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INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

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* As of 15 June 1987
** Until 15 June 1987

Foreword

Irrigation is centuries, indeed thousands of years, old. But the role of irrigation management has never been more important than it is today, with some 158 million hectares of irrigated land in the developing world, comprising slightly more than 20 percent of its cultivated area and nearly 72 percent of the world's total irrigated area.

A significant difference has already been made in development by irrigation. The recent overall abundance of food stuffs, despite woeful shortcomings in distribution and long-range planning, is basically attributable to improved crop technologies and associated land practices, increased fertilizer use, pricing and input subsidies, and the expansion of irrigated area. Of these, the last, irrigation, is the investment still waiting to be fully realized, yet that whose benefits may prove to be the most enduring.

The potential benefits of irrigation, however, go significantly further than increasing food production. Well-managed irrigation can have an important impact on incomes and on employment for the landless and near landless; on the reliability of crop output; and on the sustainability of agricultural systems. Hitherto these benefits have stemmed from investment in the physical works rather than through increased efficiency and productivity. Increasingly, however, the benefits of irrigation will need to be realized through improved performance of existing systems, rather than through investment in new works.

But how much can we increase performance in existing systems? We like to think that increases in productivity in the range of 30-40 percent are possible through such measures as crop diversification in the dry season. But increased performance does not only mean increases in productivity. It also means more equitable distribution, which increases the farmers' motivation to manage and plan water distribution more attuned to their true requirements, and at the same time increases their incomes in a more evenly distributed pattern. It means improvements in sustainability, so that losses in productivity or equity, resulting from such factors as soil salinization or the inability of maintenance departments to adequately deal with system deterioration, may be reversed. And it means improvements in the overall quality of life of the children, women, and men affected by irrigation, through adequate attention to health, nutritional, and environmental considerations.

To achieve these goals, national irrigation agencies are having to perform at even higher levels. But these demands are coming at a time when donors are reducing their investments, and governments are hard pressed to cover recurrent operation and maintenance costs. More and more irrigation policy makers are becoming persuaded that, to address these problems, a 'managerial revolution' (in the words of the Chairman of India's Central Water Commission) is needed.

The International Irrigation Management Institute (IIMI), working in close collaboration with the irrigation agencies it seeks to assist, has a fundamental and ever-increasing role to play in improving the management of irrigation systems. Our unique status as the only international institute in the world whose mandate solely concerns irrigation management makes us an especially valuable resource to the agencies we serve. Working with these agencies, we are able to bring to bear the experience of the hundreds of irrigation managers, professionals, and researchers that make up IIMI's international network in providing research, in pilot-testing management systems, and in conveying the fruits of achievement -- and sometimes, too, the challenges -- from one area of experience to another. More and more irrigation agencies, donors, and other research institutes are looking to IIMI for answers.

IIMI is a young institute. By end 1987, our program had been in operation for a little over four years. In these short years -- and thanks to the vigorous efforts of Dr. Thomas Wickham, IIMI's first Director General -- we have established projects and placed staff in five countries and laid the basis for expansion into five more. Despite the real possibility of a budget shortfall at the beginning of 1987, donor agencies rapidly accepted the need to support irrigation management development through our work, and by the end of 1987 we had managed to produce a budget surplus and identify funding to double our 1987 resources. Furthermore, through the investment of considerable time and effort into the development of a long-term strategy document, we have now clearly identified IIMI's mission, its research product, and its overall identity. What began as an experiment has become an effective force for change.

My colleagues and I are pleased to present this report on our activities and accomplishments during 1987. We look forward to your comments.

Roberto Lenton
Director General

Note: Roberto Lenton became IIMI's Director General in June 1987, following the retirement of Thomas Wickham.

1987 Highlights

During 1987, 21 internationally recruited professional staff and associated support staff were employed at IIMI's headquarters in Sri Lanka, and at its participating country units in Pakistan, Indonesia, Nepal, and the Philippines. In addition, IIMI explored new programs in India, Bangladesh, Morocco, Sudan, and West Africa.

This year's highlights are presented according to the country in which the achievements were made.

In the Sri Lanka Program, IIMI:

- Completed Phase I of a three-year research project to identify constraints to effective irrigation management in rice-based irrigation systems during the wet and dry seasons. Staff also initiated Phase II of the research, carried out in two irrigation systems in Sri Lanka's North Central Province (NCP), which included pilot-testing management innovations appropriate to the previously identified constraints. The tested innovations, a rotational plan and post-water-delivery meetings between farmers and agency officials, suggested how the agency could improve the reliability and equity of water delivery below secondary canals.

- Developed a simple, low-cost methodology for measuring field-level water adequacy, productivity, and equity for water distribution in lowland rice irrigation systems.

- Developed a concept and methodology to quantify the relative equity between the 'head' and 'tail' in irrigation systems. The 'head' and 'tail' refer to conditions of oversupply and undersupply and not to physical locations. In applying the methodology, which adapts an income distribution, Lorenz curve to show equity of water distribution, findings showed that the equity effects can differ from the traditional, locationally derived head and tail consequences.

- Concluded the research phase (field work) of an innovative case study of the internal management processes of two Sri Lanka irrigation agencies. This study utilized concepts from the social and management

sciences commonly applied to the private sector. Results include a series of recommendations to the agencies for improving internal decision making, performance control, and communications.

-- Continued research of two major irrigation systems in southern Sri Lanka, the Kirindi Oya Irrigation and Settlement Project, and the Uda Walawe Irrigation System. In the first, IIMI studied inter-agency coordination and agency-farmer communication in a recently settled section of the system. In the second, IIMI studied the rehabilitation program as a management process: decision making, communication and consultation with farmers, and the roles of contractors, consultants, and implementing agencies.

-- Began collaborative research, through a grant from the United States Agency for International Development (USAID), on the Irrigation Systems Management Project in Sri Lanka. In connection with this, IIMI reviewed a selection of literature on irrigation management in Sri Lanka, and identified and evaluated potential collaborating research organizations through which the work will be done.

-- Began research to identify management constraints in irrigated settlement schemes, and ways that improved settlement planning can contribute to improved irrigation performance.

-- Identified and field-tested research methodologies to discover effective and responsive practices for operating main canals. The methodology utilizes computer simulations (through hydraulic modeling) of the behavior of canals and structures operating under conditions similar to those observed in actual systems.

-- Conducted library research and reported results in a conference paper on six selected rehabilitation projects to determine the degree to which an emphasis on institutional strengthening contributes to long-term sustainability of rehabilitated systems.

-- Completed a study of irrigation management training needs in Sri Lanka. The report submitted by IIMI to the Government of Sri Lanka consists of three volumes containing an appraisal of current training activities and suggestions for their enhancement.

In the Pakistan Program, IIMI:

- Developed an equivalent distance methodology which provides an equity measure of water delivery along an irrigation canal. The methodology is based on the premise that inequity or inadequacy of water supply depends not on distance alone but on distance modified by hydraulic conditions at each control structure. This will assist irrigation managers in devising operation and maintenance (O&M) and rehabilitation strategies that reduce inequity.

- Concluded research to examine the cause of unreliability and inequity in water distribution along the main canals of two major canal systems. Staff analyzed 30 years of data collected by the Punjab Irrigation Department and concluded that variability in the distributary discharge was not always related to shortfalls in water supplies at the head of the system.

- Concluded research to determine the impact of distributary lining programs on deliveries to tail-end farmers on two canals. Related to this, IIMI initiated follow-up research to assess benchmark flow and channel conditions on two distributaries in one of the systems which was due for lining in the near future. This will give researchers the data to assess better the rehabilitation programs that are now planned by the Punjab Irrigation Department.

- Initiated research to determine the operative irrigation constraints to wheat production during the dry season.

In the Indonesia Program, IIMI:

- Completed Phase I of an Asian Development Bank (ADB) funded study to identify new irrigation practices to meet the complicated irrigation management requirements for diversified agriculture in the dry season. Researchers measured irrigation performance, identified performance deficiencies and their relationship to management, and recommended a series of management interventions to improve water control and delivery.

- Played an advisory role in helping the Center for Agro-Economic Research implement field research into irrigation constraints in one system in Lampung

Province in southern Sumatra and collaborated with the University of Gadjah Mada in Yogyakarta in calibrating measurement structures in Lampung.

-- Initiated Phase II of the research, funded by the ADB and the Ford Foundation, wherein IIMI will pilot-test recommended interventions, expand research to other irrigation environments in Indonesia, and assist in the process of turning over O&M responsibility to farmers in irrigation systems less than 150 hectares (ha).

In the Nepal Program, IIMI:

-- Continued research to develop and apply a systematic, low-cost inventory process for identifying farmer-managed systems for government assistance. After evaluating 152 farmer-managed systems in 1986, IIMI conducted a rapid appraisal of 21 of these systems deemed to have good potential for improved performance. The outcome of the appraisal was an implementation strategy to fit the needs of each system.

-- Tested the use of farmer exchange visits between systems that are well managed and others that are scheduled to receive government assistance. The purpose was to help farmer-managers identify the range of options to apply to improve the organization and management of their system. This innovative approach to the transfer of management techniques has been adopted by the Department of Irrigation in that country.

-- Concluded a study of a large (15,000 ha) farmer-managed irrigation system in Nepal's Tarai. One result was a series of recommendations to the government on ways to assist the system. In connection with this IIMI produced two educational videos that explain the relationship between organization and development, resource mobilization and the water distribution system in two large Tarai systems.

-- Assisted seven donor agencies in Nepal regarding projects, conferences, or research conducted in Nepal.

In the Philippines Program, IIMI:

-- Completed Phase I of an ADB-funded study to identify constraints to diversified cropping in the dry season.

IIMI submitted Phase I results and recommendations for improving irrigation performance in a final report to the ADB and the Government of the Philippines.

-- Initiated Phase II of the research which will test technical management innovations relating to irrigated diversified crops, including a microcomputer-aided mapping technique to indicate physical and socio-economic data on existing maps, on-farm water management practices, and improved operational practices.

-- Initiated a short-term project with the International Food Policy Research Institute (IFPRI) and the National Irrigation Administration (NIA) to document the Philippines experience in attempting to shift the irrigation sector to a more self-sustainable financial footing.

In the Area of Regional Programs, IIMI:

-- Initiated and implemented a three-year collaborative research program with the International Rice Research Institute (IRRI), focusing on problems of irrigation management for rice-based farming systems. Research funded by the Rockefeller Foundation is being conducted in Bangladesh, the Philippines, and Indonesia, building on the work by both institutions in those countries. As the first stage of implementation, the two centers held a series of planning meetings with host-country collaborators.

-- Continued a collaborative program with IFPRI, which focuses on irrigation policy issues relating to crop diversification in Asia and irrigation development in Africa.

-- Expanded and further developed the Farmer-Managed Irrigation Systems (FMIS) network. The network seeks to facilitate interaction among researchers, policy makers, and managers involved in this subject. In 1987 the network grew to include nearly 200 irrigation professionals from 30 countries. The network produced three issues of the FMIS Newsletter, held a planning workshop, and sponsored three visits to FMIS member sites.

In the Professional Development Program, IIMI:

- Sponsored three regional or international workshops.

- Hosted and co-sponsored the third annual IIMI-EDI-ADB Regional Course on Planning and Management of Irrigation Schemes, in which 25 people from 17 African and Asian countries participated. (EDI: Educational Development Institute)

- Sponsored six post-doctoral Fellows from four countries, seven Ph.D research Fellows from six countries, and six M.Sc research Fellows from four countries.

- Hosted its second Special Award recipient, Sunil Gunadasa, a technical assistant from Sri Lanka, to record his experience in introducing farmer participation to a small irrigation system, introducing several management innovations in the process.

In its Information Program, IIMI:

- Expanded its bibliographic database, developed a database keyword thesaurus and data input manual, and set up partner networks to render IIMI's and other databases fully interactive.

- Published and disseminated over 34,000 copies of 31 publications.

- Expanded the mailing list to contain 3,290 entries, spread over 140 countries.

In the Area of Program Development, IIMI:

- Devoted substantial resources to the preparation of a comprehensive program strategy document, with assistance from the Consultative Group on International Agricultural Research (CGIAR) Secretariat. A draft strategy paper was submitted to IIMI's Support Group at its meeting in October.

- Identified funding, and prepared a draft Memorandum of Understanding (MOU) with the Ministry of Water Resources in India for collaborative research to be

conducted in that country. IIMI also sponsored a major workshop in collaboration with the Administrative Staff College in Hyderabad.

- Prepared a draft MOU with the Bangladesh Agricultural Research Council and identified funding for three years starting in 1988.

- Laid the groundwork for implementation of research in Morocco and defined the parameters of a long-term research program for that country.

- Conducted two missions to Sudan which resulted in long-term financing for the implementation of a research program in 1988, and an MOU with the Hydraulic Research Station at Wad Medani for the sharing of research facilities and collaboration in research.

- Conducted two missions to five countries in West Africa, resulting in a West African strategy report. The report outlined the preliminary strategy of a regional research program in West Africa and identified potential collaborating partner agencies. IIMI negotiated an MOA with the Government of Burkina Faso for the placement of a regional representative in that country, and secured a grant from USAID to help establish the IIMI West Africa Program.

In the Area of Finance and Administration, IIMI:

- Successfully balanced its 1987 core income and expenditures, and by the end of the year, identified additional funding that would increase IIMI's total projected income for 1988 to about US$7 million -- nearly a twofold increase over that in 1987.

- Received 15 major multi-year grants for projects and work in 9 countries.

- Identified long-term research funding for IIMI Pakistan, including a US$2 million grant from USAID for two years beginning in October.

- Negotiated alternative arrangements for the management of Digana Village, IIMI's headquarters site, effectively returning much of the management responsibility to the Government of Sri Lanka, and thus considerably reducing IIMI's management costs.

-- Took steps to improve international communications at headquarters, which were expected to include a fax system, an electronic mail service, and direct telephone links with Colombo.

Irrigation Management

During the past two decades, irrigation schemes have become one of the most favored development projects in Asia, Africa, and Latin America because of their importance in contributing to sustained agricultural development. The remarkable increases in rural income and food production in Asia -- where 85 percent of the world's irrigated area is located -- are a result of the combined effects of introducing improved agricultural technologies and investing in new irrigation capacity. Several countries with irrigation potential have devoted over three-fourths of their public spending for agriculture to irrigation projects.

However, most of the benefits of irrigation development have stemmed from the magnitude of the investment, not from highly efficient and productive systems. Returns on irrigation investments have been disappointing, and the net incomes of farmers in irrigated areas are still far below their potential. Water distribution is frequently inequitable, unpredictable, and inadequate. Often, irrigation systems must be totally rehabilitated before the original investments are recovered.

It is doubtful whether past gains in agricultural production can be sustained within existing irrigation systems, unless appropriate management strategies are developed. There will be less water for irrigation in the future, as urban areas place greater demands on water for other uses, such as hydroelectricity. And negative externalities caused by poor management, such as land salinization, waterborne diseases, erosion and siltation, are likely to increase in the future.

The need for an international institute to initiate and promote research in irrigation management became evident in the late 1960s, soon after the introduction of new crop varieties by IRRI and others. At that time, many professionals recognized that the rapid development of irrigation systems to provide the necessary water input for the new varieties would eventually reach a limit. The need to expand water resources would eventually give way to the need to manage those resources. And so, in 1984, IIMI was established.

IIMI's mission is to strengthen national efforts to improve and sustain the performance of irrigation systems in developing countries through the development and dissemination of management innovations. Four values guide its activities: the promotion of multidisciplinary, collaborative, field-based research on real systems; an orientation towards solving real problems; the maintenance of standards of excellence; and the strengthening of its clients -- irrigation management agencies in developing countries. IIMI's research strategy responds to the needs of client agencies in developing countries. Research is conducted through field projects to examine specific problem situations and evaluate alternative solutions in collaboration with national agencies. This is carried out through a research and development program, and supported by the programs of information exchange and dissemination and professional development.

IIMI's mission is to strengthen national efforts to improve and sustain the performance of irrigation systems in developing countries through the development and dissemination of management innovations.

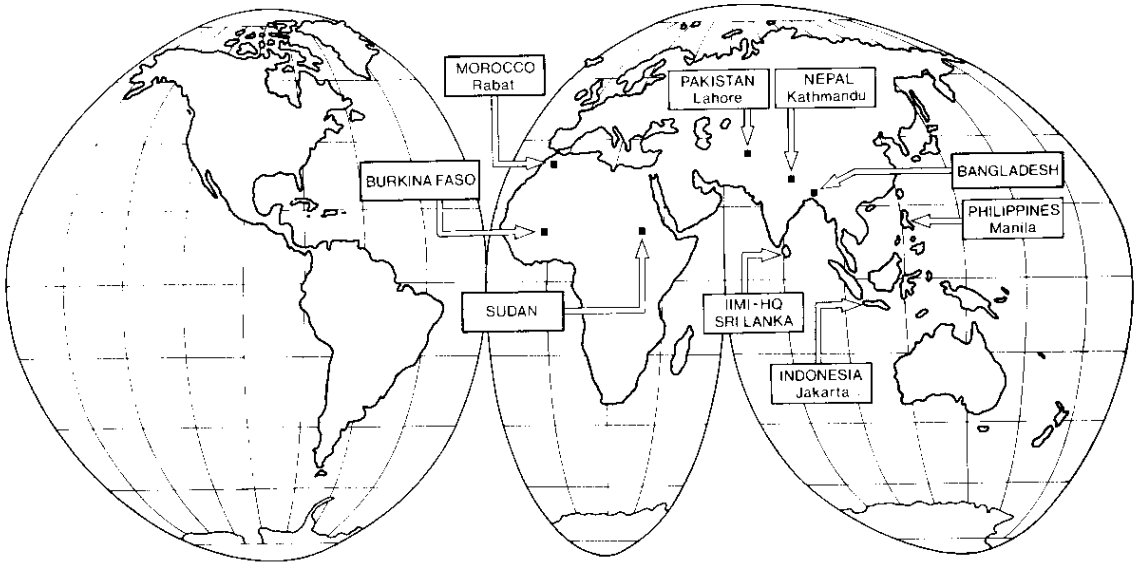
IIMI operates in a decentralized mode, with a small support staff at headquarters, and a number of staff outposted in country programs. Country programs fall into two principal categories: 1) nonresident country programs, in which IIMI undertakes intermittent functions such as participating in collaborative research projects and encouraging national participation in network research; and 2) resident country programs, in which IIMI appoints one or more senior international staff to collaborate with irrigation-related agencies in action research and training. Such programs may operate across IIMI's range of themes. Headquarters staff carry out research and development activities that draw upon the experiences gained from IIMI's field operations, support outposted staff, and coordinate and integrate the research results generated from country programs.

