INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

REVIEW

Vol. 1 No. 1 May 1987

FINANCING IRRIGATION SYSTEMS: ACHIEVING MORE EFFECTIVE O&M

PHILIPPINES STUDY CONTINUES

NEW STRATEGY IN AFRICA

IMPACT OF CANAL LINING IN PAKISTAN

PRELUDE

"Managing water for better irrigation essentially means managing people better."

Thomas Wickham, Director General

The International Irrigation Management Institute (IIMI) is the first international research institute whose efforts are devoted solely to the subject of irrigation management in the developing world. Its mandate is to strengthen national efforts to improve the performance of irrigation systems. It does this through identifying, developing, and disseminating improved irrigation practices and methods. No other international institution has either the mandate or the organizational framework to meet the increasing need for new management techniques, new training methodologies, and new information necessary to improve and sustain irrigation performance in developing countries.

IIMI's establishment in Sri Lanka in 1984 was promoted by a group of international donors, who later became members of the IIMI Support Group. The IIMI Support Group, in 1987 includes the Aga Khan, Rockefeller, Ford and General Services Foundations, the Asian Development Bank and the World Bank, the Rockefeller Brothers Fund, the United Nations Development Programme, the International Fund for Agricultural Development, and the Governments of Australia, France, India, Japan, Netherlands, Pakistan, the Philippines, Sri Lanka, United Kingdom, and the United States of America.

IIMI works most effectively with three sets of client institutions: irrigation agencies, supporting research and training institutions, and international lending organizations. The needs of its clients are met in various ways: as an immediate output of research, as a by-product of research or training activities (the development of research methodologies or performance monitoring techniques), and as a result of the broad dissemination of already available information.

The design and implementation of IIMI's program activities follow six principles: a client and problem orientation; effective integration of research, training, and communication efforts; close integration of programs in different country settings; close collaboration with client institutions; a strong multi-disciplinary perspective; and the use of irrigation systems, rather than experiment stations, as field laboratories.

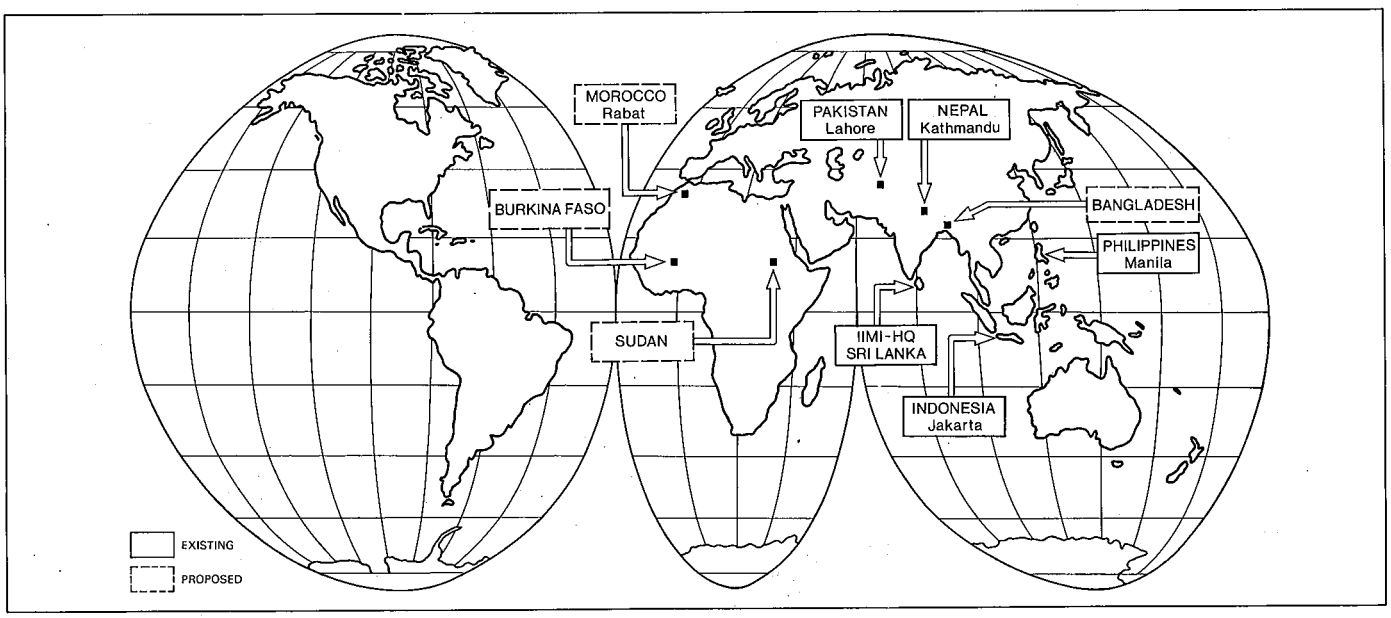
IIMI's *Research Program* is dynamic and evolves in response to clients' needs. Research projects are organized in three areas. Projects in the "System Management" area identify irrigation management practices that improve the performance of irrigation systems controlled by project authorities or irrigation agencies. Projects in the "Rehabilitation and Improvement for Management" area develop and evaluate design and rehabilitation practices that will improve the manageability of irrigation systems. Projects in the "Farmer-Managed Irrigation Systems" area identify and develop more effective intervention strategies to assist farmer-managed irrigation systems.

IIMI's research feeds directly into its *Professional Development Program.* The program prepares irrigation practitioners from developing countries for leadership roles in strengthening irrigation performance through better management; and trains researchers in the techniques of multidisciplinary and collaborative field research. The program focusses on five complementary activities: workshops and conferences; training courses; individual training; on-the-job training; and research.

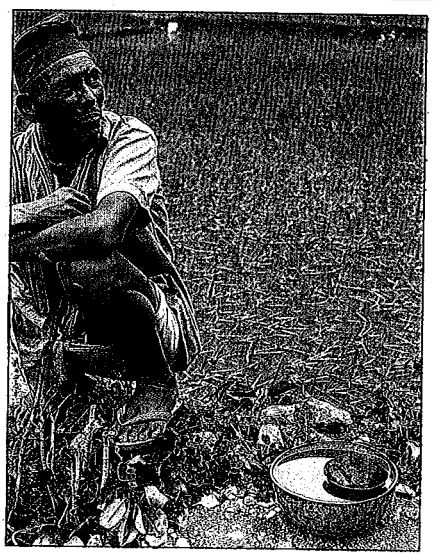
IIMI's *Information Program* provides interested individuals and organizations with the information they need on irrigation management and related issues. This is achieved through information exchange and networking, publishing, and communication research.

The Institute currently operates with a small headquarters in Sri Lanka and cooperating units in four Asian countries: the Philippines, Indonesia, Nepal, and Pakistan. Additional units are planned for Sudan, Morocco, Bangladesh, and West Africa. Criteria for selection of country programs include strong country interest, significant opportunities for impact on irrigation performance, and assurance of effective working arrangements. When its resources and management capacities permit, IIMI will give consideration to the development of programs in other parts of Africa, Asia, and Latin America.

Thus IIMI, along with associated national agencies and concerned irrigation managers, and researchers, seeks to improve irrigation performance in the developing world. Its interest lies in understanding the processes involved in water management for agriculture, resulting in improved yields, better use of resources, and finally a better life for rural communities.



REVIEW



A Nepal farmer refers to a traditional waterclock to time rotational distribution. When the smaller bowl fills with water and sinks one unit of time has passed.

To the Readers

The Review is the newest addition to IIMI's list of ongoing publications. Published three times a year, it is intended to inform irrigation management professionals, researchers, and others who may be interested in IIMI and its efforts to improve and sustain irrigation performance in developing countries. It is free and available upon request.

Readers are invited to submit their comments on its contents or on any other subject relevant to Institute activities. Future issues will publish these comments under an appropriate heading, thus enhancing IIMI's worldwide network of irrigation professionals. All submissions are subject to Institute approval and editing.

We hope you enjoy our newest initiative and will look forward to receiving your comments and views.

John Colmey, Editor

Contents

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CONCLUSIONS

FINANCING IRRIGATION SYSTEMS: ACHIEVING MORE EFFECTIVE O&M

Irrigated agriculture in Asia is taking on new dimensions during the 1980s. Gone, or slowing down, is the investment in large-scale irrigation projects, so prevalent in the past two decades. Also changing is the emphasis on operation and maintenance (O&M) of irrigation systems solely for rice in the wet and dry seasons. These changes have come with increasing costs per hectare of new irrigation projects and greater availability of food grains, particularly rice, made possible through the success of Green Revolution technologies.

As a consequence, government irrigation agencies and donors are shifting policy on irrigation investments to promote the expansion of diversified or non-rice crops in irrigated areas and the improvement of O&M of irrigation systems. The first, the expansion of irrigated crops with more specific water requirements than rice, has made the second more difficult because of the more stringent management practices required to meet the three criteria of a successful irrigation system: timeliness, adequacy, and certainty. A third priority of the eighties, cost recovery of irrigation services from farmer beneficiaries, is dependent, to a large extent, on the agencies' ability to meet these criteria.

Many donors and lending agencies, including the Asian Development Bank (ADB) require recipients to levy appropriate fees on direct beneficiaries for sufficient funds to operate and maintain irrigation facilities effeciently. In the past, recipient countries have had varying success in meeting these covenants with many agencies remaining in partial or complete default. The difficulty has arisen in projects where full benefits failed to come on line due to inadequate water control at the farm level, in countries where water has been traditionally considered a gift or paid for as part of some other land tax, and in agencies where institutional mechanisms have been inadequate to administer the collection of fees.

In 1985 IIMI undertook a regional study, financed by the ADB, to study the procedures and rationale of financing the O&M of irrigation systems in Indonesia, Korea, Nepal, the Philippines, and Thailand. The study completed in January 1986, was followed by a Regional Seminar on Irrigation Service Fees, jointly sponsored by IIMI and the ADB and held in Manila from 21-25 July 1986. Results of the study have been sent to officials in participating countries and are currently being published at IIMI Headquarters. Proceedings of the Regional Seminar are being published by the ADB.

These five countries were selected for two reasons: first, they have received more than 60 percent of the total amount of Bank loans for the irrigation sector--amounting to 14 percent of total bank lending in 1985--and second, because they typify a range of financing and cost recovery mechanisms, including land taxes, irrigation service fees, and indirect taxes such as rice export levies.

