AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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Batch 94

1. SUBJECT CLASSIFICATION

A. PRIMARY
Food production and nutrition — AP10-0000-0000

B. SECONDARY
Water resources and management

2. TITLE AND SUBTITLE
Improving agricultural production through on-farm water management

3. AUTHOR(S)
(101) Colo.State Univ. Engineering Research Ctr.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1978	36p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Colo.State

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER
PN-AAG-189

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Development
Interdisciplinary research
Pakistan
Problem solving
Project implementation
Research
Rural areas

13. PROJECT NUMBER
931048900

14. CONTRACT NUMBER
AID/ta-C-1100 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)


Improving Agricultural Production Through
ON-FARM WATER MANAGEMENT

CONTENTS

INTRODUCTION

With the urgent need for more food production and the increased cost of new irrigation systems to provide greater crop yield, it has become imperative that existing farm irrigation systems be improved.

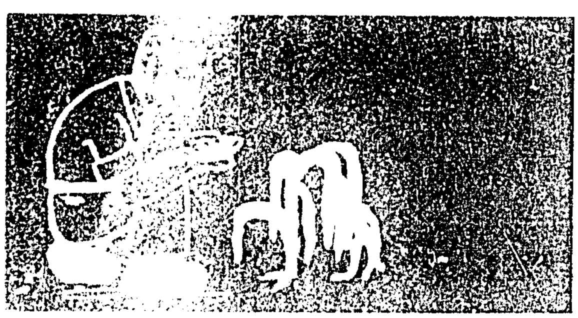
The purpose of this booklet is to describe a research-development process that works, to indicate how that process works, and to show its benefits when it is properly administered.

Colorado State University through a contract with the United States Agency for International Development (USAID) has been assisting the government of Pakistan with on-farm water management problems since 1970. In some cases crop production has been increased by 250 percent while using only half as much water to grow the crop. In addition, water supply at the field was almost doubled by reducing the irrigation water losses that occurred during travel to the field.

The major technical procedures that have been used to accomplish the improvements have included watercourse rehabilitation, land leveling, better field water application methods and improved agronomic practices. Emphasis of the project has been placed on assisting farmers with small farms to increase their production.

The uniqueness of the project has been the practical research to solve immediate problems resulting in increased crop production on small farms. Solutions to major problems are tested with farmers on actual farm sites and the successful methods used in implementing the new procedures.

Out of the effort to establish priority problems, the CSU interdisciplinary team of scientists working closely with their Pakistan counterparts developed a process for problem identification, development and assessment of solutions, and implementation of solutions for on-farm water management problems that has been successful in Pakistan and is now being adopted in other developing countries to aid rural development. The process, for example, is currently being used in Egypt under a USAID mission contract.



Preliminary Investigation
Preliminary investigation is an initial review of the irrigation systems, existing research related to this system, and organizational arrangements and procedures for managing the irrigation system

This initial step in the problem identification phase is to determine what is presently known about the existing system.

Identification
Determining what the problems are is the most important step in the research-development process.

Systematic problem identification is necessary to understand the traditional farming system of an area, and to isolate the major constraints to increased agricultural production.

The scientist acts like a doctor might when he approaches an illness. He talks with the farmer-client to search out the problems as the farmer sees them. He then measures what the farmer does to determine what the major problems are that prevent increased agricultural production. A team of specialists are used to diagnose the most important problems.

For example, farmers and water management experts in the Pakistan Mona Reclamation Experimental Project found that one major problem was considerable water loss from the time irrigation water left the canals and tubewells until it reached the farmers' fields.

Scientists work with farmers to determine the major problems of water management and agronomic practices that the farmer faces.

The water management team found that actual waterloss was five times or more what had ever been assumed.

Instead of accepting assumed losses, the water management specialists devised a way to measure the loss. A Cutthroat flume was used The flumes were manufactured locally to stimulate local industry. Water management team members worked with the farmers to identify the major problems causing the water loss. They found that much of the loss could be eliminated if the watercourses were improved.

