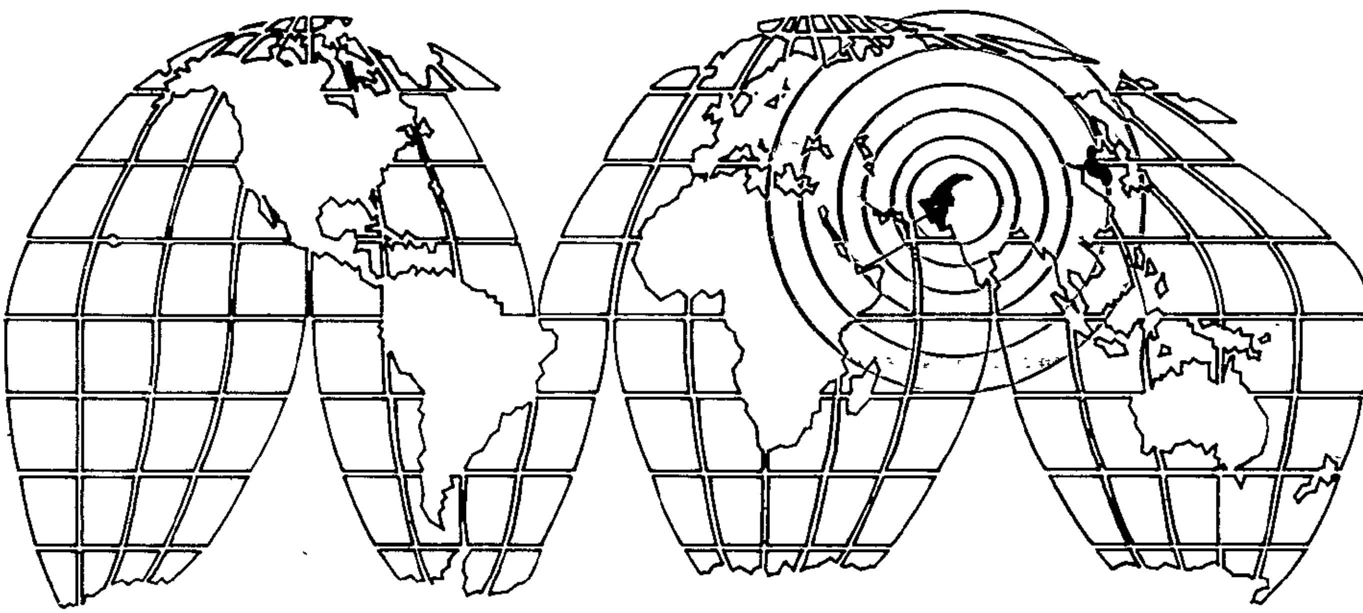
A.I.D. Project Impact Evaluation Report No. 35

The On-Farm Water Management Project In Pakistan



June 1982

U.S. Agency for International Development

PN-AAJ-617

THE ON-FARM WATER MANAGEMENT PROJECT IN PAKISTAN

PROJECT IMPACT EVALUATION NO. 35

by

James E. Painter, Team Leader
(Bureau for Program and Policy Coordination)
Emily Baldwin, Sociologist-Economist
(Bureau for the Near East)
Sandra Malone, Program Operations Specialist
(Bureau for Program and Policy Coordination)
Ernest T. Smerdon, Agricultural Engineer
(University of Texas)
Akbar S. Ahmed, Anthropologist
(Harvard University)
Masud A. Siddiqui, Evaluation Officer
(USAID/Pakistan)
Mahmood H. Khan, Agricultural Economist
(Simon Fraser University)

U.S. Agency for International Development

June 1982

A.I.D. EVALUATION PUBLICATIONS

A complete list of reports issued in the A.I.D. Evaluation Publication series is included in the last three pages of this document, together with information for ordering reports.

TABLE OF CONTENTS

FOREWORD

In October 1979, the Administrator of the Agency for International Development initiated an Agency-wide ex-post evaluation system focusing on the impact of AID-funded projects. These impact evaluations are concentrated in particular substantive areas as determined by A.I.D.'s most senior executives. The evaluations are to be performed largely by Agency personnel and result in a series of studies which, by virtue of their comparability in scope, will ensure cumulative findings of use to the Agency and the larger development community. This study of the impact of A.I.D. The On-Farm Water Management Project In Pakistan was conducted in October 1982 as part of this effort. A final evaluation report will summarize and analyze the results of all the studies in this sector, and relate them to program, policy and design requirements.

SUMMARY

The On-Farm Water Management (OFWM) project was evaluated during October 1981 by a team of AID staff, and American and Pakistani contract staff, assisted by USAID staff and short-term contract help. During three weeks of field work, the team visited project sites and met with Federal, provincial, and local officials in three of Pakistan's four provinces; the fourth province, Baluchistan, was excluded because of conditions related to an influx of refugees from the conflict in neighboring Afghanistan.

The On-Farm Water Management (OFWM) project was designed as a five-year pilot project to demonstrate the feasibility of increasing food production and rural incomes by reducing irrigation water losses in village watercourses, improving the use of water through the precision leveling of fields, and training of farmers, through agricultural extension, in improved farming practices. The project was initiated in FY 1976 with a $7.5 million loan to the Government of Pakistan. A second tranche of $15 million, planned for FY 1978, did not occur due to the temporary cessation of the entire U.S. assistance program to Pakistan following Congressional passage of the Symington Amendment.

As a result of the two-thirds cutback in the U.S. contribution, implementation of the OFWM project did not reach its planned level. However, Pakistani participation in the watercourse improvement component exceeded expectations with the result that 1,300 of a planned 1,500 watercourses had been improved as of June, 1981. Conversely, only 14 percent of a planned 425,000 acres of farmland were precision leveled and the extension element was not implemented to any appreciable degree. About two-thirds of the project implementation occurred in the Punjab and most of the rest in Sind; there was some limited implementation in the North West Frontier Province and in Baluchistan.

FINDINGS AND LESSONS LEARNED

As a result of watercourse improvements, water losses were reduced and more water was made available to farmers on a reliable basis. The result was significant agroeconomic benefits including expanded crop area, increased cropping intensity, greater emphasis on cash crops, increased use of fertilizer, and rising crop yields per acre with resultant increases in net farm incomes. As a result, popular demand for assistance with watercourse improvement has increased markedly since the inception of the project and remained high at the time of the evaluation.

Most improved watercourses visited showed greater than expected evidence of maintenance, and farmer interest therein, although it is unclear whether this will be continued over time. Maintenance is critical to sustaining benefits from watercourse improvement but is dependent on community cooperation. Water User Associations, planned as the village structure for continued watercourse maintenance, were found not to have been established as effectively as intended, although farmer awareness of the importance of maintenance seems to have increased informal cooperation significantly at project sites except where local factionalism has inhibited it. Ensuring continued cooperation may hinge on establishing such formal structures or, at a minimum, promoting voluntary cooperation through extension or media outreach efforts.

Success in generating governmental awareness of the importance of on-farm water management, and in creating an institutional mechanism for meeting the need, was found to be mixed. Federal and provincial commitment to the OFWM concept has grown demonstrably but in many areas this awareness and acceptance was found not to have reached the local (district) level to the same degree. Neither has the project produced needed changes in the curricula of academic institutions, which must supply the trained personnel for further on-farm water management improvement efforts.

The project design was found not sufficiently flexible to take into account regional variations in soil conditions and topography and in traditional local land tenure arrangements. Because land ownership patterns determine who benefits from watercourse improvement and land leveling, more attention needs to be paid to ways of assuring benefits to small farmers, especially tenants.

Inadequate baseline data collection and monitoring during project implementation hampered precise documentation of project benefits. In the case of the OFWM project, the absence of such baseline data appears not to have prevented its replication, owing to clearly perceived benefits by participating farmers and resultant growth in demand for watercourse improvement. However, to the extent that alternate approaches to on-farm water management technology are tested and the most cost-effective modes sought, better data collection will be a must.

Precision land levelling (PLL) was considerably less successful than anticipated, owing in part to small farmers' view that the risk exceeded the likely benefit and their resultant reticence to remove land from production. In addition, PLL was not fully tested due to a GOP decision to de-emphasize it mid-way through the project period in favor of watercourse improvement.

The planned agricultural extension element was not adequately implemented, possibly partly as a result of competition with an existing extension service and partly due to A.I.D.'s choice of the Fixed Amount Reimbursement mechanism for project financing. Though effective for public works activities, the F.A.R. appears to be less effective for promoting project activities, such as agricultural extension, which lack fixed unit costs; its use for such project components needs to be reconsidered.

The cost of watercourse improvement exceeded planned levels due to price escalations and failure to take into account provincial government overhead costs. Encouraging financial participation by farmers in watercourse improvement could reduce project costs or spread benefits further and might increase their commitment to contributing to and maintaining improvements.

The quality of staff in the host country implementing agency is key to successful project implementation. Recruitment and retention of such staff necessitates appropriate personnel standards, regularized positions and a strong training program well integrated with project needs. Full achievement of improved on-farm water management requires, in addition to watercourse improvement, farmer training in efficient water usage and better cropping practices through extension which requires, in turn, a cadre of well-trained agricultural extension agents whose skills may be in demand elsewhere. The establishment and maintenance of an effective extension staff thus means attention to adequate pay levels, specialized training and appropriate coordination or integration with existing agricultural extension services.

GLOSSARY

Choudry.............Gentry; upper social strata
Command.............Area served by a single watercourse
D.C.................District Commissioner
FAR.................Fixed Amount Reimbursement; method of AID payment for project implementation
Ghairat.............Honor
Hari................Tenant farmer
Izzat...............Honor
Katcha..............Unimproved or earthen
MAF.................Million acre feet
Maund...............Unit of weight, equivalent to 82.3 lbs.
Mogha...............Outlet from canal into watercourse
N.W.F.P.............North West Frontier Province
Nucca...............Diversion opening from watercourse into farmer's ditch
OFWM................On-Farm Water Management
PLL.................Precision Land Leveling
Pucca...............Improved; concrete, brick, etc.
Warabandi...........Village water scheduling system
WUA.................Water Users' Association
Zamindar............Large landowner

Exchange Rate: Rs.9.90 = $1.00 U.S.

PROJECT DATA SHEET

Project Title: On-Farm Water Management Project - Pakistan

A.I.D. Project Number: 391-0413

A.I.D. Loan Number: 391-T-172

Borrower: Government of Pakistan

Loan Amount:

	Planned	Realized
Fiscal Year 1976:	$ 7,500,000	$7,500,000
Fiscal Year 1978:	$15,000,000	-0-
TOTAL:	$22,500,000	$7,500,000

Loan Agreement signed August 19, 1976

Pakistani Contribution: $21,838,000

Total Project Costs: $44,338,000

Terms: 40 years repayment from the date of first disbursement, including a grace period of not to exceed 10 years. Interest rate of 2 percent during grace period and 3 percent thereafter.

Terminal Date for Request for Reimbursement and for Disbursement:

June 30, 1982

Purpose: To establish public and private sector capability to plan and deliver On-Farm Water Management services (improvement of 1,500 irrigation watercourses, precise leveling of 425,000 acres of farm-land and improvement of crop and water management practices), on an economic basis.

Accomplishments: Completion of improvements on 1,300 watercourses in four provinces of Pakistan and precision leveling of 60,000 acres of land.

Base 504018 1-79

PROLOGUE: WATER AND THE SMALL FARMER

Water, from the canals fed by the Indus River, is the lifeblood of Pakistan's agriculture.

The Pakistani farmer knows this well. Mohammed Faisal, a typical small farmer -- a composite, actually, of many farmers encountered during the evaluation -- offers a view of the role of water in village Pakistan. Though not an educated man, Mohammed has been farming for most of his 70 years. For the past 34 years he has cultivated the six and one-half acre plot alloted to him in 1947 when he joined the Muslim emigration to the newly formed West Pakistan from his native East Punjab state in India. Now he shares that plot with his two adult sons and their families, who also share his mud house.

The water for his land comes from the watercourse shared with the 40-odd other small farmers of his village. It is fed by a distributary canal, the last link in the vast irrigation system which constitutes the legacy of 50 years of British engineering effort.

But despite its impressive size, and the huge supply of water from the Indus, the irrigation system does not always deliver water to Mohammed's fields. The village watercourse was built years ago, by the farmers themselves. Over the years the channel has become choked with grasses and even small trees. Its course, originally more or less straight, now twists and turns its way through the fields -- the result of repeated cutting and refilling of the banks to control the flow of water to the crops. And in many places the precious water now breaches the watercourse, spilling into lowlying areas where it stands in stagnant ponds, eventually seeping into the ground and adding to the villagers' growing problems with waterlogged soil and the associated salinity.

Mohammed's plot is near the tail-end of the watercourse, one of the farthest from the mogha -- the canal outlet. Although he and his fellow tail-enders can see the water flowing freely from the mogha, they know through experience that none of them will see his full share reach the fields when he gets his turn to use the water under the warabandi, the water scheduling system by which the village shares the water. When Mohammed's turn comes, as it does every Sunday from 7 AM to 10 AM, he knows he can expect to receive only about enough water to irrigate four of his six and one-half acres. So, reluctantly, he leaves the remaining land fallow. And, as he can easily explain, he knows exactly how much money he has lost which he could have earned from planting another acre or so of cotton. He knows too what the extra income from that cotton would have meant to his family: a better house, more schooling for his children and grandchildren, a little better standard of living for them all.

An unimproved watercourse winds through the fields in Sind.

Mohammed does not fully understand why he fails to get his full share of water. There are dark suspicions, discussed amongst his fellow villagers, that the Irrigation Department which maintains the canal and regulates the flow of water to his village is holding back some of the water which is rightfully theirs. The accidental breaches of the watercourse he can see. And, he confides, there is always the occasional unauthorized borrowing or outright theft of water which often erupts into arguments. But much of the lost water is taken by seepage, vegetation, and reduced flow in the watercourse itself, which is harder for the old farmer to comprehend. Nonetheless, he understands that an improved watercourse, straightened, cleared of weeds and trees, and ideally lined and fitted with concrete turnout structures to reduce the cutting and refilling, would probably provide him with more water.

But there is the problem of cost. Lined watercourses are expensive, and the farmers of his village have neither the money to invest nor the credit to borrow the sums needed. And there is the problem of getting the villagers organized to improve the watercourse on their own. The headman and other influential farmers in Mohammed's village hold land at the head of the watercourse. They do not see the need to improve it since they get most of the water they need. Those on the tail like Mohammed, who are most in need, are also the smallest and least influential. Then too, there is the problem of rivalry with the other tribe in the village which often prevents neighbors from working together for their own best interests.

So the water loss continues -- as it has for years -- and Mohammed, his family, his neighbors and, ultimately, Pakistan lose.

Such is the picture in much of the irrigated farmland in Pakistan.

THE PROJECT SETTING

Pakistan's Natural Resources. Pakistan is a nation with enormous potential for food production. The alluvial plains of the Indus Basin contain vast areas of fertile soil. There are nearly 28 million acres of irrigated farmland with good capability for agricultural production. The climate permits year-round growing of crops. Double cropping, and even triple cropping of short season vegetables, is possible. The people of Pakistan, though their literacy rate is low, are hard working and adaptable.

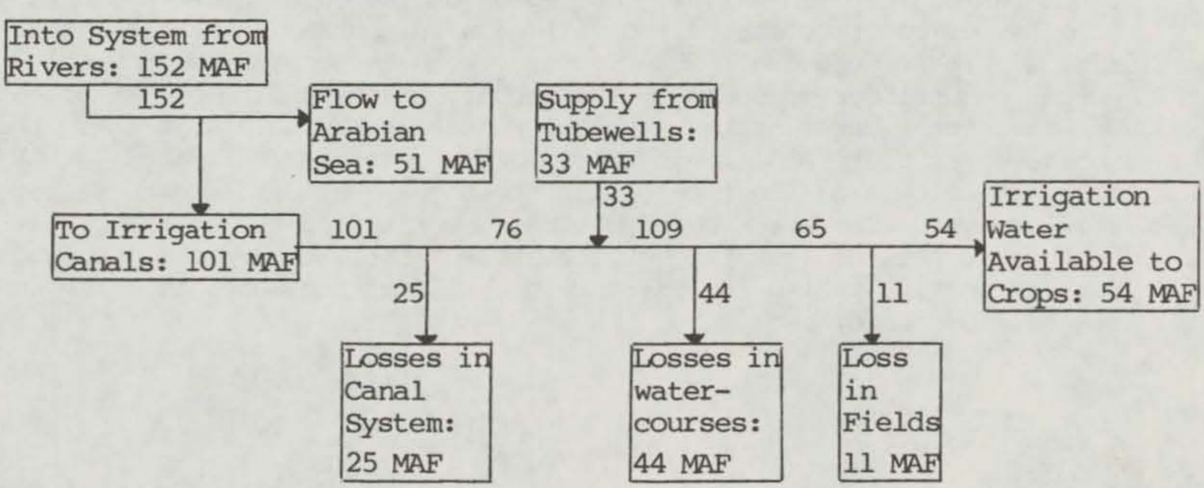
Yet agricultural production in Pakistan falls far short of its potential. Production of wheat, one of the country's major food crops, averages only one-half metric ton per acre (mt/ac) compared to an estimated potential of 1.38 mt/ac; as a result Pakistan remains a net importer of wheat. Rice, which is grown for export as well as consumption, has an estimated potential yield of 1.5 mt/acre, yet now averages only 0.65 mt.

Not only is cultivated land underutilized, much of the land lies fallow. Water is the main problem. In most areas there is too little water to meet crop requirements, leaving good land unused. In other areas, though, there is too much water, from a rising water table which waterlogs the soil, ruining once-productive land.

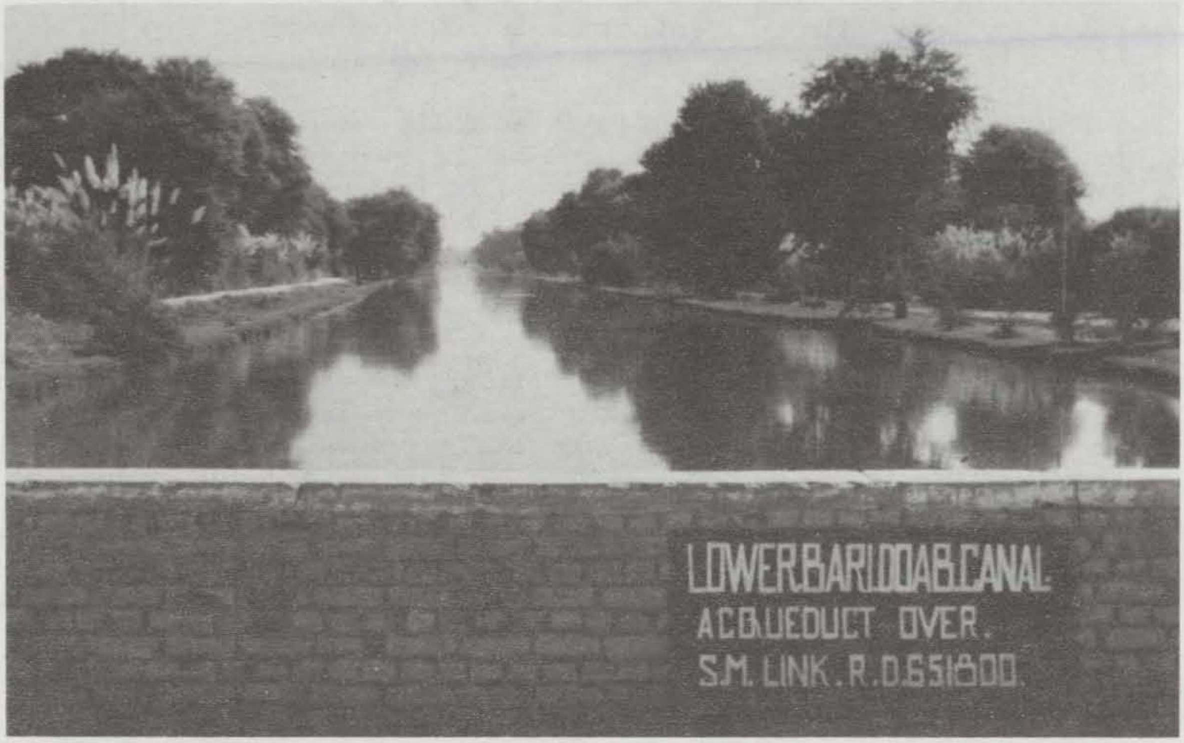
Farming in Pakistan is heavily dependent upon irrigation. In much of the Indus plain, rainfall averages no more than six inches annually. High temperatures, up to 113° F. in some areas, cause rapid evaporation of available water. Without irrigation, such arid conditions would quickly desiccate crops.

Pakistan is blessed with a good supply of water for irrigation from the Indus River, fed by the melting snows and higher rainfall of the north. According to figures from Pakistan's Water and Power Development Authority, the mean annual flow of the river into the Indus Basin is about 152 million acre feet (MAF).

INDUS BASIN IRRIGATION
Millions of Acre Feet (MAF) per year



About two-thirds of the flow, 101 MAF, is diverted into the extensive network of canals, the world's largest irrigation scheme, which was designed by the British in colonial days. From the river-fed link canals, a descending arterial system of major, minor, and distributary canals branch out to carry the water to the village watercourses which feed individual farmers' ditches within each "command" area.



A major canal in the Punjab.

Approximately one-fourth (25 MAF) of the water supplied to the canal system is lost to seepage and evaporation before it reaches the watercourses. It is supplemented, however, by water from tubewells, pumped from the vast ground water reservoir underlying much of the Indus Basin, to provide approximately 109 MAF to the country's 80,000 watercourses.

Though an engineering marvel, the design of the canal network did not provide for construction of the village watercourses which link it to the fields. These were dug by the farmers themselves, with no knowledge of proper channel design and only rudimentary understanding of the effects of watercourse deterioration on lost water. As a result, it is in the watercourses that the largest water loss occurs. An estimated 44 MAF, fully 40 percent of the supply from the mogha, is lost through seepage, spilling and evaporation before it reaches the farmers' ditches. With another 10 percent lost through inefficient irrigation practices, due in part to poorly leveled fields, only one-half of the water from the canals reaches the crops.

Ironically, the irrigation scheme designed to overcome Pakistan's water deficit has contributed, through such seepage losses, to a second and growing cause of lost agricultural potential in the Indus plain -- waterlogging and associated soil salinity. This "cancer of the soil" is threatening many areas and has reduced or stopped food production in some of those most seriously affected. (See Appendix C for more detail.)

Salt is left in depressions after water evaporation.

