded IIMI's contribution in providing very useful technical support to the ISM/R Project. In his inaugural address as Chief Guest, Mr. Raja Mohammad Nadir Pervez, Minister of State for Water and Power, praised the cooperative effort under the Project which had transcended ministerial, provincial and departmental boundaries. He quoted from Mr. McNamara's recent observation about the Indus basin's diminishing ability to sustain its productivity and thereby, emphasized the need to continue the research activities, as were done under the Project, to deal with the complex problems faced. He requested a report of the key research findings, particularly the results of the discussion on an irrigation management research agenda for Pakistan in the future. He concluded by expressing the unqualified support of his good office in the formulation and implementation of such an agenda.

The technical sessions I-VIII were devoted to a presentation/discussion of the researches with a chairman and a rapporteur. Each paper was allotted 15 minutes for presentation and 5 minutes for discussion. After the last paper for each session, an additional 20 minutes was allotted for the discussion of all papers presented during the session. A total of thirty-two papers were presented and discussed. These are documented in 8 volume proceedings (Annexure 2) which were distributed during the symposium. The volume titles are listed below:

- \* Vol. I Integrated Watercourse Management
- \* Vol. II Farm Water Management
- \* Vol. III Role of Water Users in Irrigation Management
- \* Vol. IV Drainage and Water Table Control
- \* Vol. V Groundwater and Physical Hydraulic Modeling
- \* Vol. VI Use of Database and Public Tubewell Performance
- \* Vol. VII Improving On-farm Water Use and Application
- \* Vol. VIII Irrigation Systems Outside the Indus Basin

The discussions were lively and fruitful. The conclusions and recommendations of the various studies as well as the issues which emerged from the discussions were summarized and were presented as research insights learned from the ISM/R Project during the IX technical session on Irrigation Management Research Agenda of Pakistan for the Future.

Session IX was led by a chairman and co-chairman representing agriculture and irrigation to reflect the concerns of these two areas which should jointly be taken into account in formulating a research agenda for irrigated agriculture in general, and irrigation management in particular. It was also meant to highlight the need for Irrigation and Agriculture agencies to work together in the field of irrigated agriculture. The key organizations collaborating in the ISM/R Project which have lead roles in the field of agriculture were invited to present their views on the future research agenda. These organizations are PCRWR, WAPDA, and PARC. IIMI presented the global view. Following the presentations, the two chairmen expressed their general views on the subject. It was pointed out that the broader function of research in the water sector was the realization of optimum efficiency in the development, storage, conveyance, distribution and use of water for agriculture while restoring and sustaining the productivity of the irrigated lands. It was observed that while an infrastructure had been created in various organizations, the effective coordination and integration of research left much to be desired. The introduction of an "integrated and comprehensive management" concept was advocated for enhancing the quality of research. To realize fully the benefits from research and in a timely manner, it was recommended that a mechanism for accountability of individual research organizations should be introduced by establishing linkages between declared goals and achievements. It was emphasized that there should be a strong linkage between theory and practice, and while thoughts of the scientists should be science based, their actions should be farmer based. The group was reminded that when the ISM/R Project had come up for approval before the Planning Commission, it was agreed that the research results from the different agencies would be used in implementing the Irrigation System Rehabilitation Project - the hardware component of the overall Irrigation System Management Project - to bring about more reliable and equitable supply of irrigation water and reduce crop damage due to floods through improved surface drainage. Thus the research was intended not only to result in specific improvements but to provide a means to sustain the efficiency of O&M and foster similar improvements in the future.

In the closing session, representatives of the funding, advisory and coordinating bodies involved in the implementation of the ISM/R Project gave their comments. Both the USAID Project Officer and the Chairman of the CA Planning and Review Committee presented similar assessments of the Project by recalling its start in 1984, its objectives, the involvement of collaborating Pakistani organizations, the technical assistance that was provided by the University of Idaho until December 1990 and IIMI in the last two years, the accomplishments, outstanding problems and the shared



optimism that the research program would continue and that institutions that had been involved and, in some cases, created through the program would continue to function in the future. The IIMI technical assistance coordinator reminded the group about the remaining tasks still ahead before the project's completion. These included sharing expeditiously useful research results with decision makers and views on the future research agenda with the Planning Commission and the Minister of State for Water and Power. The researchers would also have to submit final technical reports for each study, and IIMI a final report on the whole ISM/R Project to USAID. A common appeal to all the participants was made by the three representatives to continue working together in addressing the critical issues in irrigation systems management for a sustainable and profitable irrigated agriculture. The closing session ended with a Vote of Thanks by the Acting Director of IIMI.

Volume IX (Annexure 3) of the ISM/R Symposium Proceedings which was prepared and distributed after the symposium provides a documentation of the highlights of the discussions in the 8 technical sessions and the views expressed towards the formulation of an ISM Research Agenda for Pakistan for the Future. The addresses during the inaugural session as well as the comments during the closing session are also featured.

### **Project Activities Reporting**

Due to the delayed signing of the Cooperative Agreement on 18 September 1991 although it was made effective on 1 August 1991, the first quarterly activities report (September to November 1991) was submitted to USAID on 11 December 1991. A total of six quarterly reports were submitted with the last one on 6 May 1993.

The quarterly activities report described the progress and problems of the various project activities underway and included recommendations on future work with emphasis on plans for the following quarter. An added feature in each report is an attachment containing the chronology of interaction visits and meetings in implementing the ISM/R component of the CA.

The first quarterly report featured the indicative workplan for implementing the ISM/R Project which detailed the implementing procedure and schedule of activities. The second quarterly report (December 1991 to February 1992) presented the technical assistance scheme in the deployment of IIMI staff providing the needed assistance to the different subprojects/studies already underway and still to be formulated. The third report (March to May 1992) dwelt on how IIMI had implemented fully its intention to intensify its provision of technical assistance as expressed in the second report. The fourth report (June to August 1992) highlighted IIMI's concluding the last sub-grant MOU and USAID's extending additional funding to WAPDA institutions to ensure successful completion of their research and production of quality reports. The fifth report (September to November 1992) described a full array of project activities

which included the holding of the First Biannual ISM/R Progress Review Meeting, initial preparation for the mid-April ISM/R symposium, steps taken towards implementing the studies included in the recently concluded subgrant MOU with the Directorate of Hydrology and Research in Sindh (DHRS), and assistance provided to PARC and the DHRS in formulating and arranging training courses. The sixth and final quarterly report (December 1992 to February 1993) described the holding of the Second Biannual ISM/R Progress and Review Meeting in which important details on the preparation of the 11-13 April 1993 ISM/R Symposium were discussed, the further intensification of technical assistance to collaborating institutions in data collection/analyses and in writing quality symposium papers/reports, and the assistance to NARC in additional on-the-job training courses.

This report constitutes the final report on all the Project activities with emphasis on the end-of-project ISM/R Symposium and the submission of final technical reports for each study conducted under the Project.