Throughout 1987 IIMI continued to work within the framework of its three research programs: Systems Management, Rehabilitation and Improvement for Management, and Farmer-Managed Irrigation Systems. Within those programs, IIMI worked to identify, field-test, and evaluate new management practices. This included determining the conditions required for the successful adaptation of new practices from one context to another.

Professional development at IIMI in 1987 included courses; special awards, through which innovative agency officials

were invited to IIMI to share and develop their experiences; research fellowships; workshops and conferences that directly relate to IIMI's research; and on-the-job training for IIMI's staff. Information exchange and dissemination included a publications service and documentation center.

In contrast to last year, this year's Annual Report presents its research results and progress through the perspective of its country programs. As presented in the following pages, 1987 country programs existed in Sri Lanka, Pakistan, Indonesia, Nepal, and the Philippines. The establishment of new programs was explored or initiated in India, Bangladesh, Sudan, Morocco, and West Africa.



SRI LANKA

Introduction

Sri Lanka is a small but important country for irrigation management research. This is partly because of the continuing importance of irrigation in the country's development plans, and partly because of the willingness of the government agencies to experiment and test management innovations as an integral part of their evolutionary growth. In this context, emphasis is now being placed on improving the management of irrigation schemes by improving the services of the different line agencies and by ensuring farmer participation in operation and maintenance (O&M).

At present, Sri Lanka's total irrigated area is approximately 520,000 hectares (ha). Of that, about 300,000 ha is managed by the Irrigation Department (ID), 175,000 ha by the Department of Agrarian Services (DAS), and 45,000 ha by the Mahaweli Authority of Sri Lanka (MASL).

IIMI maintains a broad-based field research program in Sri Lanka. Projects covered the spectrum of research themes with significant overlap among them.

The ID has constructed a large number of irrigation schemes (reservoirs and run-of-the-river diversions) over the last 80 years. Minor schemes of less than 80 ha, of which there are now 15,000, are handed over to the DAS for O&M. Schemes with a command area of more than 80 ha are classified as major irrigation schemes and are operated and maintained by the ID. There are nearly 500 such schemes.

The Mahaweli Ganga Multipurpose Project is the biggest irrigation and hydropower development project in Sri Lanka. The main feature of the irrigation system is the diversion of water from the Mahaweli Basin by means of transbasin canals. The planned irrigable area under the Accelerated Mahaweli Programme which is being implemented by the MASL is approximately 200,000 ha, which is made up of both newly developed land as well as some former irrigated land which generally had adequate water for one wet season. Out of the present 120,000 ha that have benefitted from assured water supply, the ID maintains an area of approximately 75,000 ha, while the balance of 45,000 ha is directly managed by the MASL.

In addition to its headquarters activities related to support and backstopping of its country programs, IIMI maintains a broad-based field research program in Sri Lanka. Projects covered the spectrum of research themes with significant overlap among them. In 1987, research was conducted at a

site in the North Central Province (NCP) containing three irrigation systems, and at another in southern Sri Lanka comprising two relatively large irrigation projects and on a smaller scale at several farmer-managed irrigation systems or in parts of other agency-managed irrigation systems.

In 1987, there were 6 internationally recruited research staff and 24 national research staff engaged in research and development activities in Sri Lanka. Funding for Sri Lanka research in 1987 was derived from core funds and special project support. Collaborating agencies include the Irrigation Department, the Irrigation Management Division, the Agrarian Services Department, the Mahaweli Economic Agency, the Mahaweli Authority, the Ministry of Lands and Land Development, and the Agrarian Research and Training Institute.

Sri Lanka research is guided by a National Consultative Committee which in 1987 involved high-level officials from each of the above institutions as well as the Faculty of Agriculture of Peradeniya, the Mahaweli Engineering and Construction Agency, and the Extension Division of the Department of Agriculture. The Consulative Committee assists IIMI to carry out its mission in evaluating its activities, identifying appropriate partner agencies/institutions and staff to work with, and interpreting and relating IIMI's research findings to the larger irrigation environment.

Irrigation Management for Rice-Based Systems in the Dry Seasons

The major irrigation schemes in Sri Lanka's dry zone have provided the basis for the rapid increase in rice production recorded over the past decade. They equally hold the greatest potential for increasing production of non-rice crops. Recognizing this, national policy makers have accorded the highest priority to achieving more productive use of the existing irrigation infrastructure through intensification of diversified cropping and more effective irrigation system management.

In 1985, IIMI began research to identify and alleviate constraints to effective irrigation management for rice-based irrigation systems, with a particular focus on non-rice cropping in the dry season. The work is closely linked to similar projects in Indonesia and the Philippines. In all three

countries research has proceeded in two phases: the first phase sought to identify, evaluate, and document observed constraints, concluding with a series of recommendations to the collaborating agency and host country; the second phase, which was initiated in Sri Lanka in 1987, is an action research stage wherein IIMI staff, in collaboration with staff from the collaborating agency, pilot-test proposed management interventions.

The research in Sri Lanka is conducted in parts of two agency-managed irrigation systems, Kalankuttiya and Dewahuwa, in the NCP. The Kalankuttiya Block of System H was the first area to be settled under the Mahaweli Development Programme in 1975. Since 1979 the new settlement areas of System H have been divided into three project areas, each under a resident project manager (RPM). The Kalankuttiya Block falls within the project area of the RPM, Galnewa and has a total irrigated area of 2,021 ha. The water distribution system consists of an 11.5 kilometer (km) branch canal that takes off from the Kalankuttiya Reservoir. The Kalankuttiya Block is made up of five irrigation blocks. The distributary channel outlets have a measuring weir immediately below the gate, and the field channels that take off the distributary channel have turnout gates. Supply to field allotments of one hectare each is from field channel outlets only.

The major irrigation schemes in Sri Lanka's dry zone have provided the basis for the rapid increase in rice production recorded over the past decade. They equally hold the greatest potential for increasing production of non-rice crops.

The Dewahuwa Irrigation Scheme, also in the NCP, is 35 years old and is administered by the ID and the Irrigation Management Division (IMD), both of which are line agencies under the Ministry of Lands and Land Development (MLLD). The scheme consists of a 12 million cubic meter (mcm) reservoir and a channel network commanding a total area of 1,215 ha. The main canal is 16 km long. The source of its water resource is from its own catchment, supplemented by occasional diversions from the Nalanda Oya Reservoir. The command area is divided into nine irrigation tracts. The individual farm allotments of two hectares each are served by a network of distributary and field canals. Supply to farm allotments is from field channel outlets as well as direct outlets either from the main canal or a distributary.

The two systems adopt different irrigation management strategies to support widespread cultivation of non-rice crops during the dry season. During the first four seasons of study, two dry and two wet seasons (1985-1986), IIMI collected data on the timing and quantity of water flows, water adequacy at different levels within each system, costs and

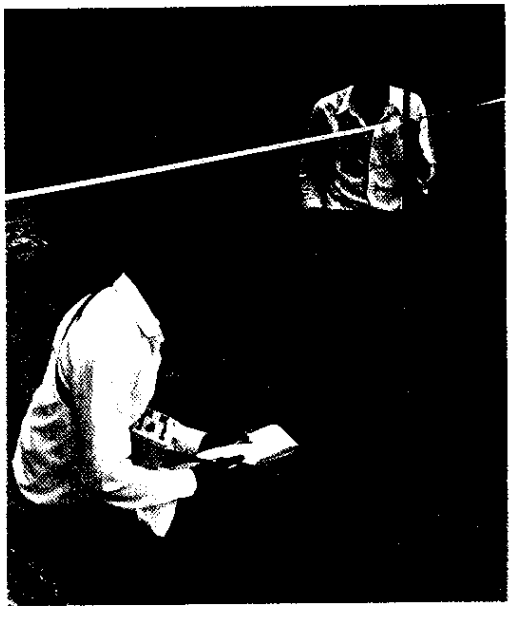
returns of different crops, farmer-agency interaction, and farmers' irrigation practices. The studies also documented and compared the management practices of the two systems.

After the completion of Phase I in early 1987, staff could identify with assurance three principal constraints to diversified cropping in those two systems. First, unreliability and inequity of supply at the turnout level resulted from inadequate control and regulation, especially at the systems' secondary levels. Second, staff found a lack of organization and management for sharing water at and below the secondary level. Third, there was poor communication between agency and farmers in water delivery scheduling.

Phase II of the research began in mid-1987 and aimed at pilot-testing management innovations appropriate to those three constraints. IIMI staff assisted agency officials to improve the reliability and equity of water delivery at and below the secondary canal, primarily by introducing mechanisms for a two-way feedback of information between the farmers and agency officials.

Two strategies were employed -- a rotational plan and post-issue meetings. A rotational plan for the distributary and field channels developed after land preparation was completed, channels provided farmers and agency staff with a clear set of performance targets. These were combined with post-issue meetings between agency officials, IIMI field staff, and farmers or their representatives; the meetings provided the opportunity to discuss and evaluate the previous issue and to plan the next. To assist in the process, IIMI field staff monitored canal flows and groundwater tables, and surveyed farmers' practices to provide the agency with regular information feedback on how the system was performing.

The intervention accomplished two objectives, though it was relatively more successful in Kalankuttiya than in Dewahuwa. The equity of water delivery among the field channels improved considerably; ratios of water delivery to field outlets between those nearest the turnout and those farther away improved from 3:1 to 1.5:1 after the intervention. Second, improved interaction between the farmers and agencies concerning the rotation plans led to better communication as to when the rotational issues would take place. The rotational planning also allowed managers to accommodate crop needs by changing the frequency of issues (from 1 in 7 days during crop establishment, to 1 in 10 during the mid-growth stages, and back to 1 in 7 during the latter stages of plant growth).



Three main conclusions have emerged.

Flow measurements constitute an important management tool. They provide an effective focal point for discussion between project management and farmer representatives and can be a useful instrument for improving farmer-agency cooperation.

Regular meetings between farmer leaders and project staff after each water issue are an effective way to improve communication between farmers and project management, especially to identify and rectify specific water problems at the secondary and tertiary levels. These meetings also enhance the positions of the farmer turnout leader and the distributary channel representative by giving them a highly visible function.

Regularly scheduled rotation of turnouts enhances the capacity of the farmers to take over management functions below the distributary channel's head gate which in turn frees the Mahaweli unit manager to attend to other duties, and allows the farmer representatives to schedule their time for operating turnouts and other related functions.

Performance Monitoring and Evaluation

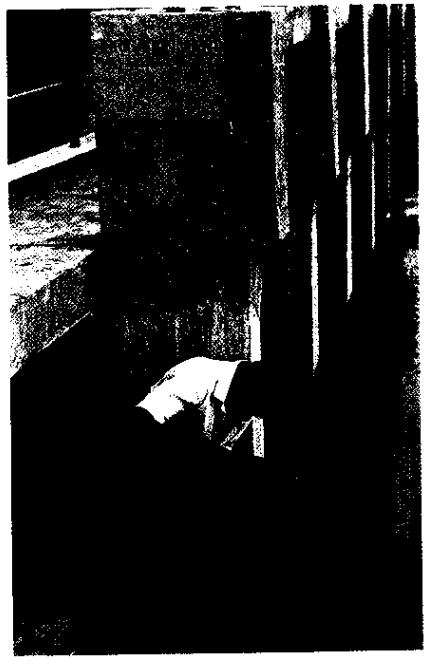
The concepts of irrigation system performance, its improvement and sustainability are fundamental to IIMI's mission and work. Performance is hence treated as a core subject to be integrated into each of the different research themes. The measurement of irrigation performance, and the determination of the impact of management innovations on performance are crucial to this work.

The concepts of irrigation system performance, its improvement and sustainability are fundamental to IIMI's mission and work.

In 1987, IIMI completed research leading to a simple and potentially low-cost methodology for measuring field-level water adequacy, productivity, and equity of water distribution in lowland rice irrigation systems. The methodology is based on work begun by Dr. Thomas Wickham while at the International Rice Research Institute in the late seventies and utilizes data collected in the NCP in connection with the irrigation management study discussed in the previous section.

The method is based on the installation of perforated PVC tubes to monitor the fluctuations of the perched water level in

paddy fields. Based on this, staff developed indices for measuring the frequency, duration, and intensity of water shortage. These three indices, termed respectively, reliability, resiliency, and vulnerability, correlate well with crop yield from selected irrigation systems in Indonesia and the Philippines, as well as from the systems in Sri Lanka referred to earlier.



The methodology has potential for application as a management tool for continuous monitoring and evaluation of the performance and benefits (if any) of changes in structural design or operating procedures in irrigation systems. The benefits can then be compared with the costs of implementing the changes.

Also in 1987, staff developed a conceptual framework, a methodology, and a parameter to quantify the relative equity between the 'head' and the 'tail' of an irrigation system. The concept of head and tail in this context corresponds to offtakes that receive more or less than their 'due share,' rather than to their location along the canal. The underlying hypothesis is that in canals with regulating structures (duckbill weirs), situations can arise where the tail end of a system receives more than its due share while offtakes in the middle section receive less. The methodology uses a form of the Lorenz curve (more commonly used as a measure of income distribution) where the percentages of the command areas served by each offtake unit are arranged in rank order from the most undersupplied to the most oversupplied in terms of water received. The parameter is represented as follows:

$$\text{Relative Equity Ratio} = \frac{\text{Supply at the head}}{\text{Supply at the tail}}$$

$$= \frac{\text{Percentage of total vol.of water at the head}}{\text{Percentage of total area}}$$

$$= \frac{\text{Percentage of total vol.of water at the tail}}{\text{Percentage of total area}}$$

When applied to data collected in the Kalankuttiya branch canal, staff found that tail-end distributaries received their due share while those in the middle sections received less than their due share. Research will continue in 1988.

Performance Control for Professional Management of an Irrigation System

The need for greater communication between headquarters staff who develop policy and operational plans, and field staff who implement the plans is showing up more and more in IIMI's research. In 1987, IIMI approached the conclusion of an innovative case study of the operational process internal to the Mahaweli Economic Agency (MEA). The MEA is responsible for the management of irrigation schemes that come under Sri Lanka's Mahaweli Authority. In the study, IIMI researchers utilized concepts from the social and management sciences more commonly applied to the private sector.

Agency field staff often lack a full understanding of the operational plans developed at headquarters, and headquarters staff lack sufficient feedback on performance of the plan.

IIMI collaborated closely with MEA staff at headquarters and field levels. The area under study included two parts of System H in the NCP. Researchers sought to assess the capacity of the MEA to plan and implement its operational plan for a cultivation season, and in particular how it responded to the uncertainties of rapidly shifting priorities that typify macrolevel operations in many irrigation agencies. The occurrence of a drought offered the additional opportunity to examine the agency's capacity to respond to crisis conditions.

The study determined that field staff often lack a full understanding of the operational plans developed at headquarters, and that headquarters staff lack sufficient feedback on performance of the plan. Resulting recommendations to the MEA ranged from mechanisms for increasing preplanning communication between the two, to the installation of a phone and computer in the field office linked to those at headquarters. Equally important, this work demonstrated the feasibility of carrying out substantive research on the internal dynamics of irrigation agencies, agencies will even welcome the work if it is done collaboratively, with frequent discussion of results.

Irrigation Systems Management

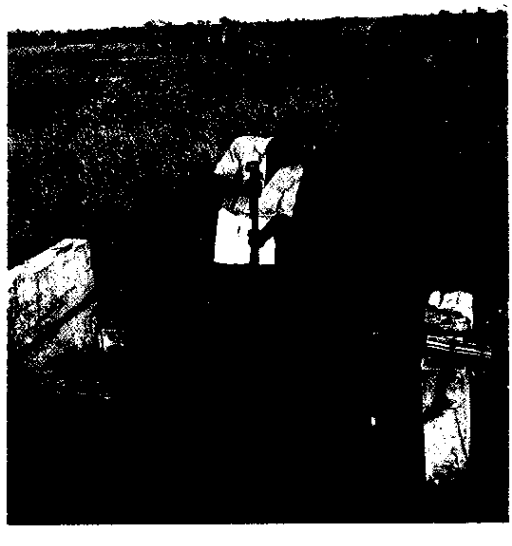
During 1987, IIMI prepared and submitted a proposal to USAID for funding under the Irrigation Systems Management (ISM) Project in Sri Lanka. A Cooperative Agreement was

signed in August 1987. Work began in October with a series of planning meetings and workshops. By the end of 1987, IIMI had completed a review of selected irrigation management literature in Sri Lanka, and had identified, evaluated, and begun selecting potential collaborating national research organizations through which the work will be done. Work in this area will focus on the development of farmers' organizations, evaluation of alternative rehabilitation strategies, cost-effective O&M practices, and performance monitoring and feedback processes of the Irrigation Management Division and Irrigation Department. This activity is expected to take place in four major schemes in the Polonnaruwa District.

Kirindi Oya and Uda Walawe

IIMI's research in southern Sri Lanka in 1987 focused on institution building, rehabilitation strategies,and canal operations, primarily at two irrigation systems, the Kirindi Oya and Uda Walawe irrigation systems.

The Kirindi Oya Irrigation and Settlement Project was developed with financial assistance from ADB, *Kreditanstalt fur Weideraufbau*, and the International Fund for Agricultural Development (IFAD). In December 1977, the ADB approved a loan of US$20 million to finance the project. This included augmenting irrigation water supplies for the existing irrigation system covering about 4,500 ha, providing irrigation facilities for an additional 8,400 ha, and the settlement of about 8,300 families on the newly irrigated land. Following a large increase in the financing requirement, a result of rapid inflation in Sri Lanka and implementation delays, the Kirindi Oya Irrigation and Settlement Project was subsequently reformulated to be implemented in two phases.



Phase I of the project was nearly completed by the end of 1987. New and improved irrigation facilities were provided for 8,800 ha of which 4,600 ha were already cultivated under the existing tanks. About 4,500 farm families in the existing irrigated areas benefited from the improved irrigation supplies. An additional 4,200 farm families were settled on the new lands brought under cultivation. Phase II, just getting underway, will develop another 4,100 ha for irrigation and settlement.

The Uda Walawe Project was initiated in 1959 with the joint

aim of hydropower generation and irrigation of some 32,000 ha. For various reasons implementation was delayed, but in 1969, the ADB approved two loans amounting to US$8.59 million and US$0.4 million for the Walawe Development Project. Although scheduled for completion by 1972, it was not until 1979 that the Right Bank area of 12,000 ha was considered essentially complete. Development on the Left Bank has been less satisfactory, with only 6,000 ha developed. A major constraint for further development of the Left Bank has been excessive water use on the Right Bank. The MEA, the implementing agency, took over operational responsibility of Uda Walawe in 1982. In 1984, the ADB agreed to provide funding for the rehabilitation and improvement of the Right Bank. The project was estimated to cost US$13.7 million, of which the Bank loan provided US$11.0 million.