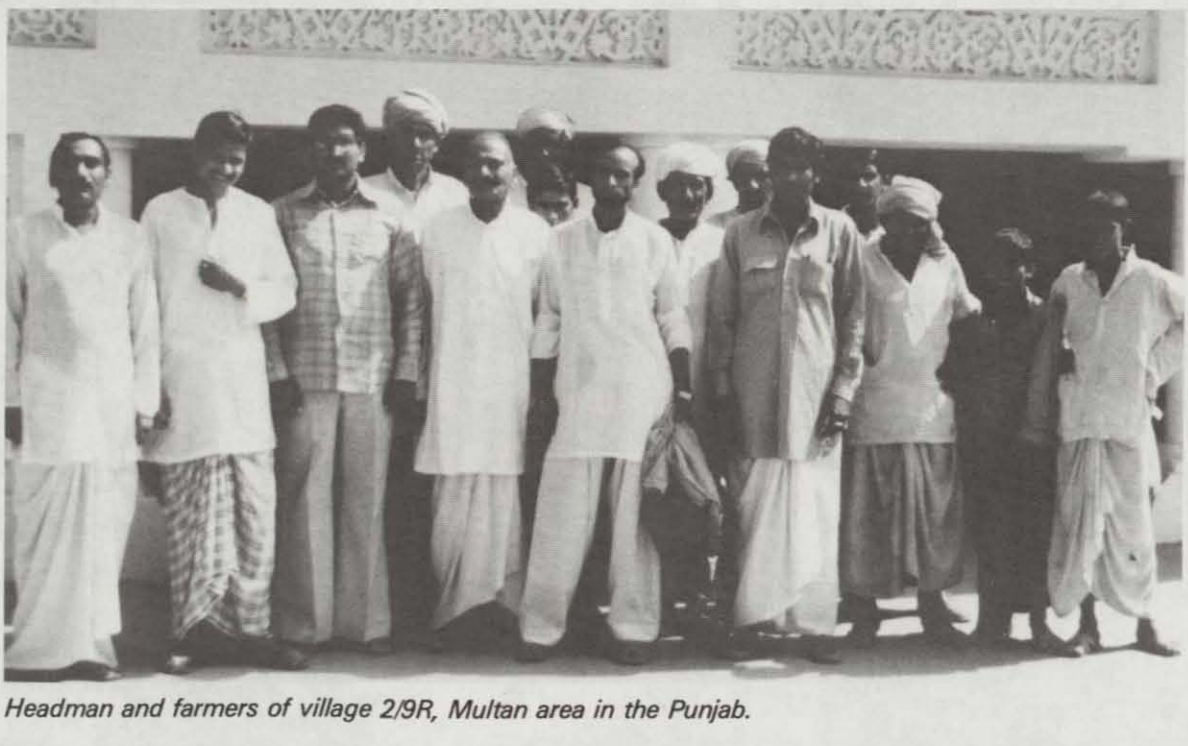
Part of the complexity of designing solutions to such irrigation-related problems is the variation in physical conditions in different provinces. The waterlogging problem is particularly acute, for example, in parts of the Punjab. Around the Faisalabad area land is being lost at an alarming rate to the rapidly rising water table.

Punjabi citrus trees in foreground were killed by salinity. Tree in center background is not yet affected.

In Sind, where the climate is warmer and more arid, the soil more porous, waterlogging is replaced by insufficient water in some areas and extensive salinization in others. Baluchistan and the North West Frontier Province are both more hilly and require different designs for irrigation systems, involving more "drop" structures and methods for slowing water flow.

Socio-cultural Factors. Agriculture is a source of livelihood for more than three-fourths of Pakistan's 84 million people. The agricultural region forms the socio-cultural core of the country, with rural village life centered around irrigated farming. Irrigation is the key to economic wealth and social status.

Within this core region, there exists a wide variety of distinct ethnic and language groups and associated economic and social patterns in the rural community. Land tenure arrangements, for example, vary by region. Among the Pathans of the North West Frontier Province (NWFP), with their traditions of fierce independence and democratic social order, land ownership tends to be equitably distributed with most cultivators holding very small individual plots of only a few acres. By contrast, in the southernmost province of Sind, land tenure resembles a feudal system with a single large landowner typically employing a group of tenant farmers housed in small villages on his land to cultivate much of the holding. In the Punjab, the largest, and economically and politically dominant province, the pattern is mixed with some very small landowners and some larger landowners who generally constitute the more influential members of the community.



Headman and farmers of village 2/9R, Multan area in the Punjab.

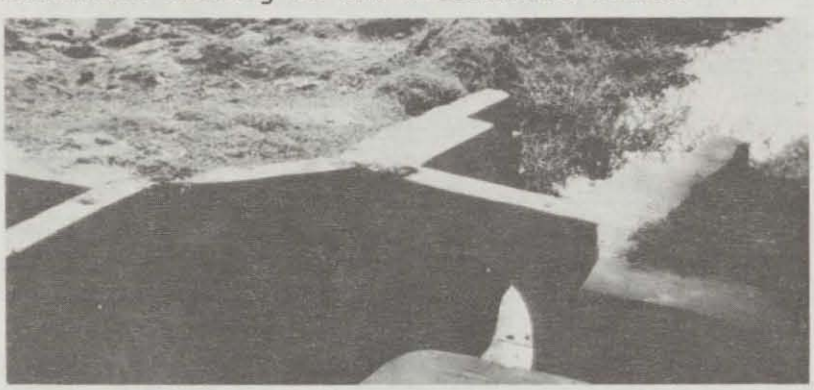
Yet beneath the diverse cultural and structural forms there is a common perceptible tribal structure. The structure possesses two characteristic features. First, life is seen as based on the notion of honor, called izzat or ghairat. Second, rivalry, both agnatic rivalry (that between male cousins) and intertribal rivalry, in villages with a heterogeneous tribal system, is a dominant aspect of social interaction. Rivalry, and the desire to attain honor, are converted into a striving for power -- acquired at the expense of a rival cousin or tribe. The success of irrigation schemes, like other agrarian development efforts which are dependent on farmer cooperation, is affected by such rivalry where it is prevalent. (Appendix F discusses this matter in more detail.)

As elsewhere, an important factor influencing development in Pakistan is the governmental administrative structure. At the grass roots level, the federal departments are frequently less visible than the local administrative apparatus which deals with a wide range of issues from law and order to revenue to water distribution. In Pakistan, as in India, this local apparatus is headed by the district commissioner, known as the "D.C." -- a holdover from the British colonial administration. The D.C. is a mid-level career officer in charge of virtually all government functions at the district level (roughly equivalent to the county in the United States). The D.C.'s involvement in, or at least his tacit recognition of, local development schemes may well determine the success or failure of the planned results.

THE ON-FARM WATER MANAGEMENT PROJECT

Project Design. Initiation of the On-Farm Water Management (OFWM) Project was preceded by more than twenty years of research on various aspects of irrigated agriculture in Pakistan. Of particular importance was the research conducted at the Mona Experimental Station in the Punjab, by Colorado State University, which established for the first time the alarming extent of water losses from deteriorated watercourses and inefficient irrigation practices on the farm.

Through experiments at Mona, new methods were developed and tested to improve watercourses through properly designed channels, partial concrete lining and installation of concrete turnout structures, called nuccas, to eliminate cutting of the watercourse banks.



Concrete turnout structure — pucca nucca — on an improved watercourse.

Precision land leveling (PLL), designed to reduce variations in field elevation -- a chief cause of overirrigation on the farm -- was adapted to Pakistani conditions as well.

Based on the Mona research and estimates of the potential savings achievable from such improvements, the On-Farm Water Management project was developed in 1976. The project was designed as a five-year pilot program to establish the capability of Pakistan's public and private sectors to plan and deliver efficient on-farm water management services to farmers on an economic basis.

Its ultimate goal, as stated in the project paper, was to foster "increased agricultural production and improved income for the low income farmers in Pakistan." Because of its limited size and duration, however, the project was not intended to achieve a significant increase in national food production in its own right. It was rather to serve as a demonstration, in selected areas, of the potential for increased food production and income from improved water management. An important sub-goal was the development of an appreciation by the Government of Pakistan of the value of on-farm water management as a concept in its agricultural planning -- evidence of which would be the inclusion of OFWM in national planning, increased budgetary support and subsequent replication of the project.

The project set three specific tasks to be accomplished during its five-year life: the improvement of 1,500 watercourses, precision leveling of 425,000 acres of irrigated farmland, and the training of 60-100,000 farmers in improved crop and water management practices. The project design also assumed, without spelling out details, that a governmental structure would be developed for the purpose of carrying out part of these tasks.

The total cost of the project was set at just under Rs. 439 million ($44 million). Of this amount, Rs. 56 million was to be borne by participating farmers in the form of contributed labor for watercourse improvement, plus one-half of the cost of leveling up to five acres of land. The balance of the project was to be shared by AID and the Government of Pakistan, 58 percent and 42 percent respectively. The U.S. contribution was to be provided in the form of two 40-year loans, the first for $7.5 million to be disbursed over three years beginning in fiscal year 1976 and the second for $15 million to be disbursed over the remaining two years of the project's life. Start-up costs, for mobilizing field teams to carry out the work, were to be covered by advance payments to the Government and liquidated through subsequent reimbursement for work actually completed, using the Fixed Amount Reimbursement (FAR) method which set unit costs for lengths of watercourses reconstructed, fixtures installed, and acres of land levelled. No reimbursement was provided for farmer training.

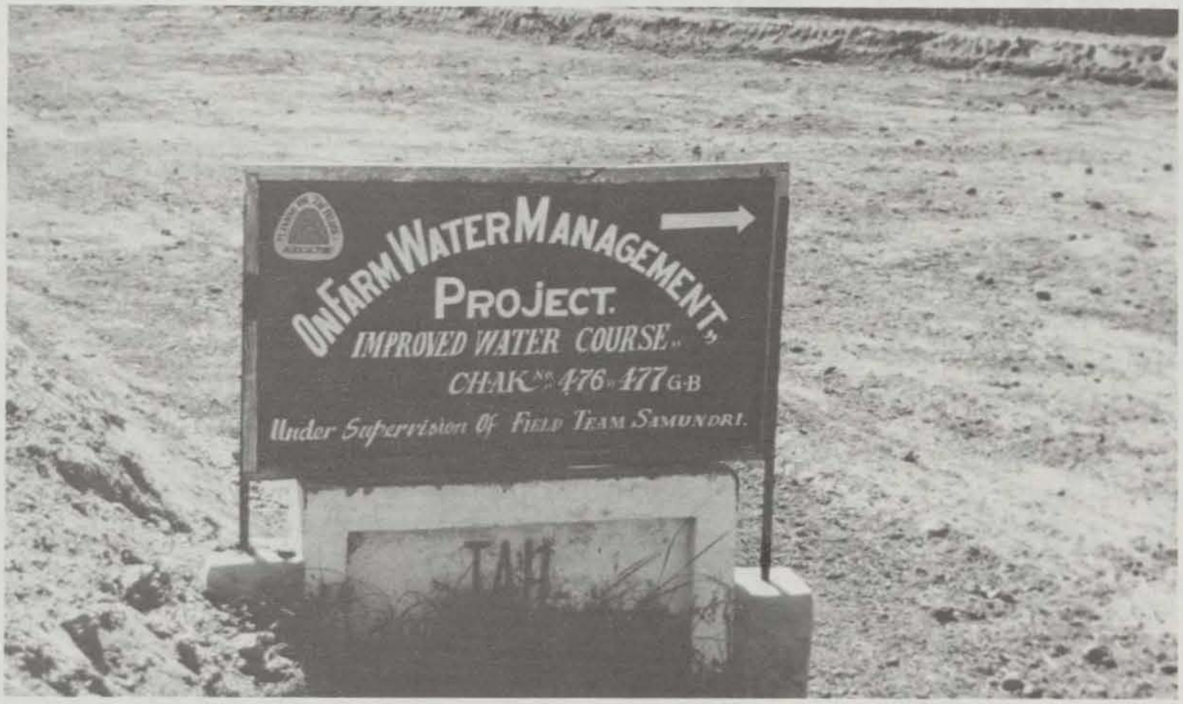
No criteria were set in the project design for provincial allocations of the total project budget. Such decisions were left to the Government of Pakistan's own internal budget process.

The only criterion for project site selection related to the focus on the small farmer; only watercourse command areas with at least three-fourths of the farmers holding small plots of not more than 25 acres were to be chosen. A precondition of participation in the project was the formation of a watercourse committee. The committee would be responsible, among other things, for organizing labor for the improvement and subsequent maintenance of the channels, and the settlement of disputes.

Project Implementation. The project was not carried out as planned. Although the first AID loan was fully obligated, the second loan, amounting to two-thirds of the planned U.S. contribution, was never made due to the passage of the Symington Amendment in 1979 which prohibited further U.S. assistance to Pakistan as a result of its nuclear development activities.

Nevertheless, significant implementation of some aspects of the project did occur. To carry out the project, On-Farm Water Management (OFWM) Directorates were created in each province. Headed by a director, each provincial OFWM organization built a management structure, including -- in the case of the Punjab and Sind -- a formalized training capacity, and staffed some 50 field teams of six to ten persons each which were deployed in rural areas.

Of the 1,500 watercourses planned for improvement, approximately 1,000 were completed by the directorates as of June, 1981; of these, some 47 percent had been approved by AID for reimbursement as of October 1981.



Roadside identification sign for an improved watercourse.

In terms of precision land leveling, out of a total of 425,000 acres planned for leveling, only about 15 percent has been achieved. Much of that done benefitted the relatively larger farmers; as discussed later, the response from small farmers was much less than anticipated.

Implementation of watercourse improvement and PLL differed considerably from province to province. Approximately two-thirds of all watercourse improvement took place in the Punjab, whereas the bulk of the land leveling occurred in Sind.

With respect to farmer training, the third component of the project, implementation, was minimal. The extension function, for reasons discussed subsequently, was largely neglected and very few farmers actually received any training or technical assistance.

PROJECT IMPACT

A total of 48 watercourses -- 38 improved and 10 unimproved -- were visited by members of the team during the course of field work. (See Appendix A.) More than 200 interviews with farmers, their families, and a wide range of others were conducted in 41 villages served by these watercourses. (Methodology is discussed in Appendix B.)

While it was difficult to quantify precisely the impacts of the project, owing in part to the lack of pre-project baseline data on production and income, the relative consistency of reported gains from watercourse improvement provided a clear impression of the project's benefits.

The various impacts of the OFWM project were all the result of the immediate and direct impact of watercourse improvement: the reduction of water losses. Cutting water losses supplied more water to crops and, thus, produced better yields, from which "flowed" subsequent economic, social and institutional impacts. This being a water project, it seems appropriate to follow this "flow" in discussing the various impacts. However, the sequence of discussion should not obscure the fact that the principal intended -- and achieved -- impacts of the project were increased farm yields and farmer income.

Lined and unlined sections of an improved watercourse.

Reduction of Watercourse Losses. As noted earlier, irrigation systems can lose water in several ways during conveyance -- through seepage, leaks, etc. The extent of loss over a given section -- the length of a village watercourse, for example -- can be accurately determined by measuring the rate of water flow at the beginning and end of the section. Thus, a watercourse in which the flow at the tail is found to be 60 percent of that at the head would be said to have lost 40 percent of its water in conveyance.

Because of the need to document losses in order to justify the need for watercourse improvement under the project, field teams of the OFWM Directorate routinely made such loss measurements prior to improvement. In the Punjab, most pre-improvement losses were found to range from 30 to 50 percent, with 40 percent a reasonable average. In Sind, with its more porous soil, the loss was found to average about 43 percent, while in the N.W.F.P. it was on the order of 30 percent.

Unfortunately for evaluation purposes, it appeared that the OFWM teams did not always make similar measurements at the completion of improvements. It was noted that post-improvement losses were often recorded in round figures such as 10 percent or 15 percent; too frequently the latter. This suggests that in some cases the post-improvement losses recorded may represent the planned, not the achieved degree of improvement. Time constraints did not permit field tests by the evaluation team to measure actual losses.
However, the team is convinced that the losses from watercourses were reduced significantly, based on numerous observations and comparisons with watercourse losses elsewhere. The team estimates that the watercourse losses, which actual measurements showed to be about 40 percent before improvement, were reduced to 25 percent or less after improvement. On the average this would mean an increase in water available to the farmers of at least 25 percent. To illustrate: the 60 percent of mogha discharge reaching the fields before improvement would increase to 75 percent after improvement. The 15 percent change would thus be one fourth greater than the 60 percent discharge prior to improvement.

Considerable indirect evidence of increased water availability was obtained from interviews with farmers on improved watercourses. Over three-fourths of the farmers interviewed stated that they received significantly more water -- estimates ranged from 20 to 50 percent more -- as a result of reductions in water losses. Even discounting for farmer enthusiasm, the perceived benefit was clear, and consistently reported. Most farmers also reported that watercourse improvement had resulted in considerable saving of time in irrigating their lands, in reduced effort and labor previously wasted dressing and mending the unimproved watercourse, in an assured and stable supply of water, and in reduced incidence of disputes about water. Such observations were made uniformly in each region.

Farmers refill a cut in bank of an unimproved watercourse following diversion of water to farmer's ditch on left.

It is noteworthy that, as a result of an increased and more dependable supply of water, farmers routinely reported reduced dependence on supplementary tubewell water. Tubewell water is often saline and thus not of the best quality. Moreover, it requires a significant amount of energy to pump and therefore is costly to the farmers (approximately Rs. 120 per acre foot). If the need for tubewell water is reduced, then, a direct and significant monetary savings results for the farmer. For example, one farmer reported that previously he could irrigate only four of his ten acres with canal water; the remaining six were irrigated with tubewell water. After improvement he needed tubewell water for only four acres, reducing his tubewell water costs by one-third. Such response was typical. (See Appendix C for further discussion.)

A tubewell supplies additional water to a farmer's private ditch (left) adjacent to an improved watercourse.

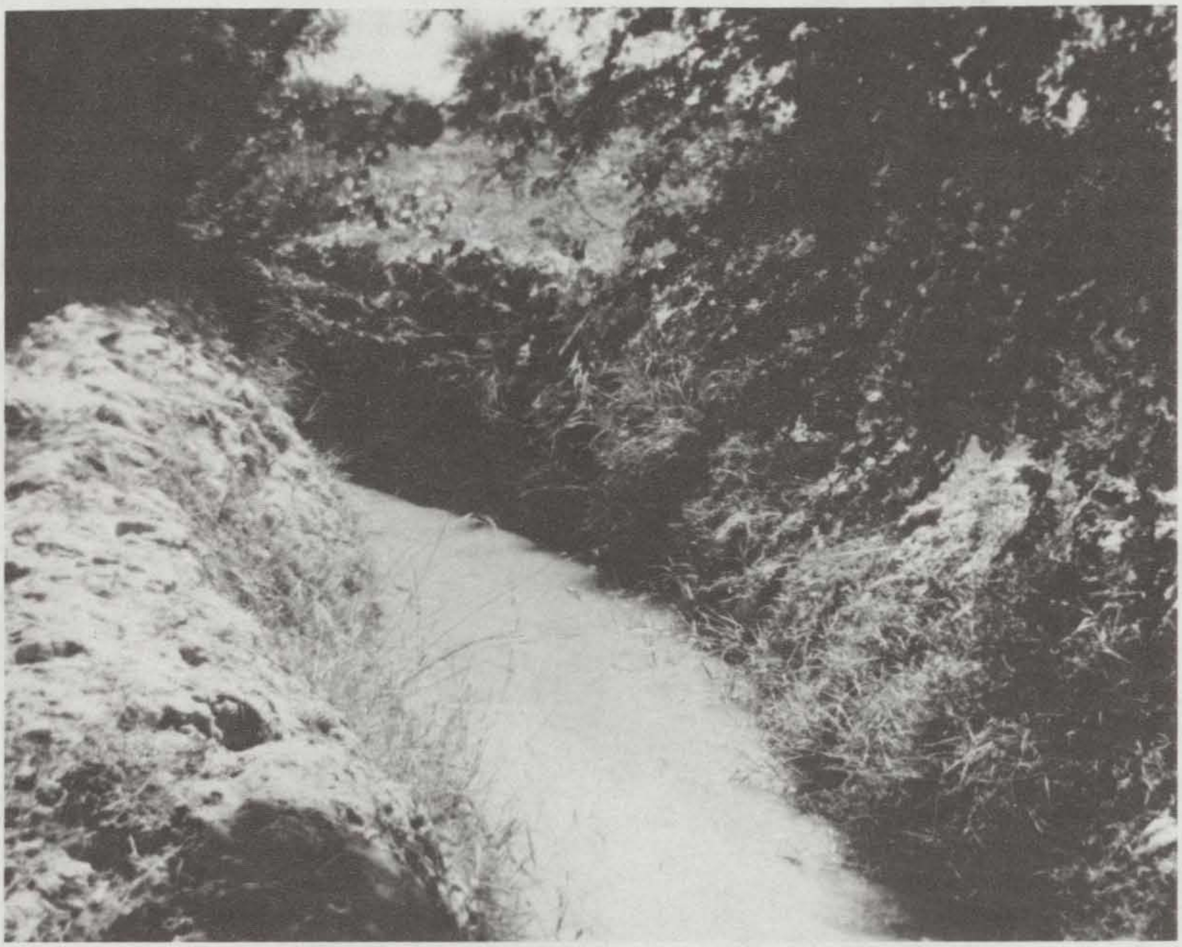
Farmers sometimes reported increased water to be the result of increased flow of water from the mogha following improvement. The supply of water from the canal to the watercourse is fixed by the size of the opening in the mogha, a matter controlled by the Irrigation Department and infrequently changed. However, flow from the canal can be reduced in an unimproved watercourse by a phenomenon known as "submergence" of the mogha, caused when the water level in the watercourse is raised by silt build-up to a point where water flow is impeded. Improvement of the watercourse, by removing silt build-up, would eliminate this condition thereby restoring the flow to its sanctioned level -- an increase from the point of view of the farmer. Though probably isolated, where such a condition exists, improvement of the watercourse will not only reduce conveyance losses but will increase the supply to that watercourse as well.

Water from distributary canal flows through mogha into lined section of an improved watercourse.

Conversely, on occasion farmers reported a diminished supply of water following improvement, which they generally attributed to a reduction in the size of the mogha by the Irrigation Department. The evaluation team was unable to substantiate this contention, but its repetition in several widely separated localities suggests some validity. However, it is not possible for watercourse improvement itself to cause a reduction in the supply to the farmers. Therefore, if a diminished supply occurred, it had to be the result of reduced flow through the mogha.

An additional, and very important impact of reduced water loss, though it too could not be quantified, is a reduction in the rate of waterlogging and the salinity so frequently associated with it. By reducing the seepage losses which percolate into the groundwater, the rate of rise in the water table is slowed.

Watercourse Maintenance. There is a great deal of silt carried by canal waters in the Punjab and Sind. Silt deposits build up regularly in the watercourses and must be removed if water supply is to be maintained. Although watercourse improvement reduces the silt deposition problem by speeding the flow and eliminating filtering vegetation, some sediment build up still occurs; regular maintenance of the watercourse is essential if it is not to revert to its previous unimproved state.



Watercourse banks are often piled high with silt removed during periodic cleaning.

Previous evaluations have cited lack of maintenance as a critical problem in the sustainability of watercourse improvement. While some watercourses seen during the impact evaluation indeed needed cleaning, in most villages farmers reported that the channels were regularly cleaned and this was confirmed by direct observation. Improved watercourses seem to have generated a good deal of community pride; in many villages a cooperative spirit was noted which is resulting in collective efforts at maintenance. Successful cooperation is hindered in some villages, particularly in the Punjab, by tribal differences despite the fact that farmers recognize the benefits that cooperation has to offer them both individually and collectively.

Most watercourse improvements are new and that newness itself may explain some of the observed enthusiasm for maintenance. There are indications, too, that the new understanding by the farmers of the importance of well maintained watercourses may lead to continued voluntary cooperation and preclude the necessity of depending solely on laws and policing to accomplish this important objective.

Farmers at work on watercourse.