### **SCHEDULE OF SIGNIFICANT PROJECT ACTIVITIES**

Below is a schedule of significant project activities:

<u>Date</u>	<u>Description of Project Activity</u>
28 July 1991	Meeting in the Office of the Additional Secretary (Water) of the Ministry of Water and Power convened by Mr. F. H. Usmani to discuss the implementation of decisions reached in an earlier meeting on 22 May 1991, considering funding and time constraints.
28 October 1991	Meeting convened by the General Manager (Planning), as Chairman of the CA Planning Review Committee, in his WAPDA House Office, to discuss reimbursement of expenditures incurred during 1 January- 31 July 1991 and other outstanding issues related to implementation of the CA such as the revision of workplans of various research institutions thru working meetings with IIMI
8 January 1992	Meeting of the Advisory/Coordination Committee chaired by the Chief Engineering Advisor, GOP, in the Office of the Chief Engineer (P&I), WAPDA, to discuss, among others, the allocation of funds available under the CA and the mode of submission of reimbursement requests for expenses incurred beginning 1 August 1991 with WAPDA indicating that its field research activities would end in June 1992 and the remaining

- institutions continuing until May 1993 including the analysis and report writing by WAPDA
- 14 January 1992      Signing of Subgrant MOU between PARC and IIMI
- 18 March 1992      Signing of Subgrant MOU between WAPDA and IIMI
- 19 May 1992        Signing of Subgrant MOU between PCRWR and IIMI
- 16-18 June 1992    Holding of training course on border irrigation design and evaluation jointly organized by PARC, UAF and IIMI at the UAF campus
- 6 August 1992      Meeting organized and chaired by Mr. Muhammad Munir, Chief Engineer, (P&I), WAPDA, at his office, in which Mr. Jan Emmert announced that USAID would grant additional funding through a separate PIL for concluding the ISM research being carried out by WAPDA in 1992-93 through the production of high quality research reports with maximum utilization of the technical assistance provided by IIMI
- 10 August 1992     Signing of last Subgrant MOU between the Directorate of Hydrology and Research in Sindh and IIMI
- 24 September 1992   Holding of the First Biannual ISM/R Progress and Review Meeting, 9:00 A.M.- 4:00 P.M., at the Pearl Continental Hotel, Lahore
- 14 November 1992   Meeting of the Principal Investigators working with the PARC Coordinator on the subproject on "Improving efficiency of on-farm water use and application"
- 8-21 January 1993   Holding of 2-week training on the design and operation of sprinkler and trickle irrigation at the NARC Training Institute in Islamabad
- 25 January 1993     Holding of the Second Biannual ISM/R Progress and Review Meeting, 9:00 A.M.- 4:00 P.M., at the Avari Hotel in Lahore
- 11-13 April 1993    Holding of the end-of-project ISM/R Symposium at the Government Engineering Academy Punjab, Niaz Beg, Lahore
- 17-22 April 1993    Holding of one-week course on-job training on surface irrigation at the NARC Training Institute in Islamabad

31 May 1992

End date of the ISM/R Project

## **ACCOMPLISHMENTS**

The ISM/R Project has been able to attain its basic objective of assisting GOP research organizations in selected research programs in enhancing their research capacity and in disseminating their research findings. This assessment was aptly expressed by the chief guest in his inaugural speech during the end-of-project April 1993 symposium. He cited as proof the fact that the symposium was being held to report on useful findings of the research studies. Over and above the development of the research capacity of a cadre of staff was the establishment of working relationships which transcended ministerial, provincial and departmental boundaries.

Some of the more tangible accomplishments of the Project in the last two years are the preparation of the following documents:

- \* Consolidated workplans for each of the studies under the different subprojects (Annexure 1)
- \* Equipment lists, specifications, cost estimates and suppliers for research commodities required by PARC and the Directorate of Hydrology and Research in Sindh in their respective subprojects (Annexure 1)
- \* Six quarterly activities project reports submitted to USAID
- \* Nine volumes of the 11-13 April 1993 Symposium proceedings (Annexures 2 and 3)
- \* Final technical reports submitted by research investigators for each study (Annexure 4)
- \* Final project report (this report) to USAID

The Project was able to organize the following meetings:

- \* Four policy and review meetings involving the membership of the CA Planning and Review Committee to discuss the scope of the project and implementation procedures, and sort out funding issues
- \* Two Biannual Progress Review meetings to provide opportunities to the researchers to present research results obtained thus far and exchange experiences

- \* End-of-project ISM/R Symposium to present, disseminate and discuss research findings with a wider audience, including target end users of research results and recommendations

The Project encouraged and supported the following training activities:

- \* Training course on border irrigation design and evaluation jointly organized by PARC, UAF and IIMI at the UAF campus
- \* Two-week training course on design and operation of sprinkler and trickle irrigation at the NARC Training Institute in Islamabad
- \* One-week training course on surface irrigation at the NARC Training Institute in Islamabad
- \* Training of five staff of the Directorate of Hydrology and Research in Sindh: two staff in Hydraulic Modeling at the Irrigation Research Institute, Lahore; two staff in Hydraulic Monitoring at the ACOP-WAPDA, Lahore; and one staff in Water Quality Testing at the Directorate of Land Reclamation, Punjab, Lahore

During the IX Session of the Symposium, the Project was able to provide a forum for the consideration of not only national but also global diverse viewpoints, the priorities as they were perceived, the research objectives which should be met and how the overall research effort could contribute to the country's development needs in irrigated agriculture. Hopefully, the deliberations of the Symposium would eventually lead to the formulation and implementation of a more effective research agenda in irrigation management.

Some key issues that emerged during the technical sessions of the Symposium for consideration in developing an immediate research agenda to build on the Project are the following:

- Policies and accompanying procedures to update databases through a continuing monitoring program and make them more useful and user friendly such as those for public tubewells, watercourse performance evaluation, water quality, etc.;
- More effective approaches to be developed to encourage water user associations to undertake organized activities such as tile drainage installation and maintenance, mechanized watercourse construction and maintenance, conjunctive use of groundwater with canal water, watercourse and water distributary delivery management;

- Ways to reduce the cost of tile drainage installation, buried irrigation pipe, trickle and sprinkler irrigation;
- Further demonstration and determination of the technical and socioeconomic viability of high efficiency water application systems such as trickle, bubbler, raingun sprinkler and modified furrow system for orchards and other high value crops in water scarce areas as in Balochistan;
- Use of computer simulation models to match crop water requirements with water supply for possible irrigation advisory services, tile drainage and skimming well design, and groundwater movement prediction; as a decision support tool to improve equity of water delivery to outlets along a distributary and to optimize the effect of desilting for more equitable water distribution;
- Further use of physical hydraulic modeling for designing silt excluders/ejectors not only for channels but also for structures like delay dams recommended for recharging karezes; and
- Development of improved machinery with equipment manufacturers and dealers for forming broad beds and furrows found essential under shallow watertable conditions and for mechanized watercourse construction and maintenance.

## LESSONS LEARNED

According to the USAID ISM/R Project Officer, when the project was conceived in 1984 it was meant to have basically two objectives: first, to enhance the capacity of the collaborating GOP research institutions (institution building); and second, to assist in priority research programs. Both of these objectives were pursued simultaneously. There are a number of institutions which have been either strengthened through this project or supported by it, such as research organizations like WAPDA, MONA, DRIP and LIM. There are monitoring organizations like SMO, WAPDA, WMED; planning organizations, especially Planning Directorate (South), which have been strengthened and made into some sort of research organization doing research work for planning purposes. Emphasis was also given to strengthen organizations for coordination of research and information sharing. With that idea in mind, two committees were set up: research advisory committee and technical coordination committee. To fill the gap of information sharing, an institution called National Documentation Center, Library and Information Network (NADLIN) was established within PCRWR. NADLIN has the potential of being a resource base for information but has yet to be effectively utilized. Another institution called Competitive Grants Program was initiated and established also within PCRWR. Under this project, there is a procedure through which research subgrants are awarded on a competitive basis to do research focused on a particular subject. However, as was pointed out by several speakers during the Symposium, until now individual scientists can do very good work but either the results are not

shared by others or there is a lack of coordination among different research organizations.

Organizations that have coordination role are PCRWR, PARC, P&I Organization (WAPDA) and IWASRI. The University of Idaho and later, IIMI filled the day-to-day research coordination role among these organizations as they were involved in the ISM/R Project. Policy questions were referred to the advisory/technical/review committee(s) for resolution. With the completion of the ISM/R Project, the need has been expressed to put in place a coordination set up to enable various institutions involved in the Project to continue to work together effectively. Moreover, the Symposium discussions gave an indication that aggressive effort is needed to establish links to action agencies of one kind or another, including provincial agriculture departments, irrigation departments, the On-Farm Water Management and Command Water Management Programs, regular extension staff, some progressive farmers and private sector representatives. These agencies/bodies are not only to be recipient of the products of research but should actively participate in the definition of research needs and in their execution as well.