For effective O&M, resources--human, financial, and material--must be mobilized. Both the amount of resources and the arrangements for obtaining them affect the performance of irrigation systems.

Cost recovery through irrigation service fees and other financial mechanisms are important only so far as it 1) results in improved irrigation performance and 2) promotes other objectives of the government. Improved irrigation performance can occur through more efficient O&M of irrigation facilities (with increased funding), by improving the accountability of irrigation managers to water users, and by encouraging greater participation of farmers in O&M and more efficient use of water. Cost recovery can promote government objectives by improving investment decisions, easing the fiscal burden, or by generating a more equitable distribution of income.

Resources for O&M can come from the national or state treasury, from farmers in the form of service fees or labor input, and from secondary sources of income controlled by an irrigation agency. Nepal's Department of Irrigation, Hydrology, and Meteorology (DIHM) for example is 100 percent dependent on the national treasury. However, 70 percent of the total

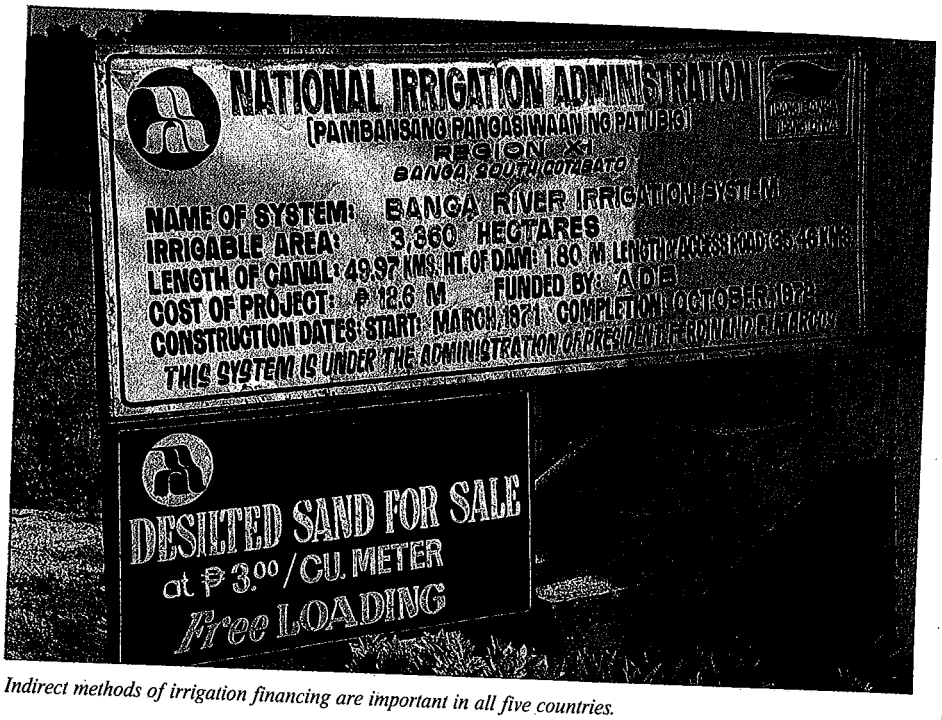
Nepali farmers in this Tarai irrigation system mobilize one hundred thousand person days per year.

irrigated area in Nepal is under systems operated and maintained by farmers with little government assistance. Similarly, Thailand's Royal Department of Irrigation (RID), derives its funds for construction of new projects and the O&M of existing projects from the central government through its annual budgetary appropriation process.

In Korea, the Farmland Improvement Associations (FLIAs) are almost entirely self sufficient in O&M with 75 percent of their income derived from irrigation service fees and the remainder from secondary income sources such as interest earned on deposits, sale of water for non-agricultural uses, and rental of land owned by the FLIA.

Irrigation financing comes through direct and indirect methods. Direct methods include irrigation service fees assessed with reference to irrigated area, and water pricing based on demand-determined consumption. Indirect methods include general taxes levied without specific reference to irrigation service, implicit taxation through control of input prices and regulation of the market sector, and supplemental income to an irrigation agency through other revenue-generating activities.

An area based irrigation service fee is charged in Korea, Nepal, and the Philippines. In Indonesia, although there is no direct charge for irrigation services provided by the government, the farmers are fully responsible for O&M of tertiary facilities. Thailand is experimenting with direct charges for O&M of tertiary facilities constructed under the land consultation program.



Indirect methods of irrigation financing are important in all five countries.

Direct methods of generating resources have the greatest potential to improve irrigation performance and investment decisions but only under conditions of financial autonomy. A financially autonomous agency relies on direct user charges for a significant portion of its resources applied to O&M, and has control over the use of funds generated from those charges. Korea's FLIAs exhibit a large degree of autonomy; Nepal's DIHM and Thailand's RID are financially dependent agencies.

In agencies or organizations such as the FLIAs, irrigation managers have a greater accountability to users and users have a greater stake, and consequently tend toward greater involvement, in day to day decisions regarding expenditures for O&M.

Indirect methods of irrigation financing are important in all five countries. Indonesia and Nepal both have a land tax, with per hectare taxes dependent on assessments land productivity. For Thailand, implicit taxation exists through an artificially low domestic price for rice resulting from a system of taxes and levies on rice exports. In Korea and the Philippines, secondary revenue is generated through activities outside irrigation services.

Indirect methods of generating resources, however, are unlikely to encourage either improved irrigation performance or better investment decisions and should be evaluated primarily on the basis of their fiscal and income distribution effects.

Pricing water deliveries is problematic for any agency. Individual pricing mechanisms in gravity irrigation systems serving large numbers of farms are prohibitively expensive, not only in trying to measure flows but in devising administration, reporting, billing, and collection procedures. Pricing is probably feasible only if groups of farmers, for example at the lateral canal level, can be served with a single consolidated bill.

In the absence of a water pricing mechanism, the argument that irrigation service fees will increase the farmer's efficiency of water use loses validity. Even if water pricing is possible, its potential to reduce wastage is often exaggerated. The water wastage present in a system is more likely attributable to poor supply control rather than excessive demand in the absence of water prices. Once the supply control exists--a prerequisite for water pricing--the potential declines for increased efficiency gains through the introduction of water pricing.

Table 1. Summary of potential consequences of irrigation financing mechanisms in relation to financing objectives in five Asian countries.

Financing objectives	Institutional context and financing mechanisms						
	Financial autonomy[a/]			Financial dependence[b/]			
	Service fees	Water prices	Secondary income	Service fees	Water prices	Taxes	Implicit taxes
Improve performance							
More efficient operation of irrigation facilities							
Greater funding for O&M	Y	Y	Y	N	N	N	N
Greater managerial and financial accountability	Y	Y	N	N	N	N	N
Greater involvement of water users	Y	Y	N	N	N	N	N
More efficient utilization of water	N	Y	N	N	Y	N	N
Improve irrigation investment decisions	?	?	N	N	N	N	N.
Improve fiscal position of government	Y	Y	?	Y	Y	Y	Y
More equitable income distribution	?	?	?	?	?	?	?

Y - yes, N - No, ? - unknown; [a/] funds controlled by irrigation agency; [b/] funds controlled by non-irrigation agency or irrigation agency financially dependent on budget allocations.

Policies and approaches toward recovery of O&M costs vary among the five countries studied. The basic direct cost recovery mechanism used is a flat rate per hectare of irrigated land, assessed by season, with adjustments possible according to crop type.

Flat-rate pricing in gravity irrigation systems does not imply a uniform rate throughout the country. In Korea and at the tertiary level in Indonesia there is considerable financial autonomy with individual schemes fixing their own rates. The National Irrigation Authority (NIA) in the Philippines however, is characterized by nation-wide uniformity in irrigation service fees for systems managed by NIA, similar to the financially-dependent DIHM of Nepal.

If irrigation service is satisfactory, the benefits derived by farmers are greater than the O&M costs in all five countries, but the balance is insufficient to cover more than a small part of the capital investment. In Korea, part of the fee is set aside for capital recovery, though total revenue fails to cover the full cost of O&M. Other countries do not use this fee separation.

Korea achieves the highest rate of fee collection--over 98 percent--largely because of the importance attached by agency staff to a 100 percent target. A similar trend is emerging in the Philippines, where in 1984 the NIA collected about 62 percent of fees due, reflecting a recent change to more autonomous management. In contrast, Nepal collected 20 percent of fees which may be attributed to the agency's ambiguous commitment to that objective and to its total financial dependence on the central government.

In Korea and Nepal, irrigation fees are assessed in cash. In the Philippines they are assessed in rice but can be paid in cash at the market price for rice. In Indonesia, water-user associations have both cash and in-kind assessments. The primary advantage of a crop-based assessment is a built-in adjustment for inflation.

The relationship between actual O&M costs and the rates set for irrigation service fees varies greatly among the five countries. Only in the Philippines is the rate set higher than actual O&M costs, but this is balanced by the failure to achieve 100 percent fee collection.

Income from secondary revenue generated through activities outside irrigation services, is important only in Korea and the Philippines. In Korea, water-user associations can derive income from their own capital, contributing 20 percent of total revenue. Because of high levels of cost recovery, these associations are increasing their share in the ownership of systems by gradually increasing capital repayments. In the Philippines, secondary income amounts to 60 percent of actual expenses for O&M. Agencies in the other three countries have no important sources of secondary income.

There is little in the financing mechanisms used in Nepal, Thailand, and at the main system level in Indonesia that enhances the efficiency of irrigation management. Because of the centralized nature of the agencies managing irrigation systems, and their financial dependence on the central government, financial procedures are not a means for encouraging either improved managerial performance through feedback from water users, or increased cooperation and participation of water users in O&M.

Financing mechanisms used for tertiary-level O&M in Indonesia have the potential to encourage both efficiency in management and increased farmer cooperation because of the internal linkages between decisions for mobilizing resources from water users and decisions for utilizing those resources to provide irrigation services. To what extent this potential is realized is uncertain, although individual cases have been studied that appear to exhibit very effective management.

However, government involvement in some infrastructure development at the tertiary level might cause water users to develop the perception that responsibility for the tertiary system belongs to the irrigation agency, rather than to the local village or water users' association. This might impair the ability of the association to mobilize

resources from the farmers.