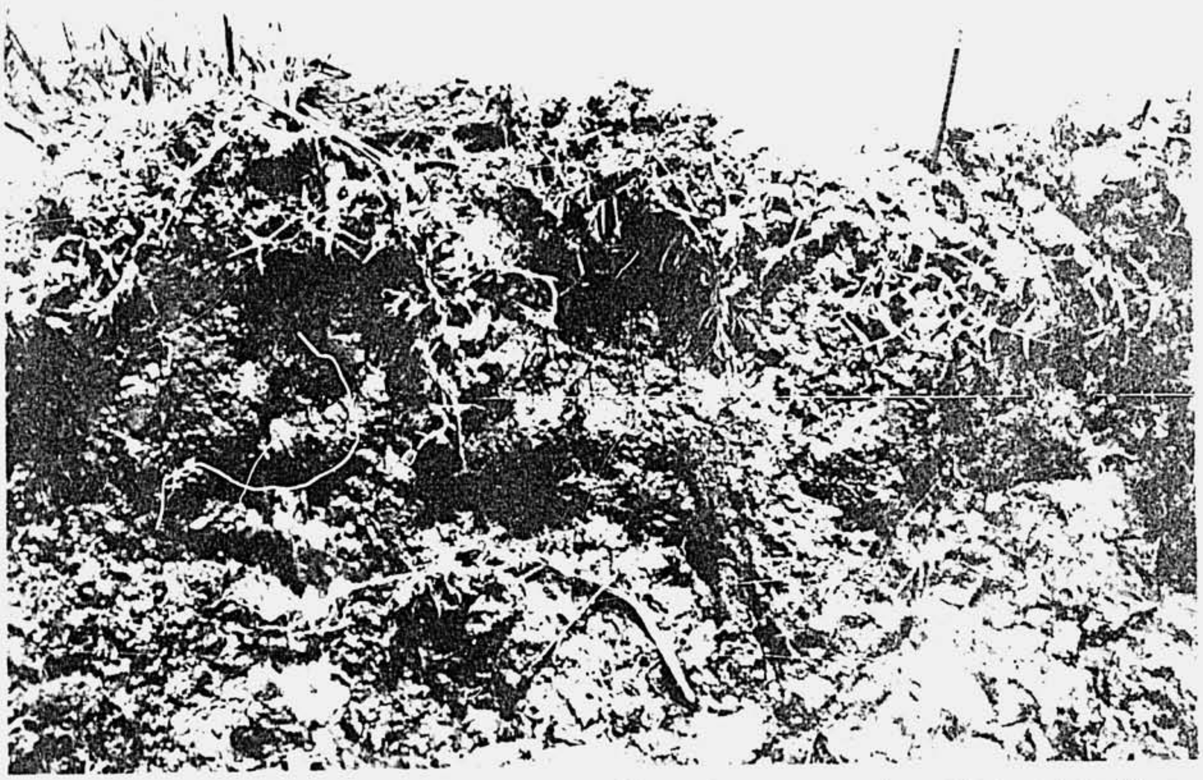
Here is a watercourse before it has been improved. Weeds and silt along with narrow banks have contributed to the overtopping, seepage and consequent loss of water.

Here is the same watercourse after it has been improved by using the correct width and depth of banks, removing the silt, weeds, and roots, and compacting the soil in and around the watercourse. This watercourse can now deliver more than twice as much water to the farmers' fields as it could before.

The farmers work long hours to improve their watercourses because they understand that they will be the ones receiving the benefits from the increased water supply. Some farmers were so anxious to finish their improvements that they worked straight through the traditional holiday period.

Farmers found that the immediate benefit of their labor was considerably increased water for irrigation.