The coordination set-up suggested can likewise address the rivalries observed by the Director of Research of IIMI between institutions under the Ministries of Science and Technology, Water and Power, and Agriculture, which explains the fragmentation of much of the research. He commented that one may expect that the research institutions which are part of a line agency such as the Irrigation Research Institutes, have a close link with the operating arms of the agencies. However, he felt that it still remains questionable whether the right research questions are being asked, and whether the research results are going to be communicated and accepted across agency boundaries.

According to the Deputy Director General of IIMI, because IIMI came towards the end of the project, it can neither take full credit nor full responsibility for shortfalls in the Project, if any. IIMI has found the assignment both challenging and rewarding. The opportunity to work with and support national institutions was particularly satisfying. Being accepted as a sincere and impartial convenor of meetings that brought together competing and rival organizations was an added bonus to IIMI. It is encouraged to continue and even enhance the working and trusting relationships that it has established under the Project.

## **RECOMMENDATIONS**

The various Symposium speakers provided their well-considered assessment of irrigated agriculture in Pakistan - its current state, problems and potential, what needs to be done, and the critical role of research. The subsequent section may be considered as the recommendations that have come out of the ISM/R Project.

In his welcome address, the Deputy Director General of IIMI stated that Pakistan faces a big challenge. On the one hand, its land and water resources constitute one of Asia's main food production systems that have the potential to not only feed its own population but also meet food needs of regional countries which are not so fortunately endowed, and yet on the other hand, there is growing evidence that these valuable resources are rapidly degrading, and thus threatening their sustainable productivity. He added that the Indus Basin, the world's largest contiguous irrigation system, has a serious environmental problem: salt and water balance is seriously in error, the performance of its vast irrigation network is rapidly becoming inequitable, inflexible, undercontrolled and unreliable - exactly the kind of factors that modern agriculture systems cannot allow to exist if growth and productivity objectives are to be achieved. According to him, the heart of the effort required to reverse these adverse environmental trends in Pakistan's irrigated agriculture is research and capacity building - the very same effort that the ISM/R tried to promote and build up.

A similar assessment was made by the Member (Water), WAPDA, in his keynote address where he underlined the value of research in irrigated agriculture as a key investment for the very survival of the country. He lamented the fact that research has not acquired the level of credibility with the result that policy makers and the people responsible for financing do not allocate to research the amount of resources needed. He cautioned, however, that unless the totality of problems is considered which includes prominently management issues as now being addressed by IIMI, the temptation would be to go into capital intensive solutions. He suggested to bring the issues more often to public attention and to the political leadership through workshops, seminars, conferences, etc. He observed that the coordination needed for such a concerted effort had been shown, proved and documented as part of the ISM/R Project.

During the symposium, a session on an irrigation system management research agenda for the future in Pakistan, the IIMI Director of Research presented the global view. He pointed out an apparent constraint in implementing such an agenda which is the division of responsibilities. He mentioned the well-known tension between irrigation and agriculture and the rivalries among institutions under the Ministries of Science and Technology, Water and Power, and Agriculture, which explains the fragmentation of much of the research. A similar observation was expressed by the PCRWR Chairman and the Chief Engineer, P&I, WAPDA when they presented their agencies' views. They noted the lack of coordination among research agencies which have developed a habit of working in isolation and are wasting funds on duplicating efforts than complementing and sharing their resources with sister organizations.

A consensus emerged during the Symposium that coordination among various research institutions similar to the pattern achieved under the Project needs to be continued and strengthened. In this regard, according to the General Manager Planning (Water) WAPDA, the Chairman of the CA Planning and Review Committee,



the beneficiaries of the ISM/R activity are the irrigation and agriculture sectors. He said that the participation of provincial irrigation departments was conceived through their representation in the Coordination Committee, and that of the agricultural sector through PARC. Unfortunately the participation of the real beneficiaries, i.e. the farmers who are ultimately to use the results of research, is absent. The importance of farmer orientation of research was reinforced by the PARC Chairman. Such a coordination could be provided by a committee, building on the one set up for the ISM/R Project, with a rotating chairman among members from the Ministry of Water and Power, PARC, PCRWR, WAPDA, four provincial irrigation and agricultural departments, Water and Agriculture Divisions of the Planning Department, the private sector, and IIMI. The possible role of IIMI was highlighted by the Chief, Agriculture and Rural Development, USAID, in his address during the inaugural session of the Symposium. He stated that with IIMI firmly established in Pakistan, it can synthesize and adapt regional experiences to Pakistani conditions while working with national organizations in a collaborative mode. The primary functions of the committee would be to determine priorities for research, establish policies for conducting research by research institutions to avoid unnecessary duplication and fragmentation, and review and advise on implementation aspects. One of the first activities of the committee could be to deliberate on the views presented during the session on an irrigation management research agenda for Pakistan. Incidentally, a similar committee already exists in the Consultative Committee of IIMI-Pakistan which only lacks a representative from PCRWR.

Considering the importance of water resources and agriculture to Pakistan's economy, the PCRWR view is that the research agenda should pass the following tests:

- \* It should be a doable program within a given time frame.
- \* The benefits of a research program should be quantifiable.
- \* Research should be end-user oriented and collaborative.
- \* End-users should be identified and involved at the planning stage of an R and D program.
- \* Environmental impacts of a development program should be properly looked into and the research project should highlight measures to overcome the consequent environmental degradation vectors.

The USAID representative concluded his address by saying that he agreed with the Member, Water, WAPDA that good work done in research has to be supported financially. According to the Chief, Water Resources Planning Division of the GOP, an indication of adequate funding is at the level of 2.5 to 3.0 percent of the development outlays.

Finally, there is an appeal directed at all those involved with the Project to have continued interest in working together in addressing the critical issues in irrigation systems management for a sustainable and profitable agriculture to be embodied hopefully in a research agenda the formulation of which was encouraged during the end-of-project symposium.

## TECHNICAL ASSISTANCE FOR THE ISM/R COMPONENT OF THE CA

Research Area/Title of Study	Principal Investigator (Agency)	IIMI Staff Providing TA
<b>A) Integrated Watercourse Management:</b>	<b><u>WAPDA</u></b>	
1. Mechanized construction and maintenance of earthen watercourse	)	)
2. Buried pipeline for watercourse	)	)
3. Water supply augmentation with fractional tubewells	) <b>MONA**</b> ) <b>LIM</b>	)
4. Effective water distribution in watercourse command	)	) <b>Senen M. Miranda*</b> M. Akhtar Bhatti Erik van Waijjen
5. Matching cropping pattern with water supply	)	)
6. Monitoring irrigation water flows in a sub system	)	)
7. Development and testing of tile drainage and reuse of drainage water	)	) <b>J.W. Kijne</b>
<b>B) Farm Water Management:</b>		
1. Water management strategies for areas with poor drainage	) <b>MONA</b> ) <b>LIM</b>	) <b>J.W. Kijne*</b> Marcel Kuper
2. Use of brackish groundwater for crop production	)	) <b>Senen M. Miranda</b> M. Akhtar Bhatti
3. Irrigation and nitrogen fertilizer management	)	)
4. Biotic and chemical reclamation of sodic soils	)	)
5. Salt balance at root zone	)	)

