ANNUAL REPORT 1988

International Irrigation Management Institute

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

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FOREWORD

1988 was a year of achievement and transition for IIMI. Programmatically, it was a year in which many of our ongoing research activities reached maturity and began to yield significant results. Institutionally, it was a year in which we greatly expanded our geographical coverage and completed many of the agreements needed to operate in the many developing countries of Africa and Asia that constitute IIMI's initial sphere of activity.

But 1988 was also a year in which we concluded the development of a strategy to guide our institute's development. After exhaustive consultation and review, in September the *Strategy of the International Irrigation Management Institute* was completed and presented to the IIMI Support Group. IIMI now has a firm framework to shape its activities over the next decade. A five year workplan to operationalize the Strategy is currently in preparation and will be published in a companion document.

During 1988 we also implemented a new organizational structure to reflect the IIMI Strategy, filled most of our key international staff positions, and appointed two distinguished individuals, Charles Abernethy and Nanda Abeywickrema, to the two newly created positions of Director, Programs, and Director, Field Operations. Thus, by the end of 1988 we were in a much better position to provide the leadership and support IIMI's complex multi-country program required, along with the interactive capacity to compare and share the lessons and results of that work worldwide.

Because of the changes in strategy and structure that took place during 1988, the present report is in a sense a transitional product. It incorporates a brief preview of the main points of the *Strategy* (see page 38) but resists the temptation to apply strategic hindsight to 1988 activities, except insofar that its editorial structure is arranged so it can be adapted and compared to future *Strategy*-related reporting.

As will be clear from this report, during 1988 IIMI's fieldwork continued to lay stress on operating in harness with national institutions with a view to strengthening their capacity and to developing practical innovations that can be directly applied to improving system performance. In addition, IIMI's thematic or generic outputs began to compare and synthesize the results of fieldwork in many countries with a view to providing policy-makers, managers, and others with more effective irrigation management tools.

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Chapter 1 in this report summarizes the results of collaborative fieldwork done during 1988 in six countries where IIMI was engaged in resident country programs, including Pakistan. Mention is also made of the incipient programs in India, Sudan, Morocco and West Africa. Chapter 2 deals with multi-country experiences that were studied under generic or thematic headings or which indicate emerging issues likely to have an impact on IIMI's future programming.

Looking forward now to the future, it is fitting to remind ourselves of the enormous scale of the problems IIMI was designed to address. The following statistics illustrate the challenge clearly:

- 1.5 billion people in Asia alone who depend on irrigated lands for their food supply.
- 7 million hectares of land in India lying unproductive solely because of the accumulation of excess salts.
- Over 100 million people throughout the world infected with schistosomiasis.
- Annual investments in new irrigation construction of the order of $10 - 20 billion a year.

Faced with these statistics, one can only conclude that IIMI's efforts to date have been — to put it mildly — very modest. Therefore, undoubtedly the most pressing challenge IIMI faces at the present time is to obtain the resources, as a leading development administrator has put it, to expand and sustain IIMI to help make it "a focal point for research and information about irrigation in the tropics".

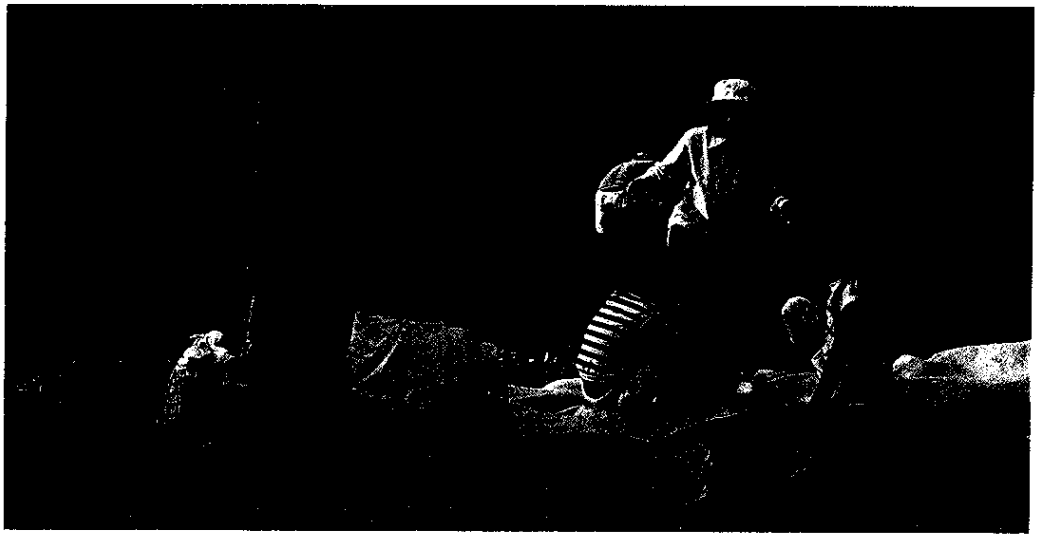
Also critical, of course, will be the need to ensure IIMI can make the appropriate internal adjustments necessary to respond to the opportunities and challenges resulting from future changes in the external environment. Of particular importance will be those resulting from the anticipated evolution of the system of global agricultural research, and the growth and strengthening of national institutions in the developing countries in which we work.