Water Users Associations. Water Users Associations (WUAs) provided for in the project design, have not taken root so far, although in many cases, the watercourse committees formed in order to make the application for improvement have continued to function informally, achieving a reasonable degree of coordination in activities such as periodic watercourse maintenance. However, a new ordinance, recommended by a 1979 evaluation of the project, is in the final stages of adoption in each province. The ordinance confers legal status on the WUAs and gives them enforcement powers over such matters as post-improvement maintenance of the watercourses. It is too early to assess the utility of the ordinance in strengthening the role of the WUAs.

The creation of the Associations also can affect agnatic rivalry in the Pakistani village. Through his leadership role in a WUA, a zamindar (dominant landowner) can force action he would otherwise have to try to accomplish through informal means. His dominance over his rivals is thereby enhanced -- a positive impact from his perspective, a negative one from theirs. Village rivalry can thus be exacerbated, with possible negative consequences for social relations in the village.

Precision Land Leveling. Research at Mona and elsewhere clearly demonstrated that precisely leveled fields help improve water application efficiency and increase crop yields. But the exact impact of PLL in Pakistan is difficult to assess for two reasons. First, although those farmers interviewed who had leveled their fields seemed satisfied with their reported increases in yields, the amount of the improvement attributable to PLL could not be quantified. Second, whatever positive impact might have been achievable through PLL was inhibited by lack of enthusiasm on the part of small farmers, plus official de-emphasis by the Government of Pakistan in order to concentrate resources on watercourse improvement. (PLL is the subject of further discussion in Appendix C.)

Cropping. The amount of cultivable land actually under production varies from region to region within Pakistan; at least some of this variation can be attributed to water availability. At some sites in the Punjab, for instance, potentially productive land is left fallow year-round for lack of sufficient water; other sites are losing available productive land to waterlogging and salinity. However, as a general rule across provinces, a large part of the available acreage at most of the project sites visited was found currently under production for at least one crop per year. Thus, while increased water supply can help to bring previously fallow land into production, the primary impact of increased irrigation water is on greater cropping intensity and increased yields per acre. (See Appendix D.) Many farmers reported increased crop acreage, ranging from 15 to 30 percent. Among farms sampled, cropping intensity now averages from 146 percent in the Punjab and 151 percent in Sind to 170 percent in NWFP. In Sind, more than one-third of the farmers expanded cropped area by 30 to 50 percent. Cropping patterns have not changed significantly as a result of increased water; there is evidence, however, that a number of farmers have shifted to increased cultivation of cash crops like sugarcane and rice.

Use of Inputs. Over three-fourths of the farmers in all three provinces reported using more fertilizer, many as much as 30 percent more, on both food and cash crops. Where a typical farmer with 10 acres was using 20 bags of fertilizer before, he might now be using 26 or more bags. In some areas they are now applying new types of chemical fertilizers, such as diammonium phosphate and potash, not previously used.

There was evidence that many farmers recently have reduced the use of pesticides, for the most part due to the removal of the government subsidy in the past year rather than a result of watercourse improvement. In some cases, however, watercourse improvement itself may have brought about a decrease in pests. Increased water supply for sugarcane, for example, does seem to have reduced the incidence of certain pests and, therefore, the need for pesticides in some areas. On the other hand, for cotton crops in Sind, increased water supply seems to have caused an increase in the incidence of pests and use of pesticide.

Although labor requirements were not reported to have increased significantly as a result of increased water, in many areas farmers identified labor as a major constraint to increased production. Farmers often reported that seasonal labor shortages, including their own family labor, are already quite severe as a result of migration to urban areas or the Gulf States. As a result, the farmer's labor costs are going up dramatically.

Yields. Increased water, and a concomitant increase in fertilizer usage, have positively affected the yield levels of all major crops in those areas sampled. In most areas, the reported increase in sugarcane yield -- 30 to 60 percent -- was the most impressive. Particularly in the

Improved watercourse passes by fields of cotton (left) and sugarcane (right).

Punjab, maize yields have also increased significantly. Yields of wheat and rice reportedly increased by 20 to 40 percent, averaging about 25 percent. Some farmers, though, complained that the poor quality of sugarcane and wheat seed held yields to less than their potential. While these percentages could not be verified by other than farmer reports, their consistency lends some credence to the estimates.

Although tail-end farms often gain most in terms of increased water supply as a result of watercourse improvement, in areas where waterlogging and salinity are most pronounced, tail-end farms seem to be the most seriously affected and consequently tail-enders' yields were found to have increased less.

Incomes. Farm families were frequently reluctant to discuss actual income. Therefore, the estimates of increased income were generally inferred from reported crop yields and selling prices. Although farm costs have risen as a result of both inflation and greater use of inputs, larger yields (and increased support prices for most crops) have raised incomes even more. This has left most farm families with a larger disposable income as a direct result of increased water supply. A very large proportion of the sample reported gains in the range of 20 to 30 percent or more. Most of those interviewed expect such increases to continue into the foreseeable future.

Farmers' perceptions about the adequacy of their income were found to vary somewhat by region. In the Punjab, farm families express much greater satisfaction with current income and greater optimism about future gains. Farm families in Sind report their income as less adequate and tend to express greater fatalism about the future when they state that better income is "in God's hands." One Sindi farmer said that, although his income had increased in recent years, his family was still living from hand to mouth -- not, he noted, handful to mouth.

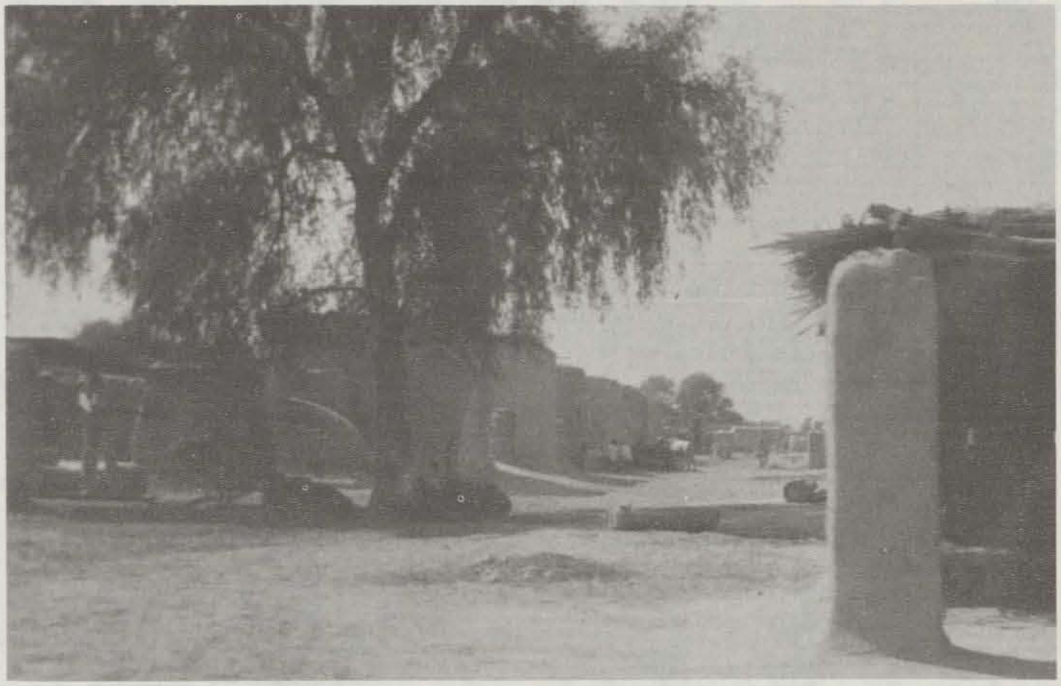
Such regional differences in perceptions of income are no doubt partly the result of different land holding patterns and social structures in the Punjab and Sind, noted under the preceding discussion of project setting. In the Punjab, where farmers are generally individual operators, their income is more directly the result of solely their own efforts than in Sind where, under the landlord-tenant arrangement, water -- and thus income -- is controlled by the landlord. The Sindi tenant (hari) also could be expected to be more attuned to the wide disparity between his own economic status and that of his nearby landlord than would be the case in the relatively more egalitarian social structure in the Punjabi village. In reality, though, comparative observation of living conditions in the Punjab and Sind suggests that there may be less real difference in income between Punjabi small holders and Sindi haris than their reported perceptions would suggest.

Improved yields are not the sole source of increased farm income. While more than half the families in the sample relied exclusively on farming for a living, a large number also relied partly on income from other sources, such as remittances from sons working in the cities or the Gulf states. The important contribution that such remittances can make to a family's income is illustrated by the family that spent its entire savings of Rs. 16,000 ($1,600) to send one son to Saudi Arabia while four unmarried daughters in their mid- to late twenties remained at home -- a sign of poverty in a culture where extravagant dowries are expected of the bride's parents.

Use of Income. Families generally reported three priorities for expenditure of additional income; first, reinvestment in the farm (usually for additional draft animals or new equipment such as tractors), second, new brick or concrete housing, and third, more education for children, especially boys, beyond the primary level. Although spending for basic necessities varied by income level, families generally did not report increased purchases of food, except for occasional instances of greater meat consumption, clothing (though the quality of clothing improved), or health care. However, increased spending for social functions such as the marriage of children (as a demonstration of prosperity) was not uncommon.

One difficulty in determining impact on family budgets is the lack of a significant cash economy in many villages. Barter of crops for needed services and commodities is a common practice. While many families are undoubtedly aware of the monetary value of transactions, most were reluctant to cite an amount for their purchases. Although many farmers pleaded ignorance of their economic position, observation indicated that many are beginning to enjoy an improved standard of living. Recently-purchased modern appliances, such as refrigerators and sewing machines, were not uncommon sights. Though most villagers still cannot afford such luxuries, it is clear that modern conveniences are finding their way into the villages and appear to be increasingly within the affordable range of at least some villagers.

Most respondents see increased prosperity as a village-wide phenomenon. Farm families generally believe that others in their community are benefitting from increased farm income as well. In fact, in villages with a cash economy (mainly those near large cities) local merchants and service providers seem to have taken advantage of the new prosperity by increasing their prices even more than the rise in farm incomes. In



Quiet afternoon in a rural village.

villages with a barter system, however, the opposite may be occurring; there, farmers more often perceived those in the non-farm sector as less well off than themselves. Though no one reported as much directly, this perception may be explained by a lag in the increase of fixed rates of barter of goods for crops such that the non-farm sector is not benefitting as much from increased yields. Increased village prosperity also has meant community improvements such as paved roads, hospitals, schools, and access to electricity.

It should be stressed that, although they constitute one of the target groups for such rural development projects, landless farmers (sharecroppers) and the near-landless, who usually must rent additional lands in order to survive, were found, by and large, not to have benefitted at all from the rising farm incomes.

This is particularly true in Sind, where the sharecropping system predominates. This system typically assigns three-fourths of total farm costs but only half of crop revenues to the tenant; the landowner, on the other hand, pays only one-fourth of the costs but receives half of the income from the harvest. In addition, the landowner usually decides the kinds and amounts of crops to be grown and the kinds and amounts of inputs, including the amount and timing of irrigation water, to be used and thus controls both the level of costs and revenues. Also, since many landowners do not rent out all of their cultivated lands to sharecroppers, they can grow high-income, low-labor demanding crops -- such as bananas -- and divert a disproportionate share of their irrigation water to those crops, thereby denying adequate water to the sharecroppers and increasing their farm revenues from sources other than tenants. (See Appendix F for further discussion of sharecropping in Sind.)

For many tenants, farm costs have risen dramatically in recent years, both in absolute terms and relative to revenues. This may be caused, for example, by a landowner purchasing a tractor and then requiring his tenants to rent it from him, thereby doubling their costs and outpacing their gains from increased yields. As their situation worsens under these cirsumstances, many sharecroppers reportedly move away from the villages, often to wage employment in the cities.

Social Impacts. Increased income is causing social as well as economic impacts on villagers. For example, lines are blurred between lineages and groups. In the villages today it is said that "every man is a Choudry" (roughly, petty chief). Status is being redefined in terms of income. A commonly heard phrase is "izzat daulat ki cheez hai" -- "honor is a matter of money." But the new emphasis on increasing one's income is having a negative social impact as well. According to traditional thinking, the Choudry should first be concerned with the good of the community, placing its needs above his own welfare. As he now strives to maximize his own gains, cynicism and bitterness are created in the traditional village society.

Meeting with farmers to discuss impacts of watercourse improvement.

In regions where there is little correlation between a farmer's location along a watercourse and his income level or tribal affiliation (more prevalent in areas with multiple landownership), the social impact of watercourse improvement is not reserved to a single ethnic group or class. Rather, it accrues to those villagers who happen to be located on the sections of the watercourse which see the greatest increase in water supply.

In those areas characterized by feudal landholding arrangements, however, such as in Sind, there is a marked tendency for the larger landowner to benefit most from the project and, thereby perhaps widen the gap between himself and his tenant farmers. He can, if he chooses, direct any or all of the increased water supply to land he cultivates himself, rather than that which is share-cropped. He will also benefit more than a group of small landowners in the same area because, with his power to order his tenants to straighten and maintain a watercourse, he ensures himself the benefits which small owners may find difficult to achieve through democratic agreement and cooperative action.

Where it exists, the democratic process clearly hinders decisionmaking. This was graphically demonstrated in the NWFP where, even after improvement, watercourses still cut serpentine paths through the fields -- a reflection of the community's inability to force intransigent individual farmers to grant right of way for a straightened watercourse across their own land for the group good.

Yet another observed social impact relates to the operation of the code of honor. Izzat (honor) is the monopoly of the dominant lineage or tribe. A leader of the dominant tribe may support development projects such as this one in order to enhance honor. Those excluded from the opportunity to express honor derive no such benefit from the project. In fact, their economic inferiority may only be further underscored by the opportunity granted the Choudry no matter what the project's economic benefits to the village. (See Appendix G for further discussion.)

Impact on Women. Women in rural areas play a major role in farm activities, from the care of farm animals to the planting, cultivation and harvesting of crops. Many women interviewed reported that time saved irrigating, as a result of watercourse improvement, allows more time for household duties and child care. In addition, the new concrete sections of the watercourses provide a cleaner, more convenient area for washing clothes and dishes, and has become something of a social gathering place for village women -- which, for many, affords the only social activity outside the home.

Although increased income has been used to further educate children, educational opportunities for girls have been limited by the lack of village school facilities beyond the primary level and the reluctance to send girls outside the village. Many women, though, expressed a desire to educate their daughters beyond the primary school level, if only to enhance marriage prospects or ability to carry out the traditional role of wife and mother.

The project had no impact on employment opportunities for women. In addition to the fact that few women work outside the home in a traditional Muslim society, few jobs created through the project were in fields culturally acceptable for female employment. (Appendix E discusses this in greater detail.)

Institutional Impacts. An immediate and very significant impact of implementation of the project, prior even to the attainment of any results from improved water management, was the impetus it provided to the Government of Pakistan to shift its development priorities from large infrastructure projects such as dams to water management -- a previously neglected function. As an expression of donor interest in reducing on-farm water losses, the initiation of the project undoubtedly influenced greater attention in the Fifth Five Year Plan (1978-83) to on-farm water management. The Five Year Plan set a target of 8,668 improved watercourses, compared with the 1,300 approved by the Government two years earlier for improvement under the five-year OFWM project. Similarly, the Plan's allocation for water management and related research was tripled compared to the level in the prior Five Year Plan.

A particularly important impact of the OFWM pilot project -- and the prime indicator of the success of the approach which it tested -- was the favorable climate it created among donors for its replication. The World Bank has already launched a $33 million loan-funded project which is a direct off-shoot of the OFWM project. It draws extensively on the findings and recommendations of previous evaluations, such as the recommended de-emphasis of PLL (a recommendation not accepted by the AID Mission) and changes in OFWM field team composition. In fact, implementation of this follow-on project represents a reversal of the World Bank's previous position on on-farm water management, as stated in its 1975 Pakistan Survey Report. Additional follow-on projects are also planned by the Asian Development Bank and the International Fund for Agricultural Development.

By design the project had a direct impact on institutionalization of both federal and provincial government involvement in on-farm water management. The creation within the Federal Agriculture Department of a Water Management Cell headed by a Director, has established a permanent body of specialists for planning and coordinating water management activities throughout the country. Provincial OFWM Directorates, created within the framework of provincial agriculture departments, serve as the implementing agencies for on-farm water management activities. Although these directorates are still tied to continued donor assistance and thus do not yet have permanent institutional status (a point of criticism in previous OFWM evaluations), their growth in terms of budget and staff suggests increasing organizational stability. From a total of Rs. 4.3 million for on-farm water management activities in the Punjab, Sind and NWFP in 1976/77, the budget for the OFWM directorates has grown to nearly Rs. 88 million for 1980/81. Similarly, since their inception in 1976/77, total employment in the three directorates has risen to over 1,000 employees.

Organizational impact, as measured by level of program implementation, has differed among the provinces. The OFWM Directorate has grown fastest in the Punjab, where 30 field teams are now in place. In Sind, 15 teams are operational, in N.W.F.P. there are four teams and in Baluchistan two. Such growth is partly a reflection of the priority accorded on-farm water management by each province in its Annual Development Plan and partly the result of budgetary allocations by the federal Government -- the largest portion of which traditionally goes to the Punjab.

Another institutional impact of the project has been the development, within the provincial Agriculture Departments, of a cadre with expertise in on-farm water management technology and the establishment by the OFWM Directorates and the Agricultural University at Faisalabad of the capacity to train that cadre. Although the institutional capacity was primarily the result of an earlier, related project which financed technical assistance by Colorado State University, the OFWM project provided further impetus for refining and continuing the training by creating an organizational demand for trained field workers to implement the OFWM project. The training capacity has been most fully developed in the Punjab, as evidenced by the construction of a training facility at Lahore and creation of a complete curriculum in watercourse improvement and precision land leveling. The attention to continued refinement of that curriculum on the basis of field experience, however, appears to have diminished somewhat following the withdrawal of technical assistance by Colorado State University. There was little evidence, for example, that the curriculum is being adjusted to take into account the observed need for more engineering training for non-engineers charged with watercourse improvement, the reduced need for expertise in precision land leveling, even though that aspect has now been de-emphasized, or the need for increased attention to agricultural extension.

The project was unsuccessful in its planned improvement of organizational capacity to deliver on-farm water management extension services. An Agriculture Extension Service was in existence prior to the advent of the project but had little or no involvement in on-farm water management. The OFWM Directorates were to establish such a capacity through the inclusion on each field team of an agricultural extension officer. Though this was done, these individuals were never engaged in agricultural extension work. Instead, the orientation of the OFWM field teams shifted to a focus on watercourse improvement. As a result, the agricultural extension officers, along with the Land Development Officers originally hired to promote PLL were diverted into the all-out effort to improve a maximum number of watercourses.

The emphasis on watercourse improvement at the expense of agricultural extension may have been an unintended consequence of the use of the Fixed Amount Reimbursement (FAR) method of payment for project implementation. The FAR payment, which reimbursed the Government for watercourses improved but not for associated extension work, may have provided an incentive for high volume work on improvement and, simultaneously, a disincentive for extension work which the Government would have to pay for on its own. Furthermore, although the problem with the extension component was recognized early in the project, because there was no provision in the design to test alternative payment methods or otherwise deviate from the given strategy, the lack of impact on extension could not be corrected.

Political Impacts. A significant impact of the project has been the building of a water management constituency among farmers. Though still limited, it shows signs of growing rapidly and is manifesting itself in the increasing sensitivity among those in official positions at the local level to the importance of on-farm water management. Neither local officials nor local elected bodies were, by design, involved in the pilot project. However, the building momentum of watercourse improvement, combined with ad hoc efforts in some areas to involve local government institutions and elected representatives and to create farmer cooperatives, has lead to greater public awareness of the value of on-farm water management. A concrete manifestation of the growth of this local constituency has been the implementation of a follow-on "crash program," involving the heavy cleaning of some 9,800 watercourses, which the Provincial governments undertook on their own initiative without donor assistance, in order to partially satisfy the escalating demand from farmers for a share of the benefits of watercourse improvement. Because the crash program was implemented with the involvement of local Deputy Commissioners, their awareness of this area has been heightened and this too can be seen as an important indirect impact of the pilot project.

Another political manifestation of project impact is the current effort at legitimation in public law of the Water Users Association. The legislation providing these associations with legal status and imbuing them with enforcement powers has already been approved in the N.W.F.P. nearing finalization in the Punjab and Sind. This legislation, a key recommendation of prior evaluations, is intended to provide both the vehicle for organization of village watercourse improvement efforts and a means for ensuring continued maintenance of improved watercourses. The concept of Water Users Associations has evolved from the informal watercourse committees created under the project, and the felt need to create a permanent institutional framework at the village level for continued cooperation. However, as discussed below, there is a question as to whether legal sanctions offer the best vehicle for fostering village cooperation within the WUAs.

Private Sector Impact. The project also has had some impact on the private sector, though not as much as envisioned in the project paper. Initially, there was some demand created for development of production capacity for land leveling implements such as scrapers. With the expansion of watercourse improvement efforts, a market developed for pucca nuccas -- the concrete outlets used in improved channels. In the resultant rush to fill the demand, a periodic severe shortage of materials developed, which encouraged the production of sub-standard structures. Standardization of these structures has taken place. However, the growth in this particular area needs further efforts and regulation, so that adequate supplies of these structures is ensured for an expanded program. Also, continued effort is needed to assure that the concrete structures are of high quality.

CONCLUSIONS

1. More water is available on a reliable basis to farmers for crop irrigation as a result of water savings realized through watercourse improvements made under the project. As a result of this increased water supply, some significant agroeconomic benefits have accrued to farmers on the project watercourses; crop area has been expanded, cropping intensity has increased, a trend toward greater emphasis on cash versus subsistence crops is appearing, more fertilizer is being used, crop yields per acre are rising, and consequently, net farm incomes are increasing. However, not all agroeconomic gains realized by farmers on the project watercourses are solely due to watercourse improvements.

2. Better than expected maintenance was found on the majority of observed watercourses. The majority of watercourses visited showed greater evidence of maintenance, and farmer interest therein, than had been expected based on the findings of previous evaluations. The team was aware, however, that many of the watercourse improvements observed have withstood less than two years of use. Also, it is possible that the watercourses visited were not randomly sampled, or were not representative of the universe, although the team believes they were. To resolve the question of the adequacy of watercourse maintenance in sustaining improvement -- a question critical to the ultimate impact of the on-farm water management concept -- more time must elapse between improvement and assessment, and a broader, perhaps more systematically defined sample will be required.

3. Farmer demand for watercourse improvements has increased over the life of the project and remains high at present. Waiting lists of local watercourse committees requesting improvements provide clear evidence of the perceived need which this project has generated.

4. The project has had mixed success in creating governmental awareness of the need for on-farm water management through the federal and provincial levels of government in Pakistan, and in establishing an institutional mechanism by which that need can be met on a continuing basis. Through the creation of the On-Farm Water Management Directorates nationwide, the dramatic growth of the on-farm water management budget over time, and the initiation of the crash cleaning program across the country, the federal and provincial governments have demonstrated growing commitment to the concept of on-farm water management. However, this awareness and acceptance has not yet filtered down sufficiently, nor been adequately institutionalized at the district level in many areas, where greater support for on-farm water management could be a significant factor in the future success of the project. The OFWM project also has not resulted in changes in university curriculum to help relieve the shortage of agriculture graduates with expertise in this area and, particularly, agricultural engineers.