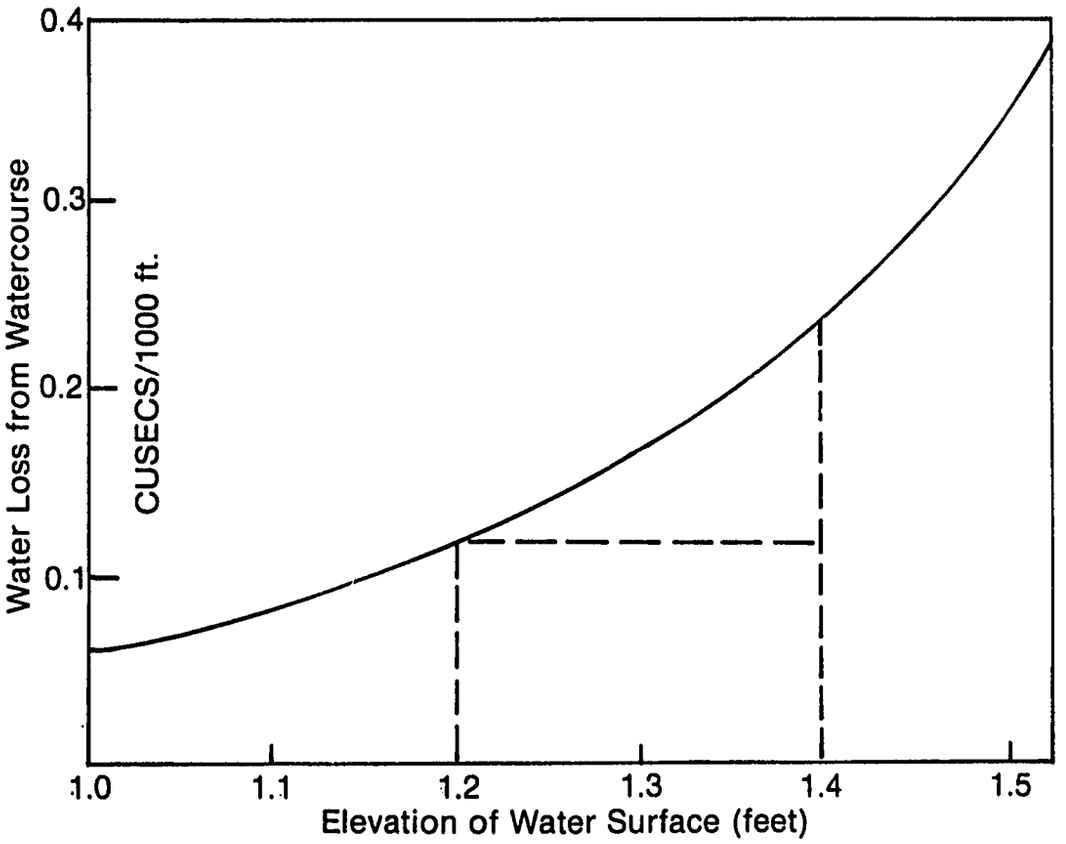
borrowed from nearby banks



Much of the loss was [illegible]

A problem identified as most destructive to the watercourse was the other uses. Buffalo used them for baths. Women washed clothes and dishes there. People bathed and played in the water at the junctions. All this activity ruined the banks and caused considerable water loss.

As the watercourse becomes filled with weeds, roots, and sediment, the rate of waterloss rises significantly. Increasing the elevation of water in the watercourse by only two-tenths of a foot can more than double the loss. The rate of loss increases very fast as the water level rises as shown on the chart below.



This is a junction causing considerable waterloss. Banks had been almost completely worn down by animals and people using the junctions.

Here is the same junction after it has been improved. The concrete structure now can serve as a buffalo bath, as a place for women to wash dishes and clothes, and as a place for people to bathe. The concrete will not erode like the earthen junctions.

SEARCH FOR SOLUTIONS

Once key problems have been identified, a search for solutions is initiated. For example, the problem of water loss at the junctions was examined to find a solution or solutions. The scientists determined that concrete structures might provide satisfactory buffalo baths and places for people to wash clothes and bathe. The benefits of the concrete structures included reduced labor, stimulation of local industry to produce them, and reduction of soil erosion.

If at all possible, known technology is adapted to the on-farm conditions to save time and money. Criteria for selecting solutions include the farmers' willingness to accept them, probability of visible success to aid diffusion, government cooperation in supporting and implementing the solutions, and the suitability to the social, economic, technological and physical environment of the farmer.

Here farmers install a concrete lid that opens to let water in and out of the watercourse at the junctions - one of the solutions identified by the research team to the problem of water loss in the watercourse. A local manufacturer makes and sells the structures to the farmers.