> ***" — 1.5 billion people in Asia alone who depend on irrigated lands for their food supply. "***

IIMI's ultimate challenge, however, will be the need to ensure that all those concerned with IIMI not lose sight of the broader institutional goals for which the Institute was established. IIMI must properly focus, in its day-to-day activities, on research output, on management training, and on information exchange. But if it fails to couple these tasks with a quest for capacity strengthening and institutional change, then it will have fallen far short of the vision of its founders, and the needs of its clients.

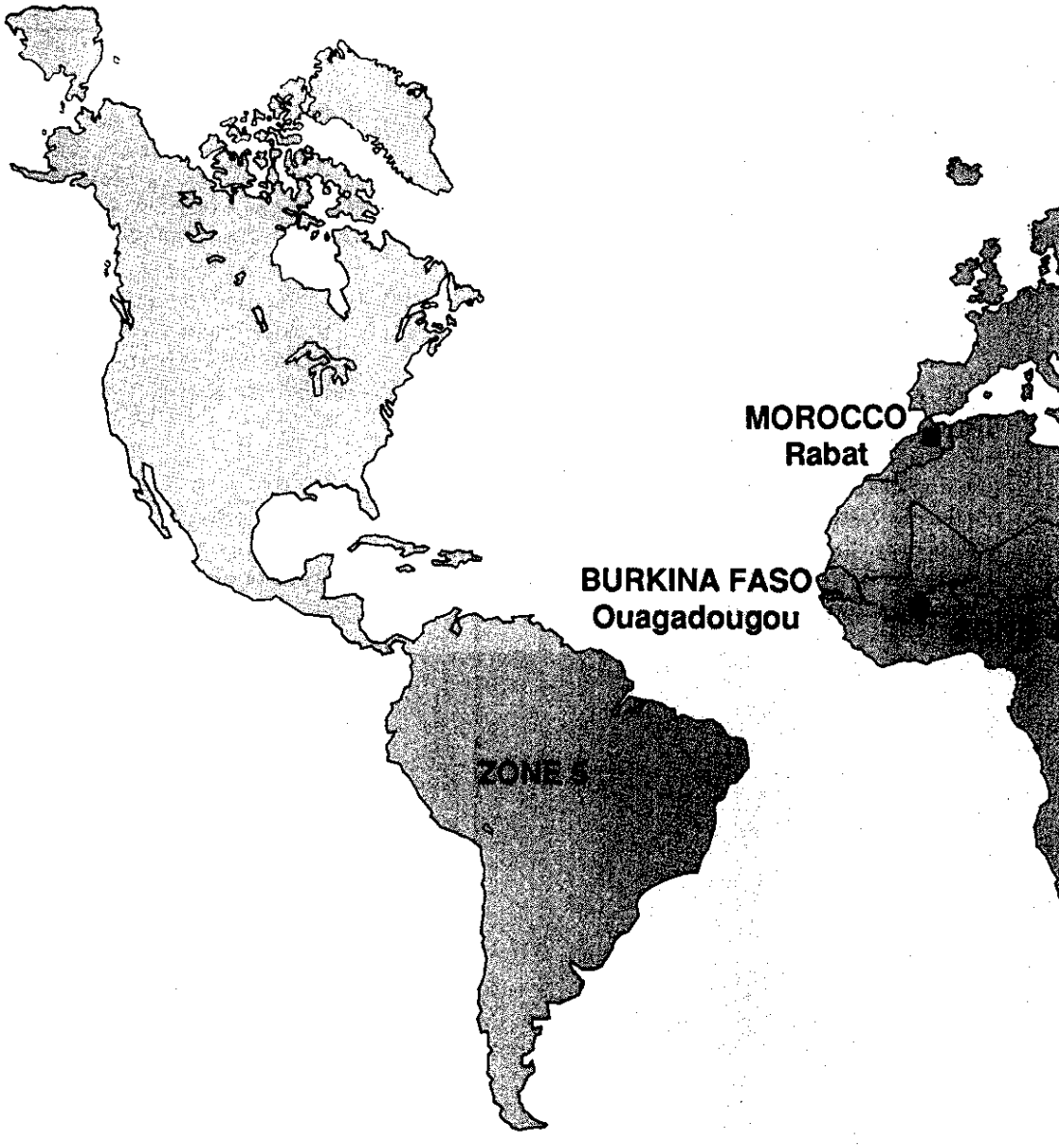
Roberto L. Lenton

Roberto Lenton
Director General



IIMI Worldwide

The map shows the five geographical zones selected in IIMI's Strategy as appropriate and distinctive units in which the Institute will operate. They are Southeast Asia, East Asia, The Arid/Semi arid zone of Southwest Asia and Northeast Africa, Africa except the Nile Valley, Latin America and the Caribbean. Boxes represent existing country units.