5. The original project design lacked the flexibility necessary to take into account the varying circumstances existing in different parts of Pakistan. Different land tenure arrangements, average size of landholding, soil and climate conditions and socio-cultural factors in the various regions of the country all affected the project's success and ability to succeed. Project site selection and criteria for selection,

in particular, should have been allowed to vary more in order to take into account such regional variations. There should have been flexibility, for example, to increase the lined portion of the watercourse depending on local requirements, and to allow the farmers to contribute more to the cost where able.

6. Baseline data collection and subsequent monitoring efforts were inadequate for project needs. Although the project was designed to demonstrate the benefits of improved on-farm water management, the documentation of benefits has been hampered considerably by insufficient attention to the assessment of project impacts and quantification of project results. Because of the lack of baseline data, a re-evaluation of the predicted cost-benefit and internal rate of return calculations could not be done with any confidence.

7. The precision land leveling component of the project has not been as successful as was envisioned in the original project design. One reason for its lack of success has been that small farmers felt they could not afford to take any of their land out of production for the amount of time required for leveling, and they judged the technology too expensive and the return too uncertain to warrant the risk. PLL never received a fair test of its relative contributions to crop productivity and efficient water application, due to the Government of Pakistan's decision to de-emphasize PLL in favor of watercourse improvement. This decision should not be considered a sign of failure of the concept itself.

8. The extension service component of the project was not adequately implemented. Possible explanations are that the FAR payment mechanism did not include any incentive for its implementation, and that a nationwide extension service already in existence in the Agriculture Department may have created resistance to the establishment of a parallel function in the OFWM Directorates.

9 The Water Users Associations have not been established as effectively as they could have been. However, farmers in project areas appear to have significantly increased their awareness of the importance of cooperation for their mutual benefit. Watercourse committees, while less fully representative than WUAs, have been formed and found to work effectively. The informal mechanisms established to date for the initiation of watercourse improvement and for the subsequent maintenance of improved channels have been quite successful in some villages. However, in villages where tribal or other factions inhibit cooperative action on watercourse maintenance, the positive impacts of the project have been reduced significantly over time.

10. Costs of watercourse improvements exceeded the original estimates due to price escalations and the fact that the overhead costs involved in the creation of the OFWM Directorates were not taken into account. Whether these cost overruns have adversely affected the projects' stated cost-benefit ratio is unknown since sufficient data are not available to assess project benefits.

LESSONS LEARNED

Project Financing

A. FAR Mechanism. The Fixed Amount Reimbursement (FAR) mechanism needs to be re-examined. In irrigation projects such as the OFWM project, which extend beyond public works efforts to increase water supply into extension-based farmer training in water use, a facilitating financial mechanism for the latter element should be incorporated into the project design.

B. Farmer Participation. Unit costs of watercourse improvement could have been reduced or the project could have been spread further for the same overall cost if farmers had been required to share in the cost, which they repeatedly indicated willingness to do. A loan mechanism could have been designed to permit farmers to make repayments through land revenues or a water duty spread over a period of several years. Increasing farmers' financial stake could have had the added benefit of improving the quality of work performed, as well as their interest in sustaining improvements through subsequent maintenance.

Design Flexibility

The designs for projects -- particularly pilot projects -- which are to be implemented in a variety of physical and cultural settings, need to allow greater flexibility to adapt to local conditions than did the OFWM project. As already noted, permitting flexibility in terms of financial participation would have permitted adaptation to the growing popularity of the OFWM project, once it caught on, permitting better use of funds available. Greater design flexibility would have permitted better adaptation to local needs, such as the need in Sind for more watercourse lining or the need on NWFP for different channel design -- perhaps funded through sliding-scale cost sharing arrangements.

Watercourse Maintenance and Farmer Cooperation

Watercourse maintenance is critical to sustained benefits from watercourse improvement. Such maintenance, particularly in a cultural setting where community cooperation is not the tradition, is highly dependent on building a formal structure for local cooperation and collective labor. However, promotion of voluntary cooperation -- perhaps through extension agents or through media outreach programs to educate farmers as to its benefits -- seems a more promising route than externally imposed legal sanctions to conform, although such cooperation is likely to be more difficult to achieve in villages with pronounced rivalry.

Land Ownership

Land ownership patterns have a profound impact on the benefits of irrigation improvement schemes such as the OFWM project. Where water is controlled by a landlord, the poorest tenants -- precisely those whom such efforts are intended to benefit most -- may see little or no gain from increased water supply. Similarly, size of land holding largely determines the ability, or at least the willingness, or a farmer to take advantage of PLL; participants are often only those with sufficient land to permit a portion to lie fallow after leveling and those with their own implements (to cut the cost and thus the perceived risk). Future projects need to give more thought to ways of reaching the small farmer under such conditions.

Implementing Agency Staff

The key to successful implementation of a development project such as this is quality staff in the responsible host country agency. To recruit and retain such staff, positions should be regularized rather than temporary as was the case in the OFWM Directorates. The personnel qualifications should fit project needs; for a project emphasizing watercourse reconstruction, more agricultural engineers are needed to maintain technical standards in the work and adjust designs to fit actual conditions than were available in this project. A stronger training program than that found is needed to develop and maintain appropriate skills. Such a training program requires acquisition of better equipment, the recruitment of more engineers as faculty, and better integration of curriculum with research on alternative approaches to on-farm water management than has taken place so far in this project.

Extension

Extension services are essential to the full achievement of on-farm water management, since they deal with efficient water usage and better cropping practices once water supply is improved. However, when the extension function connects with on-farm water management overlapping with an existing extension service is a risk; in these instances, more thought must be given to integration than was the case in this project. Furthermore, training farmers to change age-old cropping and irrigating practices may be much more difficult than reconstructing a watercourse, and require more specialized training than that possessed by most agricultural graduates; much more attention must be paid to the training of extension agents than has so far taken place in Pakistan.

Baseline Data

To the extent that the success and replication of a pilot project relies on the establishment of quantitative data on project impact -- although replication of the OFWM project seems not to have depended on such data -- it is essential that baseline data be collected. Very little attention was paid to the collection of such data in the early stages of the OFWM project, with the result that hard data on yield and income benefits are non-existent. The recently initiated efforts of Pakistan's Water and Power Development Administration needs to be accorded high priority in order to provide better information on the impacts of the expanded follow-on project now underway. It will be helpful to have more post-improvement measurements of water losses in the watercourses.

Institutional Focus

Greater attention should have been paid to developing awareness of, and commitment to, on-farm water management on the part of local government and elected bodies in the implementation of the project. In addition, there should have been more emphasis on encouraging academic institutions to build a larger on-farm water management component into agricultural curricula.

Concrete culvert crosses an improved watercourse.

EPILOGUE

ON COMPLETION OF WATERCOURSE IMPROVEMENTS
AT MAHAL NARAL-KOT JHANGRA
NORTH WEST FRONTIER PROVINCE

Farmers will now reap more
And will save their time as well!

The energies they now save
Will be the reservoir for our youth

The concrete culverts now built
Were the awaited desires of farmers

Waterlogging and salinity we fear less
We'll enjoy our water and grain more!

The land of farmers now saved
Will increase their welfare more

An added convenience for the village
Are the new bathhouses on the banks

Our paths have widened
Thanks to our friends' cooperation

It is the effort of "Pir Badshah"
It is the activity of our times

It is the reflection of our work
And it is the mirror of Muslims!

--Pir Syed Badshah
Chairman, Watercourse Committee

Translated from the Urdu by
Mahmood Hasan Khan

APPENDIX A

SAMPLE DATA

Sandra Malone

SAMPLE DATA

A total of 38 improved and 10 unimproved watercourses in the project areas were visited by members of the team. Interviews were conducted with farmers and their wives in the 41 villages served by these watercourses.

In the Punjab, 25 improved and 6 unimproved watercourses were visited and interviews were conducted in 25 villages. The average command area per watercourse in the sample was 381 acres, with an average of 50 farmers owning land. The average cost per watercourse improved was Rs. 55,537 ($5,610).

In Sind, nine improved and 3 unimproved watercourses were visited and interviews were conducted in a total of 25 villages (including 14 in which quick surveys were conducted examining a specific aspect of the land tenure question). The average command area of the sampled watercourses was 389 acres with an average of 19 farmers per command area cultivating, but not necessarily owning land. The average cost per improved watercourse was Rs. 55,000 ($5,555).

Interviews were conducted in five villages in the NWFP served by four improved and one unimproved watercourse. The average command area per watercourse was 252 acres owned by an average of 82 farmers. The average cost of improvement was Rs. 30,904 ($3,122).

The following tables provide detailed data on each of the project sites.

Table A-1. Watercourses/Villages Visited--The Punjab

Area	Village	Watercourse Number	Command Area (acres)	Number of Farmers	Cost (Rs.)	Length of Watercourse (meters)
Faisalabad	111JB	22634-L	326	31	12,964	3400
		23763-L	305	42	30,808	2460
		24884-L	504	48	63,069	5285
Faisalabad	125JB	7505	236	22	8,705	2983
Faisalabad	74JB	95026L	475	103	51,262	4259
		97249L	350	98	23,057	3015
		89480L	375	80	22,685	3685
Faisalabad	248RB	45209L	676	52	74,956	720
Faisalabad	2JB	RD/34668	290	26	52,065	2600
Faisalabad	470GB	100/R	194	58	19,463	1845
Faisalabad	477GB	62288	575	80	114,232	85
Faisalabad	5JB	45197-L	235	30	66,473	5800
Sahiwal	1179/L	70279/R	462	24	65,755	5500
Sahiwal	1389/L	69000L	322	31	74,484	3180
Sahiwal	310/L	20085	432	30	34,972	2698
		15175R	275	25	31,267	2300
Sahiwal	50/12L	69800/R	432	47	73,614	4225
Sahiwal	37/12L	17070	321	30	56,629	3240
Sahiwal	45/12L	58715/L	625	52	151,305	6150
Sahiwal	50/15L	89860/L	504	66	66,131	3940
Sahiwal	88/15L	67274/R	125	58	62,016	4000
Sahiwal	84/15L	162200/R	416	75	95,101	4538
Sahiwal	134/16L	34050/L	300	42	53,550	2240
Sahiwal	2/9R	8918	314	60	37,169	3720
		7729/R	462	40	46,684	4774

Table A-2. Watercourses/Villages Visited--Sind

Area	Village	Watercourse Number	Command Area (acres)	Number of Farmers	Cost (Rs.)	Length of Watercourse (meters)
Hyderabad	Basaran Minor	9R	774	18	97,838	4260
Hyderabad		3L	152	14	38,895	1470
Hyderabad		8AL	248	24	38,888	1310
Hyderabad	Payee	1R	725	47	51,394	2140
Hyderabad	Baccha Kalhri	3AR Qassor Minor	96	4	36,000	1500
Nawabshah	Mir Jan Mond	6R Gajrawah	185	6	36,000	1400
Nawabshah	Lyallpur Goth	1AL Dhoro Naro	608	36	85,579	3940
Hyderabad	Jamal Kirio	1AR Khadhar Minor	62	3	18,000	752
Hyderabad	Umer Bodle	11L Khadhar Minor	650		92,858	3120
Hyderabad	Qaiser	2AL	350	40	46,250	800
Hyderabad	Payee	1L	380	14	58,220	2220
Hyderabad	Marejee	1R	789	30	98,986	4500
Hyderabad	Landi	2L	824	39	100,000	6600
Hyderabad	Paksanghai	3AR	800	34	67,500	4500
Nawabshah	Shah Husain	3T	820	30	97,000	5000
Nawabshah	Daloo Shah	6L	269	10	50,898	16700
Nawabshah	Dengo	14BL	231	9	63,671	4800
Hyderabad	Ghaoot	4R	302	22	81,170	1000
Nawabshah	Gupchani	2L	854	25	71,170	4500
Nawabshah	Panwari	14AR	870	45	96,700	5400
Nawabshah	Qainkui	3LA	624	15	100,000	4600
		3LB	600	15	100,000	4600
Hyderabad	Fatehpur	6R	228	18	57,500	2100

Table A-3. Watercourses/Villages Visited--NWFP

Area	Village	Watercourse Number	Command Area (acres)	Number of Farmers	Cost (Rs.)	Length of Watercourse (meters)
Mardan	Tetara	22525/R	164	60	66,801	1800
Mardan	Sikandari	8820/L	161	31	18,600	800
Peshawar	Ambadher	Blarba	124	55	18,800	1800
Peshawar	Ambadher	Ambadher Main	560	182	19,413	790

APPENDIX B

EVALUATION METHODOLOGY

James E. Painter

EVALUATION METHODOLOGY

The methodology for the impact evaluation of the On-Farm Water Management project evolved from a plan sketched out by the team during its first several days together in Pakistan. Some aspects of the plan were altered significantly on the basis of experience during the course of the fieldwork.

I. THE PLAN

Major elements of the plan included:

1. Field work in three of the four provinces, to observe the full range of diverse project settings
2. An itinerary set on the basis of relative regional concentration of project activity
3. Emphasis on data collection in rural villages, as opposed to official sources
4. Stratification of the sample based on duration of project improvements and degree of village development
5. Use of nonimpacted "controls" to approximate preproject conditions in the absence of baseline data
6. Team operation as a unit, to obtain interdisciplinary view of sampled sites
7. Use of individual structured interviews and field records for data collection

II. THE EXECUTION

For the most part, the plan was carried out as originally conceived. Despite demanding travel over a wide area of the country, field work was successfully conducted in the Punjab, Sind, and N.W.F.P. Because of the very small number of project sites in Baluchistan, its relative inaccessability given time constraints, and unsettled conditions there due to large numbers of Afghan refugees, that province was excluded. About two of the three weeks in the field were spent in the Punjab, mostly in villages around Faisalabad and smaller towns (Sahiwal and Multan) to the south, though some limited time was also sent in the provincial governmental seat of Lahore. Five days were spent in Sind, mainly in the vicinity of Hyderabad, and three days were devoted to field work in and around the N.W.F.P. capital of Peshawar.

Distances were great not only between provinces and staging points in each province, but also out to the widely separated field sites. As a result, travel required more time than originally anticipated and the size of the sample was somewhat constrained accordingly. The trade-off, though, was the opportunity to collect data on impact across a broad range of settings in each of the three provinces.

The selection of field sites did not work out as neatly as envisioned in the plan, although by the end of the fieldwork the team was satisfied that it had sampled a characteristic set of project sites.

Stratifying the sample was difficult. In terms of level of village development, very little data were available in project files. Sites had to be differentiated on the basis of OFWM field staff and Mission staff recollections of the villages. In the Sahiwal area of the Punjab, the team identified more- and less-developed zones in the vicinity and then randomly selected villages in each zone for data collection. By the end of the second week, it was becoming clear that this variable was not particularly relevant in differentiating impacts. This may have been due to the fact that most villages shared one of the most important determinants of development—proximity to paved roads.

Though many villages lacked paved roads through them, most had them close by. This was apparently due to the OFWM teams' preference for improving easily accessible watercourses—perhaps partly because of their value as demonstration sites—though probably equally out of mere convenience. In any case, the concern with the need to rigidly dichotomize the sample on the basis of development diminished with time.

In terms of the other variable—elapsed time since completion of watercourse improvements—there were different problems. It was relatively easy to distinguish older (more than two years) from newer project sites by file data. However, the momentum of the project was such that few watercourses were completed in the early years; in some areas no sites were completed prior to 1979. Thus it was difficult to get an equally balanced sample of older and newer sites. Even where present, logistics sometimes precluded access to the older sites.

As with the first variable, no clear pattern emerged as to the effect of time on durability of improvements; some older sites were better maintained than some newer ones. Though the effort to so dichotomize the sample continued throughout the three weeks, by the end of field work the team had largely concluded that more time would need to elapse before such a variable could become meaningful.

Another factor, alluded to above, which complicated site selection was logistics. The team made the decision at the outset to move about the country as a unit rather than to split up, though members would operate independently in the villages. This was based on several considerations. First, it was judged useful to gain a multidisciplinary view of each of the sampled project areas. The team members had diverse professional discipline backgrounds and experience, with little overlap. Had the team split up, the perspective of some members would have been missing from each locale. Second, to capitalize on the diversity, it was thought useful to foster interaction among the various disciplines. This, it was hoped, would avoid a "pigeon-hole" orientation to the interrelated aspects of impact and, equally as important, would facilitate development of team concensus as to the impact observed in different locales.

Separate functioning on-site was judged particularly important, however. There was a concern with avoiding the subjection of villages to the onslaught of a large contingent of outsiders, arriving en masse to surround hapless villagers and barrage them with questions. Then too, there was the desire to use the limited field time efficiently, reaching the maximum number of interviewees and giving interviewers minimum overlap. To structure the interviews, each member developed an individual questionnaire or checklist to gather specified data; the interview schedules were developed separately but cross-checked to identify gaps and commonalities.

However, the logistical difficulties were considerable. Deploying a seven-person team, accompanied at times by a like number of support staff, translators and assorted others, in a limited number of vehicles, frequently influenced access to sites regardless of sampling criteria. It was sometimes necessary for team members to survey adjacent villages simply because of transportation constraints and to forego more distant sites. Team members regularly had to use considerable ingenuity in initially coordinating and then splitting up on-site to pursue individual agendas. There were added complications as a result of the necessity for all field work to be preceded by appropriate arrangements between intermediaries and village leaders. Additional time was thus taken up in social formalities, with the result that site selection and on-site data collection were thereby further affected. For the women on the team, there were the added challenges, both logistical and otherwise, of doing field work in conservative rural areas of a devoutly Muslim society.

Notwithstanding all these difficulties, the field work proceeded largely as planned. With experience, team members were able to conduct interviews without relying on questionnaires. The data sought were obtained. Discussions between team members reinforced and enlarged the picture which emerged. Common responses from different subjects often in separated localities confirmed estimates of impact despite lack of hard to document changes.

III. THE RESULT

Though it complicated logistics, the team's decision to operate in an integrated fashion was justified not only by the interaction among team members during the field work but by the end product as well. The team was able to come quickly to a consensus on the overall impact of the project, and it was also able to develop a good sense of the relationships between various disciplinary views of that impact and variations in each locality visited.

As to methodological "lessons learned," in hindsight probably only two factors could have significantly affected the field work process—an advance person to precede the team along each step of the field work, selecting villages to be sampled and making the all-important arrangements for contact with village leaders, and more vehicles to permit greater mobility of individual members. On the first point, however, there is an obvious trade-off to advance notice, given some brief experience with advance notice to villagers, who sometimes very accommodatingly cleaned their watercourses for "inspection," or prepared receptions--at their own considerable expense--which prevented the team from informally seeing typical village conditions. As to vehicles, given the demands on USAID/Pakistan resources, the team could hardly have hoped for more assistance than given. In any case, it is not clear that any substantially different picture of project impact would have emerged from a more efficient process.

APPENDIX C

SOME RELATED IMPLICATIONS OF ON-FARM WATER MANAGEMENT

Ernest T. Smerdon

SOME RELATED IMPLICATIONS OF ON-FARM WATER MANAGEMENT

I will discuss three subjects related to on-farm water management which I believe deserve additional elaboration in relation to the impact evaluation of the On-Farm Water Management (OFWM) project in Pakistan. These are (1) waterlogging and salinity, (2) energy and pumping, and (3) precision land leveling. The first two of these present great potential indirect impact as a result of their effect on reducing water losses through watercourse improvements. The last, land leveling, is a subject deserving special note in view of the recent deemphasis of that aspect of the OFWM project.

I. WATERLOGGING AND THE SALINITY CANCER

The Indus plain is formed by a vast alluvial deposit of great thickness. It is composed of layers of deposits ranging from clay to sand. The various permeable layers are largely interconnected and the entire alluvium comprises a single aquifer in most circumstances. Major features of the Indus plain are its flat gradient and its great length of about a thousand miles.

Before the extensive irrigation canal system that now interlaces the Indus plains was built during the last century, the water table had been in equilibrium. On the average, the percolation to the groundwater from river seepage and other recharge was balanced by the natural outflow from the aquifer. At some places the water table depth was 80 to 100 feet. However, with the network of unlined canals feeding an even more extensive network of unlined watercourses, the situation started to change. Seepage from these channels provided greater recharge to the groundwater and the water table began to rise.

Fortunately, the canal water is very low in salinity with total dissolved solids (TDS) ranging from 200 to 300 ppm. In general, seepage of such good quality water does not create a problem until the water table approaches the surface. Then the waterlogging problem emerges and that is often followed by salinity.

Percolating water from canal and watercourse seepage leaches minerals from the soil as it passes downward to the water table. This invariably causes the water in the groundwater to have a higher salt content than the surface water. In the Indus basin, the quality of groundwater is quite variable. In general, the groundwater quality near the rivers in the north part of the basin is quite good, but the quality deteriorates as distance from the rivers increases. Also, the salinity of the deeper zones of the groundwater is generally much higher than the shallower zones. This is not surprising since the deeper water has been in contact with the mineral soil longer and has moved greater distances through the soil, slowly dissolving minerals along the way. There is also an increase in the salinity of groundwater toward the sea and some groundwater near the seashore is as saline as seawater.

The suitability of groundwater for irrigation depends on its salt content and also the amount of sodium in relation to other rations. Water with less than 1,000 ppm TDS is generally suitable for irrigating most crops. Water with salinity up to 2,000 ppm or more TDS is suitable for irrigation of crops that are not overly salt sensitive.

Fortunately, much of the groundwater in Pakistan is of reasonably good quality and can be used for irrigation, particularly when blended with canal water. Some areas in Pakistan having particular difficulty with waterlogging and salinity have been designated for Salinity Control and Reclamation Projects, called SCARPs. In these areas, tubewells have been installed and measurements show that over 70 percent of the tubewells in the SCARP I, II, and III areas have less than 1,000 ppm TDS and over 90 percent have less than 1,500 ppm TDS. This water is suitable for irrigation, particularly when blended with canal water. While most tubewells produce water suitable for irrigation, a few produce water which is too salty.

A. The Process of Waterlogging and Salinization of Soil

Waterlogging occurs when the excess recharge of the groundwater aquifer over the outflow causes the groundwater level to rise and approach the surface. When the water table is within a few feet of the surface, capillary rise of the water in the unsaturated soil zone above the water table moves water to the surface where it evaporates. This process is not visible to a casual observer. The salt carried by the capillary water is left at the surface, and in serious cases can be seen as a white film on the soil surface. The evaluation team observed this phenomenon at several locations, particularly south of Faisalabad in the Punjab and near Digri in the Sind. The process continues so long as the water table remains close to the surface. The groundwater does not have to be excessively salty to create the salinity problem since none of the salt carried to the surface is removed by evaporation.

In humid areas where regular rains occur, salt does not accumulate at the surface even when the water table is near the surface because the rains regularly flush the salts down. However, in arid and semi-arid Pakistan the rains are not sufficient to regularly cleanse the soil of salt in the waterlogged areas.

Waterlogging itself is bad, and when it leads to salt accumulation in the soil it is worse. Salinity is a cancer of the soil that leads to the death of agriculture. Waterlogging alone can be solved by drainage to lower the water table. Pump drainage using tubewells is one suitable method that has been used successfully in the SCARPs. Also, if the groundwater is of reasonable quality, the pumped water can be used for irrigation, often in conjunction with canal waters. However, if salts have accumulated in the surface soil, leading to the cancer of salinity, the soil must be drained and the salts flushed from the soil through a leaching process. This is a costly process, and when excess sodium is present special soil amendments must be used to facilitate the leaching process. The best cure for the soil salinity cancer is to prevent it by good water management.