The two sites provide IIMI with an ideal opportunity for generating management innovations across the spectrum of its research program themes.

The history of these two sites, the shifting priorities of operational policies, the multiple objectives of the projects, and the complexity of funding and management arrangements provide IIMI with an ideal opportunity for generating management innovations across the spectrum of its research program themes. IIMI's established relationship with Sri Lanka's irrigation agencies will facilitate this work.

Although the research began in 1986, severe drought led to a delay in research activities in 1987. Nevertheless, considerable progress was made in implementing IIMI's research in the two systems. The results of this work are presented below.

Interagency Coordination and Agency-Farmer Communications

The need for coordination and communication among and between agencies or departments can be a critical factor in improving the performance of the irrigation system in question.

In many Asian countries, the responsibility for irrigation system development and management cuts across a number of agencies, or across a number of departments within an umbrella agency. The need for coordination and communication among and between such agencies or departments can be a critical factor in improving the performance of the irrigation system in question. Under such circumstances, agency-farmer relations become more complex. Such is the case in Kirindi Oya.

Research was initiated in October 1986, and temporarily suspended in March 1987 after a severe drought had led to crop failure and abandonment of the land by the new settlers in this scheme. During this period, a 100 percent census on a sample distributary channel was completed; and through observations, interviews, and attendance at meetings, data

were collected on farmers' irrigation behavior, field-level officials' behavior and interaction with farmers, the process of establishing farmers' organizations in a new settlement scheme, and the responses of farmers and agencies to the severe drought. These data are still being analyzed, but preliminary findings include the following:

1. The distribution of water among and within field channels on the sample distributary channel during the land preparation period was chaotic -- a result of unpredictable and constantly varying supplies, defects in the physical system, and the lack of a systematic mechanism for sharing water. Farmers on some field channels began developing informal procedures for water sharing.

2. Communication between the agency and farmers was ineffective; farmers did not know when water would be coming, or would stop, and did not know about the rotations officials were trying to implement. Relations between farmers and certain non-irrigation departments were also not smooth.

3. The agencies did not have an adequate plan for dealing with the drought; as a result, many farmers lost their investments in land preparation and sowing, and became further disenchanted with the agencies. Cooperation among agencies was weak, and there was considerable finger-pointing by officials, trying to shift blame to others.

4. The Irrigation Management Division's efforts to organize farmers on the distributary were having some positive impact until the drought, which led to divisions within the farmers' organization; the whole effort to promote farmers' organizations has probably been set back considerably by the drought.

Land Settlement Planning for Improved Irrigation Performance

In the area of land settlement, IIMI's research in Kirindi Oya, begun in 1987, addresses two questions. How can settlement planning and policy innovations contribute to improved performance in new irrigated settlement schemes? And, what rehabilitation strategies can rectify irrigation problems which

arise as the result of original settlement planning in established schemes?

The research in Kirindi Oya is proceeding in two phases. First, staff will review literature on irrigation settlements throughout the country. Second, national staff will be posted in one of the settlement villages, to begin formal surveys of the settlers. This information will be analyzed and documented in a full report in late 1988.

Rehabilitation Strategies in Uda Walawe

The Uda Walawe Irrigation Project is typical of many externally financed rehabilitation projects. IIMI's research on this project is designed to assist the management agency (MEA) and the donor to re-evaluate their rehabilitation policies and strategies, and develop more cost-effective and sustainable approaches. The long-term impact on future rehabilitation strategies may be more significant than the impact on the project itself, which has little built-in flexibility.

Many countries with mature irrigation systems are currently making large investments in their rehabilitation. The primary objective of a rehabilitation project is to improve and sustain the performance of an irrigation system.

In 1987, research focused on one distributary channel that irrigates roughly 150 ha. IIMI documented the farmers' and officers' behavior and perceptions in considerable detail for two seasons, as a baseline for predicting the likely response to the rehabilitation, and for measuring the impact. IIMI also documented the agency's internal decision making processes at the block and field levels, and agency-farmer interactions. Senior staff attended monthly rehabilitation progress meetings, and informally interviewed consultants and senior officials on the operation of the system and the rehabilitation decision making process.

Framework for Establishing Sustainability of Rehabilitation Projects

Many countries with mature irrigation systems are currently making large investments in their rehabilitation. Rehabilitation projects are frequently funded by donors and lending agencies which have an influence on the strategies adopted for rehabilitation and the processes of planning, design, and implementation. The primary objective of a rehabilitation project is to improve and sustain the *performance* of an irrigation system by appropriately upgrading the physical structures and infrastructure (hardware) and the associated organizational structures and the management processes (software).

In 1987, IIMI studied six selected rehabilitation projects in Sri Lanka in regard to one significant issue: the degree to which efforts were made to strengthen management capacity, particularly, but not only, through building effective farmers' organizations as a part of the project. Staff developed an analytical framework for comparing the degree to which rehabilitation projects emphasize institution building. The study was reported in a paper submitted to the Irrigation Design for Management (Asian Regional Symposium), held in Kandy in 1987.

The paper tested the hypothesis that irrigation system rehabilitation projects that build effective farmers' organizations which are supported by irrigation management agencies responsive to the needs of the organizations are more likely to exhibit sustainable improvements in productivity and equity than those primarily emphasizing physical reconstruction. The results strongly supported the hypothesis.

Canal Operations

It is a common belief among irrigation managers that main canals operate according to their design -- under steady flow conditions -- and that those conditions are relatively easy to achieve. These officials tend to believe that most problems in canal operations, such as inequity and unreliability, enter the system at the secondary or tertiary levels. This may not be the case.

The performance of main canals is rarely studied by irrigation researchers in the context of the developing world.

However, the performance of main canals is rarely studied by irrigation researchers in the context of the developing world. Little is known about the movement of the water surface along main canals or how the variation of head influences discharge into the secondary canal. A major difficulty in this research is that variations in flow can occur over short periods due to such factors as rainfall, and opening and closing of offtakes. Unless the variation occurs at the time a manager or researcher chooses to measure the flow, the variation may go unnoticed.

IIMI's entry point is to demonstrate to managers that there are problems at the level of the main canal regulation and that these problems are often responsible for those downstream.

IIMI's entry point for this research then is to demonstrate to managers that there are problems at the level of the main canal regulation and that these problems are often responsible for those downstream. That is one objective of the IIMI study initiated in 1987 on the impact of the main canal regulation on the performance and manageability of systems. The study will record and compare the variations of main

canal flow conditions of four systems, each with different control technology and operation procedure. The first is the Right Bank Main Canal of the Kirindi Oya Irrigation System (see description above), which has 14 gated cross regulators over a distance of 30 km. The second is the Kalankuttiya Branch Canal, which has 9 duckbill weirs along 11 km. The third is the San Domingo Canal in the Upper Pampanga River Integrated Irrigation System (UPRIIS) of the Philippines which has a high density of control structures (each 0.5 km), either gated cross regulators or simple checks with flashboard. And the fourth is at the head of the distributary canal of the Rajangana Pilot Project, Sri Lanka, fitted with an automatic level-control gate associated with a baffle distributor to control discharge in its distributary channel irrespective of the level variations in the main canal.

Control technologies, e.g., technologies designed to maintain water level and/or discharge in open canals as per given target, have been extensively used for surface irrigation in Mediterranean countries with some success. In Asia, applications of modern technologies are far less common.

The first step in this research was to identify proper instrumentation for recording flow conditions. By mid-1987, IIMI had investigated, identified, and purchased dataloggers and measuring devices, which can record water flow every few minutes. By the end of the year, staff had installed two in Kalankuttiya, one at the head and one at the tail; two in Kirindi Oya, in similar locations; and two in Rajangana. Experimentation began and preliminary results suggested wide variations in flow conditions at Kirindi Oya and Rajangana. Flow conditions in the Kalankuttiya Branch Canal, through the duckbill weirs, varied no more than 10 centimeters (cm). In the Kirindi Oya System, however, staff recorded variations under heavy flow conditions as high as 80 cm.

Technology and Design for Canal Operation

Control technologies, e.g., technologies designed to maintain water level and/or discharge in open canal as per given target have been extensively used for surface irrigation in Mediterranean countries with some success, in Morocco in particular. Modern developments of control technologies implemented in this region started about 40 years ago, shortly after World War II. In Asia, applications of modern technologies are far less common, because the policies and technologies developed over the ages for rice cultivation emphasize the sharing of water more than control of delivery.

Thus, the potential exists in Asia to improve manageability and performance of irrigation systems as required now to meet the specific demand of more diversified cropping in the dry season. This potential might be achieved by innovations in

the field of control technologies (e.g., introducing, testing, and adapting to the Asian context, control technolgies applied elsewhere for canal operation and water distribution). However, donor agencies often pressure irrigation agencies to try new technologies, whose relevance they do not necessarily share, nor indeed, the donors' enthusiasm, and this may lead to failed experiments.

The latest opportunity to examine this situation, in Sri Lanka, is the Major Irrigation Rehabilitation Programme (MIRP) currently implemented by the Irrigation Department with the support of the World Bank. The program comprises two pilot projects, Rajangana -- a water surplus system -- and Huruluwewa -- a water short system -- where control-technology is going to be tested (one automatic constant level gate associated with baffle distributors for the control of inflow into both command areas and for the distribution to the various field canals). IIMI was interested to observe the process and development of this experiment with the new technology and its eventual impact on manageability of the system.

In 1987, IIMI worked with the agency to understand and set up the technology and associated experiment. IIMI also arranged to assist the Irrigation Department via a consultancy by the manufacturer of the equipment, for the correct installation of gates and modules and for their appropriate operations. In the process IIMI learned how pilot projects can fail, and, more importantly, the necessary conditions for their success.

Problem Solving on Main Canals

In its first three years, IIMI grappled with the question of how to solve effectively problems at the level of the main canals. Unlike at the tertiary level it is very difficult to experiment at the main canal when so many people can be affected. Irrigation agencies are not willing to carry out classical experimentation, which might mean repeated adjusting of the main sluice, or offtakes. Thus, IIMI had to find another way.

At the same time there is a real need to discover effective and responsive practices for operating main canals, particulary in the extended network of canals which prevail in rice-based irrigation systems. Improving performance at this level is expected to have a profound impact over the entire system as it would facilitate current efforts by agencies to provide more reliable and equitable water supply.

There is a real need to discover effective and responsive practices for operating main canals.

In 1986, IIMI decided on a research approach which consists of simulations (through hydraulic modeling) of the behavior of canals and structures operating under conditions similar to those which can be observed in actual systems. Although not new in itself, the development of a methodology of this type appropriate to Third World conditions would open up new avenues of research. Such a model would offer researchers and agency staff a powerful tool to assess and compare performance when considering 1) a variety of scenarios for the operation of the system in response to changes in the external conditions and/or supply targets; 2) different rehabilitation options and strategies, including physical upgrading of the system (cleaning the canal, desilting, innovative design control structures); and 3) improved managerial capacities such as a better communication system and information feedback for real time operation.

In 1986, IIMI identified three suitable sites for application of such a model. In 1987, it identified, from among the many models now in use, a hydraulic model developed in France that could be adapted for this purpose. It also identified a collaborating partner who could provide the technical expertise necessary to carry out such a project. IIMI approached the *Centre National du Machinisme Agricole, du Gênie Rural, des Eaux et des Forets* (CEMAGREF) in France to collaborate in the project. CEMAGREF will provide IIMI with existing state-of-the-art computer programs, and technical backstopping, which will lead to a user-friendly simulation model appropriate to microcomputers readily available to IIMI (such models are more often run on mainframe computers). In that format the model will also assist agency staff at Kirindi Oya in main canal operation and design.

Related to this project, IIMI staff also completed a topographical survey of two of the previously identified main canals, visited Utah State University (USU), California Polytechnic University, and Cornell University to assess current activities in the field of main system modeling, and acquired two existing flow simulation models, MISTRAL, from *Société Grenobloise d'Etudes et d'Applications Hydrauliques* (SOGREAH) and USU. At the end of the year a preliminary application of MISTRAL on the first reach of Kalankuttiya Branch Canal was attempted.

Assistance Strategies for Farmer-Managed Irrigation Systems

In 1987 IIMI completed a one-year study of several farmer-managed stream diversion systems (anicuts) in southern Sri Lanka which focused on problems of intrasystem equity following a government assistance program. As shown in the study, benefits from an improved water supply and reduced risk often accrue disproportionately to larger farmers unless deliberate steps are taken at the design and construction stages. This includes the placement of new structures and the formulation of new O&M practices. The study highlighted the interaction between the implementation process and the long-term operational sustainability of farmer-management.

In the NCP, IIMI completed a two-year study of a cluster of small tank irrigation systems in Anuradhapura District, where several major assistance programs are underway (e.g., the Anuradhapura Dry Zone Agricultural Project, funded by ADB and IFAD, and the Village Irrigation Rehabilitation Project, funded by the World Bank). The study focused on the overall economic context of irrigated agriculture in this high-risk environment, and on the management of water during the cropping cycle with the goal of assessing the scope for irrigation assistance. Preliminary results suggested critical climatic constraints to returns on irrigation investments, but also pointed to possible improvements in total production through greater coordination of wet season rice planting.

In 1987, IIMI also initiated a methodological study of Farmer-Managed Irrigation Systems (FMIS) assessment techniques for the irrigation component of integrated rural development projects (IRDPs). The study focused on the assessment needs of an IRDP in the Badulla District and was conducted in collaboration with the implementing agencies to address their particular information needs. Those needs included pre-project apraisal, during-project monitoring, and post-intervention evaluation. The objective of the study is to develop more efficient data-gathering methods which agencies can use to manage the intervention process and later to monitor farmers' irrigation management practices.

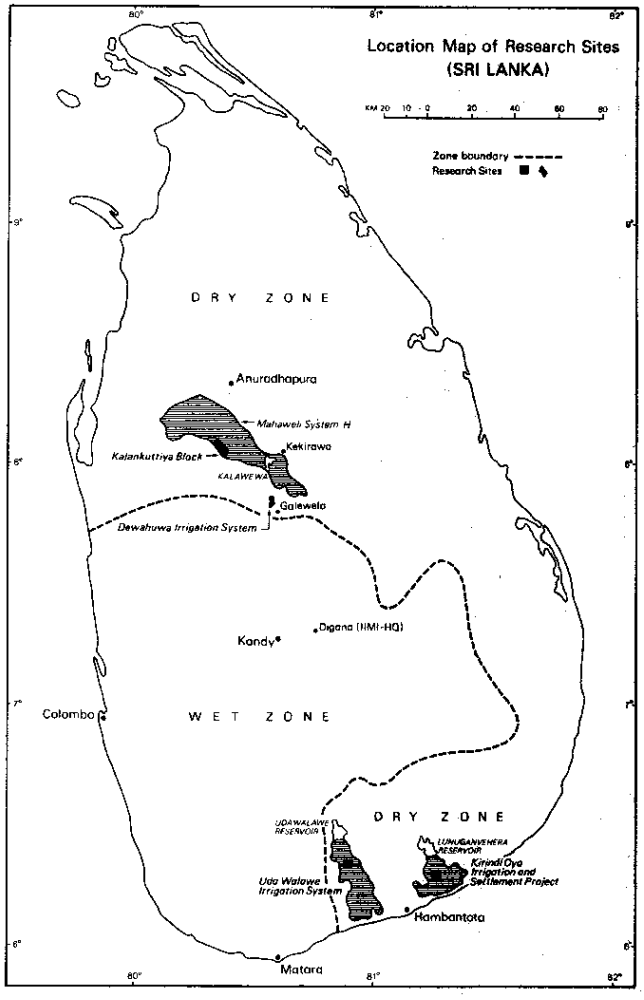
IIMI staff prepared an interim report in June and a draft report in December. The next step will include testing of the assessment methods by agency staff, followed by a national workshop to consider the general issue of information management related to FMIS assistance.

Working Group on FMIS

Sri Lanka's rich heritage of farmer-managed irrigation systems has attracted the attention of both researchers and development assistance agencies. Although considerable study and project implementation is underway, little real understanding exists of FMIS assistance needs and strategy options.

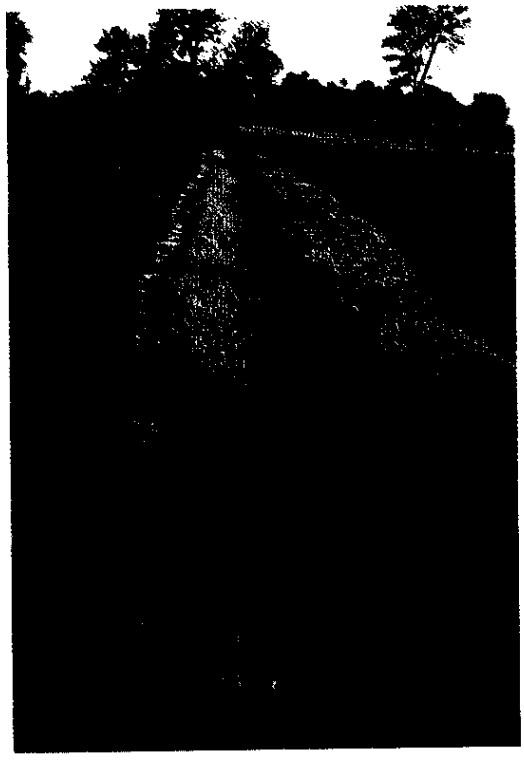
In 1987, IIMI, in collaboration with the Agrarian Research and Training Institute (ARTI), helped establish a working group which will meet periodically to exchange results of research and experience, and to discuss ongoing assistance programs. A key objective is to stimulate action research and to develop ongoing dialogue between the research community and agency officials.

A workshop was sponsored by IIMI in December at its headquarters to launch the group.



PAKISTAN

Introduction



In many respects, Pakistan's irrigation environment is different from other countries where IIMI currently employs resources. In contrast to tropical Asia, Pakistan is arid or semi-arid. It is located entirely in the temperate zone and has a long history of irrigated non-rice crops, particularly wheat. The irrigated lands are particularly vulnerable to waterlogging and salinity.

Its scale is also different. Pakistan has the largest contiguous irrigation system in the world, extending over some 14 million ha. Approximately 71 percent of Pakistan's agricultural area is irrigated. The system of primary and secondary canals stretches to 61,000 km in length with tertiary-level canals estimated to reach another 1.6 million km. Forty-two canal commands and 89,000 watercourses serve an estimated 3.6 million irrigated farms. Annual water supply, primarily from snow-melt runoff from the Himalayan Range (Karakorum), totals about 15.6 million hectare-meters. Some 250,000 tube wells supplementally provide an estimated 4.4 million hectare-meters.

