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IMPROVING APPLICATION AND WATER USE  
EFFICIENCY AT FARM LEVEL

PROJECT COMPLETION REPORT  
OF ISM-R

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NATIONAL AGRICULTURAL RESEARCH CENTRE  
ISLAMABAD

JUNE, 1993

1. OBJECTIVES:

- Develop test and adapt improved and practical procedures for border irrigation application method.
- Develop test and adapt practical irrigation procedures for specialized irrigation systems (Sprinkler, trickle, hosefed round basin, etc.)
- Develop, test and adapt various management strategies for improving water use efficiency at farm level under small scale farmer managed irrigation systems.

2. PHYSICAL PROGRESS AS OF JUNE 4, 1993:

- The border irrigation systems were developed at EUP, UAF, SAU, NARC and KARINA for evaluating performance and design criteria.
- The local manufacturing and indigenization of sprinkler and trickle irrigation systems was successfully introduced in collaboration with leading pumps and plastic industry in Pakistan.
- Trickle irrigation systems using locally produced materials were installed at Quetta, NARC and KARINA.
- Raingun sprinklers and pumps systems testing facility has been developed at NARC in collaboration with PARC funded High Efficiency Irrigation Systems project.
- Computer software laboratory has been initiated at NARC.
- Two training handbooks in sprinkler and trickle irrigation were prepared and distributed to trainees and other project scientists/engineers.

3. FINANCIAL PROGRESS AS OF JUNE 1993:

<u>ORGANIZATION</u>	<u>BUDGET</u>	<u>EXPENDITURE</u>
NARC, ISLAMABAD	Equip: 340,000 Res: 370,000	339860.00 286699.20
	S.Tot: <u>710,000</u>	<u>626559.20</u>
UNIV. OF AGRI. FAISALABAD	Equip: 70,000 Res: 253,000	49690.00 306287.95
	S.Tot: <u>323,000</u>	<u>355977.95</u>
MONA RECL. EXP. RES. STAT. BHALWAL	Equip: 36,000 Res: 297,000	7500.00 309853.41
	S.Tot: <u>333,000</u>	<u>317353.41</u>
SINDH AGRI. UNIV. TANDOJAM(SAU)	Equip: 75,000 Res: 278,000	22140.00 273335.57
	S.Tot: <u>353,000</u>	<u>295475.57</u>
NWFP UNIV. ENGG. & TECH. PESHAWAR	Equip: 70,000 Res: 257,000	70490.00 284318.62
	S.Tot: <u>327,000</u>	<u>354808.62</u>
DECIDUOUS FRUITS RES. CENTRE, SARIAB ROAD, QUETTA	S.Tot: 70,000 Res: 262,000	111315.00 274229.52
	S.Tot: <u>332,000</u>	<u>385544.52</u>
KARINA, GILGIT	Equip: 230,000 Res: 261,000	190425.00 523421.40
	S.Tot: <u>491,000</u>	<u>713846.40</u>
PARC COORDINATING UNIT, ISLAMABAD	Equip: 6,000 Res: 388,000	0.00 300886.44
	S.Tot: <u>394,000</u>	<u>300886.44</u>
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TOTAL:	3,263,000	3350452.11
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The total expenditure was close to the allocated budget of 3.263 million Rs with only excess expenditure of 2.68%. Whereas 10% is allowed as per GOP procedures. If we take the budget in US\$, then there is saving because of depreciation of Pak. RS.

The excess expenditure was mainly at KARINA and UAF. The USAID already approved additional funds for these two locations. Therefore considering the revised budget the expenditures are within the allocated budget.

#### 4. EQUIPMENTS PROVIDED UNDER THE PROJECT:

<u>Equipments</u>	<u>Quantity</u>	<u>Locations</u>
- Ovens	4	EUP, UAF, SAU, DFDCQ
- Electric Balance	4	EUP, UAF, NARC, KARINA
- Trickle Irrigation Systems	-	DFDCQ, KARINA, NARC
- Sprinkler Irrigation Systems	-	NARC, DFDCQ, EUP
- Computers	-	PARC, NARC, EUP, KARINA, UAF, SAU, DFDCQ
- Computer Softwares	-	NARC
- Computer Scanner	-	NARC

The procurement of equipments is still in process where orders have been placed by USAID and delivery is expected shortly.