According to figures from the Planning Division of the Pakistan Water and Power Development Authority (WAPDA), the leakage from the irrigation system may account for nearly 45 million acre-feet (MAF) per year flowing to the groundwater. The breakdown is 19 MAF seepage from canals, 20 MAF seepage from watercourses, and 6 MAF percolation to groundwater from over-irrigation of fields. The process of waterlogging and salinization is slowed by any reduction in seepage losses such as those that occur as a result of the watercourse improvements undertaken under the OFWM project. This impact is potentially very important.

B. Waterlogging and Salinity in Pakistan

The Planning Division of WAPDA conducts a country-wide soil salinity survey. Some recent results indicate that although the surface soil salinity status is not critical on a nation-wide basis, there are areas in which the salt problem is very serious. We observed an area of citrus production south of Faisalabad near Samundri in which the trees had died in the last year due to salinity. Entire orchards of mature trees had died rapidly.

Tables 1 and 2 give the surface soil salinity status and the salinity status of the soil profile for the four provinces. Several things are apparent from reviewing these tables. First, in the country as a whole, over 29 million acres (72 percent) are salt free. However, over 3 million acres (8 percent of the total) are strongly saline. In the Sind, only half the land is salt free and 18 percent (2,468,954 acres) is strongly saline. Clearly the salinity problem is not one to be ignored.

The Directorate, Hydrology Monitoring, WAPDA, regularly measures the depth to the water table in the various regions of the country. WAPDA provided data on the depth of the water table in the Punjab, the Sind and the N.W.F.P. The measurements were divided into SCARP and non-SCARP areas and the data were reported for two times of the year, that is, June 1980 (before the rainy season) and October 1980 (after the rainy season). Comparison of the two observations is noteworthy and shows the seasonal variation in depth of the water table. The results for the Punjab, Sind, and N.W.F.P. are shown in Table 3. Note particularly the grand total acres with water table depth less than 5 feet. In June 1980, there were 5,197,000 acres with this condition, but in October 1980, after the rainy season, the area had increased to 11,963,000 acres. These areas are candidates for salinity problems.

Table 1. Surface Salinity Status of Pakistan Soils
(acres)

Salinity Status	Province				Total
	NWFP	Punjab	Sind	Baluchistan	
Salt Free	1,186,202	21,058,757	6,906,687	646,636	29,798,282
Slightly Saline	124,005	1,756,521	2,566,649	149,554	4,596,729
Moderately Saline	32,622	1,073,306	1,428,963	39,033	2,573,924
Strongly Saline	23,622	739,570	2,468,954	34,654	3,266,800
Miscellaneous	150,719	489,209	414,722	3,414	1,058,064
Total	1,517,170	25,117,363	13,785,975	873,291	41,293,799

Table 2. Profile Salinity Status of Pakistan Soils
(number of soil profiles)

Salinity Status	Province				Total
	NWFP	Punjab	Sind	Baluchistan	
Salt Free	1,553	29,334	7,918	497	39,302
Saline	216	2,803	3,430	365	6,814
Saline of Sodic	138	1,813	373	12	2,226
Sodic	28	1,813	373	12	2,226
Miscellaneous	23	256	145	--	424
Total	1,958	39,963	20,543	1,402	63,866

Table 3. Acres With Various Water Table Depths for Punjab, Sind, and NWFP
(in thousands of acres)

Water Table	Punjab		Sind		NWFD		Total		Grand
Depth & Date	SCARP	Non-S*	SCARP	Non-S*	SCARP	Non-S*	SCARP	Non-S*	Total
0-5 feet									
June 1980	474	1,726	71	2,872	28	26	573	4,624	5,197
Oct. 1980	1,553	2,713	257	7,316	38	86	1,848	10,115	11,963
5-10 feet									
June 1980	1,834	5,486	603	7,699	65	245	2,502	13,430	15,932
Oct. 1980	2,418	5,213	493	3,067	56	284	2,967	8,564	11,531
10-15 feet									
June 1980	1,605	4,439	317	1,527	19	184	1,941	6,150	8,091
Oct. 1980	1,281	3,884	353	1,432	18	139	1,652	5,455	7,107
15-20 feet									
June 1980	863	3,070	147	680	7	136	1,017	3,886	4,903
Oct. 1980	643	2,247	176	785	8	105	827	3,137	3,964
Over 20 feet									
June 1980	215	4,908	96	448	20	488	331	5,844	6,175
Oct. 1980	192	4,476	106	475	19	465	317	5,416	5,733
Total									
June 1980	4,991	19,629	1,234	13,226	139	1,079	6,364	33,934	40,298
Oct. 1980	6,087	18,533	1,385	13,075	139	1,079	7,611	32,687	40,298

*Non-S means a non-SCARP area.

The conditions in Pakistan are such that there will be a continual battle to control the waterlogging and salinity problem. The concern about this was voiced by some farmers who were interviewed. The best way to control the problem will be to prevent it insofar as possible. To accomplish this goal of prevention of waterlogging and salinity will require that all water losses through seepage and over-irrigation be reduced as much as possible. This was one of the objectives of the OFWM project.

C. The Role of the OFWM Program

The evidence obtained in the impact evaluation of the On-Farm Water Management program consistently showed that the water losses in the watercourses were reduced by watercourse improvement. It is not possible to state with certainty the extent of the reduction in seepage losses. It is probable that the losses were reduced by at least 40 percent. Using that conservative estimate, which is less than that reported by the OFWM workers, permits one to speculate on what the impact on waterlogging and salinity would be if all the watercourses were to be improved. For example, WAPDA estimates that 20 MAF are lost each year from watercourses through seepage. If that loss is reduced by 40 percent, then 8 MAF less water would be lost through seepage. If only half the seepage loss reaches the water table, then each year potentially 4 MAF could be prevented from reaching the water table as a result of improving all watercourses.

If one assumes that this seepage loss occurs on about 40 million acres of the irrigated regions, then the net reduction in seepage loss each year would be about one-tenth an acre-foot per acre (4 MAF over 40 million acres). If the porosity of the soil is 15 percent, then a reduction of 0.1 acre-foot per acre contribution to the groundwater would result in lowering the water table by 0.67 feet (8 inches). This is a very significant lowering of the water table.

The same lowering of the water table can be accomplished through pumping, as in much of the SCARP activity, but it is very costly. Not only does it cost a lot of money to provide for pump drainage, it takes a lot of energy. For example, to pump 4 MAF with a lift of 20 feet takes about 2,400 million megajoules of energy. This is equivalent to the energy in 61 million liters of diesel fuel or 667 million kilowatt-hours of electric power.

This hypothetical example is intended to give some idea of the possible impact of reduction in water losses in watercourses on the all-important waterlogging and salinity problem. This issue should be pursued further in the years ahead, since salinity will be a continuing problem. It is not an overly dramatic statement to say that salinity is a cancer of the soil.

II. ENERGY AND PUMPING

In recent years the worldwide cost of energy has increased dramatically. As a result, those activities that require large quantities of energy have become extremely costly and in some cases are prohibited. Pumping large amounts of water such as that associated with irrigation is one of these energy-intensive and costly activities. There is enormous weight in an acre-foot of water--1.234 million kilograms (1,234 metric tons). A great amount of physical energy is required to lift that water from the water table to the surface.

When water is lifted by pumps there is an energy loss during conversion of mechanical energy in the pump to energy in lifted water. There is also an energy loss in converting fuel energy to mechanical energy through a diesel engine or an electric system--a combination of electric power generation, power transmission, and an electric motor. Although pump efficiencies can theoretically be as high as 70 percent, field studies of numerous irrigation pumps in the United States have shown that a more typical pump efficiency is about 50 percent. It is doubtful if the pumps in the fields in Pakistan have greater efficiency. The efficiency of either a diesel engine or an electric system is about 25 percent. Therefore, the overall operating efficiency of irrigation pump-motor combinations is about 12.5 percent (50 percent times 25 percent).

Using the above efficiency for the irrigation pumping unit, it is possible to determine the energy required to pump 1 acre-foot of water from any depth. For convenience, an assumed pumping lift of 20 feet will be used. The energy required for pumping is proportional to lift, so the results can easily be converted to other pumping lifts.

It takes 600 megajoules of energy to pump 1 acre-foot of water with a lift of 20 feet. (The megajoule is an international energy unit that can be converted to any other energy equivalent such as kilowatt-hours of electricity or liters of diesel fuel. For example, 600 megajoules is equivalent to 167 kilowatt-hours or 15 liters of diesel fuel.) At Rs. 3.5/liter for diesel fuel, the energy cost is Rs. 52.5 to pump an acre-foot of water under the conditions stated above. At Rs. 0.236/kwh the energy cost is Rs.39.4 to pump this acre-foot of water using electricity. The appropriate monthly load charge associated with electrical power supplies must be added. As indicated in the previous section, 8 MAF per year in seepage losses could easily be saved from Pakistan's watercourses if all the 89,000 watercourses were improved. The energy required to pump this water with a 20-foot lift is 4.8×10^9 megajoules per year (equivalent to 1,336 million kilowatt-hours of electricity or 120 million liters of diesel fuel). The annual cost of providing the energy to pump this vast quantity of water depends on the cost of the energy, but will be over Rs 300 million.

From the point of view of the individual farmer, the cost savings that accrue from less dependence on tubewell water as a result of watercourse improvement is significant. Tubewell water is costly to the farmer (generally about Rs. 120/acre-foot or more when purchased from a private tubewell owner). If the need for tubewell water is reduced, a direct monetary savings to the farmer results. Farmers repeatedly reported less dependence on tubewell water as a result of watercourse improvement. For example, one farmer reported that he had been able to irrigate only 4 of his 10 acres with canal water before improvement and now he could irrigate 6 acres with canal water. The rest was irrigated with tubewell water, so his tubewell water cost was reduced by one-third. Such responses were typical.

The conclusion appears clear. Any on-farm water management program that saves water also saves energy. This fact should be remembered when the impact of programs that save water are considered.

III. PRECISION LAND LEVELING

When surface irrigation is used, the uniformity of the water application to the land is dependent on the levelness of the fields and the labor available for irrigation. A good irrigator can become quite adept at "leading the water through the fields with the shovel." However, irrespective of how experienced the irrigator or how diligent at his task, he cannot make the flow go uphill and he can never totally compensate for poorly leveled fields. If the fields are small, the adverse effect of poor leveling is less than for large fields. Nevertheless, there is no way to achieve the goal of high water application efficiency in fields that are poorly leveled.

The results of research at the Mona Reclamation Experimental Project area of SCARP-II show that about 30 percent of the water delivered to the nucca is lost in the fields. Those field application losses could be significantly reduced if the fields were accurately leveled. For the small fields typical of Pakistan, the field application losses should not greatly exceed 15 percent. Therefore, the potential exists to cut field losses in half. In fact, Mona studies indicate that about 40 percent more land could be brought under irrigation with the same quantity of water if the fields were precisely leveled.

Besides saving wasted water, there is another value in precision land leveling. Higher yields are usually obtained from precision-leveled fields because of avoidance of at least two of the problems associated with poorly leveled fields. First, fertilizer is wasted when fields are not level because the excess water applied to parts of the fields leaches fertilizer from the soil root zone. Second, it is often difficult to get a uniform crop stand in fields that are poorly leveled. Germination of seeds is adversely affected by excessively wet or dry spots in fields where the water application has not been uniform. It is never possible to get maximum yields when the plant population in the fields is too low or uneven. Poor stands of cotton were observed in numerous fields during the evaluation.

The deemphasis on precision land leveling in the OFWM Project should not be taken as an indication that the practice is not worthwhile. The watercourse improvement program involved every farmer on the watercourse, whereas precision land leveling was an individual matter. Therefore, it is not surprising that the watercourse improvement caught on quicker with the farmers in a collective sense and was favored by officials. As stated in the report of the evaluation team, the precision land leveling did not receive an adequate test, and the conclusion should not be drawn that it is not a good on-farm water management practice. It is definitely a useful water management tool and technical assistance should continue to be provided by the field teams to farmers who wish to level their fields.

ACKNOWLEDGMENT

The author obtained data from many sources during the whirlwind travels associated with this impact evaluation. It is not possible to credit all who contributed thoughts and ideas. Much of the data used came from WAPDA reports and I hope the data has not been misunderstood or misinterpreted. In particular, two papers presented at the Seminar on Expert Consultation On Farm Water Management in Islamabad/Lahore on September 27-October 8, 1981 were used. These papers were by M. Badruddin, Deputy General Manager, Planning Division, WAPDA, and N. Ahmad and M. A. Qayyum, Soil Scientists in the Department and Planning Division respectively, WAPDA.

APPENDIX D

ECONOMIC IMPACT OF THE PILOT PROJECT

Mahmood H. Khan

ECONOMIC IMPACT OF THE PILOT PROJECT

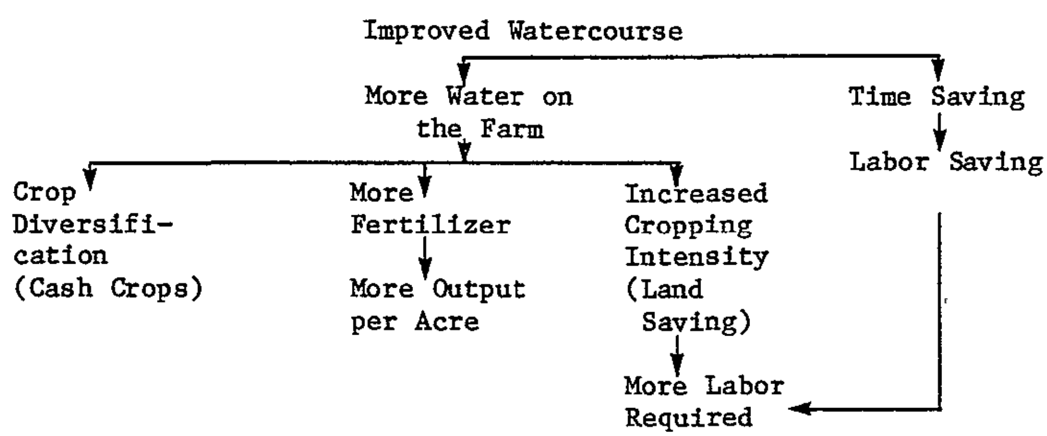
I. INTRODUCTION

Agriculture in Pakistan, in the Indus basin in particular, is almost entirely dependent on a man-made irrigation system. About three-quarters of the cropped area of the country is irrigated, and about 90 percent of the total agricultural production originates in the irrigated areas.

In this vast irrigation system, there are considerable losses of water at various stages in its delivery to the farm. Several studies have shown that although water deliveries exceed crop requirements during some periods, deliveries fall considerably short during peak requirement periods. A very large proportion of water loss in the irrigation system takes place in the watercourse from the mogha to the user's field. Water management is also affected adversely in the fields because of uneven leveling.

It was against this background, supported by research in the early seventies and encouraged by farmers' responses, that the joint Pakistan-USAID On-Farm Water Management (OFWM) pilot project was launched in 1976. This included partial lining and complete cleaning of the watercourses, construction of pucca nuccas and culverts, and precision land leveling of some portion of the users' lands on the watercourse. The farmers were to provide all unskilled labor for construction and civil works, and the government would supply all materials, technical assistance, and a 50-percent subsidy for PLL.

The objectives of the OFWM pilot project were clearly related to increasing agricultural production and farmers' income. It was also expected to lead to considerable saving of water and labor. The chain of impact on production and income was to work in somewhat the following way.



II. IMPACT EVALUATION

To evaluate the impact of the project on the anticipated economic objectives and the achievement of related physical targets, several options were considered. The impact evaluation team was constrained by at least two serious factors. In the first place, it was faced with a limited time of 3 to 4 weeks. In this period, the team was expected to design methodology, collect data and information, and, finally, analyze and interpret the results. The second, and perhaps more serious, constraint was the absence of pre- and post-improvement data about the major impact indicators, such as cropping patterns, cropping intensities, use of inputs, and crop yields. The annual reports of the preceding years were based almost entirely on either impressionistic information or limited data collected from the field. Despite the project paper's emphasis on monitoring and evaluating, no mechanism was established to constantly monitor, even on a few randomly selected watercourses, changes in various impact indicators.

A. Micro-Evaluation

In the absence of precise pre- and post-improvement data, and in view of the time constraint, it was decided to rely on information gathered from personal interviews of farmers and on relevant secondary data. In selecting the watercourses for visits, the team was guided by two criteria: the length of time since the watercourse had been improved and an insistence that the watercourse represent at least one field area in each province. In all, 42 interviews were conducted. The respondents included front, middle, and end water users. A questionnaire was designed to get farmers' perceptions on changes that the watercourse improvement may have brought in their production levels and income.

The collected information on several important impact indicators has been tabulated in Tables 1 to 6. A detailed interpretation of these data has been given in the main report. Several interesting features, with interregional differences, have been observed. The most important among the generalizations, at least for the farmers on sampled watercourses, was that farmers have been impressed by the positive impact of watercourse improvement in every area. They have all appreciated the increased ensurance of water supply, convenience of maintaining watercourses, savings in time and labor, and reduced potential for disputes in the warabandi of water. Most consistent of the findings were the positive impressions of increased production resulting mainly from increased water supply and consequent increased use of fertilizer.

Table 1. Basic Profile of Respondents

Indicator	Punjab	Sind	NWFP	Overall
1. Number of Respondents	14	17	11	42
2. Average Farm Size (acres)	23.4	9.8	18.5	16.6
3. Farms by Size (%)				
<5 acres	14.3	17.6	27.3	19.0
5 to <10 acres	28.6	52.9	9.1	33.3
10 to <20 acres	14.3	23.5	9.1	21.4
20 to <40 acres	21.4	5.9	36.4	16.7
40 to <60 acres	7.2	-	18.2	9.5
60 acres and over	14.3	-	-	2.4
4. Farms by Tenure (%)				
Owner Farms	100.0	23.5	100.0	69.0
Tenant Farms	-	70.6	-	28.6
Owner-Tenant Farms	-	5.9	-	2.4
5. Farmers by Education (%)				
No education	7.1	58.8	9.1	25.0
Madressah	-	5.9	27.3	12.5
Primary	57.4	29.4	9.1	37.5
Secondary	28.6	5.9	36.4	17.5
Higher	7.1	-	18.2	7.5
6. Cropping Intensity (%)	146.8	150.9	169.7	-

Table 2. Increase in Water Availability

Region	Percentage of Farmers Reporting an Increase*					
	No Increase	<10% Increase	10% to <20% Increase	20% to <30% Increase	30% to <50% Increase	50% and Over Increase
Punjab	14.3	14.3	21.4	21.4	28.6	-
Sind	-	11.8	23.5	29.4	23.5	11.8
NWFP	-	-	18.2	27.3	36.4	12.2
Overall	5.0	9.5	21.4	26.2	28.6	9.5

* Most farmers think that they save about 40 to 60 percent of their time in irrigating one acre of land.

Table 3. Increase in Cultivated Area (acreage)

Region	Percentage of Farmers Reporting an Increase					
	No Increase	<10% Increase	10% to <20% Increase	20% to <30% Increase	30% to <50% Increase	50% and Over Increase
Punjab	35.7	-	-	7.1	21.4	35.7
Sind	53.8	-	-	-	38.5	7.7
NWFP	90.9	9.1	-	-	-	-
Overall	55.6	2.8	-	2.8	22.2	16.7

Table 4. Increase in Cropped Area (intensity)

Region	Percentage of Farmers Reporting an Increase					
	No Increase	<10% Increase	10% to <20% Increase	20% to <30% Increase	30% to <50% Increase	50% and Over Increase
Punjab	21.4	-	14.3	28.6	35.7	-
Sind	53.8	-	-	-	38.5	7.7
NWFP	27.3	-	27.3	36.4	28.9	2.6
Overall	55.6	2.8	-	2.8	22.2	16.7

Table 5. Increase in Use of Fertilizer per Acre

Percentage of Farmers Reporting an Increase*					
No Increase	<10% Increase	10% to <20% Increase	20% to <30% Increase	30% to <50% Increase	50% and Over Increase
20.0	2.9	8.6	5.7	25.7	37.7

* In some areas, at least in NWFP, farmers say they are now using new types of fertilizer.

Table 6. Increase in Yield per Acre

Crop	Percentage of Farmers Reporting an Increase					
	No Increase	<10% Increase	10% to <20% Increase	20% to <30% Increase	30% to <50% Increase	50% and Over Increase
Cotton	-	-	33	22	22	22
Sugarcane	-	8	12	24	24	32
Wheat	-	-	24	20	40	16
Rice	-	-	-	40	60	-
Maize	-	-	17	17	50	17

Needless to say, the information given in Tables 2 to 6 provides only what the farmers were able to report from recall. These data, therefore, do not provide entirely reliable magnitudes of change in various impact indicators. They do, however, indicate the direction of change.

B. Macro-Evaluation: Illustrative Example

Even with data limitations, estimates of additional income due to watercourse improvement can be made. For this purpose, two watercourses, one from the Punjab (in Faisalabad Tehsil) and the other from Sind (in Sakrand Taluka), were selected. In making estimates of the probable aggregate net addition to the value of crop production on each watercourse, care has been taken to make realistic assumptions on variables about which no direct information was readily available.

The results of this exercise are given in Table 7. It is important to note that the net additional value estimated in each case is the one-shot effect of increased water and fertilizer during the post-improvement period of the watercourse. This additional value has thus become a part of the annual stream of net income which the watercourse improvement program may have created. If the improved watercourse is not constantly maintained, it is fair to assume that the additional income, as well as other benefits, will either diminish significantly or even disappear.

Table 7. Estimates of Additional Net Income Due to Improvement on Two Watercourses

	Variables	Faisalabad (Punjab)	Sakrand (Sind)
1.	Cropping Pattern	Sugarcane-Wheat	Cotton-Wheat
2.	Command Area	290 acres	62 acres
3.	Cultivated Area	250 acres	62 acres
4.	Assumed Distribution of Cultivated Area		
	Sugarcane	87.5 acres	—
	Cotton	—	21.7 acres
	Wheat	137.5 acres	31.0 acres
	Others	25.0 acres	9.3 acres
5.	Reported Increase in Yield Per Acre		
	Sugarcane	150 maunds	—
	Cotton	—	2 maunds
	Wheat	5 maunds	5 maunds
6.	Additional Output		
	Sugarcane	13,125 maunds	—
	Cotton	—	43.4 maunds
	Wheat	687.5 maunds	155.0 maunds
7.	Assumed Prices per Maund		
	Sugarcane	Rs. 9	—
	Cotton	—	Rs. 175
	Wheat	Rs. 55	Rs. 55
8.	Value of Gross Additional Output		
	Sugarcane	Rs. 118,125	—
	Cotton	—	Rs. 7,595
	Wheat	Rs. 37,812	Rs. 8,525
	Total	Rs. 155,937	Rs. 16,120
9.	Assumed Additional Cost (20% of Value)	Rs. 31,187	Rs. 3,224
10.	Net Additional Income	Rs. 124,750	Rs. 12,896

III. SOME CONSTRAINTS ON BENEFITS FROM WATERCOURSE IMPROVEMENT

While the watercourse improvement project in itself has positively affected farm production and aroused farmer enthusiasm for maintaining and even expanding this program, several factors constraining and offsetting the impact have been clearly identified. Five among these are quite significant and need some reflection.