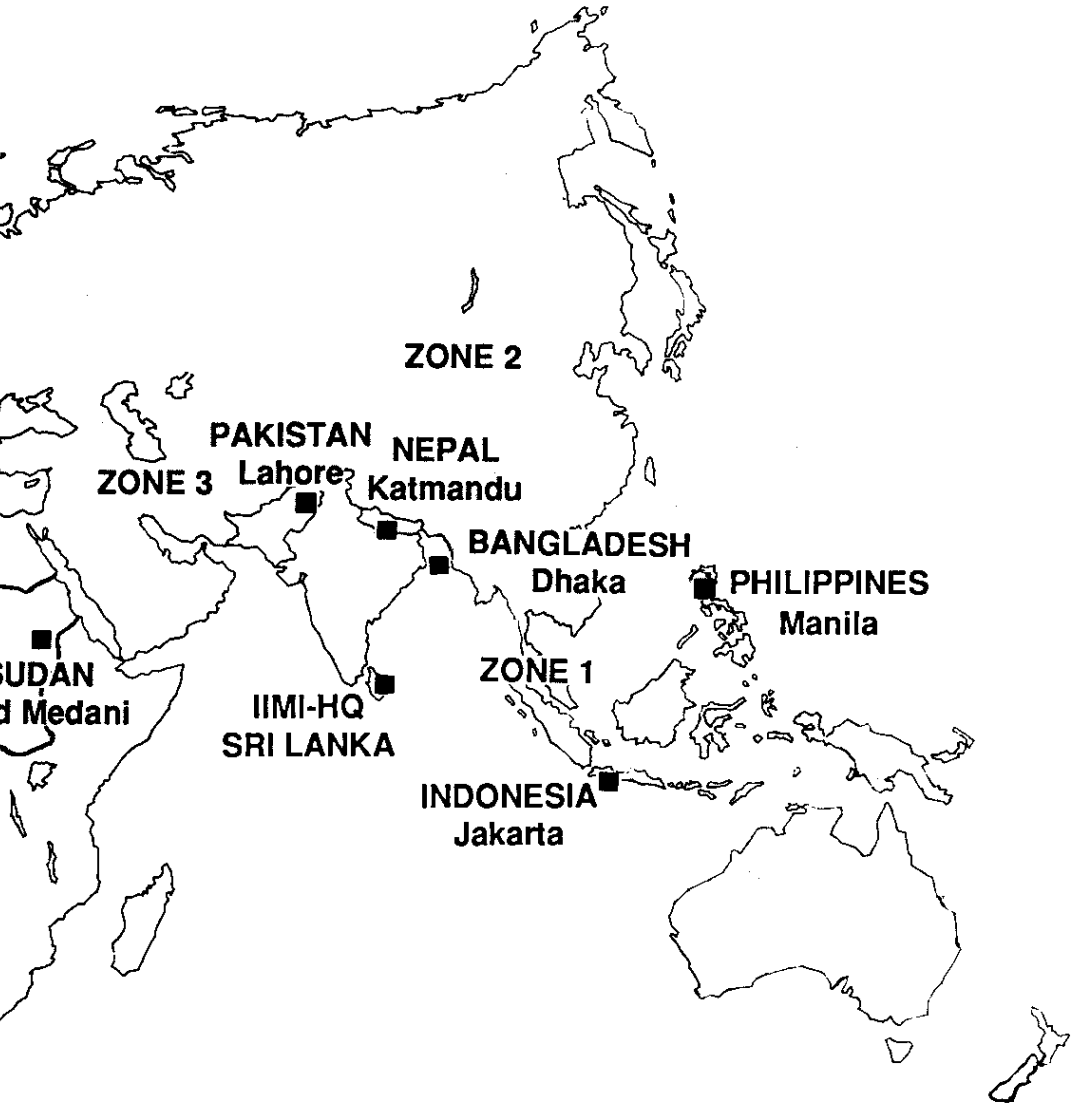


COUNTRY PROGRAMS

Introduction

IIMI country programs are run under formal agreements with national authorities and in partnership with national institutions relevant to irrigation management. Overall objectives of field activities are typically screened by national consultative committees. Within IIMI, the administration of country programs (with the exception of Pakistan, see below) is the task of the Field Operations Division set up as part of IIMI's new organizational structure in late 1988 (see Strategy Preview).

The level of field representation in country programs differs according to circumstances. The Institute's program in Pakistan involves a multidisciplinary team equipped to provide services across the full spectrum of IIMI's capabilities. For its resident programs such as those in Nepal and the Philippines, IIMI fields one or two international staff to engage in collaborative



research and training activities and help boost national research capacity.

The incipient country program in India is the prototype of a non-resident program in which IIMI undertakes intermittent functions such as organizing seminars, workshops and exchanges of staff or information. It also aims to encourage national participation in research networked across a range of countries. In regions such as West Africa, where irrigation extent in individual countries is too limited to justify separate national programs, IIMI is piloting regional or multi-country programs.

As the map indicates, IIMI recognizes five major geographical zones as its arena of operations and has activities current in three of them. Among its strategic ambitions is representation at one level or another in key countries within all five zones by 1993. An essential ingredient of all IIMI field projects is an imperative to twin research with practical testing and implementation of research-generated innovations in real systems.

BANGLADESH