5. TRAINING PROVIDED (IN-COUNTRY AS WELL AS ABROAD):

IN-COUNTRY TRAININGS

5.1 TRAINING IN SURFACE IRRIGATION

COURSE NAME:- On-job training course on border irrigation.

NUMBER OF PARTICIPANTS: 16

COURSE DURATION: 16-20 June, 1992

INSTITUTIONS ORGANIZED TRAINING

University of Agriculture, Faisalabad.

National Agricultural Research Centre, Islamabad.

NAME OF PARTICIPANTS:

UAF

-Mr.Allah Bakhsh, Lecturer

-Mr.Arshad Ali, Associate Professor

-Mr.Rafiq Ahmad, Associate Professor

EUP

-Mr.Badruddin, Professor

-Mr.Jamal Khattack, Assistant Professor

NARC

-Mr.M.Yasin, SSO

DFDCQ

-Mr. Ijaz Hussain, Agronomist

OFWM

-Six officers attended the Course.

MONA

-Three officers attended the Course.

## 5.2 TRAINING IN SPECIALIZED IRRIGATION

COURSE NAME:- On-job training course in sprinkler and trickle irrigation systems

NAME OF PARTICIPANTS:

### ABAD, RAWALPINDI

- Mr. Tahir Masood Shaikh,  
Assistant Director (EXT),  
PD&CAD Division,  
Small Dams Organization, Islamabad.
- Mr. Muhammad Ashraf,  
Water Management Officer,  
Water lifting Devices (OFWM),  
Khayaban-e-Sir Syed, Rawalpindi.
- Ch. Muhammad Sharif,  
Assistant Director (PP),  
Directorate of Barani Agri. (Ext.),  
Rawalpindi.

### AGRI. ENGG. & WATER MANAGEMENT, SINDH, HYDERABAD

- Mr. Khuda Bux Memon,  
Assistant Director (Engg.),  
Directorate of Agricultural Engineering,  
Sindh, Hyderabad.
- Mr. Muhammad Nawaz Razi Khan Baloch,  
Assistant Director (Agri.) TDF  
Sindh Institute for OFWM (T&R), Sakrand.
- Mr. Saeed Muhammad Baloch,  
Assistant Director (Agri.),  
Sindh Institute for OFWM (T&R),  
Sakrand.
- Mr. Rajab Ali Nahyoon  
Assistant Director (Engg.),  
Directorate of AE & Water Management,  
Hyderabad.
- Mr. Mohammad Waseem Siddiqui  
WMO, Office of Directorate of AE & Water Management,  
Hyderabad.

#### WATER MANAGEMENT, NWFP

- Mr. Ghulam Khaliq, WMO, Dir.
- Mr. Muhammad Azeem Khan,  
AD (Engg.)  
Water Management Training Centre,  
D.I. Khan.
- Mr. Akhtar Munir, WMO, Peshawar.
- Mr. Nadeem Amer, WMO, ATL  
Water Management, Mardan.
- Mr. Rashid Khan  
Progressive farmer,  
Village Kota. Tehsil Barikot,  
District Swat.

#### KARINA, JUGLOTE, GILGIT

- Mr. Munir Hussain,  
Assistant Engineer
- Mr. Iqbal Hassan  
Assistant Engineer

#### OFWM, BALOCHISTAN

- Mr. Qaim Khan Khetrani  
Planning & Progress Officer,  
OFWM Project, Quetta.
- Mr. Javid Kausar  
Draftsman,  
OFWM Project, Quetta.