Pakistan has a long history of irrigation. The administrative and physical structures controlling its irrigation systems developed in a physical and socioeconomic environment in which land was relatively abundant, water supply was relatively uncontrolled, professional and technical resources were scarce, and the need for equity of water allocation and delivery was high. The result, appropriate to the time, was a combined system geared to administration rather than management, and to stability rather than adaptability.

There is considerable potential for increased and sustained food production through better irrigation management. Irrigated wheat and rice fields average about 2.0 metric tons/ha. Yield for cotton, maize, and sugar cane is about one-third of the potential. Irrigation related constraints -- excess water, drainage, and salinity affecting some 4.5 million ha -- contribute to keeping yields low.

Established in 1986, the Pakistan branch made significant progress in 1987. The branch established collaborative relationships with the irrigation community, generated applicable research results, and identified additional funding for the period 1988-1993. It acquired the facilities and

equipment, and recruited the necessary support staff to fully carry out its activities.

In 1987, IIMI's Pakistan staff, which numbered 40 research and support staff, operated out of rented office facilities in Lahore. US$2 million will be provided for a permanent office building through a loan from the World Bank to the Government of Pakistan, and will be available in mid-1988. During 1987, IIMI upgraded the Farooqabad/Chuharkana resthouse on the Upper Gugera Branch Canal, provided to IIMI by the Punjab Irrigation Department. The resthouse, about 45 km west of Lahore, with office facilities for 8, and overnight accommodation for 6, serves as the base for field operations in northern Punjab.

Funding for most of 1987 was provided by the International Fund for Agricultural Development. Supplementary support was made available from the IIMI core budget. Funding from USAID became effective on 1 October 1987 through a USAID grant of US$2 million to cover a period of three years.

IIMI's research in Pakistan is assisted by a Consultative Committee consisting of the secretaries of the irrigation and agriculture departments in the four provinces, representatives of the Federal Ministries of Water and Power and of Agriculture, the Water and Power Development Authority (WAPDA), and the Pakistan Agriculture Research Council (PARC). In addition, the Pakistan unit developed collaborative agreements with research partners such as the Punjab Irrigation Department, and the Punjab Agricultural Department.

Reliability of water supply and equity of access to that supply are at the forefront of IIMI's research in many countries.

Research Focus in 1987

The Pakistan unit continued or concluded research in two thematic program areas, Canal Operations and Maintenance, and Rehabilitation. A number of research proposals were generated in 1987 in the other program areas that staff expect to implement in succeeding years.

Reliability of water supply and equity of access to that supply are at the forefront of IIMI's research in many countries. In Pakistan, where management intervention in water delivery is often limited by fixed control stuctures, postconstruction changes in supply and demand factors present managers with

daunting challenges. Those factors include changes in agricultural practices (cropping intensity, cropping patterns, new crop varieties with varied growing seasons), water supply (the construction of major storage reservoirs and link canals to re-allocate water between wet and dry seasons), sedimentation and erosion (which alter channel profiles and hydraulic conditions at control structures), groundwater development, and finances (shifting budgetary priorities between surface systems and tube wells).

Reliability and Equity in the Main System

In 1987, IIMI initiated and completed research in cooperation with the Punjab Irrigation Department to examine the causes of unreliability and inequity in water distribution of a major canal system. The research involved an investigation to ascertain where and how variability in flow enters the system and how it is transmitted downstream. To do this, staff analyzed over 30 years of data collected by the Punjab Irrigation Department.

Researchers determined that there was considerable deviation from design discharge between the distributaries of the sub-division under study. Discharges into four of the distributaries frequently exceeded design conditions but were consistently below design conditions in the other three. Data also indicated that when change in discharge occurred in the main canal, the change was not transmitted uniformly to the secondary canals. Three distributaries had a higher variability of discharge than in the main canal, while the other four had lower variability.

Staff thus concluded that differing managerial inputs at each of the control structures along the main canal resulted in different water delivery conditions at each distributary in the subdivision, and that there is opportunity to re-establish greater equity at the secondary level by improving management conditions at these locations.

Differing managerial inputs at each of the control structures along the main canal resulted in different water delivery conditions at each distributary.

Variability and Equity of Water Distribution at the Secondary and Tertiary Levels

Variability of flow in the main or branch channel (primaries) affects water distribution in the offtaking distributaries (secondary channels) and in the watercourses (tertiaries) they

serve. Research was conducted in 1987 to determine the effect of changes in secondary channel flow upon flow to tertiaries.

Water measurements collected and analyzed by IIMI staff revealed that the discharge into watercourses deviated significantly from the designed discharge. In the upper reaches of a distributary, water surface elevations are invariably higher than designed levels, due in part to siltation and poor maintenance. This results in greater discharge through upstream outlets, which decreases the water available to downstream watercourses. Along the distributary studied, which serves 23 watercourses, the discharge received by watercourses ranged from 179 percent of design for the 9th watercourse to 12 percent of design for the tail watercourse.

Although the inflow through an outlet is designed to have a hydraulic jump (modular or non-submerged) with a differential inlet and outlet water surface elevation on both sides of the outlet, this is not always achieved. Submerged flow restricts flow through the outlet. Where the submerged outlet is upstream on a distributary, the effect is to send more water to tail watercourses on the distributary. This is an inadvertent correction to inequitable water distribution. However, when modular flow is restored to these upper watercourses through watercourse improvement programs they again draw significantly more than design. This occurs at the expense of downstream watercourses, further increasing inequity between head and tail.

If there is a high ratio between discharge upstream of a structure and discharge into offtaking channels, then the offtaking channel will be less vulnerable to changes in upstream discharge than at locations where the ratio is low.

One important result of this work, which was presented to staff and others in a 1987 draft report, was the concept of equivalent distance. The concept combines hydraulic factors with the distance of an outlet along a channel. The methodology is based on the premise that vulnerability to variable or inadequate water supply depends not on distance alone, but on distance modified by hydraulic conditions at each control structure. If there is a high ratio between discharge upstream of a structure and discharge into offtaking channels, then the offtaking channel will be less vulnerable to changes in upstream discharge than at locations where the ratio is low. The methodology, which is now being tested in other countries, will assist managers in devising O&M and rehabilitation strategies that will reduce inequity.

Impact of Lining on Water Deliveries

All too often managers, often under pressure from donors, choose to line canals as a means of reducing conveyance losses. This may not always be the best solution.

In 1987, Pakistan staff completed research to determine the impact of distributary lining programs on water deliveries to tail-end farmers in both the commands of two irrigation systems, Upper Gugera (UGC) and Lower Gugera Canal (LGC). Initial work focused on Lagar and Ghordour Distributaries in the UGC; the lower third of each channel (18,000 feet, about 5,500 meters) was lined in early 1985. IIMI research showed that discharges at the tail of the distributaries did not improve after lining.

Late in 1987, IIMI initiated follow-up research to assess benchmark flow and channel conditions on two distributaries in the LGC which are earmarked for lining in the near future. This will give researchers the data to assess better the rehabilitation programs that are now planned by the Punjab Irrigation Department.

Future research will address how canal operations and irrigation practices can be more closely matched to wheat production requirements.

Irrigation Constraints to Irrigated Wheat

Research was also initiated to determine the operative irrigation constraints to wheat production. The Punjab Agriculture Department extension staff, who have responsibility for field data collection, carried out the field research with the guidance and supervision of IIMI staff. Collaboration in this case provided department staff with direct exposure to field research, as well as training in irrigation water management and its extension.

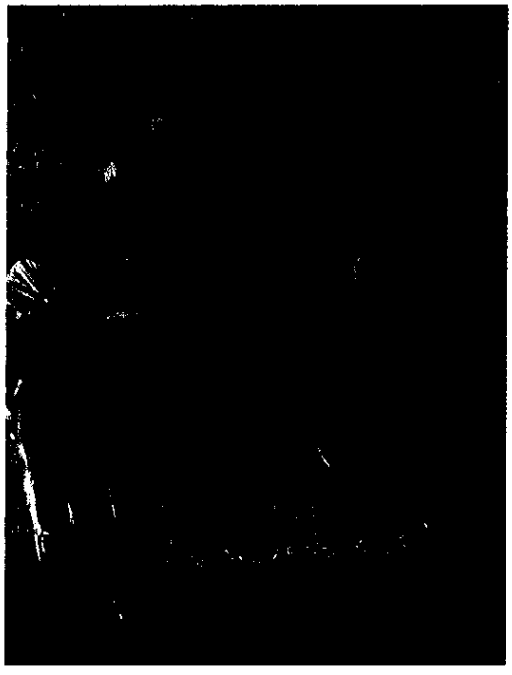
Preliminary findings showed that wheat production was strongly correlated to rainfall in March, a time when there is a general reluctance on the part of the farmers to irrigate wheat. At the end of the year, research was initiated to determine why farmers choose not to irrigate at that time and to assess the potential benefits and costs associated with March irrigations.

Future research under this project will address how canal operations and irrigation practices can be more closely matched to wheat production requirements.

INDONESIA

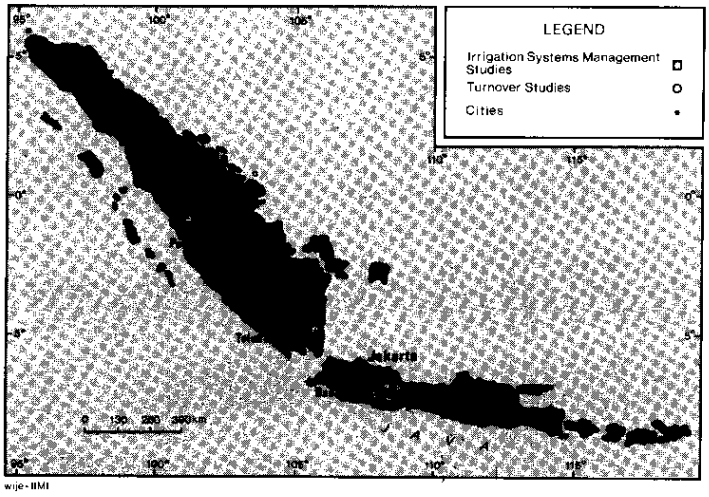
Introduction

Indonesia, where IIMI began research in 1985, contains some of the most sophisticated irrigation systems in Southeast Asia. Some US$12 billion have been invested over the past 15 years in the irrigation infrastructure. It dominates the region in irrigated area and in the number of farmers who depend on irrigation. There are more than 4.5 million ha in public irrigation systems and more than 1.0 million ha in village irrigation systems. It has a population of more than 165 million people, the fifth largest in the world. Annual cropping intensities in irrigated areas regularly exceed 200 percent. For all these reasons, IIMI chose Indonesia as the site of its second country program.



Research during the past two years has focused primarily on two components of a five-component ADB-funded Study of Food Production and Irrigation Strategies. The International Food Policy Research Institute (IFPRI) researched the first three components in collaboration with the Center for Agro-Economic Research (CAER) in Bogor. IIMI's two components included: 1) research on constraints to non-rice crop production on irrigated rice lands during those seasons when insufficient water is available to grow rice, and 2) research to assess actual irrigation system performance levels in various irrigation systems leading to the development and field-testing of approaches aimed at more effective irrigation management. The map below indicates research locations in Indonesia.

Indonesia dominates the region in irrigated area and in the number of farmers who depend on irrigation.



wije-IIMI

More effective utilization of existing irrigation systems is necessary to meet Indonesia's future food and employment requirements.

As in the Philippines and Sri Lanka, IIMI's work has been undertaken in two phases. In Phase I, which was completed in 1987, researchers measured irrigation performance in three provinces in Java. They identified performance deficiencies and their relationship to management, and recommended a series of management interventions to improve water control and delivery. In addition, IIMI played an advisory role in helping CAER implement field research into irrigation constraints in one system in Lampung Province in southern Sumatra. It collaborated with the University of Gadjah Mada in Yogyakarta in calibrating measurement structures in Lampung. Phase I was funded by the ADB with additional support provided by the Ford Foundation.

In Phase II, which commenced in late 1987, there is greater emphasis on action research to pilot-test recommended interventions developed in Phase I in West Java, and expansion of Phase I research into new areas in Lampung. IIMI is also assisting in the pilot phase of a program designed to turn over O&M responsibilities to farmers in small irrigation systems in West Java and West Sumatra. Initially work has focused on systems less than 150 ha but will expand to include systems less than 500 ha. IIMI's role includes research and advisory services regarding: 1) the nature of Provincial Irrigation Services (PRIS) investment in systems and farmer dependency on PRIS prior to turnover, 2) monitoring and assessment of the turnover process, and 3) institutional implications of turnover for PRIS sections. Collaborative work on turnover has been started with Padjajaran University in Bandung and Andalas University in Padang.

IIMI's activities in Indonesia are undertaken in cooperation with the Directorate General of Water Resources Development and the Provincial Irrigation Departments where IIMI field research and testing are being conducted. The unit is staffed by 2 senior internationally recruited staff members and 21 national staff.

Irrigation Management for Non-Rice Crops

The Government of Indonesia (GOI) recognizes that more effective utilization of existing irrigation systems is necessary if it is to meet Indonesia's future food and employment requirements. In its current five-year plan the GOI targets three specific problem areas: inadequate integration of irrigation development activities with other agricultural

activities, implementation problems related to provincial capability to manage increasingly complex irrigation systems, and inadequate utilization and maintenance of existing irrigation infrastructure.

The two components of the Phase I Irrigation Management Study were designed to help the GOI solve these priority problems. The objectives of the first phase were to identify new practices to meet the complicated irrigation management requirements for diversified agriculture, to facilitate the expansion of irrigated non-rice crops (*palawija*), and to increase the income of producers by increasing cropping intensity. Following that, IIMI began pilot-testing new practices in the field. In the relatively short time frame allocated, significant progress was made.

In 1987, IIMI staff in Indonesia accomplished the following:

* documented the actual performance levels, both in terms of water efficiency and management performance, of a wide spectrum of irrigation systems and identified operational and institutional practices that constrain performance;

* developed an operational tool for pinpointing specific systems or parts of systems where performance levels are exceptionally low;

* developed and field-tested improved management practices that can potentially increase performance with relatively minor investments in training and staff upgrading;

* detailed, through the use of decision-tree analyses, the importance of water availability and drainage as major influences on farmers' decisions to plant irrigated rice or irrigated non-rice crops;

* verified that low yields for non-rice crops often arise, in part, from over-irrigation and excessive moisture in the soil profile, even in the second dry season; and

* demonstrated the relationship between crop intensity and distance from the water source and established the potential for increased intensities and yields in the lower sections of many irrigation systems if the proposed improved operational practices were adopted.

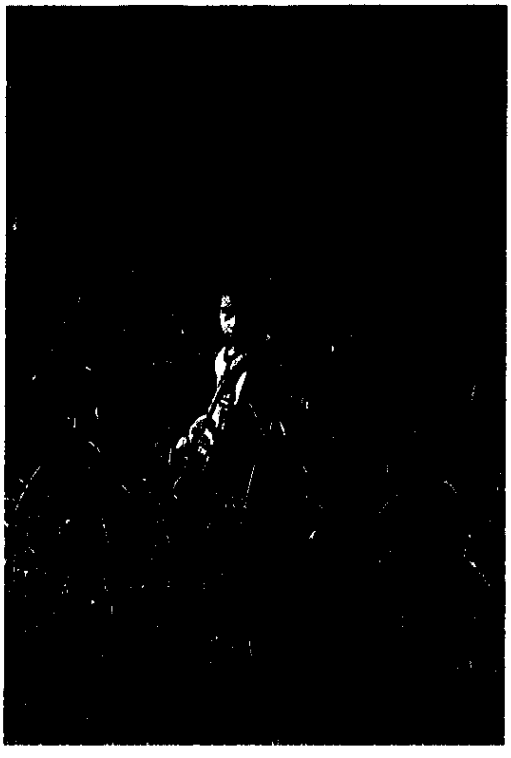
During 1987, IIMI and PRIS field staff also demonstrated two types of operational management weaknesses that lead to misallocation of water. The first one, and one that is hypothesized to be very prevalent, is miscalculation of the water required during the current time period due to incorrect estimation of actual irrigated area in the block or to incorrect information about area of crops actually growing in the block. The second type of misallocation is that resulting from overdiversion into the system.

The only way to address the problem of incorrect block size is to resurvey the irrigation blocks and, thus, ensure that the area to be served is known accurately. A similar situation arises due to the problems associated with determining exactly what crops are actually growing in the blocks and the stage of maturity of these crops during each time period. Both of these problems can be solved by developing an accurate field map of each block and using these maps to determine what crops are in the field. IIMI developed and tested the use of such a map in a series of blocks in which it was working. With this improvement in knowledge of cropping patterns, water allocations were better matched to demand, with consequent improvement in water deliveries and yields.

During the course of the study, staff documented the frequent overdiversion of water into secondary canals nearer the head of the system. In contrast, the canals and blocks that are far from the water source received significantly less water than upper blocks during the same time period. This situation is much more difficult to solve as it is not purely a case of imprecise data, but reflects a failure to record water deliveries in the field properly and to use this data for monitoring water delivery performance. To simplify the recording process, IIMI designed and tested a special field book for use by gate keepers. It is only when PRIS staff begin to keep a more precise check on actual water deliveries and compare them to planned deliveries that major inequities will be reduced. IIMI developed the "management performance ratio" as one tool for comparing actual to planned deliveries for use by PRIS field staff.

One option proposed by IIMI for improving water allocation is to test the possibility of calibrating, setting, and fixing tertiary gate offtakes along secondary canals (including many of those for which accurate measurement readings cannot be obtained). This would decrease the management burden inherent in frequent adjustment to tertiary gates, but

will require more attention to maintaining discharges in main and secondary canals at more or less constant levels for each time period in the season.



Implications of the above suggestions are quite significant, but expensive. The cost of mapping the required 4,500,000 ha, for example, would come to about US$23 million, which would have to come from outside funding. In addition to the time involved, the maps would require periodic revision to be kept up-to-date. However, without such maps, it will be difficult to increase dry season yields of irrigated non-rice crops.

Reducing overdiversions into main and secondary canals is also important, yet accomplishing this task requires improved maintenance, better training, and a commitment to stricter management practices. All the irrigation systems in the study were originally designed and built with sophisticated measuring capability. However, staff discovered that in many cases these were no longer functioning properly. Improved measurement requires better testing of measuring devices prior to acceptance, routine and periodic maintenance, and periodic checking and recalibration of all the measuring devices. Once the devices are working properly, on-the-job training would be required for all new employees to make certain they can read the measuring devices properly.