In searching for solutions to the water loss problem the scientists found that most of the water loss occurred through the banks rather than seepage through the bottom

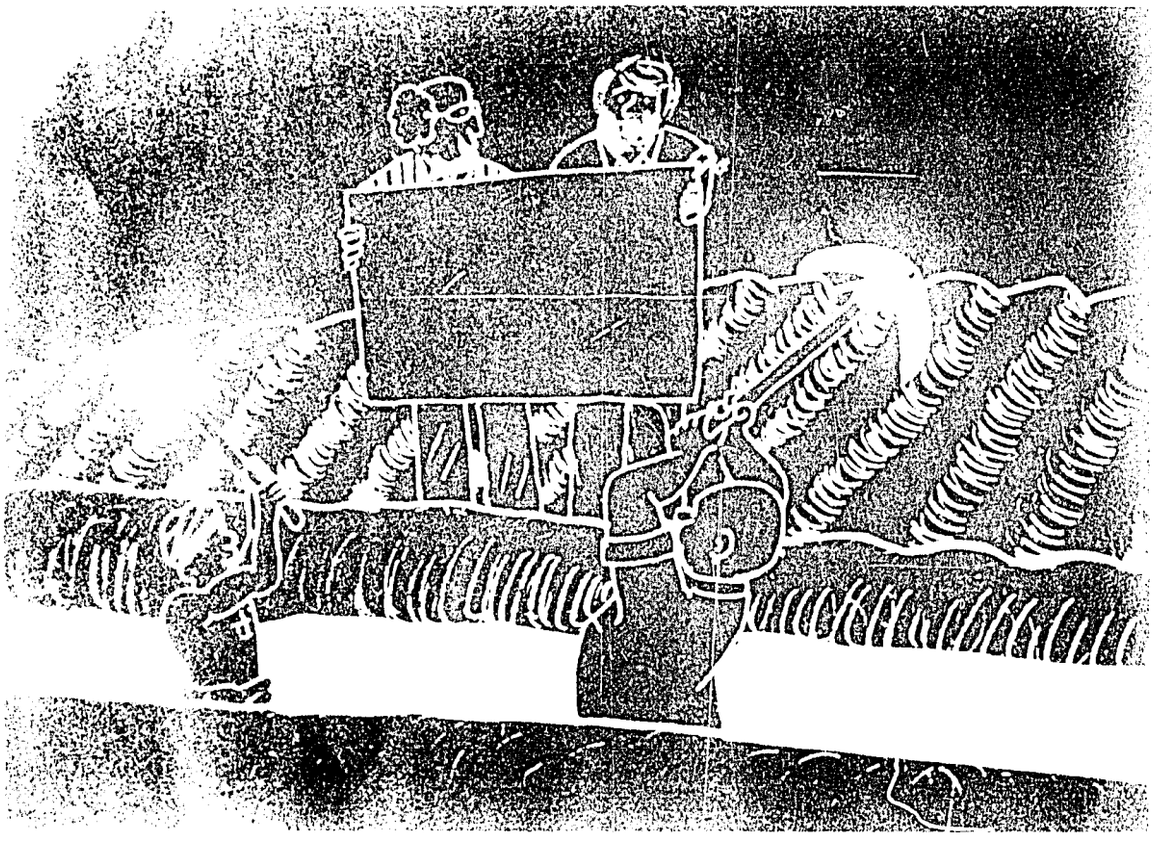
One of the solutions to the water loss was found to be watercourse rehabilitation Watercourses had to be rebuilt using the proper bank width and depth A watercourse that has narrow banks will leak much more than one designed for the proper width

Concrete-lined watercourses were tried, but under existing conditions found to be too expensive for the water saved Instead, the scientists found that by constructing the proper width bank and by compacting the soil, much of the loss could be eliminated relatively inexpensively

Assessment of Solutions

In order to assure that the innovations are appropriate, acceptable, and useful for all farmers, formal assessment of the solutions is necessary. Primary emphasis is placed on working with farmers to test the solutions under actual conditions that other farmers will encounter when they apply the same solutions.