#### OFWM, PUNJAB

- Mr. Rashid Ahmad  
Assistant Agricultural Engineer,  
Private Tubewell Development Project,  
Dera Ghazi Khan.
- Mr. Muhammad Maqsood  
Assistant Agricultural Engineer,  
OFWM Project III,  
7-A, Shadman Colony, Gujrat.
- Mr. Tajammal Hussain Khan  
Assistant Director,  
Directorate (F), OFWM,  
93-a, Satellite Town,  
Rawalpindi.

- Mr. M. Iftikhar Ahmad Chughtai  
Project Directorate OFWM,  
Assistant Director (Engg.),  
Project Directorate OFWM,  
Azia Cross, G.T. Road,  
Gujranwala.
- Mr. Muhammad Akram  
AD (T), Directorate General Agriculture  
(Water Management), Lahore.
- Mr. Tariq Maqbool  
Water Management Specialist,  
Thokhr Niaz Bag, OFWM, Lahore.
- Muhammad Anwar Ranjha,  
Agri. Officer,  
196-D, Housing Scheme No. 1,  
District Jhelum.
- Mr. Nasir Mahmood,  
Asstt. Agri. Eng.  
OFWM, 104 DN-Sector 4-A, Khyabane-Sir-Syed,  
Rawalpindi.
- Syed Zafar Iqbal Hussain Shah,  
Rural Sociologist,  
Water Management Training Institute,  
Lahore.
- Mr. Mohammad Rafiq,  
DD (Z&A),  
93-A/I, Directorate (F),  
OFWM, Rawalpindi.
- Mr. Ghulam Shabir,  
WMS, OFWM,  
Tala Gang Road, Chakwal.
- Ijaz Ahmad  
Asstt. Agri. Engineer  
Water Management Training Institute,  
Thokhar Niaz Beg, Lahore.

TRICKLE IRRIGATION PROJECT, QUETTA

- Syed Bashir Ahmad  
Agri. Officer,  
Trickle Irrigation Project,  
Quetta.



- Mr. Feroze Khan  
Agri. Officer,  
Trickle Project,  
Mastung.
- Syed Yaqoob Shah  
Agri. Officer,  
Trickle Irrigation Project,  
Uthal, Lahore.

UNIVERSITY OF AGRICULTURE, FAISALABAD

- Mr. Allah Bakhsh,  
Assistant Professor,  
Department of Irrigation & Drainage,  
University of Agriculture, Faisalabad.

NWFP UNIVERSITY OF ENGINEERING & TECHNOLOGY, PESHAWAR

- Mr. Daulat Khan  
Lecturer,  
Deptt. of Agri. Engineering  
NWFP Univ. of Eng. & Tech., Peshawar.

UNIVERSITY COLLEGE OF RAWALAKOT AJK

- Mr. Azhar Mahmood,  
Asstt. Agri. Engineer,  
University College of Rawalpindi.

NGO MEMBERS, ISRD, CHOLISTAN

- Mr. Mohammad Khadam Hussain,  
Toba Hader Wala,  
District Bahawalpur,  
Cholistan.
- Mr. Mohammad Sharif Zahid  
Toba Kakrala, District Bahawalpur,  
Cholistan.

DEPARTMENT OF AGRICULTURE, MUZAFFARABAD, AJK

- Mr. Raja Muhammad Shamoom  
Assistant Agri. Engineer,  
Mirpur, Azad Kashmir.

DECIDUOUS FRUIT DEVELOPMENT CENTRE, QUETTA

- Mr. Aijaz Hussain,  
Irrigation Agronomist, Quetta.

**COURSE DURATION:**

5-20 August, 1992

**INSTITUTION ORGANIZED TRAINING:**

National Agricultural Research Centre, Islamabad.