The situation in the Philippines differs from the above three countries in one key respect--the implementing agency for irrigation projects (NIA) is responsible for generating a portion of its funds from the users of irrigation services. For many years, supplemental funding from the central government limited the potential influence on the NIA's management procedures. But the reduction and subsequent elimination of these funds have increased NIA's financial autonomy, and thereby its reliance on the funds collected from water users. This has led to management changes designed both to enhance the willingness of water users to pay for irrigation services and to reduce O&M costs.

The primary financing mechanisms for government irrigation projects in the five countries studied have virtually no impact on the farmers' efficiency of water use. Irrigation service fees based on the area irrigated are used in Korea, Nepal, and the Philippines, and are also imposed by water users' groups at the tertiary level in Indonesia. These fees provide no incentive for a farmer to economize on the use of water.

With the possible exception of Korea and the Philippines, it is doubtful that the financing policies of the study countries have led to better investment decisions. In Indonesia, Nepal, and Thailand, responsibility for investment decisions rest with one institution and control over public funds generated by irrigation with another. Such an arrangement makes it unlikely that expectations of revenue inflows from irrigation investments will play a significant role in investment decisions.

In the Philippines, the NIA's responsibility for the repayment of foreign loans used in the construction of irrigation projects has created a greater linkage between investment decisions and the flow of resources resulting from those decisions. This has already caused NIA to reconsider the desirability of undertaking new construction involving foreign loans.

In Korea there are clear linkages between investment costs and irrigation service fees. To what extent these linkages have contributed to enhancing the efficiency of investment decisions is difficult to determine. On the one hand, government policy exhibits a clear concern about the level of fees which farmers must pay for irrigation services. As a result, proposed projects which would increase fees are evaluated more carefully than those that would not. On the other hand, the government has developed a set of special rules breaking the link between investment costs and irrigation service fees in situations where an investment would otherwise result in unacceptably high irrigation service fees. Although this reduces the linkage between additional investment costs and additional farmer payments, it implies increased outflows of government funds in the form of subsidies. To what extent concern over this increase may result in a more careful evaluation of proposed investments is uncertain.

In all five countries studied, the provision of irrigation services involves a substantial net outflow of public funds. These outflows are generally consistent with broad government policy objectives with respect to rural development and food self-sufficiency.

For Indonesia, Nepal and Thailand, if only inflows of public funds resulting from direct financing mechanisms are considered, then the full amount of capital cost and part (Indonesia and Nepal) or all (Thailand) of the O&M costs of irrigation are financed by government. When indirect financing mechanisms are also taken into consideration, it is more difficult to make definitive statements. For Indonesia, the additional revenues resulting from land taxes make it likely that the total inflows are approximately equal to the outflows for O&M. In Nepal, the real value of the land tax has declined substantially over time, so that gross inflows are probably considerably less than outflows for O&M.

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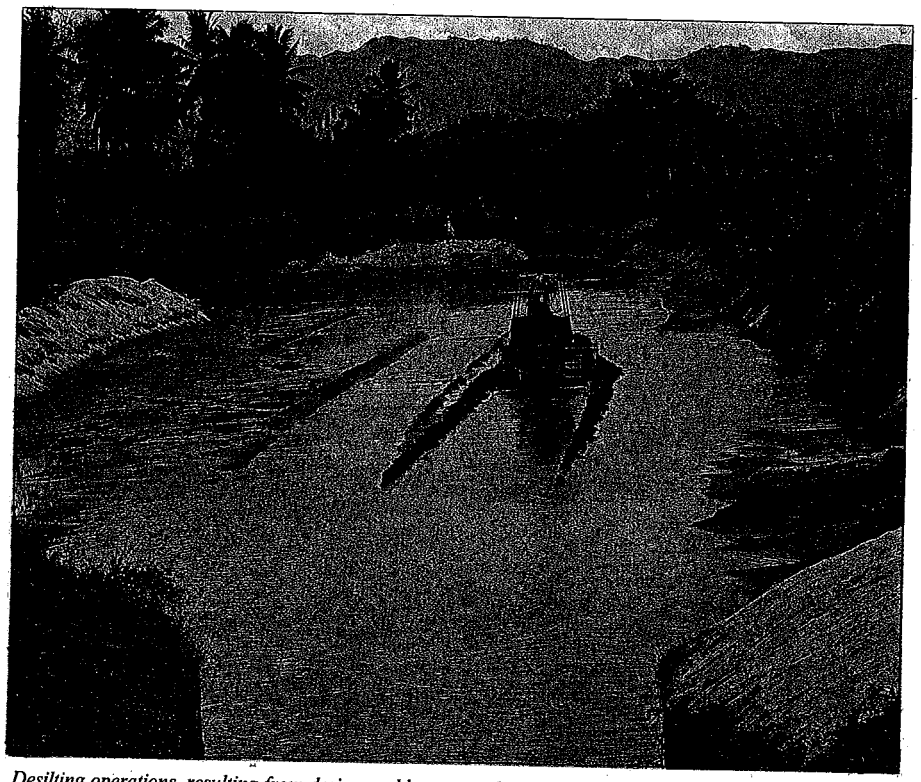


Desilting operations, resulting from design problems, cost thousands of dollars yearly.

NEW STRATEGY IN AFRICA

"IIMI's program in West Africa is taking on a slightly different character than that of its program activities in Asia," according to Ir. F. Schulze, IIMI Director of International Programs. "The West African program," says Schulze, "will still focus on the 'enhancement of national capabilities in irrigation management,' but the balance between the three functional areas--research, professional development, and information exchange--will be slightly different."

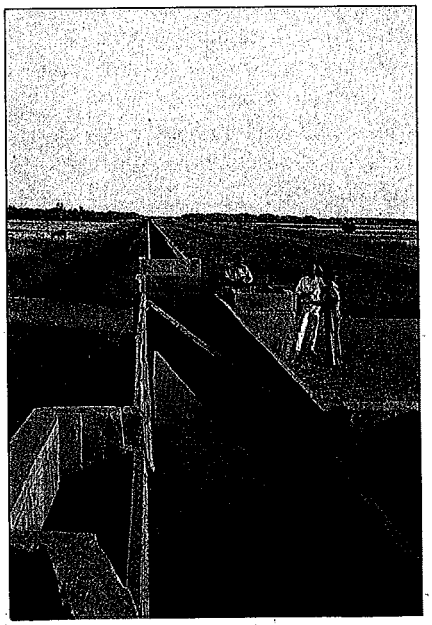
In Asia, research is dominant, amounting to approximately 70 percent of all efforts against 20 percent for professional development and 10 percent for information exchange. "All three components," says Schulze, "should again be present in the West African program but with a greater emphasis on professional development and information exchange."

Schulze says that at present there exists some confusion in management terminology, partly due to the lack of distinction made between decision making on the one hand and execution of what is being decided on the other. The misconception is to take execution and decision making together and call it management.

"In the West African context," he continues, " 'enhancement of national capabilities in irrigation management' should read as the enhancement of national decision making capabilities concerning the irrigation sector. This will be the focus of IIMI's West African program."

To achieve IIMI's overall objective in West Africa three areas of emphasis have been distinguished: human resources development, institutions strengthening, and research and development.

Human resources development targets individuals, permitting the improvement of his/her managerial capability to increase knowledge and understanding of management processes and their application. Institutions strengthening targets institutions, to strengthen the management capabilities of those national institutions having a direct or indirect responsibility towards irrigation management. Research and development supports the other two by developing methods and materials that can be used in human resources development and institutional development of appropriate management procedures and techniques.



West Africa research will focus on the interaction between design and management.

According to Schulze, the human resource development component will include participation in workshops, seminars or short training courses, fellowships or special awards, and in-service or on the-job training.
IIMI's early endeavors will include developing methods and materials exclusive to irrigation management. Schulze says "this process will begin on a regional basis in close collaboration with existing regional organizations such as the Inter-State School of Rural Engineering (EIER), and Interafrican Committee for Hydraulic Studies (CIEH) and national training.

Institutions strengthening will take on the character of technical assistance or services rendered to national institutions with direct or indirect responsibility in irrigation management. "This will exclusively introduce appropriate management procedures and techniques by improving management conditions, (better information systems, more appropriate regulations, and the introduction of management tools), and improved management processes," says Schulze.

Research and development staff will select representative irrigation systems or clusters of systems, to act as vehicles for programs of multi-purpose field research. Findings will provide irrigation management agencies with practical and replicable solutions to improve management and performance.

To keep the program manageable Schulze suggests initiating the program in close collaboration with CIEH, EIER, the Inter-State Committee Against Drought in the Sahel (CLISS) and a limited number of francophone West African countries who are members of these regional organizations i.e., Niger, Burkina Faso, Mali, Senegal, and Mauritania--depending on their interest in the program and willingness to associate themselves with IIMI's global efforts to enhance national capabilities in irrigation management.

Schulze says "the degree of participation will vary across countries, ranging from a passive role of sending participants to workshops and seminars to a more active role in developing the program and participation in the 'network' of multi-purpose field research on full scale irrigation systems. This could include the possibility of hosting one or more IIMI resident scientists. □

RESULTS

THE IMPACT OF LINING ON WATER DISTRIBUTION IN GHORDOUR AND LAGAR DISTRIBUTARIES

D. Hammond Murray-Rust[1]

Until recently the vast majority of lining of irrigation facilities in Pakistan has been restricted to watercourses under the auspices of the On-Farm Water Management Directorate of the Ministry of Agriculture. However, there is growing interest in extending lining programs into the main system in response to issues related to waterlogging and salinity, reducing conveyance losses, and decreasing the recurrent maintenance needs associated with unlined channels. This report assesses the experience of lining of the lower portions of two distributaries in Chuharkana Sub-Division of the Upper Gugera Canal system.

The two distributaries selected for lining were Ghordour and Lagar. These are adjacent distributaries on the Right Bank of Upper Gugera Branch Canal, with offtakes at RD 101000 and RD 118000. Main characteristics of the two distributaries are provided in Table 1.

Table 1. Comparison of Ghordour and Lagar Distributaries.