Finally, IIMI recommended that supervisors constantly check and recheck reported data to make certain field staff realize that flow measurement data is a critical element in the feedback and monitoring process. Again, all of these actions have a cost associated with them. Yet, without accurate measuring devices, well-trained staff that know how to use the devices, and supervisors that utilize the data for management purposes, it will be very difficult to manage properly the sophisticated irrigation systems in Indonesia.

NEPAL

Introduction

It is now widely recognized that rapid short-term increases in Nepal's per capita food production, almost constant during the last five years, must come through increased cropping intensity and production, available through better management of existing irrigation resources. Emphasis is

Irrigation systems managed by farmers will play an increasingly larger role in irrigation development.

being placed on improving the performance of already constructed agency-managed systems with the realization that this requires more participation by farmers. At the same time His Majesty's Government of Nepal (HMGN) is investigating ways to provide assistance to farmer-managed systems which are still responsible for over 80 percent of all irrigation in the country.

HMGN has taken a number of steps to improve its ability to plan and manage irrigation. It has encouraged the major banks to consider switching from project lending to irrigation sector loans. A ministerial reorganization by HMGN in late 1987 consolidated irrigation efforts under the Department of Irrigation (DOI). The Farm Irrigation and Water Utilization Division of the Department of Agriculture has been shifted to the DOI. The irrigation program of the the Ministry of Panchayat and Local Development will also be under DOI, and DOI plans to establish a number of district offices. And, most important, irrigation systems managed by farmers will play an increasingly larger role in irrigation development.

At the request of the Ford Foundation, IIMI began working in 1985 with the Water and Energy Commission Secretariat (WECS), HMGN's principal irrigation planning and policy body, to help the Secretariat develop capacity to manage irrigation-related research. IIMI's efforts to assist WECS are broad-based and multifaceted. First, IIMI assists WECS in investigating alternative approaches and appropriate technologies for farmer-managed irrigation. Second, it encourages farmer involvement in planning and implementing projects. Third, it promotes professional development, particulary through collaboration in research. And fourth, IIMI helped establish an Irrigation Management Research Planning and Utilization Unit.

The unit is staffed by one full time and one three-quarter time internationally recruited staff members and a number of support staff. In 1987 collaborative research was carried out with the Institute of Agriculture and Animal Sciences (IAAS), the Institute of Engineering, and the Department of Irrigation, Hydrology and Meteorology (DHIM). A memorandum of Understanding exists with WECS. Funding is provided by the Ford Foundation and the International Fund for Agricultural Development.

System Selection

The existing process for identifying systems for government assistance is not systematic. If a group of farmers want assistance to improve their system they must canvass the various agencies through local, district, or national political figures. Without government contacts it is difficult for them to get any assistance. This has resulted in random selection of systems to assist and those where returns to assistance are high are not necessarily selected.

In 1986, WECS, with IIMI's assistance, developed and applied a systematic, low cost, inventory process for identifying and selecting farmer-managed systems for government assistance. Primarily using the effectiveness of the land and water resource utilization as the criteria, the 152 systems identified by a 1986 inventory were quickly narrowed to 21 systems which had good potential for expansion. In 1987, a rapid appraisal study of those 21 systems then allowed further development of the profile necessary to tailor the implementation strategy to fit the needs of each system.

Implementation of Improvements

The use of local consulting firms to carry out the inventory and rapid appraisal followed the precedent of having consultants do feasibility and design studies. However, using them to follow through and direct the implementation of improvements, as tested in connection with this project in 1987, is a new innovation. Each of the activities undertaken by these consulting firms was directed according to specific terms of reference (TOR), developed by WECS with IIMI's assistance, as to how the work should be done. In addition IIMI assisted the firms to prepare the workplan and in some cases provided them with training in the field.

Farmer exchange visits proved to be an effective mechanism for transferring techniques and experience from one system to another.

Also in 1987, IIMI tested the use of farmer exchange visits between systems that are well managed and those that receive government assistance. The purpose was to help farmers identify the range of options to apply in improving the organization and management of their system. This proved to be an effective mechanism for transferring techniques and experience from one system to another. The exchange visit concept as a method of promoting water user organizations is an example of an innovation that has equal

application in agency systems. It has now been adopted by the DOI's Irrigation Management Center for use in their program.

Assistance Needs of Large Farmer-Managed Systems in the Tarai

IIMI research studies on farmer-managed systems in the hill country, IIMI's original focus in Nepal, have shown that farmer-managed irrigation can be very efficient. Comparison of organization and management principles observed in farmer-managed systems with agency systems, however, has generally been dismissed because the hill systems are small with at the most several hundred families participating in the organization. There are many examples of farmer-managed systems in the Tarai where size and scale are of the same order as some of the largest agency systems.

In 1987, IIMI concluded a study of a large farmer-managed irrigation system (15,000 ha) that diverts water from the Karnali River in the Tarai. Staff determined the difficulties faced in operating and maintaining such a large system, the organization and management methods used to mobilize necessary resources, the principles of water allocation among systems and among villages within a system, and the subsequent means of distributing the water in accordance with the allocation

Extreme deforestation is partly caused by irrigation practices.

At the Minister's request, IIMI made recommendations to the Ministry of Panchayat and Local Development for assistance to the system. This includes supplying the beneficiaries with wire to make crates (gabions) to replace the use of forest products in building temporary structures. Without this farmers would be unable to sustain their current irrigation due to extreme deforestation in the area, which is partly caused by irrigation practices.

A joint team of IIMI, DOI, and Department of Agriculture staff investigated another large (5,000 ha) farmer-managed system in the Tarai in Kailali District. WECS requested the survey, as a donor was considering providing assistance to the system. WECS asked the team to determine the capacity of the existing farmer organization to participate in making physical improvements in the system. IIMI also sought to test further and refine rapid appraisal techniques suitable for agency staff. Following the appraisal,

IIMI submitted a report which included recommendations for appropriate means of assistance.

Research Videos

To communicate the dynamic character of a well-managed irrigation system and the contextual nature of the organization and management practices, there is no substitute for a field visit. However, governmental officials have little opportunity for making such visits. In 1987, IIMI completed two videos to communicate field results more effectively. The first shows the relationship between the organizational development, resource mobilization, and the water distribution system in large Tarai systems. The video was instrumental in bringing the status of a large farmer-managed irrigation system to the attention of policy makers.

An IIMI Ph.D. Fellow directed the recording of a second video which focused on the activities and organizations found in some of the hill irrigation systems. In addition to the policy impact, both videos have proved to be useful tools for training by presenting a situation and setting for discussion. They have been used with groups of engineers and policy makers as well as farmer groups from the WECS/Ford Project.

Building National Institutional Capacity Through Collaborative Research

In support of building national research capacity, in 1987, IIMI worked closely with the faculty from IAAS in a number of activities. IIMI encouraged the establishment of a multidisciplinary irrigation management study group in the faculty and assisted them in undertaking two research activities. In one, the group completed an inventory of several river basins in Chitwan District. The group conducted a second, more detailed study of water distribution and its effect on yield in two of the systems. Both of these studies required field investigation by the faculty, which provided them with experience in field research methods and enhanced their practical knowledge of irrigation management. The faculty is now involved in applying this knowledge to a training and research program for the USAID-financed Irrigation Management Project, as well as in the teaching of IAAS students.

IIMI is an important resource on issues of farmer-managed irrigation systems.

Request for Services

All these activities have resulted in IIMI's high visibility in Nepal as an important resource on issues of farmer-managed irrigation systems. In 1987, 11 missions from 7 donor agencies contacted IIMI about approaches, processes, and innovations that their assistance to the HMGN could help promote.

The United Nations Development Programme (UNDP) asked IIMI to provide background papers for a series of discussions among the irrigation-related ministries, planning bodies, and donors. The papers will introduce issues to address in the context of changing policy, institutional restructuring, and the shift to irrigation sector loans, eventually leading to the development of a master plan. The Department of Irrigation asked IIMI to assist them in a seminar on increased farmer participation in government systems and improved methods of government assistance to farmer-managed systems. The United States Agency for International Development (USAID) requested that IIMI examine ways to assist and collaborate with the research and training work in the Irrigation Management Center for which they are providing support. Last, WECS and DOI expressed a strong interest in IIMI's collaboration in carrying out project implementing activities including improvement in joint management by farmers of agency-built systems.

Local Workshop and Training

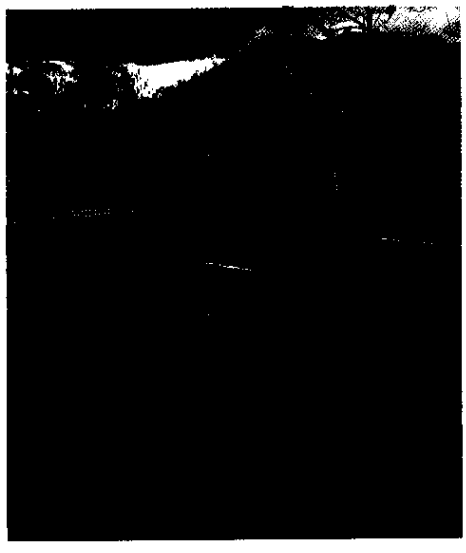
In 1987, IIMI, IAAS, and Winrock International joined in hosting a local workshop for Nepal researchers and irrigation professionals. The three-day workshop was held in early June and attended by 65 persons from 14 different organizations and agencies. Twelve of the participants were farmers from eight different irrigation systems. The farmers presented a panel discussion on how and why they keep records in their systems. Thirteen other papers were presented in the meeting and will soon be published in Nepal.

In connection with the Aga Khan Rural Development project in Pakistan, IIMI also sponsored a one-week training program for three Pakistani engineers in conjunction with the rapid appraisal study of the Babia River FMIS. Staff introduced the three to rapid appraisal techniques and used these methods to carry out an investigation on three irrigation systems in Nepal.

THE PHILIPPINES

Introduction

In Asia the Philippines is among the most progressive nations in implementing innovations in irrigation management. In both government-managed and farmer-managed systems, the Philippines experience offers important lessons to other countries in the region which plan to implement similar innovations. However, overall performance of irrigation systems is still far below the potential.



IIMI's interest in the Philippines continues to be in research and development of irrigation management innovations in collaboration with the concerned agencies. This interest lies in short-term projects designed to develop and establish innovative guidelines and procedures based on experience in managing existing irrigation systems.

IIMI's formal involvement in the Philippines started in February 1985, with a two-year research project to identify constraints to non-rice cropping in the dry season. Project funding came from an ADB technical assistance grant to the Government of the Philippines (GOP). IIMI implemented the project in collaboration with the National Irrigation Administration (NIA) and with the Philippine Council of Agriculture and Resources Research and Development (PCARRD) with its research consortia of state colleges and universities. The latter collaboration took the form of research grants for these universities to undertake component studies of the project.

During 1987, IIMI staff in the Philippines began the second phase of this research, also funded by the ADB, to identify and pilot-test irrigation practices to enhance farmers' efforts to diversify their cropping practices during the dry season. As identified in the first phase of this project, a principal constraint to irrigated non-rice crops is a lack of guidelines for irrigation managers on such functions as demand assessment, rotational water delivery, other operational procedures, and on-farm management practices. This is because, until very recently, the Philippines irrigation policy was aimed at growing rice throughout the year. Thus,

A principal constraint to irrigated non-rice crops is a lack of guidelines for irrigation managers.

IIMI's research is designed to assist the GOP in making the transition to irrigating non-rice crops by alleviating these constraints.

There are seven project sites -- in Mindanao: the Allah River Irrigation System, Banga River Irrigation System and the Mani River Communal Irrigation System, and in Luzon: the Laoag-Vintar River Irrigation System, the Bonga River Irrigation System Pump No. 2, the Upper Talavera River Irrigation System and the Tarlac-San Miguel-O'Donnell Rivers Irrigation System. IIMI hired one internationally recruited staff member as the project coordinator and eight research assistants to carry out the studies in these seven systems.

In 1987, IIMI also began a short-term research project with the International Food Policy and Research Institute (IFPRI), which will document the NIA's effort to become more independent from the treasury.

Irrigation Management for Non-Rice Crops: Phase II

The profitability of irrigated non-rice crops is better than that of irrigated rice.

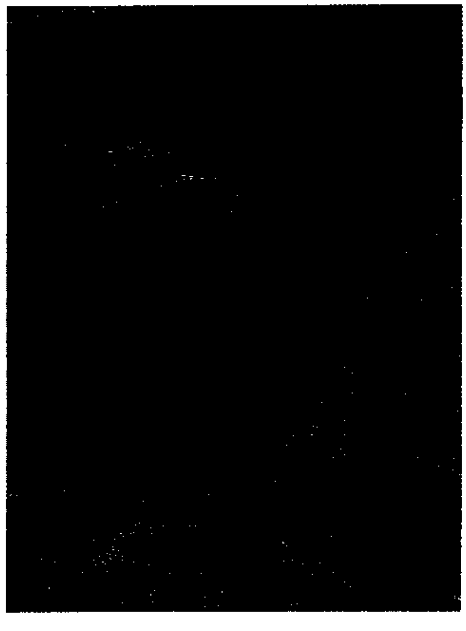
In 1987, staff identified and began testing a methodology for identifying those parts of irrigation systems suitable for non-rice cropping. The methodology utilizes a microcomputer-aided mapping technique to indicate physical and socio-economic data on existing maps. Once these maps are developed, research will seek validation in the field of the information and their usefulness in developing the operational plans.

Based on a 1987 dry season farm survey, staff concluded that the profitability for irrigated non-rice crops is better than for irrigated rice. Particularly in the Allah Valley site in Mindanao, irrigated hybrid corn was found to be significantly more profitable than irrigated rice. One reason is that farmers received a higher farmgate price for corn in the 1987 dry season in comparison with previous seasons. The profitability of irrigated versus rain-fed non-rice crops was also indicated by the farm survey, though this was not true for garlic, onion, peanut, and mungbean. Nonetheless, there is a positive indication that even with less irrigation water for non-rice crops, profitability levels are comparable to irrigated rice crop production.

In shifting from a puddled to nonpuddled soil condition for upland crops, 1987 results indicated that a majority of farms undergoing land conversion had soils with medium textural properties. The research suggests that finer textured soils or heavy clays were not amenable to land conversion for upland crop cultivation, particulary for onions. Furthermore, farms that were growing diversified crops in the dry season were located at higher elevations relative to the rice farms. This is indicative of the good drainage requirement for diversified crops.

The documentation study on irrigation management at the farm level for upland crops indicated that water application efficiencies ranged from 38-82 percent, using border, basin, and furrow irrigation methods. Staff collected relevant data on garlic, onion, tomato, mungbean, and corn. Future research will be confined to irrigation methods for irrigating garlic, onion, and corn. Only furrow irrigation for hybrid corn will be tested and demonstrated at the Allah Valley site.

On that component of the study relating to irrigation management at the system level, research activities were confined to monitoring the physical and managerial conditions and processes in the selected systems. This afforded staff the opportunity to gain a thorough understanding of the systems under study before making recommendations to improve management. In particular, staff monitored water flows to the various parts of the system and the agency management practices. Staff used this information to compare the proposed (preseason) allocation and delivery schedules with the actual. As predicted, staff found diversified crops concentrated in the downstream portions of systems. The upstream portions were planted to rice. That suggests that the decision to grow upland crops in the dry season lies mainly with the farmers and that irrigation staff responds to farmers' decisions.



In particular, the 1987 dry season study results at the Laoag-Vintar River Irrigation System (LVRIS) indicated that approximately 50 percent of the water is diverted to the upstream portion of the system, which serves only 26 percent of the command area. The remaining water supply was divided among the remaining 74 percent of the service area downstream. There are four divisions in this system. Dry season rice was grown in Division 1. Only 10 percent of that division was planted to non-rice crops. Staff went on to determine a number of physical and managerial reasons behind this observed inequity of water distribution. The length (13 kilometers), porous textured soil, and elevation of

the main canal lead to substantial water conveyance losses. Moreover, farmers in Division 1 have become accustomed to continuous delivery of water even in the dry season, which means increased irrigated area and/or decreased moisture deficits. Results indicated that there are opportunities for improvement which will result in increased irrigated area and/or decreased waterlogging.

IIMI/IFPRI/NIA Collaboration on Resource Mobilization

IIMI also began work on a small joint project among IFPRI, IIMI, and the NIA which covers an 18-month period from August 1987 until March 1989. The project involves a longitudinal case study of the Philippine experience in attempting to shift the irrigation sector to a more self-sustained footing and covers the period from the formation of the NIA in 1964 to the present. The review includes an examination of the policies and policy changes which have driven the process, NIA's responses to these policies, and the resulting impacts on the NIA and on the irrigation service it provides to farmers. Examples of policies being examined are the cessation of O&M subsidies to the NIA in 1982, and the requirement that the NIA repay capital costs of certain foreign-financed construction projects. Following the conclusion of the study IIMI and IFPRI will cosponsor a workshop to discuss the findings.

In 1987, participating staff reviewed literature and submitted a proposal to the Ford Foundation for support. In October, following grant approval, a small planning and implementation workshop involving major participants was held in Manila. Data needs defined during the workshop guided data collection and assembly by the study participants based in the Philippines for the rest of the year.

REGIONAL PROGRAMS

Introduction

In addition to its more specific country programs, IIMI undertakes regional research programs to facilitate cross-country comparisons and disseminate country-specific information. In 1987, IIMI initiated or continued three such programs, two in collaboration with international agricultural research centers funded by the Consultative Group for International Agricultural Research (CGIAR) and another with support from the United Nations Development Programme (UNDP).

Regional research programs facilitate cross-country comparisons and disseminate country-specific information.

IIMI/IRRI Collaboration on Rice-Based Irrigation Systems

In mid-1987, IIMI initiated a three-year collaborative research program with IRRI focusing on the problems of irrigation management for rice-based irrigation systems. The program is funded by the Rockefeller Foundation through a US$1.2 million grant to IIMI, and a separate US$300,000 grant to IRRI.

The overall workplan addresses three options within the context of reduced economic returns from irrigated rice lands. These include increasing the economic yields of rice, increasing the area served by scarce water resources through more effective and efficient irrigation system management, and introducing crops of higher value than rice into irrigated rice-based farming systems. The first is a major element of IRRI's Core Program, and the second, an integral part of IIMI's mission to improve irrigation system management. Both institutes are concerned with obtaining higher and more equitable social/economic returns from water and associated land resources. Taking these factors into account, a major emphasis has been placed on the agronomic, water, and irrigation system management issues related to non-rice crops in irrigated farming systems.

A major emphasis has been placed on the agronomic, water, and irrigation system management issues related to non-rice crops in irrigated farming systems.