Research Area/Title of Study	Principal Investigator (Agency)	IIMI Staff Providing TA
<b>C) Beyond Watercourse Improvements:</b>		
1. Training of the directorate's staff in quantitative, socio-economic, and salinity evaluation methods	) ) ) ) <b>WMED</b> ) )	) ) <b>D.T. Bandaragoda*</b> ) Zaigham Habib ) Pierre Strosser ) )
2. Features of watercourse	) )	) )
3. Existing flows in watercourses as compared to design discharge	) )	) <b>Senen M. Miranda</b> ) <b>M. Akhtar Bhatti</b> )
<b>D) Irrigation Systems Outside the Indus Basin</b>		
<u>Karez Irrigation</u>	) )	) )
1. Monitoring and evaluation of improved karezes Abdul Hakim, Khanozai, and Jungle Bundat	) ) ) )	) ) ) )
2. Preparation of plan for rehabilitation and improvement of karezes in Balochistan	) ) ) )	) ) ) )
3. Effect of Karez improvement on cropping pattern, intensity and yield of crops	) ) ) )	) ) ) )
4. Effect of phosphorus on onion yield irrigated with saline sodic water of Abdul Hakim Karez	) ) ) )	) <b>Carlos Garces*</b> ) <b>M. Akhtar Bhatti</b> ) Pierre Strosser
5. Improvement of Kala Cheena Karez	) <b>PD(S)</b> ) )	) <b>Marcel Kuper</b> ) <b>Senen M. Miranda</b> )
6. Improvement of Tungi karez and monitoring	) ) )	) ) )
7. Effect of delay action dams in Ziarat valley on karez discharge and its economic evaluation	) ) ) )	) ) ) )

Research Area/Title of Study	Principal Investigator (Agency)	IIMI Staff Providing TA
<u>Salaba Irrigation</u>	)	)
1. Monitoring and evaluation of improved salaba scheme of Hamid-ullah and Nali Killi (Loralai)	)	)
<u>Well Irrigation</u>	)	)
1. Monitoring and evaluation of different advanced irrigation systems installed by using dugwell in kuchlak	)	)
<u>Other Studies</u>	)	)
1. Installation of low head bubbler in Mastung area for increasing irrigation efficiency	)	)
<u>Northern Areas</u>	)	)
1. Experimental improvement of one irrigation scheme in Northern area and its monitoring	)	)
<b>E) Development of Ground and Surface Water Models.</b>	)	)
1. Solute Transport Model Study of Allahabad Unit SCARP-VI	) SMO	) <b>Mohammad Nadeem</b> ) Senen M. Miranda ) Zaigham Habib
2. Development of a General Purpose Finite Difference Two dimensional digital model	)	) M. Akhtar Bhatti )

Research Area/Title of Study	Principal Investigator (Agency)	IIMI Staff Providing TA
<b>F) Public and Private Tubewell Performance</b>		
1. Development of computerized data base for public tubewells	)	)
	)	)
2. Identification of causes of tubewell deterioration through data analysis	)	) <b>E.J. Vander Velde*</b>
	) <b>SMO</b>	) M. Badruddin
	)	) Zaigham Habib
3. Development of tubewell rehabilitation techniques	)	) J.W. Kijne
	)	) Senen M. Miranda
	)	)
4. Investigation of causes of early deterioration of tubewells	)	)
	)	)
<b>G) Improving Efficiency of On-farm Water Use and Application</b>	<b><u>PARC</u></b>	
1. Improving efficiency of on-farm water use through effective and efficient border irrigation procedures	)	)
	) <b>UAF, SAU***</b>	)
	) <b>UE, MONA</b>	)
	)	) <b>Senen M. Miranda*</b>
	)	) M. Akhtar Bhatti
2. Improving efficiency of on-farm water use through sprinkler and drip irrigation	)	) <b>Marcel Kuper</b>
	) <b>NARC, DFDC</b>	)
	) <b>KARINA</b>	)
	)	)
3. Management strategies for improving efficiency of water use under farmer managed irrigation systems	)	)
	) <b>NARC</b>	)
	)	)
<b>H) National Documentation Center, Library and Information Network (NADLIN)</b>	<b><u>PCRWR</u></b>	)
	)	)
	)	) <b>D.T. Bandaragoda*</b>
<b>I) Competitive Grants Program (CGP)</b>	)	) <b>Senen M. Miranda</b>
	)	)
<b>J) Encouraging Water Users Program (EWU)</b>	)	)
	)	)
<b>K) Surface Drainage and Water Table Control Program</b>	) <b>DRIP</b>	) <b>J.W. Kijne</b>
	)	) <b>Senen M. Miranda</b>
<b>L) Soil Mechanics and Hydraulics Lab Karachi and Hyderabad</b>	) <b><u>SID</u></b>	) <b>Senen M. Miranda*</b>
	)	) <b>Bagh Ali Shahid</b>
	) <b>DHRS</b>	) <b>M. Akhtar Bhatti</b>
	)	)

\* Lead Person

\*\* Principal Investigators (Agencies)

**WAPDA** - Water and Power Development Authority  
**LIM** - Lower Indus Water WP and Reclamation Research Project  
**MONA** - Mona Reclamation Experimental Project  
**SMO** - SCARP Monitoring Organization  
**PD(S)** - Planning Directorate (South)  
**WMED** - Watercourse Monitoring and Evaluation Directorate

**PARC** - Pakistan Agricultural Research Council

**PCRWR** - Pakistan Council of Research in Water Resources  
**DRIP** - Drainage and Reclamation Institute of Pakistan

**SID** - Sindh Irrigation Department  
**DHRS** - Directorate of Hydrology and Research in the Sindh

\*\*\* Research Institutions Collaborating with **PARC**

**DFDC** - Deciduous Fruit Development Centre, Quetta  
**KARINA** - Karakorum Agricultural Research Institute for Northern Areas  
**MONA** - Mona Reclamation Experimental Project  
**NARC** - National Agricultural Research Centre  
**SAU** - Sindh Agriculture University, Tandojam  
**UAF** - University of Agriculture, Faisalabad  
**UET** - University of Engineering and Technology, Peshawar

## ISM/R FINAL TECHNICAL REPORTS LIST

Subproject	Title of Study	Investigator Agency
<ul style="list-style-type: none"> <li>• INTEGRATED WATERCOURSE MANAGEMENT</li> </ul>	<ul style="list-style-type: none"> <li>• Mechanized Construction and Maintenance of Earthen Watercourse.</li> <li>• Buried Pipeline for Watercourse</li> <li>• Water Supply Augmentation with Fractional Tubewells.</li> <li>• Effective Water Distribution in Watercourse Command.</li> <li>• Matching Cropping Pattern with Water Supply.</li> <li>• Monitoring Irrigation Water Flows in a Sub-system.</li> <li>• Developing and Testing of Tile Drainage Farm Level.</li> <li>• Impact of Buried Pipeline Irrigation System on Farm Economy at Tubewell No. MN-144</li> <li>• Bench Mark Survey of Buried Pipeline Irrigation System at Tubewell No. MN-144</li> <li>• Agro-economic Evaluation of Mutually Installed "On Farm Tile Drainage".</li> </ul>	<p>Mona Reclamation Experimental Project P&amp;I, WAPDA, Bhalwal</p>
	<ul style="list-style-type: none"> <li>• Water Supply Augmentation with Fractional Tubewells</li> </ul>	<p>Lower Indus Water Management and Reclamation Research Project, P&amp;I, WAPDA, Hyderabad</p>



Subproject	Title of Study	Investigator Agency
<ul style="list-style-type: none"> <li>• FARM WATER MANAGEMENT</li> </ul>	<ul style="list-style-type: none"> <li>• Water Management Practices for Wheat Crop Under High Watertable Conditions</li> <li>• Effect of Irrigation and N Fertilizer on Crop Yield, N Uptake and Soil N Status.</li> <li>• Effect of N Sources and Timing of Application on Crop Yield and Nitrogen Movement.</li> <li>• Use of Brackish Groundwater for Crop Production</li> <li>• Biotic and Chemical Reclamation of Saline Sodic Soils.</li> </ul>	<p>Mona Reclamation Experimental Project P&amp;I, WAPDA, Bhalwal</p>
	<ul style="list-style-type: none"> <li>• Water Management Strategies for Areas with Poor Drainage or Shallow Watertable Conditions</li> <li>• Use of Brackish Groundwater for Crop Production</li> </ul>	<p>Lower Indus Water Management and Reclamation Research Project, P&amp;I, WAPDA, Hyderabad</p>
<ul style="list-style-type: none"> <li>• BEYOND WATERCOURSE IMPROVEMENT</li> </ul>	<ul style="list-style-type: none"> <li>• Pattern of Flow Variations in Distributaries and Reachwise Supply to Outlets</li> </ul>	<p>Watercourse Monitoring &amp; Evaluation Directorate, P&amp;I, WAPDA, Lahore</p>
<ul style="list-style-type: none"> <li>• IRRIGATION SYSTEMS OUTSIDE THE INDUS BASIN</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced Irrigation Application Techniques and Their Use in Balochistan</li> <li>• Effect of Brackish Water and Phosphorus on Yield of Onion</li> <li>• Economic and Financial Evaluation of Delay Action and Storage Dams in Ziarat Valley</li> <li>• Plan for Rehabilitation and Improvement of Karez</li> <li>• Monitoring and Evaluation of Karez Improvement (still to be submitted)</li> </ul>	<p>Planning Directorate (South), P&amp;I, WAPDA, Lahore</p>