IIMI's program in Bangladesh was initiated in late 1988 following signature of a Memorandum of Understanding with the Bangladesh Agricultural Research Council (BARC). With the support of the Ford Foundation, IIMI established its country office in Dhaka in November with the posting of a senior staff member.

Though these are early days for this resident program, the scope for useful project activities in Bangladesh holds great promise.

The Context

Straddling the delta area of three great rivers (Ganges, Brahmaputra and Meghna), Bangladesh has an irrigation potential signficantly greater than the 21 percent of its nine million cultivated ha presently under irrigation.

It will need it. Its population is likely to double within the next 40 years and present food demands cannot be met from home resources. Since virtually all cultivable land is already in use, Bangladesh must look to higher yields from each unit of land or extra harvest cycles, or both, for prospects of stepping up agricultural production in the future. Better irrigation and more of it will be essential to either strategy.

Equity Issues

Perplexing land tenure and distribution issues complicate the Bangladesh situation. Many rural workers are landless and most farmers have very small holdings. Small-scale irrigation techniques accordingly dominate the scene (see pie chart). A more equitable distribution of benefits and resources is likely to be elusive under these conditions.

One of IIMI's first projects in Bangladesh is therefore designed to develop new approaches to groundwater utilization which will enhance benefits to small-scale and landless farmers. IIMI will work in various locations with official irrigation agencies and with independent non-governmental organizations such as *Proshika* which are already engaged in pump improvement and similar projects at village level, to help find ways to expand and reorganize groundwater exploitation, and recommend improvements that will better serve the objective of poverty relief for the small holder and the landless.