In the Philippines, research will build on the work of both institutes in the context of irrigation management for both rice and non-rice crops. It is anticipated that the experience, broad discipline, and scientific strengths of IRRI will provide an excellent base for addressing the major questions associated with more economic and equitable use of scarce irrigation water.

In Bangladesh, the program will build on IRRI's research carried out in collaboration with the Bangladesh Water Development Board and the Bangladesh Rice Research Institute. That research sought to demonstrate the value of improved agricultural practices for rice production combined with relatively modest changes in irrigation management. The IIMI/IRRI program will address two of the three options -- increasing the economic and social efficiency of rice production and water use.

In Indonesia, the program will build on ongoing projects of both institutes. IIMI is currently working with the Directorate General of Water Resource Development to improve irrigation management practices related to irrigating non-rice crops during the dry season. IRRI has been working for a number of years with the Sukamandi research station to develop its research capacity in the area of soil-water/tillage interactions in rice/soybean systems. The Indonesia program complements that in Bangladesh by addressing the third option -- the productivity of non-rice crops in rice-based farming systems -- and by exploring in the Indonesian context, the factors affecting the increase in equity and efficiency of water use. In particular, IIMI will address the implications of necessary institutional changes within the irrigation agency and the farming community.

IIMI will address the implications of necessary institutional changes within the irrigation agency and the farming community.

The point of integration among IRRI, IIMI, and national agencies involved will be the research sites (operating irrigation systems) where monthly meetings or reporting of activities will be held. This will facilitate the regular interactions necessary for the success of the collaboration. Reporting and review meetings, probably twice a year, will be attended by concerned headquarters staff. The project is expected to continue over a three-year period.

In 1987, the two centers hosted a series of conferences in each country with participating institutes and agencies. The purpose of those conferences was to identify potential host country sites and research partners, and to refine further the research objectives and strategies.

IIMI/IFPRI Collaboration on Irrigation Policy Issues

In July 1986, IIMI initiated a collaborative program with IFPRI focusing initially on irrigation policy issues relating to crop diversification in Asia and irrigation development in Africa. The collaboration seeks to serve as a point of linkage between the two centers and to establish a collaborative relationship between them on irrigation related matters. The program, which was funded by the Ford Foundation and the two institutes, is due to conclude in September 1988, although the relationships and joint ventures established under it will continue.

Under the collaborative program, IFPRI and IIMI have jointly appointed a research Fellow, an agricultural engineer formerly associated with USAID's Water Management Synthesis Project. The fellow is based at the IFPRI offices in Washington and meets with IIMI specialists periodically in Digana, Manila, and other locations.

During the year, work continued on the joint "Financing Irrigation Services" project in the Philippines, partially supported under this agreement, and planning began for two additional collaborative activities involving IFPRI and IIMI. The first of these is a Policy Seminar on Irrigation Investment in Asia scheduled for the first half of 1989. Policy seminars on different topics are held periodically by IFPRI, and for the irrigation topic, IIMI was asked to collaborate. A proposal was developed and submitted to the Italian Government for possible funding.

The second collaborative activity developed is a major four-year effort to assess the performance of a cross-section of irrigation systems in Asia and Africa. The project consists of two two-year phases, the first of which will develop a framework and methodology for assessing irrigation performance. Under the second phase, the performance assessment of operating systems will take place.

Last October, a one-day meeting was held at IFPRI in Washington and attended by researchers from IIMI and IFPRI and several recognized experts in this area. The purpose was to assess the need for such a study and the likelihood that significant progress in developing a durable conceptual framework for irrigation system performance

could be made. Based on the discussions, participants drafted a proposal describing the work and submitted it to the two institutes for their review. Work is scheduled to begin in late 1988.

FMIS Network

In 1987 the FMIS network linked nearly 200 irrigation professionals in more than 30 countries.

The FMIS Network was established following the 1986 IIMI-sponsored Katmandu workshop on "Public Intervention in FMIS." Its purpose is two-fold. First, to enhance the utilization of existing knowledge through facilitating interaction among researchers, policy makers, and managers around the world. And second, to facilitate research on, and implementation of, innovative approaches to assisting FMIS. In 1987 the network linked nearly 200 irrigation professionals in more than 30 countries. A newsletter provided the central focus by publishing reports, lessons, and results submitted by the members. The newsletter also announces other network services, including dissemination of FMIS-relevant literature and publications, study tours (professional development interchanges), publication of working papers, and news of workshops and seminars.

The network is serviced by a coordinator in Digana, and by other IIMI staff at headquarters and abroad. In connection with the network, IIMI staff provide backstopping support for promising research and/or new approaches to assisting FMIS. Where these activities fit into an existing country program, as in Nepal, network functions are subsumed under the larger IIMI program; where promising work lies outside an IIMI country, as in Thailand, or outside the existing program within an IIMI country, as in the Philippines, the network provides a mechanism for facilitating that work, and a context for disseminating the results.

In 1987, the network grew from about 75 irrigation professionals at the beginning of the year to nearly 200 at the end of the year. Each person represented one or more client groups of the network: national agency staff, donors, and researchers. Two issues of the FMIS Newsletter were produced and mailed in April and August.

In June, IIMI sponsored a "Farmer-Managed Irrigation Systems (FMIS) Regional Planning Workshop" in Bangkok,

Thailand. The workshop was funded by a grant from the UNDP. Backstopping assistance was provided by Winrock International. The 14 participants, all members of the FMIS network advisory committee, discussed the orientation of the network and planned activities for the coming year. The function of the advisory committee is to ensure that network activities are in line with the needs of the membership at large, and particularly the implementing agencies. Proceedings of the workshop were published in the second issue of the Newsletter.

Visits by IIMI staff to network research locations included a field trip to Chiang Mai, Thailand where an IFAD-funded project is linking a number of small (200 ha) farmer-managed systems into a single, but divisible, system. In October, IIMI staff visited Morocco to develop research plans for a study of large-scale systems in the Tessaout Plateau near Marrakech.

In the next phase of development, the network will support four country-specific action research projects in Thailand, Bhutan, Pakistan, and Morocco. The Ministry for Economic Cooperation in Germany (BMZ) and the International Fund for Agricultural Development (IFAD) have agreed to provide funding for the network for a period of three years starting January 1988.

NEW COUNTRY PROGRAMS IN ASIA

In 1987, IIMI laid the foundation for the implementation of research with resident staff in Bangladesh and a non-resident program was planned for India.

Activities in 1987 entailed the development of Memoranda of Understanding (MOUs) with the respective countries and potential partner institutions, and the identification of funding sources. IIMI then worked with these groups to devise associated research strategies in each country. A report of those activities follow.

Bangladesh

The proposal and selection of Bangladesh as a site for an IIMI cooperating unit followed nearly four years of

planning, which began with discussions between IIMI's Director General and the Government of Bangladesh in April 1984. Bangladesh is important to IIMI for two reasons -- the potential impact that improved irrigation management could have on the rural population, and the considerable amount of resources the Government of Bangladesh plans to commit to irrigation in the next five years.

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More than a year of exploration with the Ford Foundation office in Dhaka and discussions with many Bangladesh Government officials resulted in a 1987 grant to IIMI for partial support for the placement of a resident staff member in Bangladesh for a period of three years. IIMI staff would work to strengthen the research capacity of those agencies and institutions conducting research in irrigation management issues, to link irrigation management research and operations communities through joint action research projects, to disseminate Bangladesh experience to similar situations in other Asian countries, and to facilitate training opportunities within the Bangladesh irrigation community.

The IIMI office in Dhaka will operate under an MOU to be signed in 1988 with the Bangladesh Agricultural Research Council (BARC), which oversees all agriculture-related research in that country. IIMI's initial research is expected to concentrate on tube well and surface systems. IIMI's resident staff will also be involved with research related to the Rockefeller-funded IIMI/IRRI collaborative project on rice-based irrigation systems.

India

In South Asia, India is the most significant country in terms of irrigated potential. Irrigation development and irrigation management have received much attention in the last decade in India.

In South Asia, India is the most significant country in terms of irrigated potential, 68 million ha, and predicted expansion, 2-3 million ha per year. Southern and eastern parts of India have predominantly rice-based systems similar to those of the humid tropics of South and South-East Asia, and the western and northern regions are arid and semi-arid. Rice and wheat are grown in rotation in the north and north-western parts of the country.

Irrigation development and irrigation management have received much attention in the last decade in India. Water and Land Management Institutes (WALMIs) have been set

up in 10 states to provide in-service training for professionals involved in irrigated agricultural development. Research work in irrigation management has been carried out at several institutes, including the University of Roorkee, Anna University, and the Institutes of Management at Ahmedabad and Bangalore. The Ford Foundation, and more recently USAID, have played and continue to play an active role in promoting research and training in irrigation management.

Despite these achievements, however, enhancing the capacity of Indian research and training institutions to contribute to and influence irrigation performance in India remains a major challenge. Many Indian institutions work in isolation, mechanisms to facilitate network activity and research collaboration are inadequate, and the results of research are often poorly disseminated. There is a clear need for greater communication and collaboration between Indian institutions and those in other parts of the world (particularly South and South-East Asia), where researchers are beset with similar problems.

In 1987, IIMI approached the Ford Foundation and later USAID to seek funding for a non-resident program to develop collaborative research and training activities with Indian Institutions. A Ford Foundation grant of US$200,000 was received in 1987 for two years and a USAID funding of US$500,000 for a three-year period is expected in 1988. The principal objective is to strenghthen the capacity of selected Indian research institutions to contribute to improved irrigation performance through collaboration with IIMI.

Late in the year, IIMI and the Ministry of Water Resources initiated discussions leading to an MOU to provide for an overall framework for collaborative activities with Indian institutions. The Director General of IIMI visited India in December for this purpose.

In mid-year, IIMI collaborated with the Administrative Staff College of India (ASCI), Hyderabad in planning and implementing a policy workshop on peoples' participation in irrigation management. The workshop, which ran from June 28-July 21, included an international study tour to the Philippines and Indonesia. IIMI's share in the costs was

provided by a grant from the Ford Foundation. Eighteen senior officers from the central and state governments of India participated in the workshop and the study tour. Many of them belonged to the ranks of secretaries in the ministries of irrigation and command area development and chief engineers.

The workshop provided two immediate benefits. It provided the participants with a broad perspective on farmer participation in irrigation management in Asia. And it provided the opportunity for IIMI's staff to become more acquainted with India's unique irrigation environment.

DEVELOPMENT OF THE AFRICA PROGRAM

IIMI's program strategy in Africa reflects research issues and developments that are unique to irrigation management in Africa. In particular, the irrigation sector in Sub-Saharan Africa is relatively young and of a significantly smaller scale than that of Asia. Research on operating systems would continue as a focus in those countries having a major irrigation sector (Sudan), but in those countries having little irrigation at present, there would be a greater need for providing training and professional development to irrigation planners, designers, and prospective managers.

The irrigation sector in Sub-Saharan Africa is relatively young and of a significantly smaller scale than that of Asia.

West Africa

Irrigation development in the West African subregion started, practically speaking, in the postcolonial period after 1960. This means that, in contrast to Asia, there is an absence of irrigation tradition and of irrigation administrations as such (i.e., no Ministries of Irrigation). Instead, irrigation development is in general entrusted to parastatal organizations which, in addition to irrigation, assume many other functions related to agricultural production, upstream as well as downstream. These functions demand a great amount of attention from the organization.

In contrast to Asia, there is an absence of irrigation tradition.

Hydrologically, irrigation systems in West Africa are small. There is only one large centrally-managed system of about 40,000 ha *(Office du Niger* in Mali). A second level consists of systems with service areas of 50-2,500 ha

(most common 300-500 ha) whose management is generally shared between some type of farmers' organization and the earlier mentioned multifunctional parastatal organization. In Niger the management is generally in the hands of farmers' cooperatives who receive technical assistance from the government. A third level involves small, farmer-managed village irrigation systems under 50 ha in extent. Lastly, there are systems, usually less than 5 ha in extent, built up around low-yielding tube wells and small earthen encatchment dams.

In the Sahel, irrigation plays an increasingly important role in the implementation of national food self-sufficiency policies and as a stabilizing mechanism in the Sahelian agro-climatic context; these, in turn, provide for sounder socio-economic development at the community level. Experience so far has shown that there are still many unknown factors that must be taken into consideration before answers to these questions can be found: unknowns that often trace back to the fundamental question of how to introduce modern irrigated agriculture alongside the more traditional non-irrigated crop and livestock production systems.

In the Sahel, irrigation plays an increasingly important role in the implementation of national food self-sufficiency policies and as a stabilizing mechanism in the Sahelian agroclimatic context.

In 1987, IIMI carried out two missions to West Africa. The purpose of the first was to make initial contact with potential donors, prospective research partners, and government officials. After receiving the first mission report, IIMI's Program Committee authorized a longer, more in-depth mission to develop the parameters of an IIMI program for the subregion, and directed that a full report be produced before the Committee's June meeting.

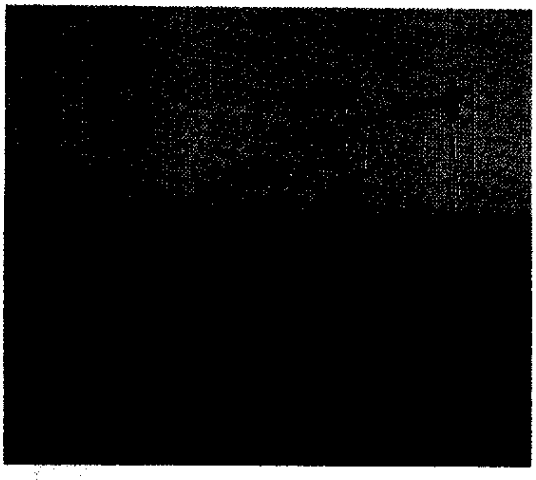
The second mission visited five countries: Burkina Faso, Mali, Mauritania, Niger, and Senegal. In each country, the mission identified specific operations that could constitute a program of cooperation with national organizations, institutions, or with field managers concerned with problems and responsibilities in irrigation. For each operation, the mission defined priority areas for research and field studies, identified prospective national partners, and explored their interests. Mission staff also estimated financial and other resources required and drew up an operational framework for program implementation.

The results of the two missions were presented to IIMI's Board in June 1987 in a document entitled "Irrigation Management in West Africa: Prospects and Proposals for a Research and Professional Development Program." The report outlined the parameters for an IIMI program in West Africa. Two regional organizations were identified as probable cooperators, the *Ecole Inter-Etat d'Ingenieurs de l'Equipment Rural* (EIER) and the *Comité Inter-Etat d'Etudes Hydrauliques* (CIEH); others were expected to follow. IIMI proposed to cooperate with EIER in the field of irrigation management training. It planned to cooperate with CIEH in the field of research documentation and information exchange.

IIMI will develop a regional research network that will bring together researchers and managers from regional and national agencies and institutions.

In Burkina Faso, IIMI proposed to cooperate with national research and development organizations on the agricultural use of water resources with limited potential (groundwater, small dams). In Niger, IIMI proposed to work with research and development organizations on farmer-managed irrigation systems in the Niger valley. In Mali, research was to be carried out with the *Office du Niger* in operational water management procedures and the synthesis of existing experiences. And in Senegal and Mauritania IIMI explored collaborative research with national organizations on analysis of irrigation systems performance in the Senegal river valley, with particular emphasis on the process of turnover of responsibility for irrigation management from government agencies to users.

Once these relationships are fully established, IIMI will develop a regional research network that will bring together researchers and managers from these regional and national irrigation related agencies and institutions.



Following discussions of the West Africa Strategy, IIMI's Board authorized the recruitment and posting of an IIMI regional representative in Ouagadougou for a period of one year. A grant proposal was prepared and approved by USAID to fund this position for one year. Recruitment was initiated in late 1987.

Sudan

Sudan has more irrigation than any other African country excluding Egypt and possesses a wide variety of types of

irrigation systems. Like many arid and semi-arid countries with abundant irrigation, Sudan has a diversified cropping system, and an element of competition (for water and for labor, particularly) among the crops which adds complexity to management analyses. Most of Sudan's irrigation systems depend on large canal networks that are fed either by gravity or by large river-bank pumping stations; there are also complex "wild flooding" systems in the East. Although its climate is arid, Sudan's irrigation is not constrained by water shortage: the amount of water available (regulated by international treaty) is roughly adequate for the present level of irrigation development.

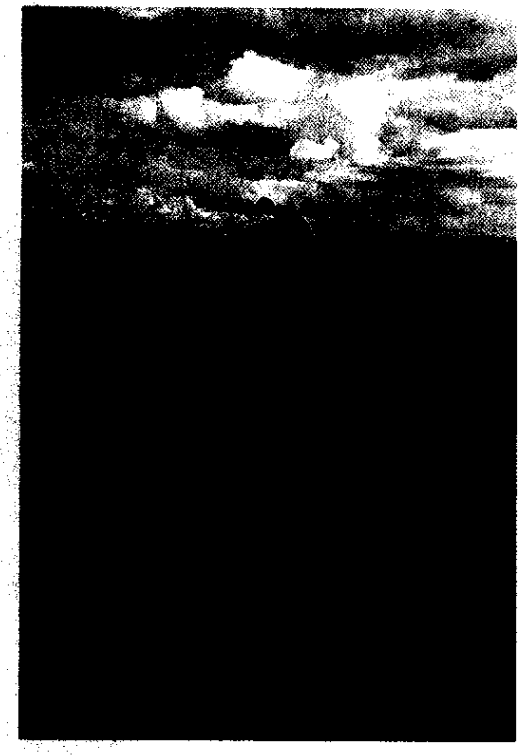
Irrigation in Sudan is dominated by the Gezira System, which has existed for over 60 years, and is crucial to the entire Sudanese economy, because the cotton it produces is the major export of the country. Other more recent large systems (New Halfa, Rahad) are similar to Gezira. However, Gezira accounts for a little more than a third of the total irrigated area in Sudan; smaller systems make up a significant and important portion.

The government and parastatal bodies which organize irrigation in Sudan wield an unusual degree of authority, especially in the Gezira model. This goes far beyond what is normally found in South Asia, and enables these authorities to dictate many aspects of on-farm activities, leaving relatively little freedom of choice to the farmer.

During 1987 IIMI carried out two missions to Sudan. The terms of reference for the first mission were to discuss with the Sudan Gezira Board their specific, project-financed, requirement for a Senior Water Management Advisor, to be based at their headquarters at Barakat. In July, IIMI carried out a second mission to discuss the placing of resident staff, with Ford Foundation funding. In October the Ford Foundation agreed to meet 80 percent of the costs of an IIMI staff member for two years.

In July IIMI signed an MOU with the Director General of the Hydraulics Research Station at Wad Medani, which provided IIMI with office facilities at that institute and the opportunity to collaborate with their staff, as well as with other research bodies.