Subproject	Title of Study	Investigator Agency
<ul style="list-style-type: none"> <li>• DEVELOPMENT OF GROUND AND SURFACE WATER MODELS</li> </ul>	<ul style="list-style-type: none"> <li>• Interaction of Saline and Fresh Water Zones in Allahabad Unit (SCARP-VI)</li> <li>• 'ZAMANHYD' A Package for Preparing Data for Regional Groundwater Flow Models</li> </ul>	SCARPs Monitoring Organization, WAPDA, Lahore
<ul style="list-style-type: none"> <li>• PUBLIC AND PRIVATE TUBEWELL PERFORMANCE</li> </ul>	<ul style="list-style-type: none"> <li>• A Data Base of SCARPs Tubewells</li> <li>• The Preparation of Computerized Database for SCARPs Tubewells</li> <li>• Development of Methods of Tubewell Rehabilitation</li> <li>• Factors Associated with Deterioration of SCARP Tubewells</li> </ul>	SCARPs Monitoring Organization, WAPDA, Lahore
<ul style="list-style-type: none"> <li>• IMPROVING ON-FARM WATER USE AND APPLICATION</li> </ul>	<ul style="list-style-type: none"> <li>• Water Application Methods - Surface</li> <li>• Water Application Methods - Special</li> <li>• Water Application Practices</li> </ul>	Water Resources Research Institute, NARC, PARC, Islamabad
<ul style="list-style-type: none"> <li>• ENCOURAGING WATER USERS ASSOCIATIONS</li> </ul>	<ul style="list-style-type: none"> <li>• Pre Project Socio-Economic Study for the Action Research Program on Encouraging Water Users Associations at Qadirabad and Bara Drush Khela Research Sites - Part I</li> <li>• Action Research Plan of Encouraging Water Users Association at Qadirabad and Swat - Part II</li> <li>• Potential Role of Water Users Associations for Better Water Management at the Farm Level: Synthesis of Nine Studies</li> </ul>	Pakistan Council of Research in Water Resources, Islamabad
<ul style="list-style-type: none"> <li>• SURFACE AND WATER TABLE CONTROL</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring of Tile Drainage Units</li> <li>• Development of Computer Model for Horizontal-Vertical Drainage System</li> </ul>	Drainage and Reclamation Institute of Pakistan, PCRWR, Tando Jam

Subproject	Title of Study	Investigator Agency
<ul style="list-style-type: none"> <li>• PHYSICAL HYDRAULIC MODELING OF IRRIGATION FACILITIES AND MONITORING OF IRRIGATION WATER (UPGRADATION OF THE HYDRAULICS AND SOIL MECHANICS LABORATORIES IN HYDERABAD AND KARACHI)</li> </ul>	<ul style="list-style-type: none"> <li>• Effect of Downstream Glacis Slope on Scour</li> <li>• Design of Vortex Tube Sediment Ejectors for the Jamrao Canal</li> <li>• Collection of Hydrological Data and Monitoring of Irrigation Water in the Province of Sindh</li> </ul>	Directorate of Hydrology and Research in Sindh, Sindh Irrigation Department Hyderabad

**TRAINING ON BORDER IRRIGATION DESIGN AND EVALUATION**  
**16-18 June 1992**  
**University of Agriculture Campus, Faisalabad**

**LIST OF PARTICIPANTS**

**Pakistan Agricultural Research Council, Islamabad**

1. Dr. Shahid Ahmad Director, WRRI, NARC, Islamabad
2. Muhammad Yasin SSO, WRRI, NARC, Islamabad

**University of Engineering & Technology, Peshawar**

3. Prof. Badruddin, Chairman, Agricultural Engineering Department
4. Dr. Muhammad Jamal Khan Asst. Professor, Agricultural Univ., Peshawar

**University of Agriculture, Faisalabad**

5. Ch. Arshad Ali Chairman, Irrigation & Drainage
6. Dr. Abid Hussain Associate Professor, Agronomy
7. Mr. Qurban Ali Awan Associate Professor, Irrigation & Drainage
8. Mr. Allah Bakhsh Lecturer, Department of Irrigation
9. Mr. Saud Akbar Lecturer, Department of Basic Engineering
10. Mr. Muhammad Younis Lecturer, Department of Farm Machinery & Power
11. Mr. Sadiq Anwar Lecturer, Department of Farm Machinery & Power
12. Mr. Abdus Sattar Ph.D. Student in Agronomy

**Mona Reclamation Experimental Project, WAPDA, Bhalwal**

13. Mr. Zahir Ahmad Piracha Senior Engineer
14. Mr. Manzoor Ahmad Junior Engineer

**On-Farm Water Management Directorate, Punjab**

15. Mr. Maher Allah Ditta Deputy Director (IA), OFWM, Lahore
16. Mr. M. Maqsood Gill Assistant Agricultural Engineer, OFWM, Lahore
17. Mr. Fazal Din Assistant Agronomist, OFWM, Lahore
18. Mr. Bashir Ahmad Water Management Officer, OFWM, Faisalabad
19. Mr. Fayyaz-ul-Hassan Sahi Assistant Agronomist (WLD), OFWM, Rawalpindi
20. Mr. Muhammad Arshad Water Mgmt. Officer (WLD), OFWM, Rawalpindi
21. Mr. Liaqat Ali Assistant Agriculture Engineer, Sialkot

**IIMI Pakistan**

- |                          |   |
|--------------------------|---|
| 22. Dr. J.W. Kijne       | Director (First day only)                         |
| 23. Dr. S. M. Miranda    | Sr. Irrigation Specialist (1st day & last 2 days) |
| 24. Dr. M. Akhtar Bhatti | Principal Irrigation Engineer                     |

**TRAINING OF DEPARTMENT OF HYDROLOGY AND RESEARCH IN SINDH OFFICERS**

**LIST OF PARTICIPANTS**

Participants		Training Duration	Training Subject	Training Agency
1	Mr. Rafiq Ahmad Arain Research Assistant	20-12-92 to 14-2-93	Hydraulic Modelling	Irrigation Research Institute, Lahore
2	Mr. Habibullah Dayo Research Assistant	-do-	-do-	-do-
3	Mr. Mohammad Abid Khan Research Assistant	20-12-92 to 31-1-93	Water Quality Testing	Directorate of Land Reclamation, Punjab Lahore
4	Mr. Altaf Hussain Agro Sub Engineer	20-12-92 to 14-2-93	Hydraulic Monitoring	ACOP, WAPDA, Lahore
5	Mr. Muzammil Ali Sub Engineer	-do-	-do-	-do-