**5.3 TRAINING IN SURFACE IRRIGATION**

**COURSE NAME:-** On-job training course on surface irrigation systems

**NAME OF PARTICIPANTS:**

**ON-FARM WATER MANAGEMENT, PUNJAB**

- Mr. Ashfaq Ahmad, Asstt. Agronomist, D.G. Khan
- Mr. Muhammad Jamil, AAE, Muzaffargarh
- Mr. Muhammad Naseem Akhtar, Asstt. Agronomist, Faisalabad
- Mr. Muhammad Afzal Bajwa, Asstt. Agronomist, Faisalabad
- Mr. Munir Ahmad, Asstt. Agronomist, Khushab.
- Mr. Anwar-ul-Haq Shahzad, Asstt. Director, Vehari
- Mr. Mohammad Khalid Mahmood, Asstt. Director Shahkot
- Mr. Muhammad Asif, Assistant Agronomist, Lahore
- Mr. Raees Ahmad Raees, T.O. Multan
- Mr. Inam ullah, AAE, Bahawalpur
- Mr. Muhammad Ashraf, WMO, On-Farm Water Management, Rawalpindi.

**ON-FARM WATER MANAGEMENT, RAWALPINDI**

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

AGRICULTURAL ENGINEERING AND WATER MANAGEMENT, SINDH, HYDERABAD

- Mr. Muhammad Waseem Siddiqui, WMD, Hyderabad
- Mr. Manzoor Hussain Samoo, Asstt. Agronomist
- Mr. Mansoor Ahmad, WMO. Mirpur Khas
- Mr. Tofique Ahmad Soomro, AAE

ON-FARM WATER MANAGEMENT, NWFP

- Mr. Bashir Ahmad, DD, Mardan
- Mr. Ijaz Ahmad Khattak, AD, Charsadda
- Mr. Mohammad Amirullah, DD., Peshawar
- Mr. Imam Ali Khan, AD, Mardan.

AGRI. RESEARCH INSTITUTE, TANDOJAM, SINDH

- Mr. Muhammad Umar Sial, Agronomist

NIAB, FAISALABAD

- Mr. Riaz Ahmad Waheed, SSO

SINDH AGRICULTURE UNIVERSITY, TANDOJAM

- Mr. Mushtaq Ahmad Issani, Asstt. Professor

NWFP UNIVERSITY OF E&T, PESHAWAR

- Mr. Daulat Khan, Lecturer

UNIVERSITY COLLEGE OF AGRI. RAWALAKOT, AJK

- Dr. Muhammad Ilyas, Associate Professor

LAND RECLAMATION DIRECTORATE, LAHORE

- Mr. Azfar Hussain, Research Assistant

WRRI, NARC, ISLAMABAD

- Mr. Mohammad Mazhar Saeed, AE
- Mr. Muhammad Aslam, AE
- Mr. Jehanzeb Khan, AE
- Mr. Muhammad Aslam, SO
- Mr. Arshad Ashraf, SO
- Mr. M. Munir Ahmad, SO
- Mr. Muhammad Riaz, AE
- Mr. Muhammad Khan Nadeem, AE

ON-FARM WATER MANAGEMENT, QUETTA

- Mr. Saeed Ahmad, Assistant Agronomist

SARHAD RURAL SUPPORT PROGRAMME, 109 DEFENCE HOUSING SOCIETY,  
PESHAWAR

- Mr. Ijaz Hussain Rizvi, Programme Engineer

AYUB AGRICULTURAL RESEARCH INSTITUTE, FAISALABAD

- Mr. Muhammad Akram, ARD (Agronomy)

UNI. OF AGRI., FAISALABAD

- Dr. Niaz Ahmad, Asstt. Professor

KARINA, JUGLOTE, GILGIT

- Mr. Iqbal Hassan, A.E.
- Mr. Munir Hussain, A.E.

SOIL CONSERVATION, RAWALPINDI

- Dr. Muhammad Bashir, Agronomist.

COURSE DURATION: 17-22 April, 1993

## INSTITUTION ORGANIZED TRAINING

National Agricultural Research Centre, Islamabad.

## TRAININGS ABROAD

The following engineers attended short courses in water management at Idaho State University, USA and IIC, Logan, Utah.