	Ghordour	Lagar
Length (ft)	67919	62218
Design Discharge (cfs)	50.0	38.0
Number of Watercourses	37	29
Total Discharge of Outlets (cfs)	39.91	32.67
Total Command Area (ac)	20965	16356
Length of Lined Section (ft)	19119	18218

Neither distributary has any control structure downstream of the distributary headgate. Flow into all watercourses served by the distributaries is controlled by the design of the watercourse outlet structure, or mogha; water surface elevation is entirely dependent on incoming discharge, cross-section, and slope of the channel. As a consequence, water availability at the tail end of the distributaries is largely governed by a combination of managerial inputs at the headgate and the current physical condition of the channel.

The lining activities did not modify this basic condition. Structural changes were limited to the lining of approximately the lower one-third of both distributaries, with no significant change to alignment and slope of the pre-lined channels. The cross-section of the lined portions was modified, however, to account for changed conditions of roughness. No additional control structures were installed, and no modifications made to the headgate. Nor were modifications made to locations and sizes of the moghas served by the lined portion of the distributaries. As a consequence it is possible to make a direct comparison of operating conditions before and after lining.

The two distributaries were lined during January and February 1985. This coincided with the period of annual closure of the Upper Gugera Canal system, although there was some subsequent disruption of irrigation deliveries during February 1985. The lined portion, therefore, has been in full operation for three complete irrigation seasons.

The lining consists of brick and mortar. In most places the lining is only one brick thick, resting on slightly compacted natural soil. The lack of readily available hardcore meant that provision of a proper base for the lining material could

Table 2. Average monthly inflow and tail stage.

	Ghordour Dy.			Lagar Dy.		
Zero Values Excluded						
	Before Lining	After Lining	% Change	Before Lining	After Lining	% Change
Inflow into Dy.						
Ave Discharge (cfs)	32.10	46.18	+43.8%	33.25	37.92	+14.0%
Ave Monthly C of V (%)	14.88	4.66	-68.7%	11.33	6.82	-39.8%
Tail Stage						
Ave Depth (ft)	0.66	0.71	+7.6%	0.56	0.60	+7.1%
Ave Monthly C of V (%)	21.25	14.38	-32.3%	24.83	14.52	-41.5%
Zero Values Included						
	Before Lining	After Lining	% Change	Before Lining	After Lining	% Change
Inflow into Dy.						
Ave Discharge (cfs)	28.44	41.45	+45.7%	30.82	34.51	+12.0%
Ave Monthly C of V (%)	42.11	27.71	-34.2%	33.06	27.79	-15.9%
Ave Depth (ft)	0.53	0.65	+22.6%	0.47	0.53	+12.8%
Ave Monthly C of V (%)	62.4	36.27	-41.9%	62.20	35.78	-42.5%

[1]Irrigation Engineer, IIMI-Pakistan

not be met without greatly increasing the cost of the entire project.

The cost of lining of the two distributaries was US$ 201,000 (Rs. 3.32 M), which was financed through the USAID/World Bank Irrigation Systems Rehabilitation Project. Actual costs were US$ 5.52 (Rs. 91.58) per linear foot for Ghordour and US$ 5.19 (Rs. 86.17) per linear foot for Lagar.

The evaluation is based largely on data provided by the Punjab Irrigation Department from the offices of the XEN Upper Gugera and SDO Chuharkana. Daily readings of water levels in Upper Gugera Branch, discharge into the two distributaries and tail water levels of both distributaries were used in the analysis.

Data were compiled over a four year period, 1 October 1982 to 30 September 1986. covering eight full irrigation seasons: four seasons of the pre-lining condition, one season during which lining actually occurred, and the three full seasons after lining.

The analysis was undertaken in two parts. In the first stage all zero readings were removed from the data base in order to assess the hydraulic changes that occurred along the distributaries since lining. However, this approach does not truly reflect the actual nature of water deliveries received by farmers at the mogha because farmers normally do not know when breaks will occur in water deliveries. The second stage therefore included all zero readings except for those associated with the annual closures during January and February.

In both stages of the analysis two primary measures of the impact of the lining program have been adopted. The first is a straight comparison of averages of discharges and water levels. The second is a comparison of the degree of variability of the averages, a truer representation of what farmers can expect to receive. When managing water along a watercourse or on his own fields, a farmer works with a range of water delivery conditions rather than a simple average. This range represents the variability of inflow into the channel itself, and the variability caused by diffusion of flow conditions along the channel. Because both distributaries are several kilometers in length, it is unreasonable to expect that variability at the tail will be identical to that at the head. Rather, there is some increase. However, a hydraulically efficient channel should have a smaller increase in variability between head and tail than one which is hydraulically inefficient.

All data have been presented on a monthly basis using the daily water readings.

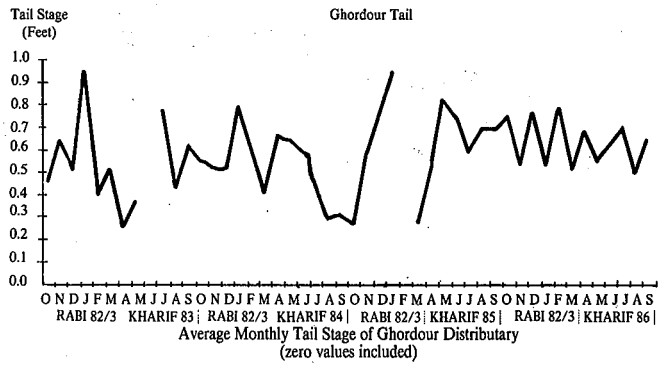
RESULTS

Average Data

Tail water levels. A comparison of the tail water conditions in both distributaries (Figures 1 and 2) indicates some degree of improvement since lining occurred (Table 2) with both channels showing an increase of approximately 15mm in the depth of water at the tail end. There is no statistically significant difference between the pre-and post-lining values for either distributary (Figures 3 and 4). The designed tail water depth is 0.21m (0.7 feet) for both channels.

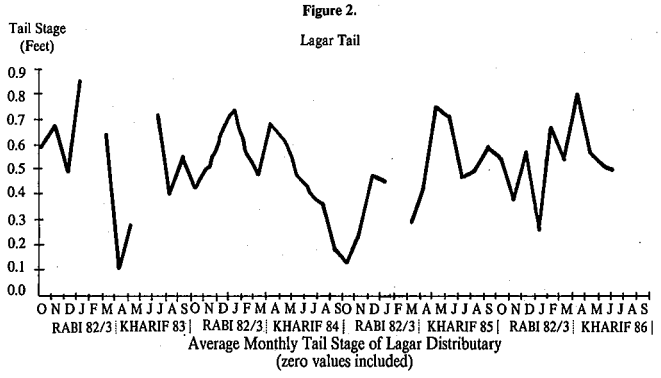
Analysis of the data when zero values are included indicate a similar picture. The data show a greater improvement in Ghordour than in Lagar.

Figure 1.



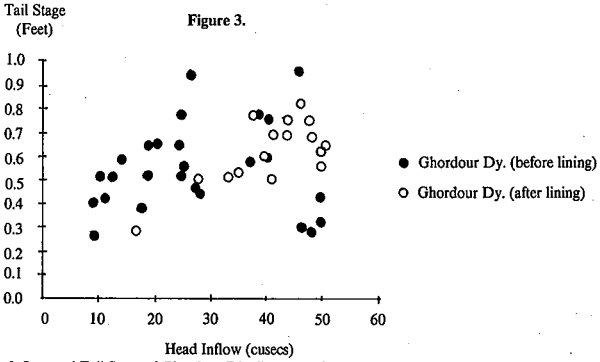
Average Monthly Tail Stage of Ghordour Distributary
(zero values included)

Figure 2.



Average Monthly Tail Stage of Lagar Distributary
(zero values included)

Figure 3.



Inflow and Tail Stage of Ghordour Distributary Before and After Lining
(zero values included)

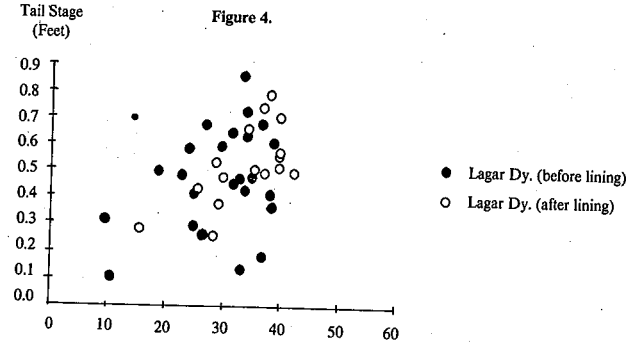


Figure 4.

Inflow and Tail Stage of Lagar Distributary Before and After Lining
(zero values included)

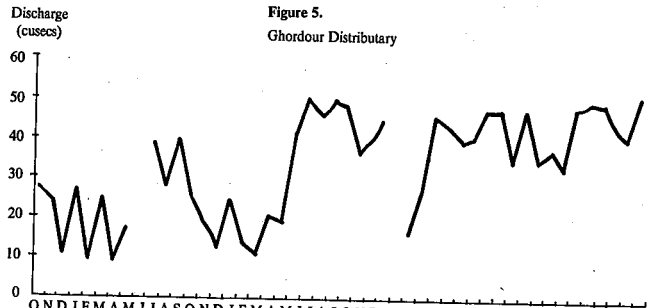


Figure 5.
Ghordour Distributary

Average Monthly Discharge into Ghordour Distributary
(zero values included)

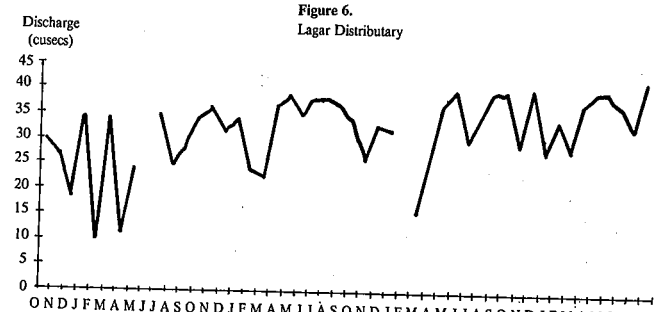


Figure 6.
Lagar Distributary

Average Monthly Discharge into Lagar Distributary
(zero values included)

The reason for the larger increase in tail water levels in Ghordour Distributary can be attributed to long periods before lining when there was no water present at the tail, particularly during the first two seasons of the study. Lagar Distributary shows fewer zero readings before or after lining. Again, these differences are not statistically significant.