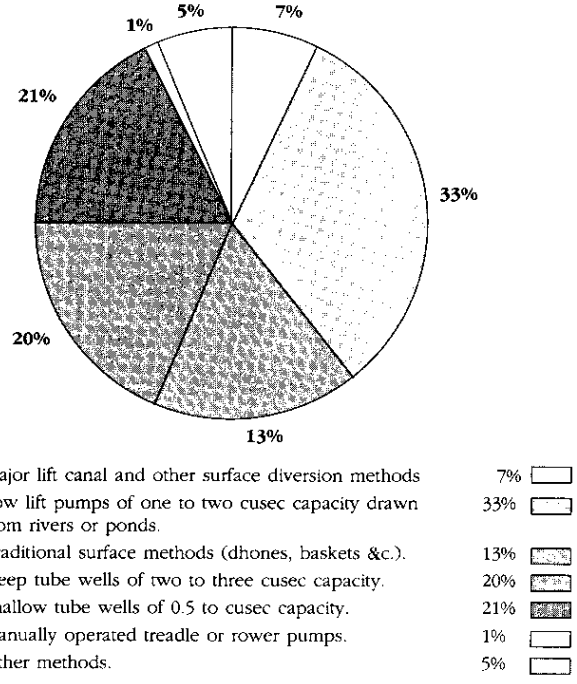
Focus on Rice

Bangladesh has also been added to the range of countries involved in the ongoing *Problems of Irrigation Management for Rice-Based Farming Systems* project which IIMI has undertaken jointly with IRRI, the International Rice Research Institute, with support from the Rockefeller Foundation, (see page 33).

Whereas the emphasis of work under this heading in other countries including Indonesia and the Philippines lies on crop diversification away from rice following their attainment of self-sufficiency in this staple food, efforts in Bangladesh will be geared to helping the country catch up with the region's leaders in rice production. National organizations participating in these efforts include the Bangladesh Rice Research Institute and the Bangladesh Water Development Board (BWDB).

The BWBD is already advancing initiatives to shift ownership and management of wells and canals to farmers' cooperative societies in several areas; these official initiatives and others like them are likely to play an important part in achieving higher productivity in rice-based systems. Questions of farmer management of irrigation systems thus form a definite link between the two IIMI project enterprises described here: fruitful interaction of efforts on this common ground is expected.

Figure 1. Irrigation use in Bangladesh. Small scale irrigation predominates.



INDIA

1988 saw the start of IIMI activities in India, in preparation for the Institute's first non-resident country program.

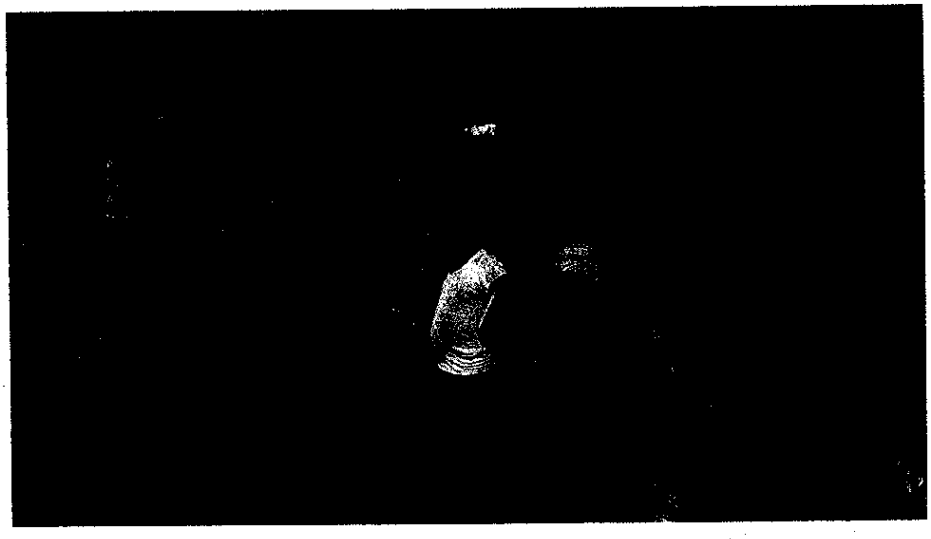
The extent of India's irrigated land is already vast and the country aims to almost double the present irrigation potential created by the turn of this century (see graph). Like the country's climate and land conditions, the quality and nature of irrigation in India varies greatly from region to region. The arid or semi-arid western and northern regions include large areas where irrigated rice and wheat are grown in rotation. The average crop yields in these areas are low (around 2t/ha) in relation to those of systems elsewhere in Asia. Yields tend to be still lower in humid tropical regions of eastern India, where abundant groundwater resources exist but have not yet been utilized to their potential.

India has many irrigation research and development bodies of her own and is in the process of establishing a National Irrigation Management Institute (NIMI). It has several major ongoing programs of activity notably through the system of Water and Land Management Institutes that have been set up in ten states within the country with the assistance of the World Bank and USAID to serve as in-service training institutions and to carry out action research programs.