- Mr. M. Yasin  
SSO, WRRI, NARC.
- Mr. M. Munir  
SO, WRRI, NARC.
- Mr. Zaheer-ul-Ikram  
SO, WRRI, NARC.
- Mr. P.M. Moshabbir  
AAE, WRRI, NARC.

## 6. TECHNICAL ASSISTANCE PROVIDED:

### a) IDAHO STATE UNIVERSITY, USA

Provided technical assistance in the preparation of the project document of this project. Dr. Day Basit and Dr. Baxter were involved in this activity. Also provided help in the preparation of the action plan

### b) IIMI-Pak

Provided technical assistance to prepare the revised work plan and in field research experimentation. Technical assistance was also provided in arranging local trainings, data analysis, paper writing for symposium and equipment procurement.

## 7- MAJOR ACCOMPLISHMENTS

### 7.1 Level Border Irrigation Design and Evaluation in Pakistan

A coordinated study was undertaken at UAF, SAU and EUP to evaluate the layout of level borders under different soils and stream size conditions. Application, storage and distribution efficiencies were used as the performance parameters for the evaluation. Under clay-loam soil conditions, the 90 meter border length performed better with a unit stream of 3 lps, while under sandy-clay-loam soil conditions, 30 and 60 meter long borders gave maximum efficiencies with unit discharge of 3 lps.

Experiments were also conducted at EUP under different soil surface conditions namely fresh tilth, post irrigation and maize crop. The advance time required was more with fresh tilth compared to post-irrigation and cropped field. About 84% more time was required for fresh tilth compared to cropped fields. This shows that first irrigation must be treated different compared to other irrigations.

The field data collected can be used to help farmers in designing their border irrigation. The data can also be used to validate some of the surface irrigation design models.

### 7.2 Innovative Surface Irrigation Methods for Fruit Orchards

Surface irrigation methods such as borders, round basins, modified round basins and modified furrows were developed and evaluated for the peach orchard at the Water Resources Research Institute Field Station, NARC, Islamabad. The three methods with slope of 0.75% were compared in terms of savings in irrigation

water and duration of irrigation against borders with slope of 0.43%. Compared to borders, savings in water application of 436%, 260% and 464% were observed in round basins, modified round basins and modified furrows, respectively. A similar trend was observed in the duration of irrigation. Distribution uniformity was estimated using minimum and average depth of water infiltrated. Distribution uniformity of 59.2%, 81.3%, 92.3% and 76.6%, was observed for round basins, modified round basins, modified furrows and borders, respectively. Therefore, modified furrows can be used to achieve higher uniformity and five times more area can be irrigated for deciduous orchards. This system also provides an opportunity to have better orchard management where transmission of soil born diseases are much lower compared to other methods. This method was designed where wetted area is more or less the same as trickle irrigation except the main furrow line. Thus this system is suitable for areas like Balochistan where water is at premium.

### 7.3 Design and Local Manufacturing of Raingun Sprinkler Irrigation Systems

Four rainguns were selected for local manufacturing (indigenization) and manufacturers' specifications were developed. These can be used to design sprinkler systems for farms of 2 acres to 15 acres. Similarly, high pressure centrifugal pumps of 2 lps, 4 lps, 6 lps and 8 lps capacity were designed and indigenized in collaboration with MECO Pvt., Lahore. This company now manufactures pumping systems for any configuration of pressure and discharge.

The rainguns PY<sub>1</sub>-30 and PY<sub>1</sub>-50 were also manufactured locally. The pumping systems are available with electric motor or diesel engine. The estimated installed cost of portable raingun sprinkler systems in Pakistan ranges from Rs. 5000 to Rs. 6000 per acre for a system of at least 10 acres using diesel-operated pumping system. The cost of electric-operated system is in the range of Rs. 3000-Rs. 4000 per acre for a system of five acres or more. These systems are simple in operation and all the spare parts are available locally. Low density polyethylene black carbon pipes with UV stabilizers were also developed for 25 mm, 50 mm, 76 mm, and 102 mm diameters in collaboration with Griffon Industrial Corporation, Lahore which can be used for delivery and suction purposes.