However, to make meaningful comparisons of the average tail water conditions it is necessary to ensure that inflow conditions were essentially the same before and after lining. The next analysis shows that this was not the case.

Inflow analysis. Average monthly discharges into the two distributaries are presented in Figures 5 and 6. The data show that there have been considerable increases in inflow into Ghordour Distributary since lining occurred. Before lining the average monthly inflow into Ghordour using non-zero data, was 32.10 cusecs, or 64.2 percent of design capacity. After lining occurred, this increased to 46.18 cusecs, an increase of 43.9 percent. A similar, but less marked pattern occurred in Lagar, where average monthly inflow averaged 33.25 cusecs before lining and 37.92 cusecs after lining, an increase of 14 percent.

When zero data are included, the same trend is observed. Ghordour inflows averaged 28.44 cusecs before lining and 41.45 cusecs after lining, while Lagar averaged 30.82 cusecs before lining and 34.51 cusecs after lining.

The increases in inflow since lining occurred make it difficult to determine the exact causes of improvement in tail water conditions. It would be possible to attribute all improvements to lining, but they could also be attributed to increased discharge into the channels themselves. In Ghordour the percentage increase in inflow was much greater than the percentage increase in water depth at the tail. This may be because the tail stage readings are close to or above design level, and further increases are impossible without overtopping the channel. This argument is less convincing in the case of Lagar.

However, there is one important indication that lining has been a major contributor to improved tail water conditions. In the eight months before lining (June 1984 to January 1985) monthly discharge into Ghordour Distributary averaged 47.53 cusecs (zeros excluded) and 44.43 cusecs (zeros included),

essentially the same as in the post-lining period. During this eight month period, however, the tail water conditions were lower than during the rest of the pre-lining period.

This indicates that despite substantial improvements in the discharge into Ghordour Distributary, the benefits were not felt at the tail end. Only after lining occurred were conditions significantly improved at the tail, and these benefits were achieved without further modifications to inflow into the distributary.

There are no comparable data for Lagar Distributary because inflow conditions have remained much more uniform throughout the eight seasons of analysis.

Variability

Analysis of the variability of the data indicates additional benefits from the lining program. Both distributaries show a healthy reduction in the coefficient of variation of tail water levels since lining, from which one can assume that farmers are more able to assess the likely availability of water when their next irrigation turn is due.

However, inflow data also show a large decrease in the coefficient of variation of inflows into both distributaries. For both distributaries, using the non-zero data set, the decrease in variability was greater for inflow than for tail water stage, making it difficult to isolate the impact of inflow changes from the impact of lining.

The non-zero data set shows a less convincing pattern. While the decrease at the tail of Lagar was 41.5 percent, compared to a decrease at the head of 39.8 percent, the decrease in average monthly coefficients of variation at the tail of Ghordour was only 32.3 percent compared to a 68.7 percent decrease at the head.

A more detailed analysis was made of those periods when inflow conditions before and after lining were essentially the same (Table 3). This gives an opportunity to better assess the impact of lining.

In Ghordour Distributary, there is evidence that the variability of tail stage data is higher during the eight months prior to lining than the variability of the tail stage data after lining, even though the variability of the inflow in both periods was essentially the same. The same is true in Lagar Distributary although the results are less dramatic.

DISCUSSION AND CONCLUSIONS

The data show some evidence that lining has improved the situation in both Ghordour and Lagar Distributaries but that it is hard to disaggregate changes that have occurred due to changes in inflows into the two channels. The most important issue to be resolved, therefore, is the extent to which lining has permitted greater discharges to be delivered.

The condition of the channels themselves becomes a factor if there are breaches and other physical problems that require closure of the distributary or reduction of discharge. It is probable that there have been fewer breaches in the lined sections, and therefore fewer overall closures of the distributaries. This is one cause of improved reliability.

Because the distributaries have only been operational for three full seasons since lining it is impossible to determine the long-term impact of lining. It is reasonable to expect efficient conditions in the period immediately following lining, with an inevitable deterioration in efficiency over several seasons.

It is clear that lining only the lower portion of a distributary ought to be accompanied by some measures in the upstream, unlined section in order to gain full benefit. In both Ghordour and Lagar there are continuing instances of breaching in the upstream, unlined sections, either due to weakness of the berm or deliberate activities by farmers, which affect the reliability of water deliveries throughout the entire length of the distributaries.

An alternative strategy that should be considered is one of lining of those sections where berm conditions are most deteriorated. This approach has the disadvantage of requiring more survey prior to rehabilitation but, in the long run, can be more cost effective as it focusses on the weakest points in the system.

It is possible to postulate that farmers have benefitted from the lining program because water supplies are much more reliable than in the past. However a parallel field study should be undertaken that examines the farmers' perceptions of the benefits, if any, of the lining program.

Further evaluation of the relative benefits of lining versus upgraded maintenance should also be undertaken. Although clearly beneficial, lining in both Lagar and Ghordour has been comparatively expensive. Alternative strategies such as partial lining or restoration or channel berms and cross-sections should be tested before embarking on a large scale program of lining minor and distributary canals. □

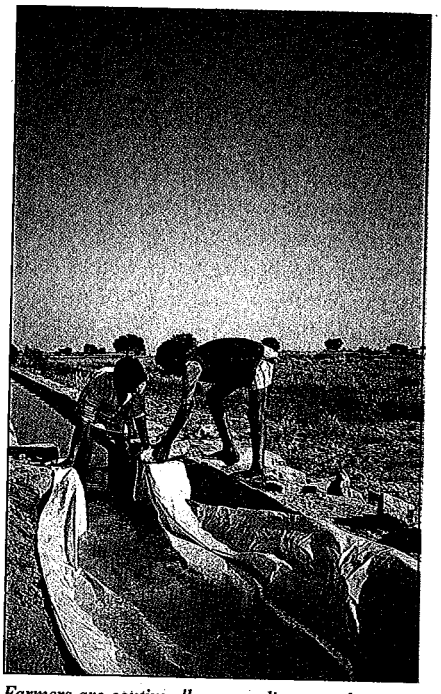
Table 3. Average monthly coefficients of variation of inflow and tail stage for periods immediately before and after lining. (All figures are percentages.)

	Zero Values Excluded					
	Ghordour Dy.			Lagar Dy.		
	8 Months Before Lining	19 months After Lining	% Change	19 months Before Lining	19 months After Lining	% Change
Inflow into Dy. Ave.	6.62	4.66	-29.6%	10.93	6.82	-37.6%
Tail Stage Ave.	23.80	14.38	-39.6%	23.93	14.52	-39.3%
	Zero Values Included					
	Ghordour Dy.			Lagar Dy.		
	8 Months Before Lining	19 months After Lining	% Change	19 months Before Lining	19 months After Lining	% Change
Inflow into Dy. Ave.	19.11	27.71	+45.0%	25.45	27.79	+9.2%
Tail Stage Ave.	47.02	36.27	-22.9%	46.50	35.78	-23.1%

IIMI-ROCKEFELLER FOUNDATION HOST WORKSHOP ON MANAGING NEW AGRICULTURAL TECHNOLOGY

The ways in which social science research can contribute to improved levels of management of new agricultural technology was the theme of a September workshop held in Lahore, Pakistan, cosponsored by IIMI and the Rockefeller Foundation. Titled "Social Science Perspectives on Managing Agricultural Technology" the workshop convened 25 scientists working in agricultural research in Asia, Africa, and Latin America.

Most participants were past or current Rockefeller Foundation post-doctoral Fellows in Social Science, a program which places scientists with international agricultural research centers (IARCs) to work on multi-disciplinary studies in the respective centers. IIMI staff from Headquarters in Sri Lanka, and from the newly opened Branch Office in Pakistan (the Memorandum of Agreement was signed just two days after the workshop), also participated.



Farmers are continually responding to technical challenges.

The workshop was opened by Dr. Amir Muhammed, Chairman of the Pakistan Agricultural Research Council, who emphasized the need to bridge the "agricultural yield gap" between potential and actual crop production. "It is the interaction between social scientists and technicians', said Dr. Amir Muhammed, "which can lead to the better application of existing agricultural technology."

The 14 workshop papers were organized into four sessions dealing with the contribution of social science research in various phases of generating and applying agricultural technology at the IARCs: 1) Setting the IARC's research agenda, 2) The Development, Adoption, and Evaluation of Agricultural Technology, 3) Management as Agricultural Technology, and 4) Implementing management improvements.

Within the IARCs, decisions are made about the kinds of technology which will be produced. The default mode appears to be higher yields of food (rice, wheat, potatoes, corn, cassava). Managing the resources of the IARC to better reflect real needs of target groups involves socio-economic research to determine what these needs are. Pest and drought resistance, minimal fertilizer requirements, and long stalks for fodder may be as important as yields or time to maturity.

This relationship can be diagrammed as follows:

Management of Resources within IARCs ➧ New Agricultural Technologies

The new technologies that IARCs develop (e.g., new plant varieties) generally require that farmers change their agricultural practices. Changes are also required in the agencies, both governmental and private, which have a hand in delivering the new technology to farmers, and in the extension system and marketing system which support these efforts. The research which most RF Post-docs conduct at their respective IARCs falls into this category of technology adoption, which can be diagrammed as follows:

New Technology (developed by IARCs) ➧ Management Changes (by farmers and agencies)

Existing technology can be put to better use through management changes on the part of farmers and/or government agencies. Irrigation, fertilizer and pesticide use, cultivation practices, and cropping patterns (including trees) are currently known and used, but are underutilized. This aspect of management is becoming increasingly important, as more and more technological products (including HYVs) are becoming well known, nominally adopted by farmers, and generally available at the national level, if not always locally.

The "proper" use of agricultural technology by farmers depends a range of actions beyond an individual farmer's control--at the level of international finance, national agencies, regional politics, local officials, and intra-community relations. The relationship can be diagrammed as follows:

Development of Better Management Techniques ➧ Potential for Increased Productivity and/or other Development Objectives

To realize the potential benefits of better management techniques requires that they first be adopted. A three-way learning process involving the IARCs (or other researchers), implementing agencies, and farmers can be envisaged. The

management techniques developed by the IARCs need to be tailored to the needs of particular agencies as well as farmers.