**ON-JOB TRAINING COURSE ON SURFACE IRRIGATION SYSTEMS**  
**17-22 April, 1993**  
**NARC, Islamabad**

**LIST OF PARTICIPANTS**

**ON-FARM WATER MANAGEMENT, PUNJAB**

- |     |                             |                                  |
|-----|-----------------------------|----------------------------------|
| 1.  | Mr. Ashfaq Ahmad            | Assistant Agronomist, D.G. Khan  |
| 2.  | Mr. Muhammad Jamil          | AAE, Muzaffargarh                |
| 3.  | Mr. Muhammad Naseem Akhtar  | Assistant Agronomist, Faisalabad |
| 4.  | Mr. Muhammad Afzal Bajwa    | Assistant Agronomist, Faisalabad |
| 5.  | Mr. Munir Ahmad             | Assistant Agronomist, Khushab    |
| 6.  | Mr. Anwar-ul-Haq Shahzad    | Assistant Director, Vehari       |
| 7.  | Mr. Mohammad Khalid Mahmood | Assistant Director, Shahkot      |
| 8.  | Mr. Muhammad Asif           | Assistant Agronomist, Lahore     |
| 9.  | Mr. Raees Ahmad             | T.O. Multan                      |
| 10. | Mr. Abu-ul-Barkat F. Nadeem | AAE, Multan                      |
| 11. | Mr. Inam Ullah              | AAE, Bahawalpur                  |
| 12. | Mr. Muhammad Ashraf         | WMO, OFWM, Rawalpindi            |

**ON-FARM WATER MANAGEMENT, RAWALPINDI**

- |     |                         |               |
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| 13. | Mr. Basharat Aziz       | AAE, Mianwali |
| 14. | Mr. Muhammad Asghar Ali | AAE, Khushab  |

**AGRICULTURAL ENGINEERING AND WATER MANAGEMENT, SINDH, HYDERABAD**

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|-----|------------------------------|--------------------------------|
| 15. | Mr. Muhammad Waseem Siddiqui | WMD, Hyderabad                 |
| 16. | Mr. Manzoor Hussain Samoo    | Assistant Agronomist           |
| 17. | Mr. Mansoor Ahmad            | WMO, Mirpur Khan               |
| 18. | Mr. Tofique Ahmad Soomro     | Assistant Agriculture Engineer |

**ON-FARM WATER MANAGEMENT, NWFP**

- |     |                        |                               |
|-----|------------------------|-------------------------------|
| 19. | Mr. Bashir Ahmad       | Deputy Director, Mardan       |
| 20. | Mr. Ijaz Ahmad Khattak | Assistant Director, Charsadda |
| 21. | Mr. Mohammad Amirullah | Deputy Director, Peshawar     |
| 22. | Mr. Imam Ali Khan      | Assistant Director, Mardan    |

**AGRICULTURE RESEARCH INSTITUTE, TANDO JAM, SINDH**

23. Mr. Muhammad Umar Sial                      Agronomist

**NIAB, FAISALABAD**

24. Mr. Riaz Ahmad Waheed                      SSO

**SINDH AGRICULTURE UNIVERSITY, TANDO JAN**

25. Mr. Daulat Khan                              Lecturer

**UNIVERSITY COLLEGE OF AGRICULTURE, RAWALAKOT, AJK**

27. Dr. Muhammad Ilyas                          Associate Professor

**LAND RECLAMATION DIRECTORATE, LAHORE**

28. Mr. Azfar Hussain                              Research Assistant

**WRRI, NARC, ISLAMABAD**

29. Mr. Mohammad Mazhar Saeed              AE

30. Mr. Muhammad Aslam                        AE

31. Mr. Jehanzeb Khan                            AE

32. Mr. Muhammad Aslam                        SO

33. Mr. Arshad Ashraf                            SO

34. Mr. M. Munir Ahmad                        SO

35. Mr. Muhammad Riaz                           AE

36. Muhammad Khan Nadeem                    AE

**ON-FARM WATER MANAGEMENT, QUETTA**

37. Mr. Saeed Ahmad                              Assistant Agronomist

**SARHAD RURAL SUPPORT PROGRAMME, 109, DEFENCE HOUSING SOCIETY, PESHAWAR**

38. Mr. Ijaz Hussain Rizvi                        Programme Engineer

**AYUB AGRICULTURAL RESEARCH INSTITUTE, FAISALABAD**

39. Mr. Muhammad Akram                        ARD (Agronomy)



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40. Dr. Niaz Ahmad Assistant Professor

**KARINA, JUGLOTE, GILGIT**

41. Mr. Iqbal Hassan A.E.

42. Mr. Munir Hussain A.E

**SOIL CONSERVATION, RAWALPINDI**

43. Dr. Muhammad Bashir, Agronomist

**ON-JOB TRAINING COURSE ON SPRINKLER AND TRICKLE IRRIGATION SYSTEMS  
9-21 January 1993  
NARC, Islamabad**

**LIST OF PARTICIPANTS**

**ABAD, RAWALPINDI**

1. Mr. Tahir Sheikh Assistant Director (Ext), PD&CAD Division  
Small Dams Project, Islamabad
2. Mr. Muhammad Ashraf Water Management Officer, Water Lifting  
Devices (OFWM) Khayaban-e-Sir-Syed,  
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3. Ch. Muhammad Sharif Assistant Director (PP), Directorate of Barani  
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Agricultural Engineering, Sindh, Hyderabad.
5. Mr. M. Nawaz Razi Khan Baloch Assistant Director (Agri) TDF  
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6. Mr. Saeed Muhammad Baloch Assistant Director (Agri), Sindh Institute for  
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**WATER MANAGEMENT, NWFP**

9. Mr. Ghulam Khaliq WMO, Dir.
10. Mr. Muhammad Azeem Khan AD (Engg), Water Management Training  
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| 11. Mr. Akhtar Munir | WMO, Peshawar   |
| 12. Mr. Nadeem Amer  | WMO, ATL Water Management, Mardan                               |
| 13. Mr. Rashid Khan  | Progressive farmer, Village Kota, Tehsil Barikot, district Swat |

**KARINA, JUGLOTE, GILGIT**

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|-----------------------|--------------------|
| 14. Mr. Munir Hussain | Assistant Engineer |
| 15. Mr. Iqbal Hassan  | Assistant Engineer |

**OFWM, BALOCHISTAN**

- |                           |  |
|---------------------------|--|
| 16. Mr. Qaim Khan Khetran | Planning & Progress Officer, OFWM Project, Quetta. |
| 17. Mr. Javid Kausar      | Draftsman, OFWM, Project, Quetta                   |

**OFWM, PUNJAB**

- |                                    |   |
|------------------------------------|---|
| 18. Mr. Rashid Ahmad               | Assistant Agricultural Engineer, Private Tubewell Development Project, Dera Ghazi Khan. |
| 19. Mr. Muhammad Maqsood           | Assistant Agricultural Engineer, OFWM Project III, 7-A, Shadman Colony, Gujrat          |
| 20. Mr. Tajammal Hussain Khan      | Assistant Director, Directorate (F), OFWM, 93-A, Satellite Town, Rawalpindi.            |
| 21. Mr. M. Iftikhar Ahmad Chughtai | Assistant Director, Project Directorate OFWM, Azia Cross, G.T. Road, Gujranwala         |
| 22. Mr. Muhammad Akram             | AD (T), Directorate General Agriculture (Water Management), Lahore.                     |
| 23. Mr. Tariq Maqbool              | Water Management Specialist, Thokar Niaz Beg, OWM, Lahore                               |
| 24. Mr. Muhammad Anwar Ranjha      | Agriculture Officer, 196-D, Housing Scheme No. 1, District Jhelum.                      |

25. Mr. Nasir Mahmood Assistant Agriculture Engineer, OFWM, 104 DN-Sector, 4-A, Khayaban-e-Sir-Syed, Rawalpindi
26. Syed Zafar Iqbal Hussain Shah, Rural Sociologist, Water Management Training Institute, Lahore.
27. Mr. Tajamal Hussain WMS, OFWM, 196-D, Housing Scheme, Gujar Khan
28. Mr. Mohammad Rafiq DD (Z&A), 93-A/I, Directorate (F), OFWM, Rawalpindi
29. Mr. Bashir Ahmad Anjum T.O., 93-A/I, Directorate (F), OFWM, Rawalpindi
30. Mr. Ghulam Shabir WMS, OFWM, Tala Gang Road, Chakwal.
31. Mr. Ijaz Ahmad Assistant Agriculture Engineer, Water Management Training Institute, Thokar Niaz Beg, Lahore.