"The extent of India's irrigated land is already vast and the country aims to almost double the present irrigation potential created by the turn of this century."

IIMI's Role

Considerable scope clearly exists for IIMI to make useful contributions to India's progress in irrigation management. The institute's approach has been to seek collaborative links with selected Indian institutions and their funding supporters with a view to carry out joint collaborative research and training activities. The need for the support structure an IIMI country office might provide is obviated in India's case by the efficacy of existing national facilities and the country's convenient proximity to IIMI headquarters. Hence a non-resident program was opted for, at least as a trial arrangement.



Overtures

Discussions took place during 1988 between IIMI and several Indian institutions, including the Ministry of Water Resources and the Central Water Commission, to establish general lines along which collaboration could proceed. The promising results of these discussions led to the drafting of a Memorandum of Agreement signed in January 1989 to provide a general framework for project development and implementation. Support for collaborative activities in India was committed by the Ford Foundation and USAID, New Delhi.

During 1988 IIMI staff helped steer research on tank irrigation system diagnostics using the 'Expert System' technique, done partly in two villages in South India. The researcher was a pre-doctoral fellow sponsored by IIMI under the institute-managed professional development program. IIMI also contributed actively to a planning seminar on policy-related issues in Indian irrigation supported by the International Food Policy Research Institute (IFPRI) in Ootacamund in late April. The seminar dealt principally with the outlook for research into irrigation policy and management proposed by IFPRI as suitable cases for joint efforts with national institutions.

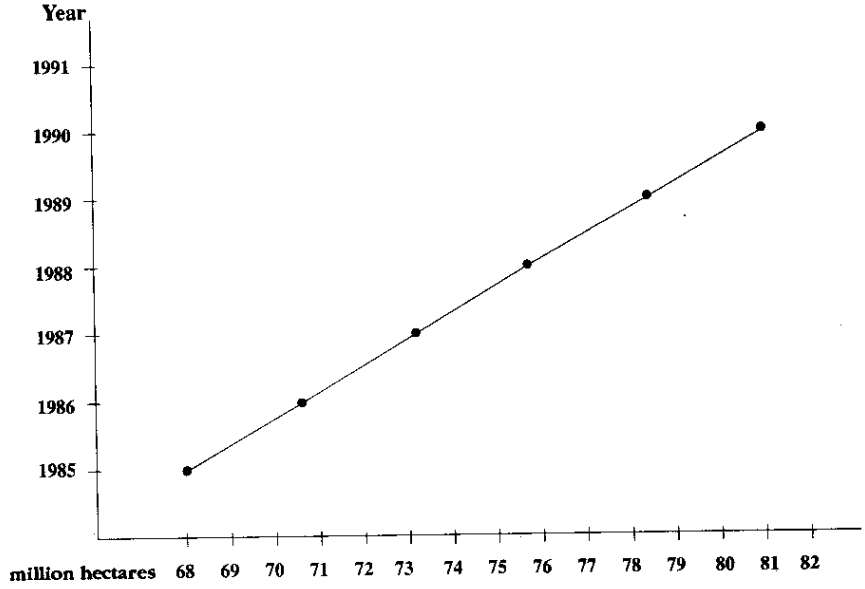


Figure 2. India's 6th 5-year plan, proposes expansion of irrigated area by 2.6m.h per year from 1985-1990)

INDONESIA

Indonesia has a greater irrigated area than any other country in southeast Asia. Its irrigation sector is presently in a critical state of transition towards the day when its 5.5m.ha of irrigation systems can be sustainably operated, maintained and financed with minimum state or outside intervention. This follows a fifteen-year period of system construction and development which required $12 billion of capital investment and helped the country recently attain self-sufficiency in rice production for its 170 million people.

To maintain this impressive record, rice production must increase by about 3 percent a year. But the rate of increase is currently declining. The Government recognizes that part of the problem lies in deterioration of complicated irrigation facilities that provincial irrigation services are hard pressed to keep running (still less improving) indefinitely.

Moreover, as a result of the continuing slump in world oil prices, Indonesia has had to cut back by half the amount of state funding available to subsidize operating and maintenance costs. New ways have to be found to shoulder the financial burdens involved, at the same time as improving the efficiency of system management nationwide. Possible approaches include the progressive turning over of smaller systems to water user associations representing farmers and related groups.

Opportunities are also seen to exist for increasing the returns from irrigation systems by adapting them for use outside the water-rich seasons to support marketable non-rice crops.