Throughout the year, discussions were carried out to secure a formal MOU with the Ministry of Foreign Affairs to grant IIMI the status appropriate to a nonprofit international institution. A final draft of that agreement awaited signing at the end of the year.



Morocco

During 1987, IIMI concentrated on the preparation of an MOU with the Government of Morocco for the establishment of an IIMI office in Rabat. IIMI's interest in Moroccan irrigated agriculture lies in the potential for cross-country comparisons, particularly with Asian countries. There are three areas which are of special interest in this respect: crop diversification, decentralization of management responsibilities for large irrigation systems, and the use of modern irrigation and canal regulation technologies.

A series of missions - including two visits by the Director General - explored the interest of a number of agencies to collaborate with IIMI on issues of irrigation management. IIMI focused its effort on three tasks: laying the groundwork for implementation, recruiting a resident staff member, and defining the parameters for a long-term program.

PROFESSIONAL DEVELOPMENT PROGRAM

Introduction

IIMI's Professional Development Program strengthens the leadership and capability of people who plan and manage irrigation systems in developing countries. It also provides opportunities for researchers to work on conceptual and methodological issues, and communicate innovations to policy makers and field-level irrigation professionals.

Workshops and conferences provide an arena to plan and review research projects and the results of IIMI and others. They also offer opportunities to interest a wide range of professionals and institutions in IIMI's work, and to facilitate communication among them.

During 1987, the bulk of the Professional Development Program was closely integrated with the Institute's research programs. Because in 1987 there were no staff specifically hired for this program, all of IIMI's research staff contributed their time in professional development activities comprising 1) workshops and conferences, 2) training courses sponsored by IIMI, 3) fellowships and special awards, 4) on-the-job training associated with carrying out IIMI's research program, and 5) research on issues of professional development.

Workshops

In February, IIMI cosponsored with Hydraulics Research Limited, Wallingford, UK, and the Overseas Development Institute, UK, an "Asian Regional Symposium on Irrigation Design for Management," held in Kandy, Sri Lanka, with 102 participants. The proceedings were published shortly thereafter.

Many other conferences were held in 1987 as part of the individual research programs.

In March, IIMI sponsored a "Farmer-Managed Irrigation Systems (FMIS) Regional Planning Workshop" in Bangkok, Thailand. The workshop was funded by a grant from the UNDP. Backup assistance was provided by Winrock International. The 14 participants, all members of the FMIS network advisory committee discussed the orientation of the network and planned activities for the coming year.

IIMI also cosponsored two national workshops, one in Nepal, and another in Sri Lanka. In June, IIMI, Winrock International, and the Institute of Agriculture and Animal Science jointly sponsored a workshop on "Irrigation Management in Nepal: Research Results" in Bharatpur, just outside of Kathmandu. The workshop brought together 65 persons from 14 different organizations and agencies. The proceedings are now being published. In December, IIMI and the Sri Lankan Agrarian Research and Training Institute cosponsored the "Sri Lanka Farmer-Managed Irrigation Systems Research," with 14 participants.

Training Courses

In April, May, and June, the institute hosted the third annual "Regional Course on Planning and Management of Irrigation Schemes." The ADB joined the World Bank's Economic Development Institute in cosponsoring the course. Twenty-five senior irrigation and planning officials from 12 Asian and 5 African countries participated and were awarded certificates on completion.

Research Fellowships

During 1987, IIMI hosted six postdoctoral Fellows -- two from Sri Lanka, one from Malaysia, one from Pakistan, and two from the US. Three finished their two-year term while three others are expected to continue through 1988.

One postdoctoral Fellow in Sri Lanka, a water resources engineer, contributed to the identification, development, and initiation of IIMI's research on Canal Regulation and Design and Management interactions. This included assistance in identifying potential sites for the research, carrying out topographical surveys, and reporting results on preliminary research on hydraulic modeling at the Kalankuttiya Branch Canal. A second postdoctoral Fellow in Sri Lanka worked closely with high-level irrigation officials in an innovative study of internal management processes (see Sri Lanka country program). A third played a fundamental role in carrying out field activities connected with the Indonesia research to improve irrigation management for irrigated non-rice crops. Fluency in Bahasa Indonesia enhanced the researcher's ability to gather data among farmers and lower level agency officials, which led to many of the resulting recommendations.

In 1987, IIMI sponsored six Ph.D. research Fellows -- two from Sri Lanka, one from Indonesia, one from Nepal, one from Pakistan, and one from Canada. Five of them completed their fellowships, while one began his research in late 1987.

In Pakistani a Ph.D Fellow from Lahore's University of Engineering Technology researched irrigation constraints to crop production and the agricultural response to irrigation supplies (relative water supply). A Nepali Ph.D student examined agricultural development in two communities, one in a favorable environment (i.e., with irrigation), and one in a harsh environment.

Six M.Sc. research scholars completed their field research in 1987 -- one from Sri Lanka, one from Pakistan, three from Nepal, and one from the Philippines.

A Pakistan Master's student from the Asian Institute of Technology in Bangkok completed his research which compared irrigation practices on improved and unimproved watercourses.

Special Awards

The second IIMI special award was granted to a technical assistant of the Irrigation Department of Sri Lanka. He spent two months at headquarters writing up his experience based on an innovative approach to improve the irrigation management of the Kimbulwana Oya Scheme. The innovations he introduced, which included farmer participation in the scheme's rehabilitation, their subsequent participation in the overall operation and maintenance of the scheme, and the introduction of rotational distributions, increased cropping intensity in the scheme from 150 to almost 300 percent.

Research on Training Needs

In early 1987, IIMI completed a study of irrigation management training needs in Sri Lanka at the request of the Sri Lanka-IIMI Consultative Committee. The Government of Sri Lanka partially financed the study through a World Bank loan. The final report recommended the creation of a small interagency Professional Development Team to coordinate, monitor, and evaluate on-going training activities in the country.

The report submitted by IIMI to the government consisted of three volumes containing an appraisal of current training activities and suggestions for their enhancement. The volumes included a main report, three annexes, and an irrigation management training directory.

THE INFORMATION PROGRAM

IIMI's organizational structure as a decentralized research institute with a small support staff at headquarters and a relatively large number of program units located throughout the world is rare among research institutes. Furthermore, the information needs of its target audience are different from others. As field and management professionals responsible for developing and implementing irrigation policy and management, this group has information needs that differ from those of national researchers, the more typical audience of most other international agricultural research institutes. Consequently, there are few, if any, information models available that can be readily applied at IIMI.

IIMI's information program has responded to this challenge and continues to evolve, as IIMI learns more about its audience.

IIMI has clearly identified three levels of information exchange that must take place to fulfill its mission. First, are those people who are in positions to adapt management innovations developed by IIMI and its collaborating agencies. Second, are those people concerned with the study or analysis of irrigation management, who are interested in research methodologies as well as findings. Third, are those people who maintain an interest in IIMI's activities and progress, including representatives of donor agencies or other IARCs.

To date the Information Program has comprised two activities: publishing, and information exchange and documentation.

Publications

Technical publications are produced at four principal levels:

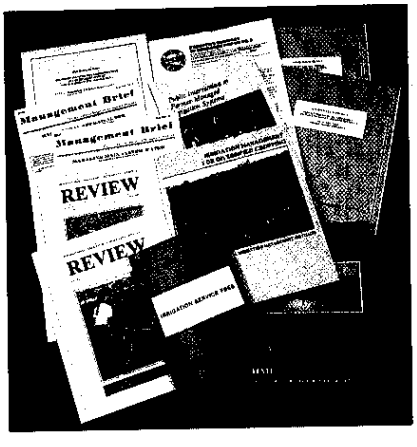
1. Project reports, which describe in full detail the activities and results of specific field-work. These are often site-specific, and written with an immediate, relatively small audience in view -- such as the relevant national irrigation department and collaborating institute, and the project funder.

2. Working papers, case studies, and other series. These are aimed at wider international audiences, broadly in

the second audience category identified above. They review, in a more condensed format, principal findings, especially those that seem to be of more general relevance. Such papers may be derived directly from IIMI's field-work; but they may also be commissioned, for example under IIMI Special Awards, from non-IIMI people with relevant experience; or they may be produced by program staff based on reviews of both IIMI's and other institutes' work.

3. Management briefs. These are intended primarily for the first group -- middle- to senior-level irrigation officials. They are similar to fact sheets produced by extension organizations and are used to disseminate quickly any information that IIMI thinks is of widest relevance. Management briefs generally describe the essence of some finding; readers with particularly high interest in that finding are told how to obtain the next, more detailed level of publication that amplifies it.

4. Newsletters. Newsletters generally fall into two categories: first, are those newsletters, such as the IIMI Review, aimed at donor representatives, host country professionals, and others interested in the progress of the institute; second, are those newsletters which publish network information and theme specific research results, such as the current FMIS and ODI-IIMI Newsletters, which are aimed at irrigation management professionals and researchers.



During 1987, IIMI published 15 publications. In addition, the production unit completed 54 incidental printing jobs and 52 art assignments (e.g., maps, signs, conference materials, etc.). One new serial publication -- "The IIMI Review" -- was printed, and a second issue prepared. The Program assisted with three issues of the ODI-IIMI Network Newsletter, one of which was in French.

Dissemination

In 1987, the mailing list contained 3,290 entries, from 140 countries. The percentage breakdown was:

Asia	45.3	Africa	14.2
Europe	17.6	South America	4.3
North America	17.5	Australia & NZ	1.1

In 1987, 34,656 publications were disseminated from Digana. In three mass mailings, 29,610 publications were sent to entries in the IIMI Mailing List, and 2,145 publications were sent in response to 715 requests. The balance -- 2,901 publications -- were given to visitors to headquarters and overseas units. At mid-year, mailing costs were reduced when IIMI began packaging and mailing publications in clear plastic envelopes.

Library

At the end of 1987, the Library contained 2,548 titles shelved and available for circulation. Of these, 1,323 are commercially published books, 508 are unpublished reports and manuscripts, 299 are annual reports, 238 are reproduced journal articles and analytical entries (e.g., chapters from books), 14 are restricted organizational documents, 33 are reference works, 37 are dissertations, 9 are periodicals issues, and 87 are other titles

Library material is exchanged with four other libraries in Sri Lanka and five libraries outside the country. Interlibrary loan agreements are in operation with all nine.

Database

In December, the Irrigation Management Information Network (IMIN) database contained some 2,300 bibliographic entries; about 65 percent of these are held in the IIMI library, 17 percent in the ODI library, and 18 percent in the IIMI-Indonesia office.

In late 1987, the IMIN Keyword Thesaurus and the IMIN Data Input Manual were prepared by a consultant in collaboration with IIMI and ODI, published, and distributed. The first issue of the IMIN Bibliography, a listing of the 1,900 database entries as at end 1986, is now available.

Finances

SUMMARY OF 1987 FINANCIAL RESULTS

1987 Report of the Auditors

The following is a reproduction from the 1987 report of IIMI's auditors, Ernst & Whinney, of their opinion on IIMI's 1987 financial statement:

Ernst & Whinney

Chartered Accountants

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

454/3, PIACHAUD GARDENS
KANDY, SRI LANKA

TELEPHONE: 08-24244
CABLES: ERNSTAUDIT, KANDY

REPORT OF THE AUDITORS TO THE BOARD OF GOVERNORS
OF THE
INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

We have examined the financial statements of the International Irrigation Management Institute for the year ended December 31, 1987 exhibited on pages 2 to 34.

Our examination was made in accordance with generally accepted auditing standards. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit.

As described in Note 1, the Institute's financial statements are prepared mainly on the basis of accounting practices adopted by International Agricultural Research Centres seeking assistance from support groups, which practices differ in some respects from generally accepted accounting principles. This year the financial statements are prepared in accordance with the recommendations made by the CGIAR Secretariat.

In our opinion, so far as appears from our examination, proper books of account have been maintained by the Institute and, to the best of our information and according to explanations given to us, the said financial statements which are in agreement therewith, together with the notes referred to therein give a true and fair view of the state of affairs of the Institute as at December 31, 1987 and the results of its operations for the year ended on that date. We are satisfied that the accounts of the Pakistan Branch which are consolidated with the accounts of the Head Quarters are in form and content appropriate and proper for the purposes of the preparation of the consolidated accounts, and we have received satisfactory information and explanations as required by us for those purposes.

The auditors' report on the accounts of the Pakistan Branch is not subject to any qualification.

CHARTERED ACCOUNTANTS

Kandy,
Sri Lanka.
11 April 1988.

PARTNERS: M T L FERNANDO FCA T K BANDARANAYAKE BSc FCA K H K WIJAYADASA FCA

Annual Operating Expenditure

Financially 1987 was a successful year. IIMI received US$2.481 million to support annual operating expenses of US$2.367 million, and thus ended the year with an operating surplus of US$114,000. Of this surplus, US$50,000 was allocated to reserves and US$64,302 was allocated to the core operating surplus account, an account which finances IIMI's working capital requirements and provides a reserve against prior year adjustments.

The US$2.481 million received in 1987 to support IIMI's annual operating budget breaks down as follows:

	(US$ million)
Core and restricted core grants	2.022
Interest	0.051
Recovery of indirect costs	0.032
IIMI core staff time charged to Special Projects	0.376
	2.481

Details of the core and restricted core grants, IIMI core staff time charged to Special Projects, and recovery of indirect costs are shown in Tables 1 and 2.

Table 1. Core and restricted core grants received for 1987

Donor	Funds received for 1987 (US$)
Ford Foundation	300,000
France	212,415
Japan	66,063
Netherlands	112,719
Rockefeller Brothers Fund	25,000
United Kingdom	131,197
United States	325,000
World Bank	850,000
Total	2,022,394

Source: 1987 Report of the Auditors.

Table 2. Statement of indirect cost recoveries & staff time charged to special projects - 1987 (US$)

Indirect Cost Recoveries		
ADB	- Philippines TA Phase II	9,698
Ford	- India	2,641
Ford	- Indonesia Phase II	13,006
USAID	- ISM Sri Lanka	6,716
Total		32,061
Staff time charged to Special Projects		
ADB	- Philippines TA Phase II	3,855
Ford	- Africa	255,301
Ford	- India	4,337
Rockefeller	- IIMI/IRRI Project	99,251
USAID	- ISM Sri Lanka	12,650
USAID	- ISPAN	461
Total		375,855

Source: 1987 Report of the Auditors.

Tables 3 and 4 show the breakdown of the US$2.367 million in expenditures by expense categories and by program/administrative units. In both cases, the 1987 actual expenditures are compared with the 1987 budget as revised and approved by IIMI's Board in June 1987.

Table 3. Applications by expense categories, 1987 (US$ '000)

	Revised approved budget 1987	Actual expenditure 1987	Difference (over)/ under expenditure
International staff salaries & benefits	1,079	1,114	(35)
National staff salaries & benefits	388	444	(56)
International travel	170	153	17
National travel	54	45	9
Supplies & services	267	274	(7)
Equipment	54	80	(26)
Leasehold improvements	2	5	(3)
Others	113	18	95
Unrestricted support to			
Pakistan	233	211	22
Indonesia	99	15	84
Nepal	7	8	(1)
Total	2,466	2,367	99

Source of actual expenditure: 1987 Report of the Auditors

Table 4. Applications by program/administrative units, 1987 (US$ '000)

	Revised approved budget 1987	Actual expenditure 1987	Difference (over) under expenditure
System Management	326	326	
Rehabilitation & Improvement	126	133	(7)
Farmer-Managed Irrigation Systems	79	81	(2)
Professional Development	211	164	47
Information Exchange	274	220	54
Other	13	54	(41)
Unrestricted support to			
Pakistan	233	211	22
Indonesia	99	15	84
Nepal	7	8	(1)
Governing Board	115	94	21
Director General's Office	411	440	(29)
Accounts, Purchasing, Personnel	98	103	(5)
Rent & Utilities	29	4	25
Telephone, Telex, Postage	47	79	(32)
Building & Grounds	380	390	(10)
Equipment	18	45	(27)
Total	2,466	2,367	99

Source of actual expenditure: 1987 Report of the Auditors

Table 5 provides a comparison of sources of core and restricted core support for the years 1986 and 1987.

Table 5. Sources of core support 1986 and 1987

Donor	Funds received for 1986	Funds [illegible] for 1987
Aga Khan Foundation	125,000	
Australia	69,690	
Ford Foundation	1,500,000	[illegible]
France	92,593	[illegible]
General Service Funds	7,500	
Japan	61,082	[illegible]
Netherlands	54,029	[illegible]
Rockefeller Brothers Fund	25,000	[illegible]
Rockefeller Foundation	45,000	
United Kingdom	147,290	[illegible]
United States	250,000	[illegible]
World Bank		[illegible]
Total unrestricted & restricted support:	2,377,184	[illegible]

Special Projects

As reflected in Table 6, 1987 was a very successful year for Special Projects as some 18 projects with a value of just over US$7 million were approved during the year. Expenditure of $1.76 million on special project in 1987 are shown in Table 7.