1. Canal Water Supply. One of the most persistent complaints of farmers in almost every area concerned regulation of water at the mogha by the provincial irrigation department. Instances were cited of changes in design of the mogha, especially after the watercourse had been improved, resulting in reduced water supply.

2. Waterlogging and Salinity. Generally waterlogged and saline conditions in certain areas do not allow farmers to use more water to their benefit. Within one village, the low-lying farms or fields are often severely affected, particularly at the tail-end of a watercourse.

3. Agricultural Extension Service. Additional water alone is not enough to increase production on the farm. A competent and readily accessible farm extension service must be an integral part of an OFWM program. Most farmers have little or no access to such service at the present time.

4. Watercourse Maintenance Organization. The positive impact of OFWM will quickly diminish or even disappear if a well-coordinated and regular program of watercourse maintenance is not followed. Local-level initiative and participation by water users, buttressed by a properly designed legal framework, must be maintained. Informal arrangements within the village, dependent on traditional relations in which coersion and cooperation may or may not work, cannot guarantee effective maintenance of watercourses after improvement. Likewise, dependence on civil bureaucracy can introduce more corruption and use of unnecessary outside force or authority in the village.

5. Distribution of Landownership. The impact of OFWM on the individual water user will not only depend on his location on the watercourse, but also on his tenurial relations with others. Considerable differences in landholdings by size and tenure can result in large variation in benefits from watercourse improvement. A differentiated landownership structure affects access to water in the same way as almost everything else in the village.

APPENDIX E

SOCIOECONOMIC IMPACTS OF INCREASED INCOME ON VILLAGE FARM FAMILIES

Emily Baldwin

Sandra Malone

SOCIOECONOMIC IMPACTS OF INCREASED INCOME ON VILLAGE FARM FAMILIES

In Pakistani village life, the extended family is a common settlement pattern, with adult sons often keeping their wives and children within their parents' housing compound. It is not unusual, then, to find several nuclear families sharing one kitchen and living off of one plot of farm land; from 10 to 25 people might typically live in a single housing unit, where three to five adult men might farm the same or adjoining plots of land and the same number of adult women would share the household tasks of cooking, cleaning, laundering, caring for children, and tending live-stock. To be sure, nuclear families do exist as frequently as extended families, but even where a separate house is maintained, close family members are likely to live nearby and play at least some role in the nuclear family's economic life, be it through sharing jointly owned farming resources or helping one another in times of particular need.

Pakistani village society is decidely male dominated; in the ideal state, women are to minimize their public presence, while men exclusively carry on the economic tasks of the family. In reality, of course, few village families can afford to keep their women completely hidden behind closed doors; the economic necessity of female labor in the fields at peak agricultural periods (primarily harvest) and the inability of most families to afford individual household water systems force most village women out of their homes and into the fields or to the watercourse to wash laundry and dishes and to carry water for household use. Women and children are also responsible for tending family livestock. A major portion of each village woman's day is taken up by cleaning livestock compounds and washing, milking, and feeding of animals. Livestock washing and grazing, in particular, take the women out of their houses and into public view. However public their actual image in the village itself, few women probably venture beyond the village limits. Trips to larger towns or cities to purchase goods or to sell crops is usually restricted exclusively to men. Thus, the cultural ideal of women and the real situation may more nearly approximate one another at this level.

Watercourse improvements have made an impact on village family life. Most obviously, the increase in water supply available for irrigation has led to an increase in crop production, and, therefore, an increase in family net income. While a large portion of this increased family income is reinvested in the farm (in order to assure a continuation of increased income), much of it is also spent to improve the family's standard of living. In particular, new houses, built of brick or concrete, are replac-ing the older mud structures. Improved family shelter is a high priority expenditure for most families. The other major use of increased family income is for the education of children. Many families reported that educating their children was their first priority when additional income became available. In Pakistani society, girls have traditionally not been educated, but there is now a strong indication on the part of many families that education for their daughters is desirable, at least through primary school. The length of boys' education appears to be expanding as family income increases; increasingly, families are paying to send their sons outside the village, if necessary, for high school and even university education, despite the fact that this means a significant financial burden for tuition, commuting or boarding costs, books, and clothing. The increasing education of village children in turn is bringing more new ideas into the village, as well as higher family income as educated sons take jobs in the cities or abroad and send part of their income back to the village.

An occasional, but obviously major, expense for farm families is the marriage of children. The wedding of a daughter requires her parents to furnish an extensive dowry, while marriage of a son requires his parents to purchase gold jewelry and other gifts for the bride and her family. Respondents spoke with obvious pride of the thousands of rupees they had spent on the recent marriage of a child. A lavish wedding is a symbol of wealth and success to neighbors and family. Although not directly stated by respondents, it is easy to imagine that expenditures on weddings, as well as other celebrations, have increased as income has increased.

Another occasional, but no less major, family expense is illness. For villages without health clinics or a hospital, serious sickness can mean a major expense, since a patient must be transported to another town or city, along with an attendant relative or two for whom lodging and food must be provided in addition to the actual cost of medical attention. Increased family income does not seem to be (and probably cannot be, at least not yet) translated into family savings that could serve as insurance against such unanticipated expenses as illness. Most families are obviously still too close to the margin of survival to be able to absorb such unexpected costs.

Most farm families interviewed did not articulate recognition of a significant change in diet as a result of increased income. It should be added that in no village visited was there obvious visible evidence of poor diet; most village dwellers appeared reasonably well-nourished (although not necessarily always healthy). Few families can live exclusively on their own farm production, but many small landowners appear self-sufficient in wheat, corn, dahl (legumes), and other staples. Tenant farmers in the Sind reported that they must grow the crops that the landowner wants--usually commercial crops such as cotton or sugarcane. They said that they were not allowed to grow food for their own family's consumption without the landowner's permission, and therefore, that they bought all of their family's food in the local market. Meat consumption is apparently low since farm-owned livestock are too precious a commodity to slaughter for food; milk from farm cows and buffalo, however, seems adequate to fulfill a family's requirements in most cases. Vegetables, then, seem to be the family's major food expense. Many farmers expressed a desire to grow and market vegetables themselves, but many felt that their irrigation water supplies were insufficient for them to do so.

Expenditures on clothing have undoubtedly increased as income has risen, but clothing does not appear to be a major budget item for most farm families. New clothes are typically purchased (or rather the material purchased and the clothes made by the women of the family) for a special occasion such as a wedding or a religious holiday.

As individual family incomes increase as a result of a village-wide increase in water supply for irrigation, the community as a whole also becomes wealthier. Local merchants and artisans enjoy increased business as farmers have more disposable income to spend. Better community services—particularly health and education—also become more affordable as the village income grows.

Besides the more obvious, direct economic impacts of increased family income resulting from watercourse improvements, there are other social impacts as well. Irrigation of crops has become easier with the installation of pucca nuccas and the reduction of watercourse leaks, spills, and breaches. Many families reported that their young children could now assist in the irrigation process, whereas prior to watercourse improvements the work had been too strenuous for them. This apparent substitution of child for adult labor, combined with the general labor saving that farmers attribute to watercourse improvements, indicates that adult labor has been freed for other tasks, or perhaps for increased leisure.

The lined portions of the improved watercourses provide a service to women who use the concrete surface as a laundry and dishwashing area as well as a convenient place from which to fetch water. Because laundry and dishwashing are activities that offer village women an opportunity to gather and socialize, the concrete lining serves an unanticipated social function in addition to its primarily agricultural function.

The original project paper for the On-Farm Water Management Project envisioned several other socioeconomic impacts that warrant attention. First, the anticipated increase in farm income and employment resulting from watercourse improvements was expected to reduce fertility over time. Obviously, the project has not been implemented long enough nor extensively enough to offer any verification of such an anticipated outcome. Although the project paper correctly identifies a typical pattern of declining fertility as income rises, it seems optimistic to expect on-farm water management alone to have much impact on population growth rates.

Second, the project paper discussed the "increasing employment opportunities" that the project would offer women. Explanation of what was specifically envisioned is missing. The only hint as to what may have been intended is mention of a growth of agroprocessing industries, resulting from the anticipated increase in crop production, in which women could be employed. Not only does the potential for significant agroindustrial growth seem optimistic except for the more distant future, but the expectation that Pakistani village women would be permitted to work outside the home in factories anticipates a much more rapid pace of social change in the rural areas than is actually occurring. Other areas of anticipated employment generation by this project—such as for on-farm water management engineers, watercourse brickmasons, or ditch maintenance workers—are equally off-limits to women in rural Pakistan. The most likely increase in employment for women resulting from this project would be on the farm itself—in the form of increased crop yields likely to be harvested in large part by women.

Although several anticipated socioeconomic impacts from this project--specifically, reduced fertility and increased female employment--have not been visibly forthcoming as yet (and should not realistically have been expected to be forthcoming in so short a time frame), the project has had a number of impacts on the family. The largest and most direct impact has been on family income, which has helped to raise the standard of living. Improved housing and more education for children, as well as further investments in the family farm, are the priorities for use of any increased income. Some modest changes might also have occurred in the family distribution of labor as a result of watercourse improvements. Specifically, children can play a more active role in the irrigation process now while adults devote more time to other tasks. The watercourse may also have taken on a more social function with project improvements. The concrete lining seems to serve as a convenient gathering place for women to do laundry, wash dishes, and haul water. The project has not, however, contributed to any major changes in family structure or in individual family member's roles, nor was it intended to do so. Life in the rural village is gradually changing as a result of a number of influences -- increasing education and rising income among them. This project has undoubtedly contributed in small and subtle ways toward these trends of gradual change.

APPENDIX F

A CASE STUDY: DISTRIBUTION OF OFWM BENEFITS IN SIND.

Masud A. Siddiqui

A CASE STUDY: DISTRIBUTION OF OFWM BENEFITS IN SIND

I. INTRODUCTION

The On-Farm Water Management Project (OFWM) in Pakistan has been implemented predominately in three provinces: North West Frontier Province (N.W.F.P.), Punjab, and Sind. Coverage within each province vaires; it includes two districts of N.W.F.P. (Peshawar and Mardan), four districts of Punjab (Faisalabad, Sahiwal, Vehari, and Multan), and three districts of Sind (Hyderabad, Nawabshah, and Sanghar). The extent of project implementation in the three provinces has also varied substantially. The number of watercourses improved under this project, as of June 30, 1981, is 80 in N.W.F.P., 1,072 in Punjab, and 162 in Sind.[1] The selected sites represent a higher concentration of agricultural activity than exist in non-selected areas. Agro-climatic differences also exist among the selected project areas.

No specific data or studies are available that refer specifically to program beneficiaries; the issue of beneficiaries has been buried under macrostatistics and average landholding patterns. The previous Agency evaluations of this project also dealt with the subject in a rather perfunctory manner. Given the time constraints, the scope and methodology of the impact evaluation did not include any exhaustive study of this particular dimension, aside from this brief study confined to Sind Province.

The sample in this study is largely representative of the general landownership pattern in the three districts of the province where the OFWM project was implemented. Although it represents a 10 percent sample of 160 improved watercourses in Sind, the study has its limitations. No statistical validity can be claimed, but the results are consistent with other research findings.

II. BACKGROUND

Agrarian structure in different regions and provinces of Pakistan is highly varied. The diversities include degree of concentration of landownership, form of tenancy, distribution of farms by size, and productivity.

Despite successive land reforms, recent studies indicate a high concentration of landownership, except in NWFP (Tables 1 and 2). An assessment of the effectiveness of land reform implementation is made difficult by the fact that no direct evidence is available in the official documents. However, indirect evidence in terms of the magnitude of land taken

[1] Reported by the Federal Water Management Cell.

Table 1. Distribution of Landownership in Pakistan and Its Provinces, 1976

Farm Size	Pakistan		Punjab		Sind		NWFP	
	Percentage of Owners	Percentage of Owned Area	Percentage of Owners	Percentage of Owned Area	Percentage of Owners	Percentage of Owned Area	Percentage of Owners	Percentage of Owned Area
Marginal (6.25 acres or less)	70.8	24.9	69.0	26.0	40.4	8.2	85.9	40.8
Small (>6.25 to 12.5 acres)	17.5	21.3	19.6	24.3	23.9	12.4	8.6	19.7
Medium (>12.5 to 25 acres)	7.6	18.1	7.8	18.6	17.6	18.3	3.8	13.3
Large (>25 to 50 acres	2.6	13.2	2.3	12.7	10.1	19.2	1.1	8.1
Very Large (>50 acres or more)	1.5	22.8	1.2	18.2	8.0	42.0	0.6	18.1

Source: Pakistan Land Commission, cited in Khan, M. H., "Underdevelopment and Agrarian Structure in Pakistan," (Boulder, Colorado: Westview Press, 1981).

Table 2. Distribution of Self-Cultivating Owners in the Punjab and Sind, 1976

Farm Size	Punjab		Sind	
	Percentage of Self-Cultivating Owners	Percentage of Self-Cultivating Area	Percentage of Self-Cultivating Owners	Percentage of Self-Cultivating Area
Marginal (6.25 acres or less)	76.0	72.9	87.1	88.4
Small (>6.25 to 12.5 acres)	71.4	68.6	84.2	84.7
Medium (>12.5 to 25 acres)	61.9	65.1	68.2	67.7
Large (>25 to 50 acres)	63.0	61.7	45.8	44.1
Very Large (>50 acres or more)	39.0	40.5	8.0	8.6
All sizes (average)	73.3	64.5	72.8	42.7

Source: Pakistan Land Commission, cited in Khan, M. H., "Underdevelopment and Agrarian Structure in Pakistan," (Boulder, Colorado: Westview Press, 1981).

over by the Government under the 1972 land reform laws would help in the analysis of the implementation process. Looking at available statistics, it becomes clear that the land reforms did not seriously alter the concentration of landownership in the Indus Basin (Table 3). The total farm area thus taken over by the Government was reduced as a result of (a) the use of Produce Index Units (PIUs)[2] to classify individual holdings, and (b) the exemptions and transfers allowed to landlords for orchards, fruit gardens, etc.

A high proportion of farm operators are small farm owners and tenants, with the former predominating in Punjab and the latter in Sind. According to official statistics, 63 percent of farms in Sind are tenant operated and 24 percent are small, owner-operated farms, whereas the numbers in Punjab are 29 percent tenant-operated and 42 percent small farm owner tenant operated (Table 4). The large and very large farm owners in Sind constitute 18 percent of the total number of farms, covering approximately 61 percent of the farm area. Comparable figures for Punjab and NWFP are approximately 4 percent for large farm owners holding 31 percent of the farm area and 1.7 percent for large farm owners with 26 percent of the area, respectively (Table 1). This information can provide the basis for a general profile of the likely beneficiaries of the OFWM program in the three provinces of Pakistan.

A working definition for each of these three basic categories of farm tenancy follows.

1. "Sharecroppers" are tenants (haris), who work on land that belongs to others. Each tenant is generally given four to eight acres of land in Sind to cultivate, and shares the cost of inputs such as fertilizer, seed, and machine operation. The output is also shared equally between tenant and landlord (see Appendix A).

2. "Small and Medium Farm Owner-Operators" generally cultivate their own land and live essentially at or close to a subsistence level. The group, though small (24 percent), has the potential for increasing agricultural production in Pakistan. A subset of this category, which has become significant during the last decade, is that of owner-operator-with-tenants. This includes a landlord's traditional tenants who have come to own a piece of the land they cultivate, mostly as a result of reform policies (Table 3).

3. "Large Landowners and Absentee Landlords" are the traditional Zamindars, who generally depend on tenants for cultivation of their lands. "Large Landowners" usually participate actively in farm management; "Absentee Landlords" own the land and use it as a source of power and income in rural society, but take little or no active role in managing the farm. Their land is generally managed

---

[2] For purposes of parity, land in different provinces is classified using Produce Index Units per farm/crop, which differed from region to region.

Table 3. Resumption and Redistribution of Land Under the Land Reforms Regulation of 1972

Province/ Division	No. of Owners (150+ acres)	Area Owned (acres)	All Declarants	Affected Declarants	Area of Affected Declarants (acres)	Area Retained (acres)	Area Resumed (acres)	Acres Allotted (acres)	No. of Persons Benefited	Balance Area (acres)
Punjab	10,920	2,221,695	6,148	1,064	653,849	380,740	273,109	183,365	34,673	38,744
Multan	2,337	785,198	-	310	-	-	145,911	90,057	13,910	55,854
Sargodha	2,085	727,002	-	357	-	-	56,175	39,716	9,105	16,459
Rawalpindi	5,524	466,108	-	100	-	-	34,567	20,749	4,695	13,818
Lahore	404	81,556	-	122	-	-	7,676	7,112	1,536	564
Bahawalpur	570	161,231	-	166	-	-	28,780	25,731	5,427	3,049
Sind	6,799	1,665,373	6,777	690	536,844	220,454	316,390	125,025	15,875	169,050
Khairpur	2,360	570,117	3,150	255	261,568	79,863	181,705	68,258	7,820	112,168
Hyderabad	4,373	1,079,317	3,476	431	273,548	140,514	133,034	56,560	8,047	56,288
Karachi	66	15,939	151	2	1,728	77	1,651	117	8	502
Punjab & Sind	17,719	3,887,068	12,925	1,754	1,190,693	601,194	589,499	318,490	49,548	258,794

Source: Pakistan Land Commission, cited in Khan, M. H., "Underdevelopment and Agrarian Structure in Pakistan," (Boulder, Colorado: Westview Press, 1981).

Table 4. Distribution of Farms According to Farm Size and Tenure

Province	Total No. of Farms (private)	Farm Size (percent)					Tenure (percent)		
		1-5 acres	5.01 - 1.25 acres	12.01 - 25 acres	25.01 - 50 acres	50 acres and above	Owner	Owner-With-Tenant	Tenant
Pakistan	37,61,688	28	39	21	8	4	42	24	34
Punjab	23,75,369	26	39	23	9	3	42	29	29
Sind	7,47,627	19	51	22	5	3	24	13	63
	4,65,926	56	28	9	4	3	55	22	23
Baluchistan	1,72,766	24	32	21	13	10	73	8	19

Source: Pakistan Census of Agriculture, 1972.

by a traditional "Kamdar" (manager). A trend toward increased self-cultivation and mechanization by medium and large farm landowners seems to be emerging.

III. THE CASE STUDY

This study of some randomly selected farmers in Sind has been carried out to revalidate the project hypothesis that small (less than 25 acres) and medium farmers would be the major program beneficiaries. As a result of the emphasis given in the project design to selection of watercourses on the basis of 75 percent ownership by small farmers and the cost-sharing arrangement under precision land leveling, it was assumed that there would be a direct relationship between project implementation and the flow of benefits to small and medium farmers.

Differences in agro-climatic conditions, soil productivity, and structures of landownership seem to have been underemphasized as determinants of the project's potential beneficiaries and the spread of accrued benefits. For example, a sample division of farms by size into small and large may not have any bearing on the value of production, as the value depends on a complex set of factors including water, soil structure, and other inputs. Similarly, farmers of all land-holding sizes and tenurial relations may operate on a single watercourse, and front- and tail-end farmers cannot be distinguished simply as rich (or large) and poor (or small) farmers. Furthermore, the degree of participation is greatly affected by the ownership and control of land and related assets and not necessarily by the location of the farm on the watercourse, although there could be a coincidental relationship between these factors.

The OFWM project in Sind has been implemented on the Rohri canal command area in Hyderabad, Nawabshah, and Sanghar. Rohri is a perennial canal and its command area is regarded as the most fertile in the province, with a high concentration of agricultural activity. Although there is a high concentration of landholdings generally throughout the province, this is particularly true in the selected districts, and some of the more influential landlords are also found in these selected districts (Table 5). Provincial statistics also indicate that only 24 percent are small owner-operators, 64 percent are tenants (representing largely the interest of larger landlords), and only 12 percent are owner-operator-with-tenants, who are also in the category of small to medium size farmers (see Table 4).

During October 17-21, 1981, while the impact evaluation team was collecting data, questions were raised about the distribution of benefits of the project among the various farm groups in Sind. Given the highly differentiated landholding pattern, which was further confirmed during initial field observations, it appeared that the provisions included in the project design to direct the project benefits toward small farmers may not have had the intended results. (Sufficient empirical data exists to support the team's hypothesis regarding the skewed distribution of program benefits.) It was, therefore, decided to create new area-specific data to draw a clearer picture of actual beneficiaries.

Table 5. Classification of Farms by Size and Areas--Selected Districts in SIND

Farm Size	Hyderabad		Sanghar		Nawabshah		Total Sind	
	No. of Farms	Farm Area	No. of Farms	Farm Area	No. of Farms	Farm Area	No. of Farms	Farm Area
7.5 acres or less	23,762	115,179	15793	78,082	27,110	115,747	270,841	1,181,303
7.5-12.5 acres	43,555	425,482	22,967	225,711	32,690	331,705	256,858	2,502,582
12.5-25 acres	32,963	564,760	18,726	309,703	21,352	363,225	165,126	2,776,424
25-50 acres	7,942	266,365	3,595	118,929	4,746	152,041	38,531	1,247,232
50-150 acres	4,069	330,529	1,289	92,673	1,164	83,138	13,418	1,013,124
150 acres or more	960	154,691	242	53,622	84	22,978	2,853	748,325

Source: Pakistan Agricultural Census 1972 Province Report Sind

A. Data and Methodology

A small survey was carried out, targeted at 10 percent of the improved watercourses in Sind. Sample villages were selected on a random basis from the three districts, taking into consideration the number of watercourses improved. The sample included six villages each in Hyderabad and Nawabshah and three in Sanghar. The sample consisted of 55 respondents, including tenants, owner-operators, small and large farmers. A profile of the sample, including the variables covered, is given below. In view of the time constraint, no specific target group was designated and the interviews were largely unstructured and open-ended. However, the primary objective of the sample survey remained the collection of adequate information regarding village characterisitics, ownership and operational pattern, cropping pattern, comparative cropping intensities, and yields on different landholdings by size and tenure.

The benchmark data for comparison purposes were obtained from the Agricultural Productivity Study of the Sind Regional Plan Organization (APS-SRPO), because the information on specific variables required for this study was not available in the province. This choice was made to avoid the variability in information given by individual respondents of this case study for the pre- and post-project period. Two important considerations should be kept in mind here. First, the APS-SRPO was a much larger and more comprehensive survey, covering 622 farms in the perennial and non-perennial areas of Sind. Second, the composition of respondents in the two samples differed significantly. Therefore, where necessary, the results have been interpreted and explained in footnotes.