In the same way that Robert Rhoades has described a "farmer-back-to-farmer" learning process (involving agricultural scientists and farmers), there also needs to be an "agency-back-to-agency" learning process with active collaboration between IARC researchers and agency staff. The primary emphasis would be to help the clients of the IARC -- sometimes farmers, but more generally agencies -- figure out how to do their jobs better. □

Learning Process	➧	Adoption of Management Improvements

The workshop papers are currently being prepared for publication in a Proceedings volume co-edited by David Groenfeldt (IIMI) and Joyce Lewinger-Moock (Rockefeller Foundation), the workshop organizers. A publication release date of October 1987 is anticipated.

David Groenfeldt
Economic Anthropologist

MORE RESEARCH NEEDED ON IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPPING

In the past two decades a number of countries, especially those in the humid tropical regions of Asia, have approached consistent levels of self sufficiency in rice production through the introduction of improved rice growing technologies. This trend, combined with a decline in rice prices, has led policy makers to recognize the potential in growing irrigated non-rice crops during the dry season.

At the same time many farmers now seek ways to diversify their production and income sources but face several obstacles in growing non-rice crops in irrigation systems designed exclusively for rice. As a consequence, the shift in policy and on-farm management practices has not come easily.

The need to identify the constraints to diversified cropping under irrigated conditions during the dry season and to determine appropriate management practices prompted IIMI to undertake a series of studies on the subject shortly after it began operations in 1984. These studies, underway in Indonesia, the Philippines, and Sri Lanka, are now nearing completion of their first phase or are at a stage where discussion of findings and future directions is useful.

To foster these discussions IIMI hosted a workshop at its Headquarters on 24-27 November 1986 entitled "Irrigation Management for Diversified Cropping." Interested parties from many countries traveled to Digana Village to review current research findings, those of IIMI and others, to compare differences in irrigation system management, and to develop plans for future research activities. Thirty-two participants, including irrigation managers, researchers, and agency officials, from 10 countries took part in the proceedings.

Participants discussed country papers and research reports, visited an IIMI research site and a pilot research project of the Sri Lanka Department of Irrigation, and in the final session met in workshop groups to discuss five critical issues: 1) constraints in production of diversified crops under irrigation; 2) applicable and promising irrigation management practices for relaxing constraints; 3) researchable issues in irrigation management of diversified cropping; 4) the formation of a research network; and 5) associated issues with policy implications.

In concluding the group sessions, seminar participants identified a number of constraints to producing irrigated diviersified crops, as well as ways to relax them. Constraints were divided into five categories: agronomic, irrigation, economic, social (institutional), and policy.

Agronomic constraints included unsuitability of soils, availability of quality seeds, pest and disease suitability, heavy and untimely rains and waterlogging. Relaxing these constraints require improved irrigation management and further research and technology application.

Irrigation constraints occur at all levels of the irrigation system and

Chilli is an important irrigated diversified crop in Sri Lanka.

consequently require the attention of farmers, agencies, and researchers. Problems range from inflexibility of water supply to inappropriate organizational and physical structures for water distributions.

Low prices, risk-high cash inputs, inadequate landholding for viable production, access to unirrigated land, availability of off-farm employment, and lack of crop insurance have all tended to steer the farmer away from diversified crops. Governments may be in the best position to relax these constraints, in some cases with more intervention and in others, with less.

Farmers' and agencies' lack of experience in non-rice crops leads to various social constraints: the absence of marketing facilities, unsuitable land tenure arrangements, the absence or inadequate formation of farmers groups, insufficient extension services, and poor coordination between relevant agencies. More research is needed in all these areas as well as greater efforts by farmers and agencies.

Policy constraints on the other hand fall in the government's domain. Government must reevaluate existing policies and regulations that evolved when rice was the principal irrigated crop.

Seminar participants also identified applicable and promising irrigation practices to relax these constraints. At the farm level these include identification of suitable land, improved land shaping, increased flexibility and reliability of water supply, and staggering of cultivation activities.

At the distributary level of the system, operating principles must be made more responsive to actual user needs. Water resources must be equitably distributed to all portions of the system. At the main canal level, control structures require more efficient operation.

In addition to the discussion of the country reports and group findings, which will be available in the forthcoming "Workshop Proceedings," the group closed by defining parameters for a research network of crop diversification in rice-based irrigation systems, which IIMI is now in the process of facilitating. More information on the Network is available by writing S. Miranda, IIMI, Digana Village via Kandy, Sri Lanka. □

GOOD START FOR IIMI'S SPECIAL AWARD PROGRAM

A common approach to applying research to action is evaluating the impact of an action program--assessing what happened in the field against a set of objectives. After assessing production gains, interviewing beneficiaries, and examining structures built under a project, researchers write up their findings and often make recommendations. These are forwarded to people responsible for the action program through a report, a seminar, or both, in the hope that the research will contribute to improving programs.

But often researchers and implementers alike come away from this process with an uncomfortable feeling that somehow it does not really help. Often nothing much changes as a result of the research. Researchers commonly complain "No one in the implementing agencies listens to us," "Our reports just go on the shelf," or "The government is too sensitive to criticism."

The implementers complain "Academics are too theoretical," "The researchers just criticize without giving constructive suggestions," "The recommendations aren't realistic--they don't take into account our constraints."

Frances Korten, Program Officer, The Ford Foundation. 1986

To answer these criticisms IIMI initiated its special award program to seek out irrigation professionals who have tried innovative approaches to improve the performance of irrigation systems. The award recipients come to IIMI Headquarters to document their experiences through IIMI's case study series.

The program became official in September 1986 with the arrival of *Mr. Honorio Bautista.* Bautista, Manager of the Agricultural Development Division of the Magat River Irrigation Project (MRIP) in the Philippines, spent two months with IIMI documenting his experience and that of his colleagues in organizing irrigator associations on nearly half the 100,000 ha project.

Bautista started organizing Rotational Unit Groups and Farmers Irrigators Groups at the turnouts in 1976 to ensure farmers' participation in the distribution of water and maintenance of irrigation facilities. Beginning in 1980, 23 Irrigators Associations (IAs) were organized in the sub-lateral and lateral canals to test the ability of organized farmers' groups to assist in the minor maintenance work of larger irrigation canals and in the collection of irrigation service fees.

What happened in the succeeding years was beyond expectations. The number of IAs grew from 23 in 1980 to 240 in 1986 with 20,198 members cultivating 40,766 ha of rice land. Nearly 60 percent of these IAs now maintain about 600 km of irrigation canals and assist the National Irrigation Administration in the collection of irrigation service fees. Bautista's final report, "Experiences with Organizing Irrigators Associations: A Case Study from the Magat River Irrigation Project in the Philippines" is now available.

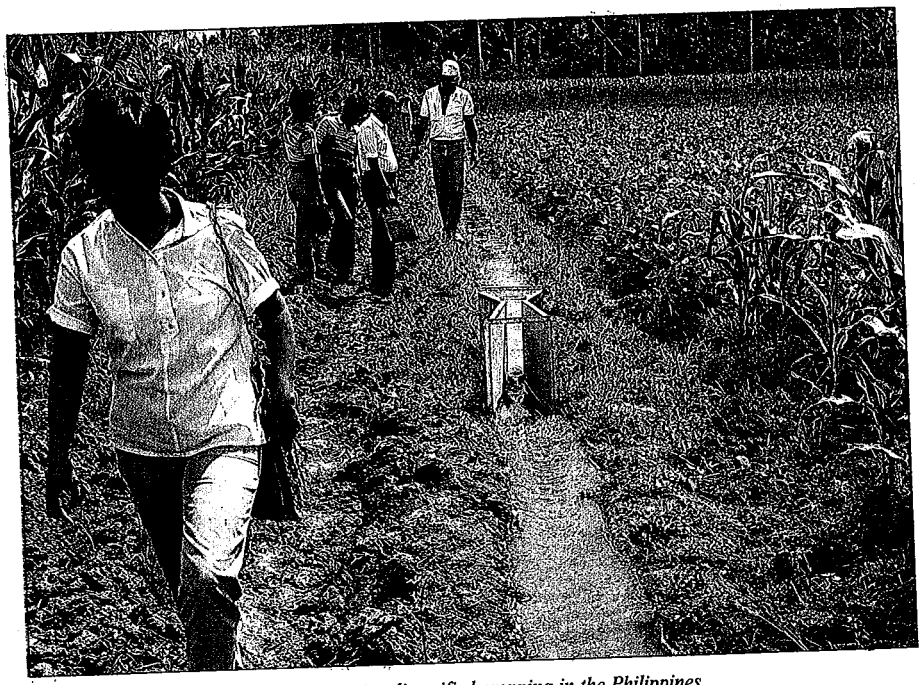
IIMI's 1987 special award recipient, *Mr. A.M.S.S. Gunadasa,* Technical Assistant in charge of the Kimbulawana Oya Scheme in Sri Lanka, also recently arrived at Headquarters. Over the next two months he will be documenting his experiences in introducing new techniques for water distribution and management in the rehabilitated Kimbulawana Oya scheme. □

PHILIPPINES STUDY SUPPORTED BY ADB

The Asian Development Bank (ADB) will fund a second phase of IIMI's study of irrigation management for diversified crops in the Philippines, according to Fred Valera, IIMI's Resident Scientist in the Philippines. The first phase began in February 1985 and was completed in December 1986. Phase II will now extend from February 1987 to July 1989.

Phase I results point to important agricultural and socio-economic aspects of diversified cropping under irrigated conditions which are not yet fully understood, but which exert a profound effect on the profitability of cultivation and return on investment in irrigation. Several constraints to successful diversified cropping in irrigated areas were identified together with ways to mitigate those constraints.

IIMI's Phase I study followed an IRRI-IFPRI study on food demand and supply for Developing Member Countries of the ADB. A second phase of the IRRI-IFPRI study, complementary to IIMI's Philippine research, was undertaken to further refine strategies for agricultural development. Results from the second study suggest that earlier conclusions require qualification, among them the assumption of the Philippines' comparative advantage in non-rice crops.