#### 7.4 Indigenization of Trickle Irrigation Technology

PARC established the National Irrigation Systems Testing Laboratories at the Water Resources Research Institute, NARC, for research, evaluation and testing of trickle irrigation systems and indigenization. In collaboration with the Plastics Technology Centre (PTC), Karachi and GRIFFON Industrial Corporation, Lahore, PARC successfully completed the indigenization process and commercial production of trickle irrigation components has been initiated. Now the tubbings, emitters, connections and filters are available which will be used in the future for large scale adoption of trickle irrigation in the country. The estimated cost of a standard trickle irrigation system is around Rs. 9000/acre based on the Ex. Factory price. Locally produced materials were used to install trickler irrigation systems at NARC, DFDCQ and KARINA.

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## 7.5 Benefits of Supplemental Irrigation for Wheat in Barani Environment

A field experiment was conducted to evaluate the benefits of supplemental irrigation for wheat crop under Barani environment. Three irrigation treatments, namely 10 mm at Rauni, 10 mm at 50% MAD, and 25 mm at 75% MAD, were employed. The experiment was conducted at the Water Resources Research Institute, Field Station, National Agricultural Research Centre, Islamabad using raingun sprinklers for supplemental irrigation. The wheat crop yield with supplemental irrigation was compared with Barani crop yield, and a considerable increase in yield of 45% and 117% was observed during 1990-91 and 1991-92 wheat growing seasons at Islamabad, where seasonal rainfall of 523 mm and 354 mm was received, respectively. The seasonal rainfall was in excess or sufficient to meet seasonal crop evapotranspiration requirement but was not well spread during the growing season. The highest net benefits from supplemental irrigation were Rs. 6,583 and Rs. 9,651 per hectare during 1990-91 and 1991-92 wheat growing seasons, respectively. The benefits from supplemental irrigation are expected to increase in dry years and/or in dry regions. However, the three years of experimentation revealed that even in sub-humid to humid regions, and during wet years, considerable increase in farm net return can be achieved through supplemental irrigation.

## 8. CONSTRAINTS:

- Delays in the availability of imported equipments and supplies.

- Delays in availing of foreign trainings due to the lengthy procedures and shortage of time.
- Insufficient budget to accomplish the targets, resulted in seeking funds from other sources. Some success was achieved during early 1993 which will help to continue some of the activities during 1993. The release mechanism of budget is also one of the constraint in smooth running of the project.

9. COMMENTS REGARDING SUSTAINABILITY AND USE/APPLICATION:

- During 1993 a programme on "Integrated Land and Water Management for Stressed Lands": A pilot project for Technology Development and Adaptation was initiated under Productivity Enhancement Programme at 11 locations. This project is aimed to take PARC research based technologies including ISM-R achievements to farmers fields. Border, sprinkler and trickle irrigation are the major components.
- Hopefully financial resources will be available during 1993-94 if the PEP project is extended. However, some equipments and technical assistance are required to strengthen these activities. Training is another component which need to be arranged from other sources.
- PARC is collaborating with provincial development agencies for transfer of technologies at the farmers fields.

#### 10. REMARKS:

In summary, the project produced three major technologies and related scientific knowledge which have already been adopted by the development agencies. Especially the Punjab OFWM and AJK Agriculture department is now providing sprinkler systems to farmers on cost sharing basis. The ADB funded project on trickle irrigation has approved the use of local materials for the pending 430 hectares installations. Recently, ADB trickle irrigation project awarded contract for 100 ha trickle irrigation in Balochistan where GRIFFON Industrial Corporation will provide the materials.

The trickle irrigation tubings produced in Pakistan is going to replace PVC garden hose. Furthermore, farmers are now using LDPE pipes for injector pumps because these are almost half of the price of GI pipe. Same pipe is now being used for drinking water supply. Therefore, indirect benefits may exceed the irrigation benefits as envisaged in the beginning.