B. Summary of Sample Survey

Data and Coverage

Category	Total
Number of Respondents	55
Owner Operators	19
Tenants	27
Large Owners/Landlords	9
Number of Districts	3
Number of Talukas (Tehsil or subdivision of district)	9
Number of Irrigation Canals	1
Number of Irrigation Minors	12
Number of Dehs (Villages)	16
Number of Watercourses	16
Total Command Area of Watercourses	8,660

Distribution of Villagers by Ownership and Operational Pattern

Number	Ownership	Owner Area	Tenant Operated	Tenant Operated
6	Single Owner	2,963	40%	60%
6	Multiple-Large	3,846	49%	51%
4	Multiple-Small	1,851	48%	52%

Distribution of Villages by Ethnic Composition and Ownership Pattern

Number	Ethnic Composition	Area	Single	Multiple, Large	Multiple, Small
8	Predominantly Sindi	4,552	6	2	-
4	Predominantly Punjabi	1,897	-	1	3
4	Mixed Villages	2,211	-	3	1

Average Area Operated by Tenant (by ownership grouping)

Ownership Grouping	Average Area
Single Owner Villages	10.0 Acres
Multiple, Large	13.6 Acres
Multiple, Small	5.8 Acres
Average of 27 Tenant Respondents	9.8 Acres

IV. ANALYSIS AND INTERPRETATION

The differences in benefits accruing from the watercourse improvement program, at least in Sind, appear to be largely a function of landownership and farm size, that is, increased benefits correlate positively with larger farms. However, some of the apparently prosperous respondents were small owner-operators and tenants. While there seems to be no evidence that large landowners have displaced small owners or tenants, there is evidence of an increased tendency toward self-cultivation and mechanization on very large farms. This may have adversely affected the tenants. The study also indicated that most of the additional water was used by larger landlords to irrigate orchards and fruit gardens, using wastelands; hence, there was only a residual impact of the increased irrigation water on tenant-operated lands. The trend is the reverse in the case of tenant-operated units of small- to medium-size landholdings, where increased cropping intensities and more favorable changes in cropping pattern and yields were observed as more water became available.

It is justifiable to suggest that in spite of the stated intent of the project paper to direct benefits principally to small farmers (those farming less than 25 acres), this target group was not necessarily the exclusive or even major beneficiary of the OFWM pilot project in Sind. However, a significant increase in the cultivated area in all categories of farms is evident throughout the project area; this increase is indicated by an average area per operator of 55.3 acres in the sample, compared with the benchmark average of 21 acres for Sind as a whole (Table 6). The largest increase was found in Hyderabad. The data also reveal that the farmers with larger holdings, most of whom are big landlords, were able to increase further their cultivated area up to 81.5 percent.[3] The cropping intensities in the sample districts (calculated for traditional and nontraditional crops) have also increased from 102.94 percent in 1977-1978 to 120.5 percent in 1980-1981. This increase in cropping intensity is largest in Sanghar, especially for small landholders or tenants (Table 7).

There is evidence of significant increases in yield per acre of major crops, such as cotton, sugarcane, and wheat (Table 8). Cotton yields increased from 11.6 maunds to 15.8 maunds (36.2 percent), sugarcane from 423.0 maunds to 591.6 maunds (39.8 percent), and wheat from 17.5 maunds to 28.3 maunds (61.71 percent). Hyderabad leads in yield per acre of cotton, Nawabshah in wheat, and Sanghar in sugarcane. The yield data based on village characteristics indicate that farmers in villages with multiple small ownership had higher yields of most crops. Large landholders and landlords had comparatively higher yields in cotton (71.27 percent) than the benchmark yields.

---

[3] This large increase could be accounted for by the increase in new areas of self-cultivation, plantation, and fruit gardens on culturable wastelands. Partially, it may also reflect sample bias since the benchmark data were based on subdivision of these holdings in order to circumvent land reforms.

Table 6. Acres Operated (classified by different categories)

Variable	Average Number of Acres Operated	
	Benchmark Sample 1977 *	Project Sample 1981
Sind Districts	21.00	55.3
Hyderabad	20.01	
Nawabshah	17.00	
Sanghar	13.62	
Village Structure		
Single Family Ownership	**	52.2
Multiple Ownership (large holdings)	**	65.8
Multiple Ownership (small holdings)	**	50.6

* Benchmark sample is derived from the Agricultural Productivity Study (APS) of the Sind Regional Plan Organization, 1977. APS data are based on a 303-respondent sample of perennial areas of Sind, consisting of 150 small farmers (0.1-12.5 acres) of whom 56 percent are tenants. The project sample for 1981 comprises 55 respondents; 27 are small farmers with 89 percent tenants.

** Benchmark data are not available.

Table 6. Acres Operated (classified by different categories) (cont.)

Variable	Average Number of Acres Operated	
	Benchmark Sample 1977 *	Project Sample 1981
Farm Size		
Small (0.1-12.5 acres)	8.76	6.7
Medium (12.5-50 acres)	21.76	21.8
Large (50.1 acres or more)	77.6	140.9
Tenure		
Owner-operator	18.2	46.7***
Tenants	10.1	9.7
Landlords	39.4	162.6

*** If the distribution of the sample of owner-operators is changed according to the land holdings of the benchmark sample, the average area operated is 23.2 acres.

Table 7. Cropping Intensity (classified by different categories)

Variable	Benchmark Sample 1977* (percent)			Project Sample 1981 (percent)		
	Kharif	Rabi	Annual	Kharif	Rabi	Annual
<u>Sind Districts</u>	52.54	50.4	102.94	63.7	56.7	120.5
Hyderabad	53.00	45.5	98.5	63.0	56.1	119.1
Nawabshah	49.62	51.8	101.42	63.4	56.0	119.5
Sanghar	53.99	59.4	113.39	72.5	69.5	142.0
<u>Village Structure</u>						
Single Ownership	**	**	**	63.7	56.0	119.7
Multiple Ownership (large holdings)	**	**	**	66.6	55.6	122.2
Multiple Ownership (small holdings)	**	**	**	62.3	60.1	122.4

* Benchmark sample is derived from the Agricultural Productivity Study, Sind Regional Plan Organization, 1977.

** Benchmark data not available.

Table 7. Cropping intensity (classified by different categories) (cont.)

Variable	Benchmark Sample 1977* (percent)			Project Sample 1981 (percent)		
	Kharif	Rabi	Annual	Kharif	Rabi	Annual
Farm Size						
Small (0.1-12.5 acres)	53.00	51.7	104.7	85.1	61.2	146.3
Medium (12.5-50 acres)	51.01	53.7	104.8	67.9	54.1	122.0
Large (50.1 acres or more)	53.0	47.1	100.1	62.7	56.8	119.4
Tenure						
Owner-operator	51.5	52.5	104.0	61.9	59.7	121.6
Tenants	54.4	51.6	106.0	77.3	63.9	141.2
Landlords	47.9	43.8	91.7	63.1	56.0	119.2

Table 8. Cotton, Sugarcane, and Wheat Production (classified by different categories)

Variable	Cotton				Sugarcane				Wheat			
	Benchmark* Sample 1977		Project Sample 1981		Benchmark* Sample 1977		Project Sample 1981		Benchmark* Sample 1977		Project Sample 1981	
	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds
Sind Districts	7.6	11.63	18.9	15.8	5.73	423.0	8.1	591.6	7.4	17.5	21.1	28.3
Hyderabad	9.1	13.3	27.4	16.5	5.4	482.0	9.6	608.5	8.0	17.9	28.5	22.5
Nawabshah	6.8	11.7	9.2	15.8	4.4	361.7	8.4	553.3	7.0	20.4	13.3	35.7
Sanghar	5.9	10.2	18.1	13.3	1.5	333.3	1.6	733.2	6.7	16.8	18.1	22.6
Village Structures												
Single Ownership	**	**	16.1	15.8	**	**	7.8	610.5	-	-	16.4	29.2
Multiple Ownership (large holdings)	**	**	25.4	16.1	**	**	10.8	437.8	-	-	25.7	31.0
Multiple Ownership	**	**	18.9	16.2	**	**	7.6	630.4	-	-	23.0	26.9

* Benchmark sample is derived from the Agricultural Productivity Study, Sind Regional Plan Organization, 1977.

** Benchmark data not available.

Note: The above analysis is for cotton, sugarcane, and wheat only, whereas cropping intensities, as shown in table 7, are calculated for all crops including fodder, vegetables, oilseeds, and orchards.

Table 8. Cotton, Sugarcane and Wheat Production (classified by different categories) (cont.)

Variable	Cotton				Sugarcane				Wheat			
	Benchmark* Sample 1977		Project Sample 1981		Benchmark* Sample 1977		Project Sample 1981		Benchmark* Sample 1977		Project Sample 1981	
	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds	Average Area	Average Y/A Mds
Farm Size												
Small (0.1-12.5 acres)	3.3	11.7	3.2	15.3	2.0	607.9	1.8	602.7	3.2	18.0	3.4	29.0
Medium (12.51-50 acres)	10.35	11.1	9.1	16.0	5.25	471.7	5.3	633.8	10.8	17.3	8.9	27.0
Large (50.1 acres or more)	29.6	9.4	48.3	16.1	10.8	361.6	17.8	537.0	26.2	16.1	57.5	28.4
Tenure												
Owner-operators	7.4	10.0	15.6	15.0	5.0	319.6	5.4	556.8	7.1	18.4	20.9	28.4
Tenants	5.5	13.0	4.0	15.6	2.2	601.1	2.2	609.6	4.5	17.1	4.8	27.9
Landlords	14.1	10.9	54.4	16.9	8.2	457.2	23.6	597.5	12.8	17.8	55.0	29.0

Table 9. Gross Productivity Value per Acre (classified by different categories)

Variable	Benchmark Sample 1977 *	Project Sample 1981	Percentage Increase/Decrease
Sind Districts	1,403.3	1,766.0	25.9
Hyderabad	1,537.2	1,694.0	10.2
Nawabshah	1,309.4	1,982.7	51.4
Sanghar	1,005.7	1,336.2	32.9
Village Structure			
Single Ownership	**	1,864.7	
Multiple Ownership (large holdings)	**	1,698.0	
Multiple Ownership (small holdings)	**	1,726.5	

* Benchmark sample is derived from the Agricultural Productivity Study, Sind Regional Plan Organization, 1977.

** Benchmark data not available.

Table 9. Gross Productivity Value per Acre (classified by different categories) (cont.)

Variable	Benchmark Sample 1977 *	Project Sample 1981	Percentage Increase/Decrease
Farm Size			
Small (0.1-12.5 acres)	1,606.4	1,863.9	16.0
Medium (12.51-50 acres)	1,317.8	1,948.1	47.8
Large (50.1 & Above)	1,065.5	1,678.0	57.5
Tenure			
Owner-Operators	1,165.7	1,595.9	36.9
Tenants	1,550.2	1,820.4	17.4
Landlords	1,369.9	1,871.6	36.6

The results in gross value of production (GVP), calculated for different areas and groups of farmers, are quite informative. While for the sample as a whole the GVP increased by about 26 percent, the percentage increase was largest on larger landholdings, followed by that for medium and small holdings. In monetary terms, medium-size landholders were able to get a GVP of Rs. 1,948 per acre compared with Rs. 1,863 for small landholders, and Rs. 1,673 for large owners. These figures reflect partly the differences in the samples and partly the differentiated structure of landholdings.

From the foregoing observations on changes in acreage under cultivation, cropping intensity, yield levels, and GVP, it seems that farmers generally have benefitted from the increased supply of water. However, it should be noted that on holdings cultivated by a large number of tenants but owned by only a few landlords, income shares have tended to remain concentrated. This may have been partly the result of a tendency among large landholders to move towards mechanization and the use of tubewells, which perhaps adversely affects the tenants and widens the gap between the large landholder and the small owner-operator who does not usually enjoy the same access to investment capital, land, and inputs.

V. CONCLUSIONS

1. Areas under cultivation and cropping intensities have significantly increased in the sample villages. While large landlords and landholders were able to increase their cultivated areas substantially, small landholders were able to increase their cropping intensities to a more significant extent.

2. Yield levels of major crops have increased, ranging from 39.8 percent for sugarcane, 61.71 percent for wheat, to 36.2 percent for cotton.

3. A GVP increase of 25.9 percent per acre has been estimated for the sample farmers.

4. The landless laborer has benefitted from increased wages as a result of intensive agricultural activity on large farms.

5. All categories of farmers in the sample seem to have benefitted substantially.

6. Farmers in villages with multiple small ownership were able to get higher yields compared with yields in villages in which single ownership predominated.

VI. PROFILE OF TENANT FARMER IN SIND

As a result of discussions with 27 tenant respondents, the following tenant profile was developed. It should be helpful in determining the distribution of benefits among landowners and tenants and the percentage share of each.

— Receives a 50 percent share of crop if he owns a pair of bullocks and a 25 percent share without bullocks. Each operates usually 4 to 8 acres of land with one pair of bullocks.

— Few respondents reported any change over the years in the area operated.

— Land is rotated by the landlord.

— The landlord's practice of rotating tenants around his land denies the tenants the three years of tenancy necessary to establish a claim on a particular piece of land.

— Tenant cropping patterns fall within the larger cropping pattern of the landlord.

— Tenants are usually assigned a cropping intensity by the landowners according to the Irrigation Department's programmed supply of irrigation water in the province (27 percent Kharif and 54 percent Rabi) which compels them to leave at least 50 percent of the land fallow.

— Tenants pay 50 percent of the cost of all inputs and services.

— Tenants pay for water if receiving partial supply from the landowner's tubewells.

— Tenants pay 50 percent of tractor operation cost for weeding after sugarcane and leveling after cotton. Charges are Rs.50 per acre/hour.

— Tenants pay full cost of tractor operation for ploughing.

— Tenants pay 5 percent of the product to landlord's Kamdar (manager), who is the middleman between tenants and the landlord. On a small landholding, direct relationships exist between tenants and landowner.

— For tenants, the dwelling place comes with land tenure on the landlord's land. Tenants may not convert housing from mud into brick..

— Almost no nonfarm employment was reported by the tenants. A similar negative situation was noted with respect to the education of tenants' sons and daughters. In some cases, where the tenant's family had lived in a particular village for two generations, a piece of land was added by the landlord for the subsistence of adult sons of tenants, although a period of "good behavior" was required before the sons were accorded tenant status.

— Most tenants come from the Kohli and Bhil tribes (low-caste Hindus), who are basically nomads and docile people. They hardly ever claim permanent tenancy rights to land under the existing government tenants' Protection Laws. Sindi Muslim and Punjabi tenants are also represented in large numbers. They enjoy slightly better status.

— Tenants generally live under the feudal-like domain of landlords.

— Most tenants were indebted to their landlords, which compelled them to continue their tenancy with the same landlord.

— Indirect buying by tenants prevails in the form of "advances." Ready cash plus incentives to clear old indebtedness attract tenants to new owners.

— Sindi Muslim tenant families have been traditional farm families, settled for generations. A new category of owner-operator-with-tenant has emerged from this group as a result of land reforms.

— In the Punjabi settler villages in Sind, tenants invariably came from East Punjab. Cash crops and fodder were the preferred cropping pattern of Punjabi tenants, who usually bought grains from the landowners. Very intensive cattle breeding activity was also noted in these villages.

— Punjabi tenants maintain their linkages with families back home through marriages. Savings are usually remitted with a view to buying land in Punjab.

— Tenants seemed well-off on smaller landholdings; indications of this included allowed cropping intensities, more cash crops (sugarcane, vegetables, etc.), and possession of cattle. On small landholdings, tenants reported harvesting grass, fodder, and vegetable crops between winter and summer crops.

— Ironically, many of the higher yields in the province have come from tenants.

ACKNOWLEDGMENT

I am thankful to Dr. Badruddin Soomro, Director, Sind Regional Plan Organization (SRPO), for his valuable assistance and input in the processing of field data and the use of SRPO computerized benchmark data for comparative analysis. I am also indebted to Dr. Mahmood Hasan Khan, Simon Frazier University, British Columbia, Canada for his review of and valuable comments on this paper.

APPENDIX G

SOME SPECULATIONS ON HONOR, POWER, AND AGNATIC RIVALRY IN PAKISTANI VILLAGES

Akbar S. Ahmed

SOME SPECULATIONS ON HONOR, POWER, AND AGNATIC RIVALRY IN PAKISTANI VILLAGES

I. INTRODUCTION

Agrarian economic development schemes do not operate in a vacuum, but are embedded in the social structure and are influenced by the social organization of the community. In the discussion that follows, we suggest that beneath the diverse cultural and structural forms of Pakistan a tribal structure may be perceived. The structure possesses two characteristic features: life is based on some understanding of the notion of honor (especially related to women) and on rivalry that is largely expressed through agnatic or cousin enmity (called tarboor in the N.W.F.P. and sharika in the Punjab, this cousin is usually the father's brother's son). The desire for honor and agnatic rivalry are converted into a desire for power. It is a zero-sum situation: the more power cousin A has the less his rival, cousin B, will have. Every power unit added to A subtracts power from B. In certain places, as in the N.W.F.P., this is the only model; in other areas, as in the Punjab, this pattern is blurred, while in the Sind it is fused and sometimes converted into a feudal order. Irrigation schemes, including the On-Farm Water Management project, affect such traditional structures and organizations and, in turn, are affected by them.

Also influencing development projects is the administrative apparatus that deals with issues of law and order, revenue collection, and water distribution. For this project, the administrative structure incorporated the On-Farm Water Management project. The latter was indeed an important factor as we shall see below. To assess the impact of the project, it is necessary first to deal with the social structure and administrative framework.

My questionnaire elicited information focusing on the following issues in society: the code of behavior; the concepts of "tribe," "caste," and ranked hierarchies; memory of agnatic ascendants (in support of lineage status); prevalence of endogamy and exogamy (marriages are almost entirely homogamous); household composition; physical description of respondents; emigration; and the role of religion in decision making. The questions were structured to throw light on larger issues. For instance, the code is consciously upheld by senior lineages who maintain memory of their ancestry and who also maintain group purity through endogamy. These groups look and appear better fed and healthier then junior or depressed lineages. It is these groups who can afford to emigrate.

Related studies have been conducted previously. Although they are based mostly in one province (mostly the Punjab), they contribute to our understanding of the problems. However, in some of them, important conceptual errors have been introduced, such as the common use of "caste" for tribal or occupational groups.[1] "Caste" has specific associated religiocultural characteristics in South Asia, which include commensal rules.

The question when dealing with a large and socially complex nation like Pakistan is: can we talk of one universal structure? The administrative structure is indeed central and identical in all parts of the country. It is divided in a series of descending hierarchies. The key figure is the District Commissioner, a mid-level career official, and the key unit is the District under his charge.[2] Although the administrative structure is central, locating a common social structure presents problems. Before dealing with the major ethnic zones separately, we will briefly present an all-Pakistan picture.

II. PAKISTAN

Pakistan is an agricultural country with more than three-quarters of its population directly dependent on agriculture. Pakistan may be viewed socioculturally as a single unit; this assessment is supported by its geography and its predominantly agricultural economy, which interlock the various regions. The river Indus and its supporting irrigation networks constitute the core agricultural area of Pakistan, an area with complex and extensive irrigation systems and fertile lands. In this area lie most of the estimated 87,000 watercourses of Pakistan. The area is largely coincidental with, and a consequence of, the Indus River basin. The water improvement projects we visited were in this core area of Pakistan. The other areas of Pakistan are peripheral to this core area. In the core area, access to irrigation is the key to social status and economic wealth. As we will demonstrate in the following sections, it also provides a critical vehicle for the articulation of the primary theme of village society in Pakistan: the concept of honor, known as izzat and ghairat.

Since Pakistan's creation in 1947, an entire generation has come of age within its present boundaries. This generation shares major historical

---

[1] D. J. Merrey, Irrigation and Honour: Cultural Impediments to the Improvement of Local Level Water Management in Punjab, Pakistan, UMT Report No. 53 (Colorado State University, 1979); A. H. Mirza, A Study of Organization Factors Affecting Water Management Decision Making in Pakistan, WMT Report No. 34 (Colorado State University, 1975); A. H. Mirza and D. J. Merrey, Organization Problems and Their Consequences on Improved Watercourses in Pakistan, WMT Report No. 55 (Colorado State University, 1979).

[2] For a discussion related to this point in the context of what he calls "the Islamic district paradigm," see A. S. Ahmed, Religion and Politics in Muslim Society (Cambridge University Press, 1982).

experiences and, above all, a common language, Urdu (however imperfectly it may be employed in the hinterlands). It is partly because of these similarities that common problems of the project are found throughout the land. Whether a Sindi or N.W.F.P. landowner, members of this generation will respond along similar lines to the questions posed to them: the head-enders are less satisfied with the project than the tail-enders; the representative of the senior lineage wishes to manipulate his role of Chairman of the Water User's Association to strengthen his position against his lineage rivals.

However, distinct structural and organizational differences lie beneath the sociocultural and, to an extent, the linguistic similarities. These must be understood to make sense of how and why people behave as they do. It is essential to differentiate between tribal and peasant characteristics to avoid misusing the concept of "caste." Tribal society is organized on segmentary principles, and decisions are made on the basis of kinship—one characteristic of segmentary societies is that lineage memory is important as a diacritical feature. N.W.F.P. tribesmen will recall five to six generations of male ascendants whereas Punjab villagers have little memory beyond two to three ascendants. In contrast, peasant society is based on villages that are largely socially and economically self-sufficient. One characteristic of village society is its encapsulation within larger state systems and its domination by their official representatives.

III. THE NORTH-WEST FRONTIER PROVINCE (N.W.F.P.)

In the tribal areas, the N.W.F.P. provides us with excellent material for the conceptualization of the least encapsulated society. The international border tribes such as the Afridi, Mohmands, and Wazir are included in this area. Here people are free to organize their lives as they will. The criminal and revenue laws of Pakistan do not apply. The people live according to a traditional tribal code which has been called for centuries the Pukhtunwali, or the code of the Pukhtuns. They are egalitarian in the extreme. Hospitality, revenge, and courage are primary features of their code, which is often articulated through agnatic or cousin rivalry and situations involving the honor of women. Death may be the result in some cases involving the code: a wife or sister suspected of infidelity may be peremptorily shot. This society can be considered to be nang, or honor-based.[3]

In contrast, the Pukhtun tribes in the other half of the NWFP operate within the administrative structure of Pakistan. While upholding the code, they encounter the laws of the land. A wife or sister cannot be shot

---

[3] A. S. Ahmed, Pukhtun Economy and Society: Traditional Structure and Economic Development in a Tribal Society London: Routledge and Kegan Paul, 1980).

without invoking the criminal procedure code. In addition, social and economic hierarchies based on vast irrigated land holdings have emerged within tribal groups, displacing the original egalitarian tribal structure.

With the disturbance of the essential egalitarianism of the tribal areas, social relations have come to be based on land ownership: those who own land and those who work on the land paying qalang (rent and taxes). This group can be called the qalang society. Charsadda and Mardan, the richest areas of the N.W.F.P. provide the base for the qalang group. The Yusufzai are the dominant tribe here. However, the situation is more complex than this. Between the nang groups in their barren mountains and the qalang groups on their vast irrigated demesnes are another emerging group: those who own and work 1 to 10 acres of land and who can be called peasant farmers. These are based largely in the Peshawar valley and are a mixture of various tribes such as the Khattaks, Mohmands, Afridis, and even such non-Pukhtun tribes as the Awan. Irrigation schemes early in this century and the introduction of fertilizers and better seeds have benefited these tribes, who form a hardworking, economically independent group.

IV. PUNJAB

Although it is tempting to suggest that in the Punjab the nang-qalang tribal categories give way to a peasant or agricultural one, it would not be an entirely accurate statement. Tribal structures are perceptible beneath the otherwise schematic and tidy "model" villages of the Punjab. Rivalries are often based on agnatic tensions or on local understanding of honor, whether one is a Rajput or Arain. In certain villages, agnatic rivalry expresses itself through the establishment of separate mosques, even though both rival parties belong to the same sect.

Change from a tribal model came about through the introduction of the pioneer agricultural community that was settled here by the British in the last century. The British simply moved in with maps and rulers and demarcated 25-acre squares called chaks within which farmers were settled. The British thereby created a new community of small-to-medium sized farms that was not based on religion or tribes. The land was supported by a complex and extensive system of canals. The famous canal colonies of the Punjab had their origin here.