The need for on-farm structures constrains diversified cropping in the Philippines.

"In Phase I we have found three principal constraints to diversified cropping: first, the lack of guidelines for irrigation managers in the allocation and delivery of water; second, the wastage of water and the longer times needed in basin flooding; and third, the need for on-farm facilities for irrigating diversified crops, such as field and drain ditches," says Valera.

"To effectively irrigate diversified crops, large canal capacities are needed, particularly in sandy soil. Existing gravity systems can accommodate large and intermittent demands by extending the duration of water delivery periods, but only where appropriate control is maintained" he adds.

Timing of cultivation for diversified crops was found to be particularly important. Valera says, "Two major problems remain unanswered; how to irrigate without saturating the soil around the crops and how best to convert the soil from a puddled condition during the wet season to a well structured and aerated condition for diversified cropping during the dry season, and vice-versa."

Profitability is the first consideration of farmers in making the cropping decision. "Stable prices and high input costs for non-rice crops presently discourage farmers from adopting irrigated diversified cropping," Valera continues. "For most non-rice crops, prices are normally less stable and at lower levels than for rice. Where prices are at profitable levels, there is clear evidence that diversified crops can be grown productively and efficiently under irrigation."

An equally important constraint is the lack of communication between farmers and operators of irrigation systems. The intermittent nature of irrigation for non-rice crops demands quick response on the part of irrigation managers. "New organizational forms such as joint management between farmers and system authorities are necessary to fully utilize irrigation potential," says Valera.

"Based on the findings from Phase I, "says Valera, "Phase II will sharpen its focus and determine those irrigation practices, at the farmer and system levels, most likely to enhance the cultivation of non-rice crops in limited parts of irrigation systems during the dry season. We will also field test the most promising of those practices in selected commands."

Phase II field sites will be the same on Mindanao island but will differ on Luzon island. The final report planned for August 1989 is expected to include policy recommendations for more profitable farming practices and investments in irrigation development as related to diversified crops. Outputs will also include a set of irrigation guidelines and irrigation management practices for diversified cropping. □

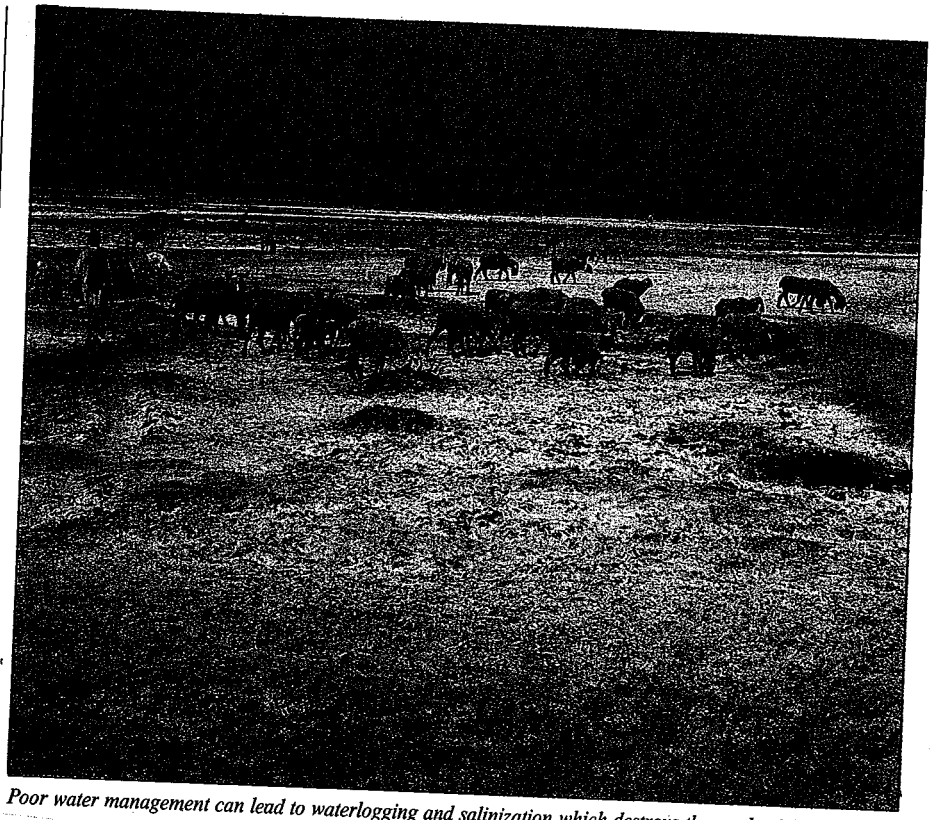
OPERATIONS AT IIMI PAKISTAN UNDERWAY

Six months after the formal signing of a Memorandum of Agreement between IIMI and the Government of Pakistan on 28 September 1986, operations at IIMI's branch office in Pakistan are successfully under way, according to James Wolf, Agricultural Engineer and Director of IIMI Pakistan.

Wolf is joined in Pakistan by Geographer Edward Vander Velde, Irrigation Engineer Hammond Murray-Rust, Director of Administration Michael Jones, and Post Doctoral Fellow M. Akhtar Bhatti, an Agricultural Engineer from Pakistan.

In addition to IIMI Pakistan's temporary headquarters in Lahore (the government of Pakistan has agreed to finance a headquarters building and supporting facilities at a cost of US$ 2 M), the Punjab Irrigation Department has handed over a Department resthouse located on the right bank of the Upper Gugera Branch Canal at Farooqabad/Chuharkana, about 40 km away from Lahore. The resthouse serves as IIMI Pakistan's first field station, and has been the site of its initial research activities.

It has been acknowledged policy that Pakistan would play a permanent role in the world wide program activities of IIMI. Three major factors have contributed to an IIMI unit in Pakistan: its location in an arid temperate zone, the extent of irrigation in Pakistan, and its potential for improved irrigation performance through better management practices.



Poor water management can lead to waterlogging and salinization which destroys the productivity of land.

Pakistan offers a set of agro-ecological conditions that are fundamentally different from those found in tropical Asia as typified by Sri Lanka. Pakistan is arid, Sri Lanka has higher rainfall; Pakistan is located entirely in the temperate zone, Sri Lanka in the tropics; Pakistan's crops are largely diversified, Sri Lanka's are oriented to rice production.

Although IIMI Pakistan will focus its work initially in Pakistan, its reach will extend to other parts of the world, particularly arid and semi-arid environments, where inadequacy of water supply imposes a severe constraint on organizational activities.

Pakistan has the largest contiguous irrigation system in the world extended over some 14 M ha. Approximately 71 percent of Pakistan's agricultural area is irrigated. The system of primary and secondary canals stretch to 61,000 km in length with tertiary level canals estimated to reach another 1.6 M km. Forty-two canal commands and 89,000 watercourses serve an estimated 3.6 M irrigated farms. Annual water supply, primarily from snow-melt runoff from the Himalaya Range (Karakorum), totals about 15.6 M ha/m. Some 200,000 tube wells supplementally provide an estimated 4.4 m ha/m.

Wolf says that "irrigation system performance in Pakistan is far below its full potential. Irrigated wheat and rice fields average about 2.0 metric tons /ha. Yield for cotton, maize and sugar cane is about 1/3 of the potential. Unreliable and poorly distributed supplies of water together with excess water, drainage and salinity--which affect some 4.5 M ha--are all irrigation-related constraints which contribute to keeping yields low.

For more information on IIMI Pakistan correspond through the following address. □

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Tel. 305810, 302842, and 302924
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(Continued from page 4)

In the Philippines, linkage between inflows and outflows for O&M associated with NIA's financial autonomy has led NIA to attempt to reduce the net outflow of funds for O&M. NIA has taken steps both to decrease outflows and to increase inflows by providing better service and increasing incentives for payment.

In Korea, linkages between inflows and outflows of funds exist for both capital costs and O&M expenditures. Outflows for O&M are fully balanced by inflows of funds to the FLIAs, although a portion of these inflows may represent indirect government subsidies.

All five countries show a a net transfer of public funds to the irrigation sector. There is thus a redistribution of income from the general taxpayer to the beneficiaries of irrigation, including not only farmers, but other indirect beneficiaries such as landless laborers and those involved in the marketing of farm inputs and outputs.

In the case of Thailand, with its rice export tax, there is also a tendency to redistribute income from rice farmers to consumers and to non-rice farmers; and from rice farmers producing under rainfed conditions to rice farmers with irrigation. Indonesia and Nepal, through their land taxes, may cause some redistribution of income from landowners to landless. The land tax of Indonesia also provides for some redistribution of income from large to small farmers, due to farm-size differentials explicitly incorporated into the tax rates.

The IIMI Study was the first step of a two step approach to the problem of resource mobilization for O&M in ADB-financed irrigation systems. The Regional Seminar, held to review the study's findings and recommendations, was the second step. Participants included 25 representatives from 13 Developing Member Countries (DMC) of the ADB, one observer each from the World Bank, the FAO, and the United States Agency for International Development, three researchers from IIMI and 10 Bank staff. During the five days of the seminar, country papers were presented, sessions were held to discuss key issues identified by the IIMI study, and session reports were presented for further discussion.

The Seminar focussed on one of the two aspects of irrigation financing pointed out by the IIMI study, financing O&M of irrigation projects to improve irrigation performance. Most DMC representatives agreed that the question of capital cost recovery, the second aspect, was premature at this stage of development in their respective countries.

Seminar consensus favored the recovery of O&M costs from the beneficiaries/farmers in line with the benefits gained through irrigation projects. The IIMI study concluded that in Korea, Philippines, Indonesia, Nepal, and Thailand, in the presence of satisfactory irrigation services, farmer beneficiaries could feasibly pay for 100 percent of O&M costs based on incremental income gained through irrigation. However, of those countries present, only Korea successfully reached a 100 percent target.

Recognizing the inadequacy of resources generated to meet O&M costs, the participants felt additional funds should be sought from government budgets. In order to limit the fiscal burden to government, one participant recommended the transfer of O&M responsibility, both physical and financial, to water users' organizations. In general, participants favored the proposal and felt farmer participation in O&M, particularly at the tertiary-level, would lead to better performance of the irrigation system. Some felt however that the main system O&M should be financed by the government as it was considered a basic infrastructure which benefitted the entire nation.