**TRICKLE IRRIGATION PROJECT, QUETTA**

32. Syed Bashir Ahmad Agriculture Officer, Trickle Irrigation Project, Quetta
33. Mr. Feroze Khan Agriculture Officer, Trickle Irrigation Project, Mastung
34. Syed Yaqoob Shah Agriculture Officer, Trickle Irrigation Project, Uthal, Lahore

**UNIVERSITY OF AGRICULTURE, FAISALABAD**

35. Mr. Allah Bakhsh Assistant Professor, Department of Irrigation & Drainage.

**NWFP UNIVERSITY OF ENGINEERING & TECHNOLOGY, PESHAWAR**

36. Mr. Daulat Khan Lecturer, Department of Agricultural Engineering.

**UNIVERSITY COLLEGE OF RAWALAKOT, AJK**

37. Mr. Azhar Mahmood                      Assistant Agricultural Engineer.

**NGO MEMBERS, CHOLISTAN**

38. Mr. Mohammad Khadam Hussain      Toba Hader Wala, District Bahawalpur,  
Cholistan.

39. Mr. Mohammad Sharif Zahid          Toba Kakrala, District Bahawalpur, Cholistan

**DEPARTMENT OF AGRICULTURE, MUZAFFAR ABAD, AJK**

40. Mr. Raja Muhammad Shamoan        Assistant Agriculture Engineer, Mirpur, Azad  
Kashmir

**DECIDUOUS FRUIT DEVELOPMENT CENTRE, QUETTA**

41. Mr. Aijaz Hussain                      Irrigation Agronomist

**IRRIGATION SYSTEMS MANAGEMENT RESEARCH (ISM/R)  
SYMPOSIUM**

11-13 April 1993  
Government Engineering Academy Punjab  
Niaz Beg, Lahore, Pakistan

**P R O G R A M**

10 April (Saturday)

Arrival of participants from outside of Lahore and hostel check-in

1700  
1900      Registration

11 April (Sunday)

**Inaugural Session**

0745  
0830      Registration

0845      Guests to be seated

0855      Arrival of the Chief Guest, Mr. Raja Muhammad Nadir Pervez,  
Minister of State for Water and Power

0900      Recitation from the Holy Quran

0905      Welcome Address by Mr. Khalid Mohtadullah, Deputy Director  
General, IIMI

0910      Keynote Address by Mr. Shams ul Mulk, Member (Water),  
WAPDA

0920      Address by Mr. Arnold J. Radi, Chief, Agriculture and Rural  
Development, USAID

0930      Inaugural Address by the Chief Guest

Master of Ceremonies: Dr. Bagh Ali Shahid

0940  
1020      T E A

**Technical Session I:**

**INTEGRATED WATERCOURSE MANAGEMENT**

Chairman: Mr. Muhammad Abdullah Khan

Rapporteur: Mr. Erik van Waijjen

- 1020 Lessons Learned on Mechanized Construction and Maintenance of Earthen Watercourse  
Ghulam Mohy-ud-Din and Muhammad Hanif
- 1040 Buried Pipeline Irrigation System and Its Impact on the Farm Economy  
Zahir Ahmad Piracha, Abdul Ghaffar, Muhammad Rafique Gill, and Muhammad Arif
- 1100 Augmentation/Conjunctive Use of Surface and Groundwater Through Fractional Skimming Wells  
Mumtaz Ali Buriro and Waryam Ali Mohsin
- 1120 Pattern of Flow Variation in Distributaries and Reachwise Supply to Outlets  
Bashir Ahmad, Mian Asghar Ali and Akhtar Raza Ahmad Khan
- 1140 Procedure for Adjusting Cropping Pattern to Irrigation Supplies  
Ghulam Mohy-ud-Din and Muhammad Hanif
- 1200 Manually Installed Tile Drainage System - Its Effect and Economics  
Zahir Ahmad Piracha, Abdul Ghaffar and Muhammad Rafique Gill
- 1220 Discussion  
1300
- 1300 LUNCH & PRAYERS  
1420

## **Technical Session II:**

### **FARM WATER MANAGEMENT**

Chairman: Dr. Jacob W. Kijne  
Rapporteur: Dr. Ramzan Chaudhry

- 1420 Use of Brackish Groundwater for Crop Production  
Abdul Hameed and Muhammad Qaim Channa
- 1440 Water Management Strategies Under Shallow Watertable  
Conditions  
Muhammad Iqbal
- 1500 Water Management Strategies for Areas with Poor Drainage or  
Shallow Watertable Conditions  
Abdul Hameed and Abdul Khaliq Solangi
- 1520 Discussion  
1540

### **TEA & ADJOURNMENT**

12 April (Monday)

- 0815 Recitation from the Holy Quran

## **Technical Session III**

### **ROLE OF WATER USERS IN IRRIGATION MANAGEMENT**

Chairman: Mr. D. T. Bandaragoda  
Rapporteur: Dr. Muhammad Nawaz Bhutta

- 0820 Potential Role of Water User Associations for Sustainability of  
Agriculture: Synthesis of Nine Studies  
Bashir Ahmed Chandio, Abdul Majeed, and  
Mohammed Azam
- 0840 Pre-project Socioeconomic Study at Qadirabad and Swat  
Research Sites  
Munir Ahmed Bhatti, Zafar Iqbal Khan and  
Arshad Mahmood
- 0900 Discussion  
0920



**Technical Session IV:**

**DRAINAGE AND WATER TABLE CONTROL**

Chairman: Mr. Jalil U. Ahmed  
Rapporteur: Dr. Abdul Majeed

- 0940 Comparative Effect of Organic, Inorganic and Biological Material on Reclamation of Saline Sodic Soils Under Tile Drainage System  
Muhammad Haroon Chang, Moula Bux Mirbahar and Muhammad Khan Marri
- 1000 Collaborative Tile Drainage System: Key to Solve Waterlogging and Salinity Problems  
Moula Bux Mirbahar, Muhammad Khan Marri, and Muhammad Haroon Chang
- 1020 Effect of Drain Positions and Boundary Conditions on Seepage Interception Using Galerkin Finite Element Model  
Bashir A. Chandio, Abdul Samad Chandio and Arshad M. Sheikh
- 1040 Discussion  
1100
- 1100 T E A  
1120

**Technical Session V:**

**GROUNDWATER AND PHYSICAL HYDRAULIC MODELING**

Chairman: Mr. F. A. Zuberi  
Rapporteur: Dr. Muhammad Nadeem

- 1120 Estimation of Hydrologic Parameters for Regional Groundwater Models  
Javed Zaman
- 1140 An Appraisal of Groundwater Pollution in Allahabad Unit, SCARP-VI  
Javed Zaman

- 1200 Interaction of Saline and Fresh Water Zones in Allahabad Unit,  
SCARP-VI  
Farhat Zaman and Mohammed Nadeem
- 1220 Physical Modeling of Sediment Ejectors for the Jamrao Canal  
and Effect of Downstream Glacis Slope on Scour  
Muhammad Khan Memon and Shamim-ud-din Ahmed
- 1240 Discussion  
1300
- 1300 LUNCH & PRAYERS  
1420

**Technical Session VI:**

**USE OF DATABASE AND PUBLIC TUBEWELL PERFORMANCE**

Chairman: Mr. Ishaq Khan Niazi

Rapporteur: Mrs. Zaigham Habib

- 1420 Classification of SCARP Tubewells in the Data Base by Their  
Characteristics and Performance Record  
Parvez Arif
- 1440 Factors Associated with Deterioration of SCARP Tubewells  
Muhammad Memon and Parvez Arif
- 1500 Groundwater Quality Changes in Allahabad Unit, SCARP-VI  
Imtiaz Ali, Javed Zaman and Mohammed Nadeem
- 1520 Evaluation of Mechanical and Air Surging in Wells with  
Fiberglass Casing  
Muhammad Memon
- 1540 Discussion  
1600