Indonesia has embarked on a five-year program of work (assisted by the Asian Development Bank and the World Bank) aimed at progressing towards efficient and self-sustaining operation and maintenance of all its irrigation systems.

IIMI's role

IIMI has been closely associated in several aspects of this initiative for three years; its own participation funded mainly by the Asian Development Bank and the Ford Foundation. The inaugural study phase of IIMI's work, performed in collaboration with Indonesia's Directorate General of Water Resources Development, its Provincial Irrigation Services and other bodies, was completed in 1987 (see *IIMI Annual Report 1987*, page 35 *et seq.*). It concentrated on measuring irrigation system performance in three provinces in Java, identifying persistent shortfalls in relation to management conditions and coming up with recommendations on ways to improve water control and delivery through better management, with special emphasis on the needs of systems where mixed cropping is a prominent feature.

The second phase, now current, mainly concerns pilot testing of the new measures recommended as a result of the Phase I studies in West Java and extends Phase I type activities to other parts of the country. The dimension of turnover of systems management to the farmer was added to this work in 1987. And the initial focus is on irrigation systems in West Java and West Sumatra.

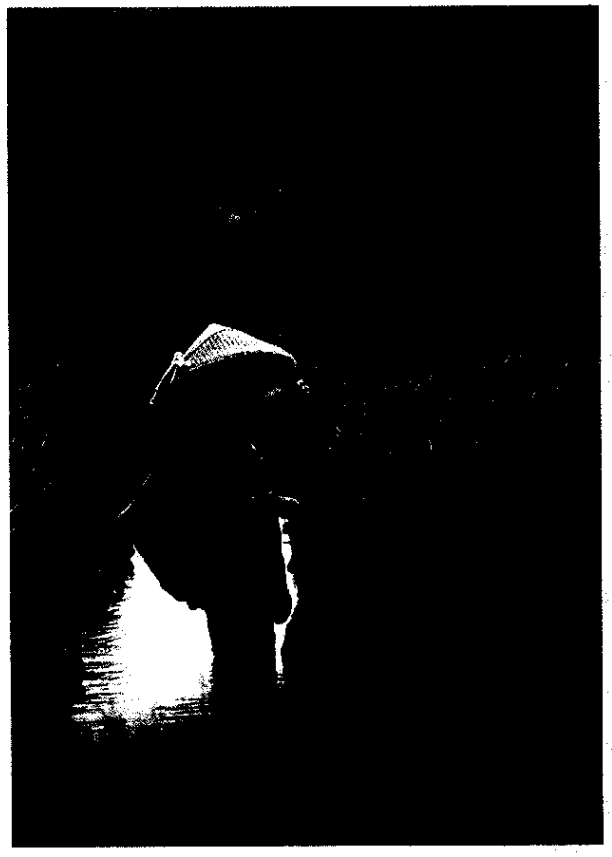
Several aspects of IIMI's Indonesia country program tie in with broader programs of multi-country research the Institute has under way.

1988 results of IIMI's work in Indonesia are described in detail elsewhere (see *IIMI Review* Vol. 2 No. 2, August 1988, page *3 et seq*) and summarized below.

Efficient Irrigation Management

Many of IIMI's 1988 project activities were a continuation of work done in the earlier phase, while some were new. The aim in both cases was to develop and pilot test methods to ease system operation and reduce constraints to good management.

Fieldwork was sited mainly in West Java. Work also began in the Way Jepara system near Lampung, southern Sumatra, where irrigation works are generally of more recent establishment and less advanced than in West Java.



Improving System Management

The *pasten* system and variations on it are widely used in Indonesia as means to assess water consumption in a system at routine intervals and extrapolate likely demand for succeeding periods. In practice, the data used as a basis for such calculations often turn out to be faulty leading to poor estimates of seasonal and annual plans for cropping. IIMI has helped develop and test inexpensive (about $3/ha) methods to achieve much the same result, using ordinary measuring tapes. Test results show only minor and adjustable deviations from statistics obtained using costlier techniques.

IIMI has also demonstrated total water requirements can often be overestimated because managers lack proper information on additional unmeasured water resources. Another kind of distortion occurs when not altogether reliable soil maps are used by planners in determining soil water requirements throughout a given system.

Such factors can only be corrected by more systematic and first-hand monitoring in the field. IIMI investigations show that the gains in precision such improvements can bring are very significant.