Participants agreed that the Bank should consider financing O&M costs in the initial years after project completion to ensure adequate and proper O&M. The duration of such financing would depend on the project.

In order to determine the appropriate O&M charge, it is essential to quantify the benefits derived from irrigation projects. Seminar participants unanimously agreed that a project benefit monitoring and evaluation system should be applied to all irrigation projects from the start of the preparation stage onward. It was also recommended that farmers' participation should be fully obtained, beginning with project preparation and including the design of institutional arrangements and implementation of the project.

On the last day of the Seminar, participants agreed that many aspects of cost recovery had been clarified, but that a number of questions remained. More research is required to enable the separate quantification of O&M costs of the main system and tertiary system in various irrigation projects and of irrigation benefits under various cropping patterns. Financial yardsticks/-standards for O&M expenditures and O&M manuals should be prepared, and study tours of projects with successful O&M financing arranged.

More work needs to be done on the institutionalization of water users' organizations. And pilot projects should be initiated for wholesale of water to those organizations where conditions for implementation exist.

In addition to the five country studies, IIMI has initiated similar studies at the state level in the states of Bihar and Haryana in India, and at the national level in Sri Lanka. Studies at the irrigation system level were begun in Korea in 1986 and will be initiated soon in Sri Lanka and Thailand. This phase of the research will examine in more detail the connection between irrigation financing, under conditions of financial autonomy, and enhanced system performance.

Further study at either the national or system level will be undertaken as more irrigation agencies and research institutes express interest in the subject.□

Edward Martin (Agri. Economist)
and John L. Colmey
(Based on the work of Leslie E. Small)

PUBLICATIONS

Groenfeldt, D. (ed.). 1986. Proceedings from a workshop on selected irrigation management issues, 15-19 July. Digana Village, Sri Lanka: International Irrigation Management Institute Research Paper No. 2 (April).

These papers grew out of a planning workshop held at IIMI during December 1985 to assess the present state of knowledge in several irrigation management research areas, and to help identify issues that IIMI might focus on its research programs as a follow-up to the January workshop (Research paper No. 1). The proceedings summarize papers on Rapid Appraisal, Rehabilitation, Main System Management, and Institutional Aspects of Irrigation Management, and include discussion on each topic.

Chambers, Robert and Ian Carruthers. 1986. Rapid appraisal to improve canal irrigation performance: experience and options. Digana Village, Sri Lanka: International Irrigation Management Institute Research Paper No. 3 (November).

As attention focuses on improving the performance of existing canal irrigation systems, it becomes increasingly important to identify approaches and methods which make manageable demands on staff and lead to implementable actions with early benefits. Chambers paper assists in the search for such methods. It draws on experience with rapid rural appraisal (RRA) on canal irrigation in Asia and on RRA experience in other fields.

Merrey, Douglas J. and James M. Wolf. 1986. Irrigation management in Pakistan: four papers. Digana Village, Sri Lanka: International Irrigation Management Institute Research Paper No. 4 (November).

These four papers present different facets of irrigation in Pakistan's Indus Valley. The Wolf paper looks at Pakistan's Provincial Irrigation Departments (PIDs), particularly the implications of financial and staffing structures on O&M policy. The three Merrey papers are related and analyze local level sociological and ecological processes that have important implications for irrigation system management and development policy at the macro level.

Bautista, Honorio B. 1986. Experience with organizing irrigators associations: a case study of the Magat River Irrigation Project in the Philippines. Digana Village, Sri Lanka: International Irrigation Management Institute Case Study No. 1 (December).

IIMI's first case study documents the experience of an irrigation management official, the author of this re-port, in his efforts to organize irrigators associations on nearly half of the Magat River Multi-purpose Project area. Most of these are now effective, active organizations. This experience is a valuable source of ideas for agency officials concerned with developing water-user associations in other systems.

Rao, P. S. and A. Sundar. 1986. Managing main system water distribution. Digana Village, Sri Lanka: International Irrigation Management Institute Management Brief No. 1 (June).

This describes a main system, discusses methods of distributing water, and identifies several typical problem areas, and lists five priorities for research and development activities.

Chambers, Robert. 1986. Rapid rural appraisal for irrigation systems. Digana Village, Sri Lanka: International Irrigation Management Institute Management Brief No. 2 (July).

A companion to Research Paper No. 3, this describes RRA and how five techniques can help managers and irrigation professionals avoid bias in their appraisals.

International Irrigation Management Institute (IIMI) and the Joint WHO/FAO/UNEP Panel of Experts on Environmental Management for Vector Control (PEEM). 1986. Proceedings of the workshop on irrigation and vector-borne disease transmission. Digana Village, Sri Lanka: International Irrigation Management Institute.

Vector-borne diseases continue to be one of the predominant public health problems in Sri Lanka and other developing countries. Diseases such as malaria and filariasis pose an undeniable threat to the success of water resource development. The role of preventive or mitigating measures is discussed as a priority in the planning, implementation, and management of irrigation systems.

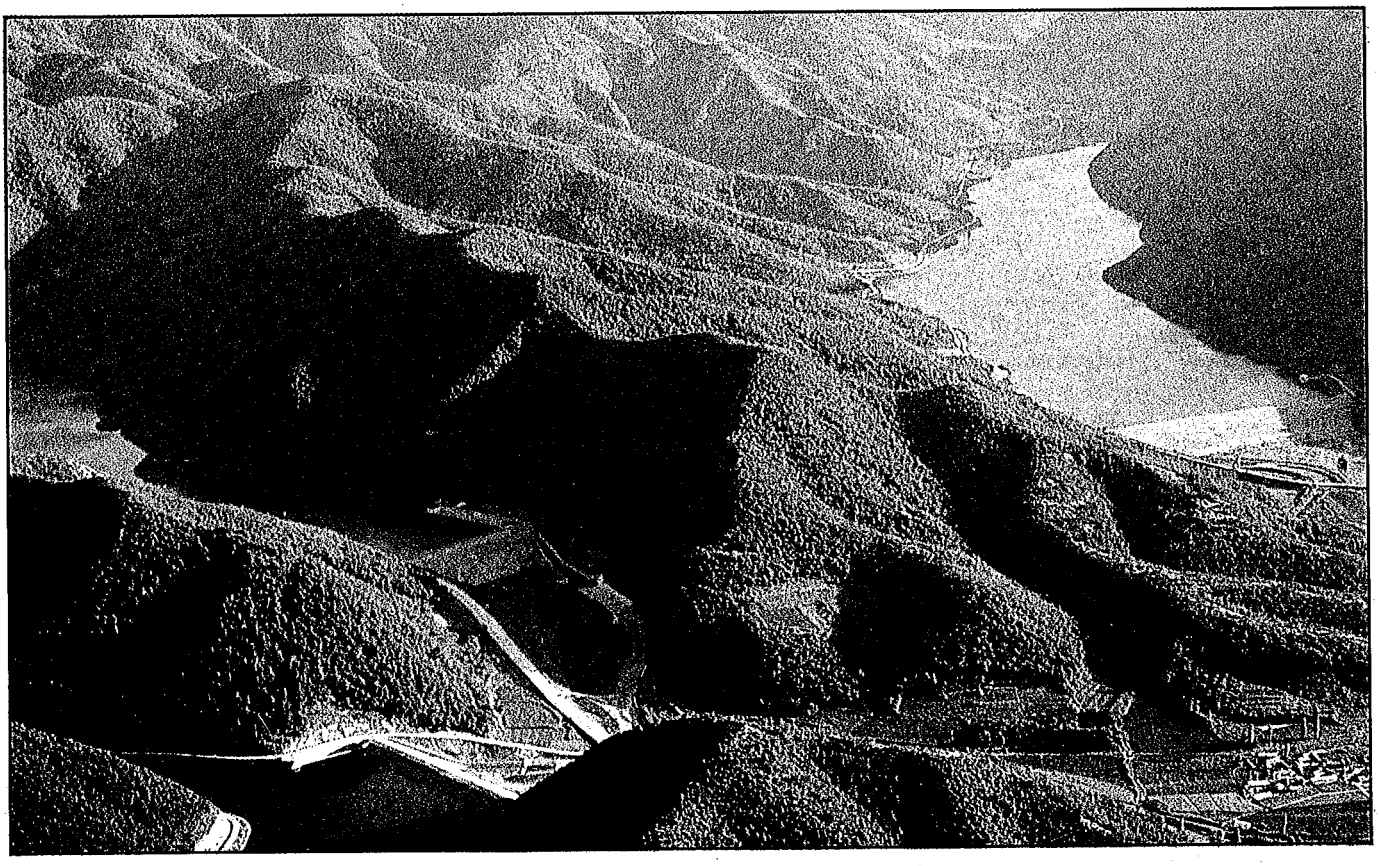
International Irrigation Management Institute (IIMI). 1986. Proceedings of a workshop on participatory management in Sri Lanka's irrigation schemes. Digana Village, Sri Lanka: International Irrigation Management Institute.

Several forms of participatory management are either experimented with, in use, or have been used in Sri Lanka. An overview of village irrigation systems in Sri Lanka, with reference to ongoing irrigation development efforts and particular irrigation management needs is presented, as well as priority research issues relevant to small-scale irrigation systems.

International Irrigation Management Institute. 1986. annual report for 1984-85. Digana Village, Sri Lanka. (December.)

IIMI publications are available free by writing Office of Communications and Publications, IIMI, Digana Village via Kandy, Sri Lanka. Allow one to three months for delivery.

CALENDAR



April

27 - June 5
The third IIMI-EDI-ADB regional course on planning and management of irrigation systems at Digana Village. Twenty-three participants at senior irrigation management level from 17 countries are following this course.

May

23
IIMI Support Group meets in Montpellier, France.

June

7 - 10
Conference on Farmer Managed Irrigation Systems to be held in Kathmandu, Nepal.

11 - 13
IIMI Board of Governors meet at IIMI Headquarters, Digana, Sri Lanka.

24 - 27
IIMI sponsored planning workshop for the newly-established Farmer-Managed Irrigation Systems (FMIS) Network: Bangkok, Thailand.

28 - July 30
IIMI & Ford Foundation co-sponsor an IIMI Policy Workshop in Hyderabad, India. International study tour and subsequent discussion and recommendations.

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