The Punjab was a model province for the British. It was a colonial experiment in agricultural organization that worked. The idea behind it was simple. When they conquered the Punjab from the Sikhs, the British inherited a vast, sparsely populated, but potentially rich land. Because the post-Mutiny (War of Independence) era after 1857 required a new approach to India, the British decided to experiment. Irrigation schemes were launched, and lands were allotted in neat parcels to various categories of loyal subjects, irrespective of their religion or caste (although the caste schema was maintained in the village). Three features characterized the experiment: the opening of new lands (the canal colonies); the ethnic and religious mix of the population (Sikh, Hindu, and Muslim); and the high turnover of ownership (as sons drifted to urban centers). These features, which are still recognizable today, contrast with conditions in the N.W.F.P. and Sind.

However, an older tribal structure is clearly perceptible in the Punjab. This older structure, which provides the base for the qalang groups, is led by traditional (Rajput) families and provides men for high offices in Pakistan.[4] The other group, the small independent, industrious peasant proprietor working his few acres, is the backbone of the agriculture of Punjab. The Rajputs, who were once the warrior aristocracy of northern India, have a saying that provides insight into their behavior: jan jae par izzat na jaee (one should lose one's life rather than one's honor). But the majority of members are not entirely motivated by a tribal nang code. In the act of becoming settlers and farmers, their memory of a tribal code suffered. Their code is now that of the peasant farmers, not of the nang tribesmen, and the rhythm of their lives takes its cue from the agricultural seasons.

A good example, because it is so visually striking, of the structural and organizational differences between the two categories in Punjab is found in the chaks fields of Zafarabad near Sahiwal. Those fields owned by the Rajputs, large landlords living in Sahiwal or Lahore, are neglected. The watercourses are crooked, untidy, and, in some places, 10 to 12 feet deep. Almost 10 to 15 percent of the land is lost to wild grass. The landlords are jealous of their feudal privileges, but in a changing world they do little else but hunt and show hospitality. They prefer to live in the towns. Across the canal are the lands of the small Arain farmers whose lives are a complete contrast. They cultivate their own lands, and the watercourses are neat, tidy, and well-maintained. The farmers themselves point out the differences. "Those people," they observe pointing across the canals, "kill themselves for honor, hospitality, and enjoyment. We work our own lands."

The small farmer is industrious and law-abiding. It is this group that is the secret of the Punjab success story. Their average land holding in one of the most fertile districts, Sahiwal, is 6 acres, whereas the Punjab average is 13 acres. In my interviews with them, I learned that they lived on the land and worked it themselves and, therefore, spoke from experience. They also appeared highly responsive to suggestions for improvements in yield and quality of crops. Although the traditional tribal code is clearly subordinate to the agricultural one, the picture is not quite so simple. The Punjabi farmers' agricultural drive is not entirely the result of the Protestant ethic; in certain cases agnatic jealousy helps motivate individuals. (In one village, Christians abandoned their code to adopt one based on agnatic rivalry, and the split marred Christmas festivities and Church organization.)

---

4 J. Pettigrew, Robber Noblemen: A Study of the Political System of the Sikh Jats (Routledge and Kegan Paul, 1978).

A typical "chak" village of the Punjab is neatly structured, with three distinct categories living in three areas reflecting social status and function. The first are the agriculturists, the zamindars, or owners of land. Social and economic positions here coincide (qalang Khans, like Choudries in the Punjab, mean owners of land).[5] These are members of the dominant tribes of the Punjab, the Rajput, Gujar, or Arain. Among these are the Choudry (or Choudries) the informal elder or head of the community, and the lambardar, the officially appointed village representative whose main duty is to collect revenue. The lambardar was given one moraba (25 acres) by the British as a sign of their favor to use as long as he lived.

The second group may be called the Muslim religious group. Traditionally, they do not own land and remain neutral in agnatic politics. The group is a living reminder of the duties of religion. It consists of holy lineages like the Sayyeds (descendants of the Prophet). The Mullah, or religious functionary, who supervises rites de passage and lives in the mosque, is another member of this group. However, during the colonial period, the British had placed him in the third category, that of the nonland-owning kammis (from kam or work) occupational groups, a deliberately insulting action.

Kammis do odd-jobs and serve as the tenant force for the zamindars. Of these, the most important are the carpenters, the barbers, and the blacksmiths. Also included in this group are the Christians, many of whom converted from low caste Hindu groups. Punjab villages have 10 acres of land set aside (previously, they had one moraba) for the use of this group as long as it serves the village. Payment to this group was traditionally made in kind rather than cash. The politics of the last 10 years has transformed them into a highly class-conscious group rejecting its inferior social status.

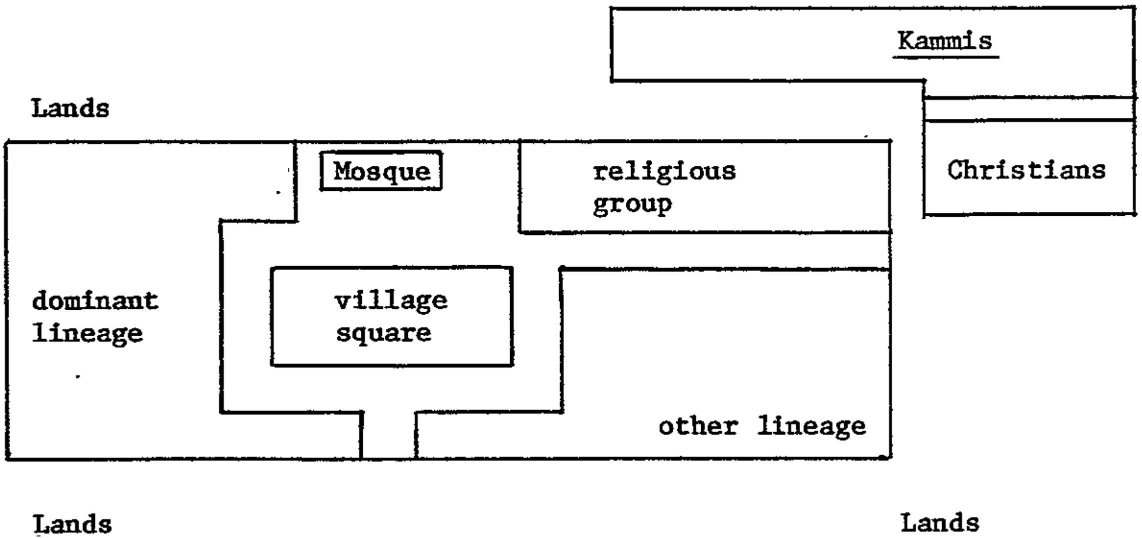
The changes in attitude of the kammis have resulted in the zamindars becoming more self-reliant. Sons and cousins who would have drifted to towns now stay to work on their lands. Life for the kammis is hard. The life of the South Asian peasant was once idealized in studies of village life. The villager was seen as an uncomplaining, sturdy, contented fellow living within a self-sufficient universe. When we attempted to discover this purer, happier life in the village, we found that this is not a true picture. Recent studies point out the harsh realities: the insecurity, rising prices, changing social conditions. These studies express "the peasant view of the bad life."[6]

---

5 F. Barth, Political Leadership among Swat Pathans (London: LSE Monograph, 1972).

6 F. Bailey, The Peasant View of the Bad Life in Peasant Societies, ed. T. Shanin (Penguin Books, 1971).

The average village might look something like this:



V. SIND

In terms of cultural complexity, Sind presents the most interesting picture. It has a history dating back to Mohen-jo-Daro (2500 B.C.). Its conversion to Islam came with the dramatic incursion into South Asia by the Arabs, led by their general, Mohammad bin Qasim, in 712 A.D. It was ruled by Sindi dynasties and the Baluch Talpurs before the British annexed it. The continuing social complexity of Sind results from its mixture of a large indigenous Hindu population (about 1 million) speaking Sindi and a larger refugee population (about 6 million) who arrived in 1947. Language became a key feature of group-boundary maintenance between them. These two groups form a large percentage of Sind's total population of 13 million.

Sind's vast desert areas with their limited irrigation facilities have led to a crude method of survival of the fittest: the dominant groups are placed along the watercourses. These lands have supported a distinctly feudal social structure. The lords of the lands (Rais in Baluchi groups and Vadera in Sammat Sind groups) fit the classic qalang mold. Their tenants, the haris, are a mixture of ethnic groups, poorer fellow-tribesmen, nomads, and Hindus. The haris share the crops they produce on a fifty-fifty basis. They also tend to stay located on one estate and, in spite of working the land, are barely able to make both ends meet. The barren landscape and proximity of large cosmopolitan urban centers tempt the qalang lords to leave their lands in the charge of a trusted servant, the kamdar. The kamdar, for a fixed pay and certain other benefits, administers the lands for his absentee master. Paradoxically, the Sind provides a good example of successful water improvement projects. As the holdings are large and the ownership rests with one person, the leveling, straightening, and maintenance of the course present no problems. Problems will arise, however, if the kamdar should become indifferent to his master's interests (indeed, we saw some poorly maintained watercourses on such estates).

The interaction of administrative and social structure is clearly illustrated in the water problems here. A "difficult" hari will find himself involved in a false criminal case with the police. The lord, who engineered the drama through informal contacts, will then intervene to extricate the hari. He will provide sureties for his tenant, so the haris is now bound to future good behavior.

Needless to say, the village structure here does not follow the schematic pattern of the Punjab depicted above. Settlements are divided into those permanent and central ones of the lord and clusters of temporary mud huts of the hari in the fields.

Another relevant element of the cultural context of the OFWM project in Sind relates to the role of the Sufi--an ascetic, mystical Muslim sect. Sufi organizations have traditionally provided a "safety valve" for the depressed in Sind society. It is no wonder that the great Sufic poets of Sind, who were highly venerated in the countryside, couched their message in a populist idiom. Their leadership, example, and language still provide a potent and coherent sense of identity for the nonprivileged of the land. The Sufis have traditionally challenged the tyranny of the rich and privileged. The contrast between Sind and Punjab (and the Peshawar valley agriculturists) in this regard is pronounced. Cultural themes dominate economic ones. There is a deep Sufic influence--intensely religious, other-worldly, ecstatic behavior--in the Sind. The Sufi--or his tomb--provides a highly emotional point of social focus. Sufi ideology, articulated in themes of universal populism, dominates social life. The Punjab farmer is, in comparison, more pragmatic and his interests primarily focus on issues of crops and yields.

(An interesting study could be based on the question of whether the Sufi orders of the Sind have converted into economic organizations such as the highly successful Bamba of Senegal [in their ground nut schemes] or the Tijanyya of West Africa [monopolizing trade], and if not, why not?)

VI. HYDRAULIC SOCIETY CONCEPT

Although there is not sufficient space in this volume to treat it, the OFWM project offers a point of contact with the so-called "hydraulic society"--a society structured around large irrigation works--and suggests a subject for further investigation.

The central agricultural region of Pakistan, especially the Punjab, provides perhaps the most successful example of the "hydraulic society" created by the British in the last century in their Empire. (The interesting process whereby vast, irrigated, land systems created and supported an organized and centralized bureaucracy and state, termed "Oriental Despotism"[7] was here reversed. The British, through their organized bureaucracy, created extensive irrigation systems when they opened the canal colonies of the Punjab and brought a hydraulic society into being.) As mentioned above, the older tribal lines are still perceptible despite more than three generations of this society. (The "Occidental Despotism" thereby raises fascinating issues with far-reaching social and political ramifications.) One characteristic of hydraulic societies is their malleability when confronting centralized authority. The individual (whether he be an Egyptian fellah by the Nile or a peasant by the Euphrates or the Yangtze) is vulnerable and helpless when confronting the power of the state. He submits easily to authority. This attitude is in sharp contrast to that of the nang tribesman who possesses the capacity to pack and move into the interior, thereby escaping the state. He is mobile, unlike the peasant whose land defines and binds him.

It would be instructive to examine similar hydraulic societies in a global context, especially societies that approximate village life in Pakistan in ecological or historical background (such as East Punjab in India or parts of Egypt). Do traditional codes survive hydraulic societies? If they do not, can they reemerge in situations of change? If we were to attempt such an exercise, we would be able to develop universal models which would illuminate not only social structure and organization in rural society but also could interpret processes of change.

---

[7] K. Wittfogel, Oriental Despotism (Yale University Press, 1971).

BIBLIOGRAPHY

USAID, On-Farm Water Management Project--The Second Joint U.S.-Pakistan Evaluation, Islamabad, September 16-October 13, 1979

USAID, On Farm Water Management: A Joint U.S. Pakistan Evaluation, Islamabad May 8, 1978

USAID, End of Tour Report, Donald Haslem, Islamabad, June 1980

USAID, Project Evaluation Summary, March 31, 1980

Jeffalyn Johnson and Associates, Inc. Summary Report of a Review of United States Development Assistance to Pakistan 1952-1978

Jeffalyn Johnson and Associates, Inc., A Review of United States Development Assistance to Pakistan, 1952-1980

USAID, Office of Evaluation, AID Program Evaluation Discussion Paper No. 9 The Impact of Irrigation on Development: Issues for a Comprehensive Evaluation Study

USAID, Project Impact Evaluation Report No. 12, Korean Irrigation

USAID, Project Impact Evaluation Report No. 4, Philippine Small-Scale Irrigation

Hunt, Robert J., The Local Social Organization of Irrigation Systems: Policy Implications and its Relationship to Production and Distribution, May 1978

USAID, Project Paper - On Farm Water Management, April 1976

USAID, End of Tour Report, C. A. Hackbart, Undated

Lowdermilk, Max, "Memoranda of Conversation"

World Bank, Staff Appraisal Report, Pakistan On-Farm Water Management Project, May 1981

"Punjab Ordinance No. V of 1981"

"Northwest Frontier Province Water Users' Ordinance No. 11 of 1981"

Kemper, W. D., Research and Linkages Needed to Support the Provincial Farm Water Management Improvement,

CDSS, January, 1979

Development Assistance Program, 1975, Pakistan

Field Budget Submission, 1976
Ashrif, M. and Hooker, Raymond, Survey of Improved Watercourses, Punjab Province on Farm Water Management Project

Government of Pakistan, On-Farm Water Management Field Manual, Volumes I, II, III, IV, V.

BIOGRAPHIC DATA OF TEAM MEMBERS

Akbar S. Ahmed is currently visiting Professor in the Department of Anthropology, Harvard University. He received his Ph.D. in Anthropology from the University of London in 1978. As a member of the Civil Service of Pakistan since 1966, he has held a number of senior posts in the Government of Pakistan. He is the author of numerous articles and books on Pakistan and Islamic society.

Emily Baldwin is currently a program analyst in the Project Analysis and Evaluation Unit, Development Planning Office, Bureau for the Near East, A.I.D./Washington. She has a B.A. in anthropology-sociology from Middlebury College, Vermont, and an M.A. in Latin American Studies and has done additional graduate work in economics at the University of Texas at Austin.

Mahmood H. Khan is currently Professor of Economics at Simon Fraser University in British Columbia, Canada and a visiting Professor at the University of Karachi, Pakistan. The holder of a Ph.D. in Economics, his research interests are in agricultural development. He has published three books and numerous professional articles on various aspects of Pakistan's agriculture.

Ernest T. Smerdon is currently Vice Chancellor for Academic Affairs for the University of Texas System and Professor of Engineering at the University of Texas at Austin. He is a registered professional engineer with B.S., M.S., and Ph.D. degrees in agricultural engineering from the University of Missouri. His research interests include irrigation, water erosion, water control and energy conservation in food production, subjects on which he is the author and co-author of numerous articles.

Sandra Malone is currently a Program Operations Specialist with the Office of Evaluation, Bureau for Program and Policy Coordination, A.I.D./Washington. She is pursuing a degree in Business Economics and Finance at the University of the District of Columbia, Washington, D.C.

Masud A. Siddiqui is currently Evaluation Officer with USAID/Pakistan. During his 26 years with the Agency, he has been associated with the project planning, development, monitoring and evaluation functions. He has been a member of project design teams, project implementation committees and also served on several evaluation teams. He has extensive training and experience in project design and evaluation and has received graduate level education in social sciences.

James E. Painter is currently with the Office of Planning and Budgeting, Bureau for Program and Policy Coordination, A.I.D./Washington. The holder of Master's degrees in international public administration and in social services, he has held former positions with the U.S. Senate Committee on Appropriations, and other Federal, state, and local government agencies.

A.I.D. EVALUATION PUBLICATIONS

The following reports have been issued in the A.I.D. Evaluation Publication series. Those documents with an identification code (e.g., PN-AAG-585) may be ordered in microfiche and paper copy. Please direct inquiries regarding orders to:

Editor of ARDA, S&T/DIU/DI
Bureau for Science and Technology
Agency for International Development
Washington, D.C. 20523
U.S.A.

PROGRAM EVALUATION DISCUSSION PAPERS

No. 1: Reaching the Rural Poor: Indigenous Health Practitioners Are There Already (March 1979) PN-AAG-685
No. 2: New Directions Rural Roads (March 1979) PN-AGG-670
No. 3: Rural Electrification: Linkages and Justifications (April 1979) PN-AAG-671
No. 4: Policy Directions for Rural Water Supply in Developing Countries (April 1979) PN-AAG-691
No. 5: Study of Family Planning Program Effectiveness (April 1979) PN-AAG-672
No. 6: The Sociology of Pastoralism and African Livestock Development (May 1979) PN-AAG-922
No. 7: Socio-Economic and Environmental Impacts of Low-Volume Rural Roads -- A Review of the Literature (February 1980) PN-AAJ-135
No. 8: Assessing the Impact of Development Projects on Women (May 1980) PN-AAH-725
No. 9: The Impact of Irrigation on Development: Issues for a Comprehensive Evaluation Study (October 1980)
No. 10: A Review of Issues in Nutrition Program Evaluation (July 1981) PN-AAJ-174
No. 11: Effective Institution Building: A Guide for Project Designers and Project Managers Based on Lessons Learned from the AID Portfolio (March, 1982) PN-AAJ-611
No. 12: Turning Private Voluntary Organizations Into Development Agencies Questions for Evaluation (April 1982) PN-AAJ-612
No. 13: AID Experience in Agricultural Research: A Review of Project Evaluations (May 1982) PN-AAJ-613
No. 14: Private Sector: Ideas and Opportunities: A Review of Basic Concepts and Selected Experience (June 1982) PN-AAJ-618

EVALUATION REPORTS

PROGRAM EVALUATIONS:

No. 1: Family Planning Program Effectiveness: Report of a Workshop (December 1979)
No. 2: A.I.D.'s Role in Indonesian Family Planning: A Case Study with General Lessons for Foreign Assistance (December 1979) PN-AAH-425

No. 3: Third Evaluation of the Thailand National Family Planning Program (February 1980) PN-AAH-006
No. 4: The Workshop on Pastoralism and African Livestock Development (June 1980) PN-AAH-238
No. 5: Rural Roads Evaluation Summary Report (March 1982) PN-AAJ-607

PROJECT IMPACT EVALUATIONS

No. 1: Colombia: Small Farmer Market Access (December 1979) PN-AAH-768
No. 2: Kitale Maize: The Limits of Success (May 1980) PN-AAH-723
No. 3: The Potable Water Project in Rural Thailand (May 1980) PN-AAH-850
No. 4: Philippine Small Scale Irrigation (May 1980) PN-AAH-749
No. 5: Kenya Rural Water Supply: Program, Progress, Prospects (June 1980) PN-AAH-724
No. 6: Impact of Rural Roads in Liberia (June 1980) PN-AAH-750
No. 7: Effectiveness and Impact of the CARE/Sierra Leone Rural Penetration Roads Projects (June 1980) PN-AAH-751
No. 8: Morocco: Food Aid and Nutrition Education (August 1980) PN-AAH-851
No. 9: Senegal: The Sine Saloum Rural Health Care Project (October 1980) PN-AAJ-008
No. 10: Tunisia: CARE Water Projects (October 1980)
No. 11: Jamaica Feeder Roads: An Evaluation (November 1980)
No. 12: Korean Irrigation (December 1980)
No. 13: Rural Roads in Thailand (December 1980) PN-AAH-970
No. 14: Central America: Small Farmer Cropping Systems (December 1980) PN-AAH-977
No. 15: The Philippines: Rural Electrification (December 1980) PN-AAH-975
No. 16: Bolivia: Rural Electrification (December 1980) PN-AAH-978
No. 17: Honduras Rural Roads: Old Directions and New (January 1981) PN-AAH-971
No. 18: Philippines Rural Roads I and II (March 1981) PN-AAH-973
No. 19: U.S. Aid to Education in Nepal: A 20-Year Beginning (May 1981) PN-AAJ-168
No. 20: Korean Potable Water System Project: Lessons from Experience (May 1981) PN-AAJ-170
No. 21: Ecuador: Rural Electrification (June 1981) PN-AAH-979
No. 22: The Product is Progress: Rural Electrification in Costa Rica (October 1981) PN-AAJ-175
No. 23: Northern Nigeria Teacher Educational Project (Sept. 1981) PN-AAJ-173
No. 24: Peru: CARE OPG Water Health Services Project (October 1981) PN-AAJ-176
No. 25: Thailand: Rural NonFormal Education - The Mobile Trade Training Schools (October 1981) PN-AAJ-171
No. 26: Kenya: Rural Roads (January 1982) PN-AAH-972
No. 27: Korean Agricultural Research: The Integration of Research and Extension (January 1982) PN-AAJ-606

No. 28: Philippines: Bicol Integrated Area Development (January 1982) PN-AAJ-179

No. 29: Sederhana: Indonesia Small-Scale Irrigation (February 1982) PN-AAJ-608

No. 30: Guatemala: Development of ICTA and Its Impact on Agricultural Research and Farm Productivity (February 1982) PN-AAJ-178

No. 31: Sudan: The Rahad Irrigation Project (March 1982) PN-AAJ-610

No. 32: Panama: Rural Water (May 1982) PN-AAJ-609

No. 33: Food Grain Technology: Agricultural Research In Nepal (May 1982) PN-AAJ-614

No. 34: Agricultural Research In Northeastern Thailand (May 1982) PN-AAJ-615

No. 35: The On-Farm Water Management Project In Pakistan (June 1982) PN-AAJ-617

SPECIAL STUDIES

No. 1: The Socio-Economic Context of Fuelwood Use in Small Rural Communities (August 1980) PN-AAH-747

No. 2: Water Supply and Diarrhea: Guatemala Revisited (August 1980) PN-AAJ-007

No. 3: Rural Water Projects in Tanzania: Technical, Social, and Administrative Issues (November 1980) PN-AAH-974

No. 4: The Social Impact of Agribusiness: A Case Study of ALCOSA in Guatemala (July 1981) PN-AAJ-172

No. 5: Korean Elementary - Middle School Pilot Project (October 1981) PN-AAJ-169

No. 6: The Economic Development of Korea: Sui Generis or Generic? (January 1982) PN-AAJ-177

No. 7: The Vicos Experiment: A Study of the Impacts of the Cornell-Peru Project in a Highland Community (April 1982) PN-AAJ-616

No. 8: Toward A Health Project Evaluation Framework (June 1982) PN-AAJ-619

PROGRAM DESIGN AND EVALUATION METHODS

Manager's Guide to Data Collection (November 1979) PN-AAH-434

Directory of Central Evaluation Authorities (April 1981)
(distribution restricted to official agencies)