Assessment of the solutions is important to provide insight into how the innovations can be improved for wider and more rapid diffusion among farmers. Evaluation of the solutions is also important to determine feasibility for all classes of farmers and to estimate the socio-economic impacts. Focus is on assessment of both individual and group adoption behavior of farmers. Two-way communication is essential if technology is to be improved.



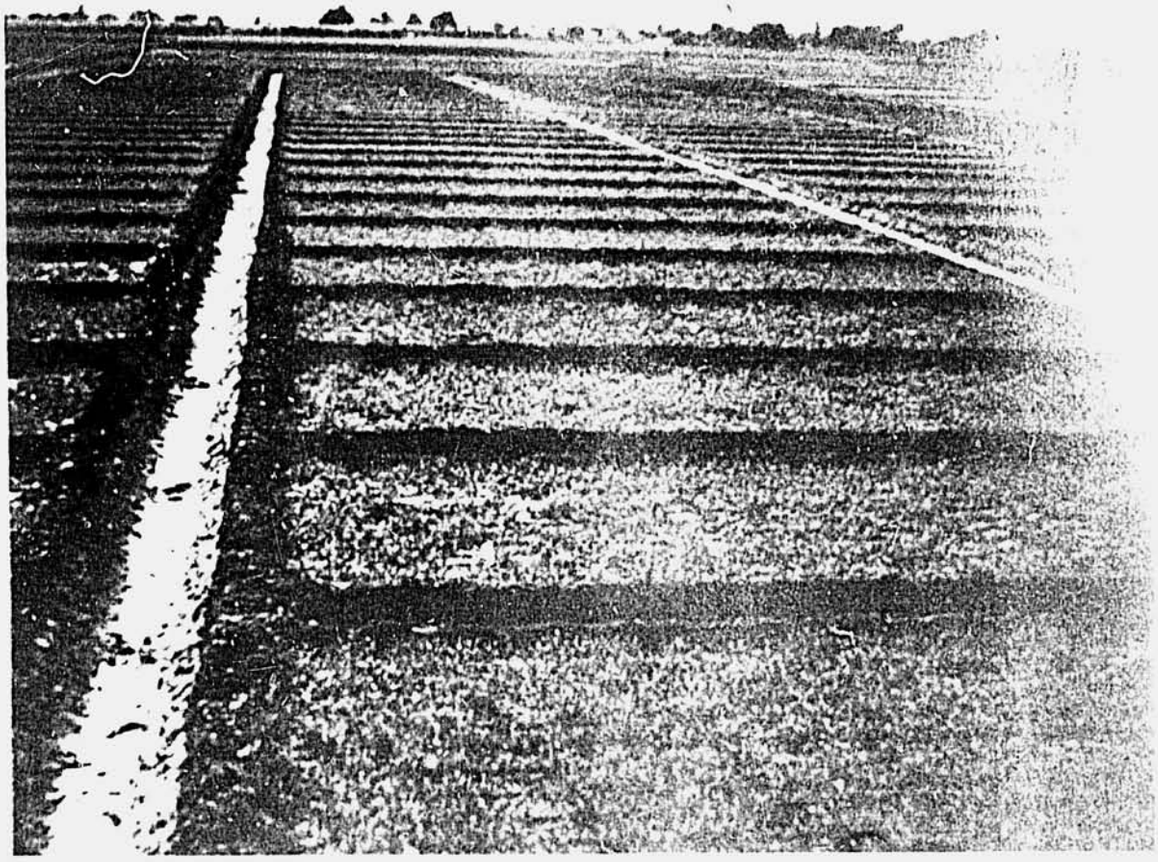
Another phase of the process is putting all the solutions together in a package of technologies for implementation on a larger scale

An extension worker discusses plans for implementing a watercourse improvement project with the farmers whose land is irrigated by the watercourse

The solutions are being implemented here as farmers are trained to remove the old banks and rebuild the channel to proper shape.

Personnel are also trained to design the right width and elevation for the banks.

Part of the pilot project involves training personnel who will then work with the farmers to implement the solutions to the problems that they face in increasing food production.



A final step in the project is communication of the program to other farmers in other areas of the country. Diffusion of the program depends a great deal on the project results. A successful program is worthwhile to promote. Thus, visible success of the pilot project will speed adoption of the program throughout the country.