**TEA & ADJOURNMENT**

13 April (Tuesday)

0815 Recitation from the Holy Quran

**Technical Session VII:**

**IMPROVING ON-FARM WATER USE AND APPLICATION**

Chairman: Mr. Mushtaq Ahmad Gill

Rapporteur: Mr. Marcel Kuper

- 0820 Innovative Surface Irrigation Methods for Orchards  
M. Yasin, Shahid Ahmad, M. Munir Ahmad and Asif Ali Bhatti
- 0840 Level Border Irrigation Layout and Evaluation in Pakistan  
Arshad Ali, Badruddin, M. Jamal and Nisar A. Memon
- 0900 Level Borders Irrigation Efficiency Under Different Soil Surface Conditions  
Badruddin, M. Jamal Khan and Arshad Iqbal
- 0920 Benefits of Supplemental Irrigation for Wheat in Barani Environment  
Asif Ali Bhatti, M. Munir Ahmad, P. M. Moshabbir and Shahid Ahmad
- 0940 Design and Local Manufacturing of Portable Raingun Sprinkler Irrigation Systems  
Shahid Ahmad, P. M. Moshabbir, Asif Ali Bhatti and M. Yasin
- 1000 Indigenization of Trickle Irrigation Technology  
P. M. Moshabbir, Shahid Ahmad, M. Yasin and M. Munir Ahmad
- 1020 Discussion  
1040
- 1040 T E A  
1100

**Technical Session VIII:**

**IRRIGATION SYSTEMS OUTSIDE THE INDUS BASIN**

Chairman: Mr. Muhammad Munir

Rapporteur: Dr. Carlos Garces-Restrepo

- 1100 Effect of Karez Improvements and Future Plan of Balochistan  
Ijaz Ahmad Humayun and Mushtaq Ahmad
- 1120 Delay-action Dams in Ziarat - An Estimation of Economic Impact  
Muhammad Khalil
- 1140 Advance Irrigation Application Techniques and Their Use in  
Balochistan  
Mushtaq Ahmad
- 1200 Effect of Brackish Water and Phosphorus on Yield of Onion  
Riaz Ahmad
- 1220 Discussion  
1240
- 1240 LUNCH & PRAYERS  
1400

**Technical Session IX**

**IRRIGATION MANAGEMENT RESEARCH AGENDA OF PAKISTAN  
FOR THE FUTURE**

Chairmen: Dr. Zafar Altaf

Mr. Abdul Hafeez Qaiser

Rapporteur: Mr. M. Badruddin

- 1400 Research Insights Learned from the ISM/R Project  
Senen M. Miranda
- 1415 Irrigation Management Research Agenda: View from PCRWR  
Bashir Ahmed Chandio
- 1430 Irrigation Management Research Agenda: View from WAPDA  
Muhammad Munir
- 1445 Irrigation Management Research Agenda: View from PARC  
Shahid Ahmad

1500 Irrigation Management Research Agenda: Global View from IIMI  
Jacob W. Kijne

1515 Discussion

1545

**Closing Session**

1555 Recitation from the Holy Quran

1600 Comments by the Project Officer, ISM/R  
Mr. Jalil U. Ahmed

1615 Comments by the Chairman, CA Planning and Review  
Committee  
Mr. Javed Saleem Qamar

1630 Symposium Wrap-up  
Dr. Senen M. Miranda

1645 Vote of Thanks  
Mr. D. T. Bandaragoda, Acting Director, IIMI-Pakistan

**TEA & ADJOURNMENT**

11-13 April 1993  
IRRIGATION SYSTEMS MANAGEMENT RESEARCH (ISM/R) SYMPOSIUM

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	Mr. Shams-ul-Mulk	Member (Water)
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	Mr. Riaz Nazir Tarar	General Manager (Dams and Coord.)
	Mr. Mian Ashraf	Ex-General Manager (Planning)
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	Mr. Muhammad Muzaffar	Project Director (Central)
	Mr. Ali Akbar Naqvi	Director (E&S)
	Mr. Aman Ullah Mughal	Director (A&S)
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	Mr. Javaid Akhtar	Deputy Director (Technical)
	Mr. Mohy ud Din Khan	Ex-General Manager (Planning)
	Mr. Atta ur Rehman	Ex-General Manager (West)
	Mr. Ata Tufail	Ex-Deputy Director (Planning)
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	Mr. Muhammad Abdullah Khan	Chief Engineer/Project Director
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	Mr. Muhammad Iqbal	Sr. Research Officer (Agric)
	Mr. Zahir Ahmad Piracha	Sr. Engineer
	Mr. Muhammad Rafique Gill	Sr. Economist
	Mr. Abdul Ghaffar	Jr. Agricultural Economist
	Mr. Muhammad Saddique Rafiq	Jr. Agronomist
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	Mr. Muhammad Memon	Sr. Geologist
	Mr. Farhat Zaman	Jr. Geologist
	Mr. Javeed Zaman	Jr. Engineer
	Mr. Parvez Arif	Jr. Geologist
	Mr. Imtiaz Ali	A. Research Officer
<b>Watercourse Monitoring &amp; Evaluation Directorate</b>		
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	Mr. Abdul Rauf	Sr. Agronomist
	Mr. Naseem Khan	Sr. Engineer
	Mr. Akhtar Raza A. Khan	Asst. Research Officer
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	Mr. Khalid Javed Upal	Project Director
	Mr. Ijaz Ahmad Humayun	Ex-Project Director
	Mr. Mushtaq Ahmad	Sr. Engineer
	Mr. Muhammad Khalil	Agricultural Economist
	Mr. Riaz Ahmad	Jr. Agronomist
<b>Pakistan Agricultural Research Council</b>		
	Dr. Zafar Altaf	Chairman
<b>National Agricultural Research Centre (Water Resources Research Institute)</b>		
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	Mr. Muhammad Yasin	Sr. Scientific Officer
	Mr. P.M. Moshabbir	Sr. Scientific Officer
	Mr. Asif Ali Bhatti	Scientific Officer
	Mr. Muhammad Munir Ahmad	Scientific Officer
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	Prof. Badruddin	Principal Investigator

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<b>Pakistan Council for Research in Water Resources</b>		
	Dr. Bashir A. Chandio Dr. Munir Ahmad Bhatti Dr. Abdul Majeed Mr. Gul Muhammad Shah Mr. Muhammad Zafar Iqbal Khan Mr. Zahid Masood Ahmad Mr. Muhammad Azam Mr. Arshad Mahmood	Chairman Director (CGP) EWU Chief (Research) Regional Director (Lahore) Anthropologist Hydrologist Deputy Director Deputy Director
<b>Drainage and Reclamation Institute of Pakistan</b>		
	Mr. Moula Bux Mirbahar Mr. Muhammad Haroon Chang Mr. Abdul Samad Chandio	Director General Deputy Director Research Officer
<b>Sindh Irrigation Department, SHL, Hyderabad</b>		
	Mr. Muhammad Khan Memon Mr. Shamim-ud-din Ahmed Mr. Younas Khokhar	Director, H&R Deputy Director, Hydrology Deputy Director, R.D. Kar.
<b>Ministry of Water &amp; Power</b>		
	Raja Muhammad Nadir Pervez Mr. F.H. Usmani Ch. Altaf Hussain	Minister of State Federal Coordinator (ISRP) Ex-Chief Engineering Adviser



<u>Organization</u>	<u>Name</u>	<u>Designation</u>
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**International Waterlogging and Salinity Research Institute**

Mr. F.A. Zuberi	Director General
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Dr. Muhammad Nawaz Bhutta	Director, Drainage
Dr. Muhammad Mehboob Alam	Sr. Engineer
Mr. Muhammad Saleem Bashir	Sr. Engineer
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Mr. Talat Mahmood	Research Consultant (NRAP)

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Mr. D.T. Bandaragoda	Sr. Management Specialist
Dr. Carlos Garces-Restrepo	Irrigation Engineer
Dr. Senen M. Miranda	Sr. Irrigation Specialist
Dr. Edward J. Vander Velde	Sr. Irrigation Specialist
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