Table 6. Special projects approved in 1987

Donor	Project	US$
ADB	Philippines Phase II	350,000
ADB	Sri Lanka TA	350,000
Ford	Bangladesh	450,000
Ford	India	200,000
Ford	Indonesia Study	26,200
Ford	Indonesia Phase II	300,000
Ford	Professional Development	46,300
Ford	Sudan	495,000
France	Simulation Model	114,000
HRL	Asian Regional Symposium	38,448
Rockefeller	IIMI/IRRI Project Development	27,000
Rockefeller	IIMI/IRRI Project	1,200,000
UNDP	FMIS Workshop	39,000
USAID	ISM Sri Lanka	389,333
USAID	ISPAN	570,000
USAID	ODI Newsletter	66,000
USAID	Pakistan	2,000,000
USAID	West Africa	344,000
Total		7,005,281

Table 7. Special project expenditure in 1987

Donor	Project	US$
ADB	Indonesia TA Phase 1	129,030
ADB	Philippines TA Phase II	142,995
ADB/EDI	Training Course	67,279
Ford	Africa	366,514
Ford	Bangladesh	1,587
Ford	IFPRI/IIMI Project	39,425
Ford	India	7,924
Ford	India Workshop	50,000
Ford	Indonesia Study	14,682
Ford	Indonesia Phase II	145,739
Ford	Nepal	34,000
Ford	Professional Development	5,367
France	Simulation Model	2,948
HRL	Asian Regional Symposium	38,448
IFAD	Nepal	85,714
IFAD	Pakistan	365,343
Rockefeller	IIMI/IRRI Project Development	27,000
Rockefeller	IIMI/IRRI Project	106,838
Rockefeller	Pakistan Workshop	39
UNDP	FMIS Workshop	8,555
USAID	Crop Diversification Workshop	19,319
USAID	ISM Sri Lanka	20,148
USAID	ISPAN	465
USAID	ODI Newsletter	30,286
USAID	Pakistan	51,390
USAID	West Africa	375
Total		1,761,410

Source: 1987 Report of the Auditors

1987 Net Expenditures

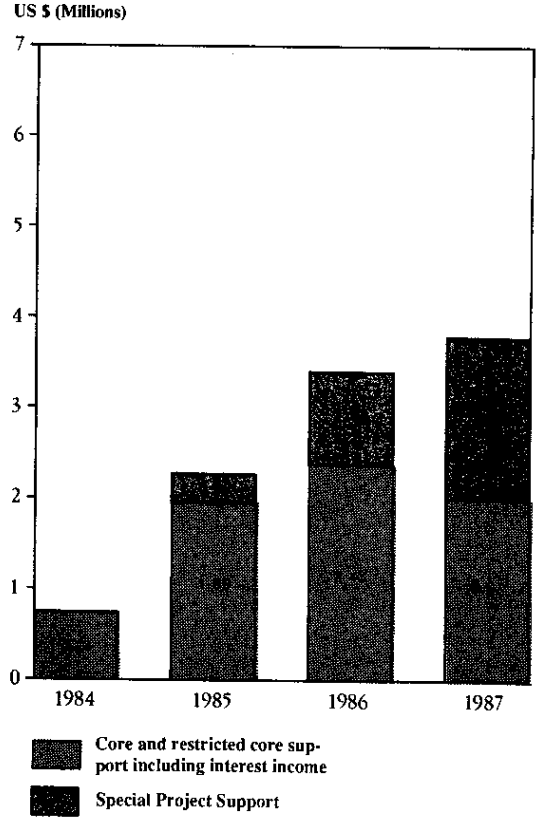
Net expenditures in 1987 were approximately $3.72 million as follows:

	(US$ '000)
Core, restricted core expenditures	2,367
Special project expenditures	1,761
Sub-total	4,128
Less: recovery of indirect costs	(32)
Less: IIMI core staff time charged to special projects	(376)
Net 1987 Expenditures	3,720

1987 Net Income

The following figure shows IIMI's net income of $3.83 million from core and special poject sources for the year 1987 in comparison with net income for the years 1984, 1985, and 1986.

Figure 1. The growth and development of IIMI's finances; the relative proportion of core and Special Project Support for 1984-1987



Statement of Assets, Liabilities and Fund Balances (Balance Sheet)

IIMI's consolidated balance sheet as of 31 December 1987 shown below reflects the lagre increase in Special Projects received in 1987 (accounts receivable from donors having increased by about US$4.3 million from 31 December 1986) and IIMI's very healthy cash position (cash and short-term deposits having increased by about US$2.5 million).

IIMI's total assets stood at US$9.9 million on 31 December 1987 whereas total assets were US$2.9 million on 31 December 1986.

STATEMENT OF ASSETS, LIABILITIES AND FUND BALANCES AS OF 31 DECEMBER 1987

	1987 US$	1986 US$		1987 US$	1986 US$
ASSETS			**LIABILITIES**		
CASH	3,316,489	786,955	ACCOUNTS PAYABLE	206,381	62,306
ACCOUNTS RECEIVABLE			GRANTS APPLICABLE		
DONORS	5,022,067	690,643	TO SUCCEEDING YEARS	7,488,383	856,242
INTERNATIONAL STAFF	16,431	40,641			
LOCAL STAFF	16,602	13,818			
OTHER INTERNATIONAL RECEIVABLES	62,241	63,701			
OTHER LOCAL RECEIVABLES	506	2,340	**FUND BALANCES**		
ADVANCES AND PREPAID EXPENSES	102,968	196,790	INVESTMENT IN NON-EXPENDABLE ASSETS	1,264,425	1,033,696
ADVANCES TO PROJECTS AND PROGRAMS	98,668	113,197	CORE OPERATING SURPLUS	591,208	689,537
PROPERTY AND EQUIPMENT	1,264,425	1,033,696	RESERVES	350,000	300,000
Totals	9,900,397	2,941,781		9,900,397	2,941,781

Source: 1987 Report of the Auditors

Annexes

1987 SPECIAL PROJECTS

(Refer to table on page 71 for consolidated financial information on special projects)

Project/Purpose	Funding Source	Amount*	Duration
STUDY ON IRRIGATION MANAGEMENT IN INDONESIA PHASE I To study technical, socio-economic, and institutional aspects of irrigation management in order to make more productive use of irrigation systems in Indonesia	ASIAN DEVELOPMENT BANK	350.000	2 years
STUDY ON IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPS IN THE PHILIPPINES PHASE II To strengthen the long-term viability of Philippines irrigation systems by identifying management improvements which are sustainable throughout the process of system rehabilitation, design, and management.	ASIAN DEVELOPMENT BANK	350.000	30 months
IIMI-EDI-ADB REGIONAL COURSE ON PLANNING AND MANAGEMENT OF IRRIGATION SCHEMES To improve the knowledge and skills of senior officials in planning, appraising, and managing irrigation schemes.	ASIAN DEVELOPMENT BANK/EDI	67,279	40 days
INITIATION OF IRRIGATION MANAGEMENT ACTIVITIES IN AFRICA To initiate and develop IIMI's research program in Africa beginning with the identification of research partners and activities, including network and training relationships in Morocco, Sudan and the West African region.	FORD FOUNDATION New York	500,000	2 years
SUPPORT TO BANGLADESH IN RESEARCH AND TRAINING IN IRRIGATION SYSTEMS To strenghten the capacity of relevant institutions and people in Bangladesh in managing irrigation systems and irrigation development	FORD FOUNDATION Dhaka	450,000	3 years
IIMI/IFPRI COLLABORATION ON POLICY RESEARCH ON IRRIGATION IN AFRICA To conduct policy research with IFPRI to address food security problems in Africa through irrigation investments, and to strengthen the capacity of the centers to undertake research in Indonesia and the Philippines on irrigation investment strategies for non-rice irrigation systems originally designed for rice.	FORD FOUNDATION New York	64,563	2 years

COLLABORATIVE RESEARCH AND TRAINING ACTIVITIES IN IRRIGATION MANAGEMENT WITH INDIAN INSTITUTIONS	FORD FOUNDATION Delhi	200,000	2 years
To explore and initiate collaborative projects between IIMI and Indian Institutions through research, professional development, and information exchange. This work is designed to strengthen the capacity of Indian Institutions to contribute to the improvement of irrigation systems.			
WORKSHOP SERIES ON POLICY ISSUES FOR IRRIGATION MANAGEMENT IN INDIA	FORD FOUNDATION Delhi	50.000	2 years
To support a workshop series designed to aid key Indian policy makers in the review and development of irrigation policies that promote improved management and performance of irrigation systems in India.			
ANALYSIS OF IRRIGATION RESEARCH FINDINGS IN INDONESIA	FORD FOUNDATION Jakarta	26,200	18 months
To support development of a water management team in the principal irrigation agency for collaborative research with the Gadjah Mada University to recalibrate irrigation measurement devices in selected irrigation schemes in Java.			
EFFICIENT IRRIGATION MANAGEMENT AND SYSTEM TRANSFER IN INDONESIA	FORD FOUNDATION Jakarta	300.000	30 months
To identify changes for efficient use of O&M resources, to pilot test suitable O&M practices for non-rice crops, and to analyze and document processes used in turnover to water users. This project builds on Phase I of the IIMI/ ADB study to identify constraints to irrigated non-rice cropping in the dry season.			
ESTABLISHMENT OF RESEARCH PLANNING AND IMPLEMENTATION UNIT ON IRRIGATION MANAGEMENT IN NEPAL	FORD FOUNDATION Delhi	90,000	4 years
To establish a program in Nepal to strengthen the capacity of that government's principal irrigation agency to plan, manage, and utilize irrigation management research, particularly related to government assistance to small-scale and farmer-managed irrigation systems.			
FELLOWSHIP SUPPORT FOR IMPROVED IRRIGATION MANAGEMENT	FORD FOUNDATION New York	46,300	3 years
To support post-doctoral research on irrigation-related settlement planning, and pre-doctoral research to develop a model that would simulate the functioning of an irrigation system.			

APPLICATION OF A MATHEMATICAL MODEL FOR SIMULATIONS OF MAIN CANAL OPERATIONS IN SRI LANKA	FRANCE	114,000	3 years
To support research on main canal operations using a mathematical model produced on microcomputers.			
ASIAN REGIONAL SYMPOSIUM ON IRRIGATION DESIGN FOR MANAGEMENT	HRL	38,448	3 days
To bring together the various disciplines involved in irrigation in order to discuss the influence of irrigation project design on the subsequent operation and management.			
RESEARCH AND RURAL IRRIGATION IN THE HILL REGIONS OF NEPAL	IFAD	SL Rupees 7,770,000	3 years
To conduct research on rural irrigation in the hill regions of Nepal by posting a liaison scientist to provide technological and scientific support to Water and Energy Commission Secretariat (WECS). Activities include the development of training and information exchange activities in Thailand, Bhutan, and India.			
ESTABLISHMENT OF AN IIMI BRANCH IN PAKISTAN	IFAD	Pak. Rupees 22,400,000	3 years
To establish a branch in Pakistan for research on improved management techniques and operational methods in irrigation systems, in collaboration with agencies and on-going projects in Pakistan and other countries with similar ecology, and to create training programs.			
COLLABORATIVE RESEARCH AND TRAINING BETWEEN IIMI AND IRRI	ROCKEFELLER FOUNDATION	27,000	6 months
To develop a collaborative research and training program in irrigation management with IRRI.			
IIMI/IRRI COLLABORATION ON IRRIGATION MANAGEMENT FOR RICE-BASED FARMING SYSTEMS	ROCKEFELLER FOUNDATION	1,200,000	3 years
To conduct collaborative research with IRRI in the problems of water management in irrigation systems devoted to rice-based farming systems in the Philippines, Indonesia, and Bangladesh.			
PUBLICATION OF PROCEEDINGS OF WORKSHOP ON SOCIAL SCIENCE PERSPECTIVES ON MANAGING AGRICULTURAL TECHNOLOGY	ROCKEFELLER FOUNDATION	10,000	10 months
To over costs of publication and distribution of the proceedings of the workshop on social science perspectives on managing agricultural technology.			

FARMER-MANAGED IRRIGATION SYSTEMS NETWORK To support network activities in FMIS research, workshop of network advisory committee, travel/study funds for network members and publication and dissemination of proceedings of FMIS Kathmandu conference.	UNDP	39,000	4 days
INTERNATIONAL WORKSHOP ON APPROPRIATE PRODUCTION OF UPLAND CROPS WITHIN A RICE CROPPING SYSTEM To support a workshop to identify the constraints to diversified cropping under irrigated conditions, ways to relax those constraints and to discuss feasible practices which will make irrigation of selected upland crops more profitable and effective.	USAID S&T Bureau	19,319	15 months
IRRIGATION SYSTEM MANAGEMENT IN SRI LANKA To assist USAID's Irrigation System Management project through the development and implementation of research on key irrigation management questions, and to strengthen national capacity for research. This work will build on IIMI's collaborative relationships with Sri Lankan irrigation-related research institutions and agencies.	USAID Sri Lanka	389,333	35 months
IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST (ISPAN) To increase IIMI's capacity to develop more effective training and professional development programs.	USAID Asia and Near East Bureau	570,000	3 years
IRRIGATION MANAGEMENT NETWORK To expand the distribution and number of issues of the IIMI/ODI Newsletter.	USAID S&T Bureau	66,000	10 months
INSTITUTIONAL SUPPORT GRANT TO IIMI PAKISTAN To provide support to IIMI Pakistan for institutional development with the purpose of strengthening national capacity to improve the performance of irrigation systems through management innovations.	USAID Pakistan	2,000,000	2 years
INITIATION OF AN IIMI PROGRAM IN WEST AFRICA To support an IIMI regional representative in Burkina Faso to plan the deployment of the Institute's resources in the region in collaboration with interested national agencies.	USAID Africa Bureau	344,000	1 year

*In US dollars unless otherwise stated
USAID = United States Agency for International Development
IFAD = International Fund for Agicultural Development
EDI = Educational Development Institute
HRL = Hydraulics Research Limited

SIGNED COLLABORATIVE AGREEMENTS

A. Through Memoranda of Understanding

Organization	Purpose
France:	
Centre de Formation International a la Gestion Ressources en Eau (CEFIGRE)	To translate, publish and disseminate selected IIMI documents in French-speaking Africa
India:	
Secretariat of the International Commission on Irrigation and Drainage	To cooperate towards enhancing the capacity to exchange information and promote collaboration among individuals and organizations involved with irrigation
Indonesia:	
The Ministry of Public Works of the Republic of Indonesia	To cooperate in irrigation management development
Nepal:	
The Water & Energy Commission Secretariat of His Majesty's Government of Nepal	To establish an IIMI regional base in Nepal
Pakistan:	
The President of the Islamic Republic of Pakistan	To establish a Pakistan unit of the International Irrigation Management Institute
Philippines:	
National Irrigation Administration, Republic of the Philippines	For scientific and technical cooperation in research on irrigation systems management
Philippine Council for Agriculture and Resources Research and Development	For cooperation towards the improvement of irrigation management in the Philippines
The International Rice Research Institute	To embark on a cooperative program of research on irrigation management in rice farming areas

Sri Lanka:

Agrarian Research and Training Institute	To cooperate in the areas of research, training and communications in irrigation management in Sri Lanka
Ministry of Lands and Land Development, Government of Sri Lanka	For the establishment of IIMI
Ministry of Lands and Land Development, Government of Sri Lanka	To implement the ADB-funded study on irrigation management and crop diversification in close collaboration and coordination with concerned Sri Lanka agencies

Sudan:

The Arab Organization for Agricultural Development	For collaboration in areas of mutual interest for the purpose of agricultural development

Thailand:

Thammasat University, Faculty of Economics	To collaborate in training post-graduate students from developing countries in irrigation management-related fields

UK:

The Overseas Development Institute	To continue and expand the ODI Irrigation Management Network (IMN) Newsletter and Network Papers and cooperate in the development of the database and library services

USA:

The Economic Development Institute of the World Bank	To cooperate in conducting regional courses on Planning and Management or Irrigation Projects
Winrock International Institute for International Development	To facilitate collaboration in agriculture and agriculture-related research, training and development activities

B. Through Exchange of Correspondence

Asian Institute of Technology	Joint sponsorship of graduate students at the thesis stage of their M.Sc. or Ph.D programs
International Food Policy Research Institute	To collaborate on a program of researching food security problems in Africa through irrigation investments, and to strengthen and coordinate work in Indonesia and the Philippines relating to irrigation investment strategies

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* Joined IIMI in 1987
** Left IIMI in 1987
† Changed departments or designation in 1987

FELLOWSHIPS AND SPECIAL AWARDS

Postdoctoral Fellowships

Name	Dates	Research Topic	Location
1. Poh-Kok Ng	October 1985 October 1987	Development of indices of irrigation performance	Sri Lanka
2. Hilmy Sally	October 1985 October 1987	Canal regulation and management	Sri Lanka
3. Douglas Vermillion	January 1986 September 1987	Institutional component of irrigation management	Indonesia
4. Namika Raby	August 1986 July 1988	Irrigation agency processes	Sri Lanka
5. Muhammad Bhatti	November 1986 November 1988	Irrigation water management at the farm level	Pakistan
6. Pamela Stanbury	September 1987 December 1988	Land settlement planning for improved irrigation performance	Sri Lanka

Ph.D. Research Fellowships

Name	Dates	Thesis Research Topic	Location
1. Russ Cramer	March 1985 September 1987	Farmers' management decisions in small tank irrigation systems	Sri Lanka
2. Chris Wensley	January 1986 September 1987	The sustainability of rehabilitation in rice-based irrigation systems	Philippines
3. Ujjwal Pradhan	January 1986 August 1987	Property structure and resource mobilization in hill irrigation systems	Nepal
4. Wimson Purba	June 1986 July 1987	Irrigation water management for the small basin sub-irrigation (*sorjan*) system	Indonesia

5. Shyamala Abeyratne	August 1986 February 1988	Agency intervention in farmer-managed diversion irrigation schemes	Sri Lanka
6. Mohammad Bhutta	April 1987 September 1989	Effect of discharge variation on equity of water distribution	Pakistan

Masters Degree Fellowships

Name	Dates	Research Topic	Location
1. M. Elkaduwa	October 1985 August 1987	Field studies on irrigation management practices	Sri Lanka
2. W. Dumayas	October 1986 October 1987	Farmers' participation in system management and operation	The Philippines
3. C.N.H. Javeid	January 1987 May 1987	Irrigation practices on irrigated wheat	Pakistan
4. Khadka Giri	January 1987 September 1987	Site study of FMIS	Nepal
5. Y. Adhikari	May 1987 September 1987	Seepage and percolation losses in terrace irrigation systems	Nepal
6. R.B. Thapa	May 1987 August 1987	Organizational pattern and resource mobilization in FMIS	Nepal

Special Award

Name	Dates	Research Topic	Location
1. S. Gunadasa	February 1987 May 1987	Irrigation management improvement in the Kimbulwana Scheme	Sri Lanka

1987 CONSULTANTS

Name	Mission
Charles Abernethy	IIMI's Africa Program
Raj Bhatia	To implement and test a computerized accounting system
Regina Z. Cowell	International recruitment
Gerard Egan	Strategy development
Osman Fadl	Research and training in the Sudan
Jean Goussard	To assist in the installation of control technologies at two pilot projects in Sri Lanka
Kapila Goonesekera	Fabrication and calibration of trapezoidal flumes
Alex Gunasekera	Computer hardware and software
Alain Gueguen	To install software for hydraulic modeling
Jean-Claude Legoupil	Development of IIMI's West Africa Program
Jane Johnson	Development of the Irrigation Management Information Network
Gilbert Levine	Development of IIMI's Bangladesh Program and collaborative work with IRRI; assistance to IIMI Pakistan
Richard Morris	Development of a proposal for irrigation research associated with rice-wheat rotations
Effendi Passendaran	Crop diversification and agricultural policy in Indonesia
Suprodjo Sus	Calibration of structures and development of measurement devices in Indonesia
Donald Taylor	Development of a program of work in Indonesia
Elie Teboul	To assist in the installation of control technologies at two pilot projects in Sri Lanka
Ed Wiser	Computer hardware and software

1987 PUBLICATIONS

(Including publications issued by IIMI, and publications issued elsewhere)

Asian Development Bank and International Irrigation Management Institute. 1987. *Seminar Fees.* Manila, Philippines: ADB.

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