KEY ELEMENTS

The process has certain key elements that are essential for its success.

- On-farm Focus
- Farmer Participation
- Interdisciplinary
- Problems Selected with Highly Visible Solutions

Especially important to the process is its *on-farm focus*. Farmers are working here to improve their own watercourse.

Farmers participate in every phase of the process. Organization of the farmers is essential to the success of the project.

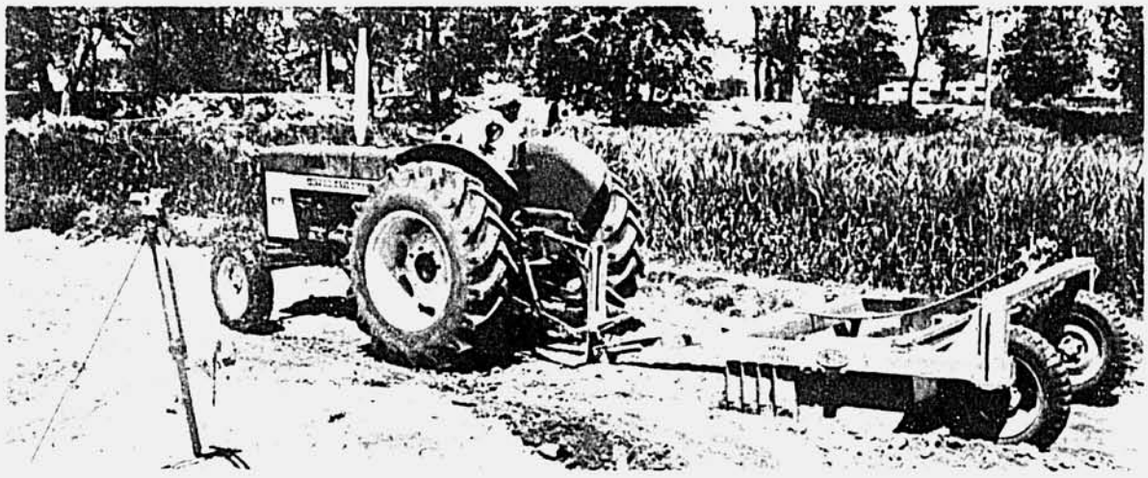
Here a Pakistani extension worker talks with farmers in a village that is planning to implement the project. The extension worker is discussing ways to work together so they will get the most from the project. It is truly the farmers project that's what the extension worker wants them to know.

It is important to give farmers recognition for their hard work as is being done here

The approach to the problems is interdisciplinary. Irrigation engineers, agronomists, water law experts, agricultural economists, sociologists and communication specialists all work together with farmers to understand and solve farmer problems.

A Pakistani extension worker with a sociologist and agronomist discuss watercourse rehabilitation plans with a group of farmers. The rehabilitation will be done on their own farms.

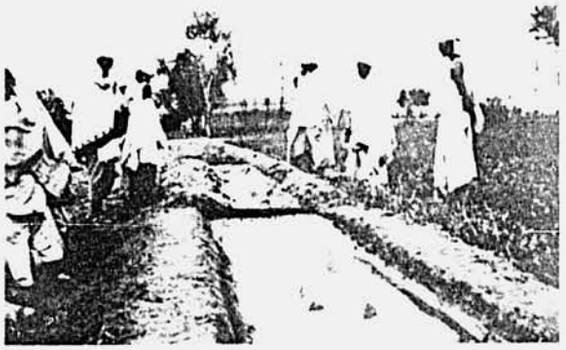
Highly visible, immediate problems that face rural poor are selected for action-oriented research by the interdisciplinary team of scientists.



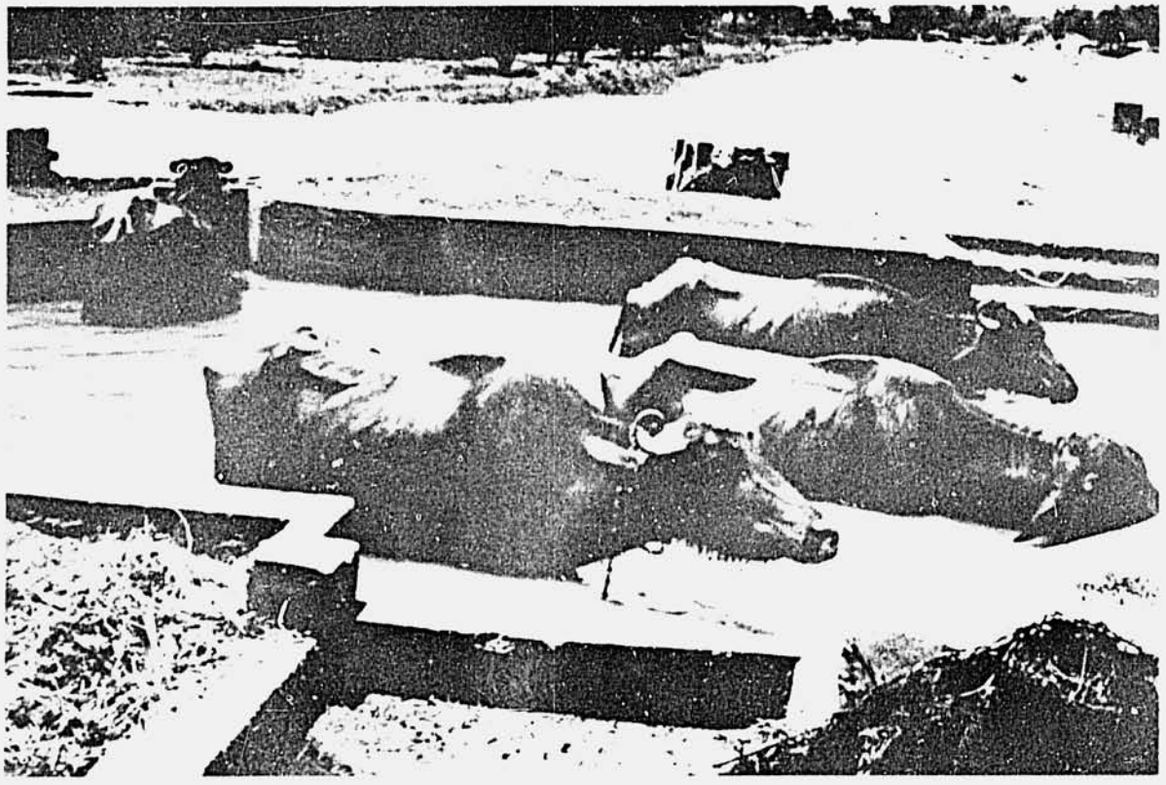
One problem faced in the Pakistan Project was unlevel land. Here farmers and engineers work to level the farm land.

Another problem was the need for improvement of watercourses. When the watercourse is improved, the farmers experience immediate results of more water - a highly visible result. As one farmer said, "Even a child can see."

In some cases as much as 50 percent of the present water loss has been prevented



Here, for example, [illegible] cases have been cut considerably. Concrete baths have been built to reduce the deterioration of the banks where the people had been bathing. The baths also provide a place for the women to wash dishes and clothes and for the people to bathe



Improved agronomic practices have helped increase crop yields considerably. Here an agronomist adviser is talking with a Pakistani extension worker about the land leveling and better planting and irrigation methods used on this farm to increase production.

For more information about the research-development process applied to water management, contact USAID, or Water Management Research Project, Engineering Research Center, Colorado State University, Fort Collins, CO 80523, U.S.A.

Detailed reports on each phase of the process will soon be available, as will how-to-do-it handbooks on each phase.

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Jim Mealler, illustrator
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Thanks for help in the preparation of this booklet also go to Wayne Clyma, Max Loudermilk, Gaylord Skogerboe, Doral Kemper, Bill Schmehl, Bill Franklin, Gilbert Corey, and Rick Aust.

Colorado State University
Water Management Research Project
in cooperation with
United States Agency
for
International Development
and
the many Pakistani agriculturalists, engineers and scientists representing water management and agricultural agencies of the Government of Pakistan who have participated in this research-development process.