Gate Adjustment Practices

IIMI has also been involved in scrutinizing gate adjustment practices in the systems under study. Obstacles to efficient system and subsystem management include physical breakdown of gates and their associated measuring devices, lack of standard gates, favoritism on the part of gate keepers, unscheduled discharges of water following imperfect demand forecasts, and deviations from system-wide plans that result in unscheduled water deliveries. Problems of this nature add greatly to the difficulties of matching water supply and demand at various levels.

IIMI and its research partners are working to counter this tendency through trials of more localized assessment and allocation procedures that enable gate keepers to participate more responsibly in decision-making. Simplified methods for recalibrating faulty measuring devices at gates and new ways to use gates as measuring structures are also being experimented with. Water conveyance losses, usually assessed by a standard calculation rather than by measurement, are often significantly under-rated, so such methods could make an important difference to the efficiency of short-range management planning.

Management of Irrigation Water Supplies

Following indications from Phase I studies that variations in discharge upstream of weirs can greatly impede effective operation of systems served by a single water source, IIMI field studies initiated in 1988 focussed on larger-scale questions of rivercourse and reservoir management.

Early results of this work show that cropping patterns differ substantially between head-end and tail-end of systems, with cropping intensities in the latter sometimes falling behind by 60 percent or more. This situation reflects decline and flux in river discharges at weirs further downstream; there can be long periods when weirs far downstream receive no water at all from the main rivercourse. For want of effective guidance and intercommunication, upstream weir operators tend to keep a constant discharge running into the systems they cater to, regardless of fluctuations in the main supply.

"Early results of this work show that cropping patterns differ substantially between head-end and tail-end of systems, with cropping intensities in the latter sometimes falling behind by 60 percent or more."

Similar problems beset reservoir management. Discharges from reservoirs are not flexibly varied in step with varying inflow during wet periods, or when system-wide demand is reduced.

The annual planning of water allocations commences at the driest time of the farming year, when reservoirs are at their lowest and demand at its highest, so optimal reservoir data cannot be factored into the information on which allocation decisions are based.

New Approaches to Periodic Planning

The way annual and seasonal plans are prepared by irrigation committees or their equivalent can affect system management downline in a number of ways. Phase I studies showed there was room for improvement in the general effectiveness of such procedures as well as scope to make them more flexible and to use them to help reduce the heavy management load imposed by the complex design of many Indonesian systems.

In areas where simple cropping practices prevail, planned and actual deliveries usually match best. In other areas like Cikeusik, use of various non-rice crops and the non-standard crop rotation practices partly reflects uncertainty of water distribution to tail-end blocks. While many farmers would in any case prefer to grow other crops for economic reasons, much land is commonly left entirely fallow for want of reliable irrigation water supplies.

In each of these predicaments, IIMI has observed that better timing of planning procedures and streamlined rotational practices, including more flexible use of major control structures, could raise productivity and enlarge the range of irrigation options available to producers as well as facilitating more end-user participation in management.

Turnover of Management Responsibilities

Indonesia's policy of transferring small systems presently managed by official agencies to the care of water user associations is intended for phased implementation over 15 years. At the end of this period, it is expected that operation and maintenance of more than 70 percent of today's state-run irrigation systems (serving nearly 900,000 ha of irrigated land) will become the responsibility of user-managers. A system of irrigation service fees is meanwhile to be introduced, from which systems that have been turned over will be exempt – a strong incentive for farmers to welcome the change.

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During the opening three-year phase of pilot testing in systems smaller than 150 ha in parts of West Java and West Sumatra (provinces which have high concentrations of very small systems), about 200 systems totalling around 24,400 ha are expected to undergo the turnover process.

This will be no easy matter. Many of the systems involved pose daunting technical challenges, not least in the form of high sediment rates and complex irrigation structures. Land use in many of these systems is often intricately varied, while the communities involved may also have divided expectations and approaches, especially in areas where resettlement programs are in operation.

IIMI's role in the pilot program is to collaborate with national and provincial bodies in researching and developing ways to fine-tune the program for effective implementation on the ground; monitoring and evaluating its impact before, during and after turnover; giving advisory support in such matters as the long-term sustainability of turned-over systems; and streamlining official agencies that are likely to undergo change as a consequence of the shift to user-management.

The Process

The turnover process as presently defined consists of a 12-18 month cycle in which a mainly quantitative field inventory of each subject system is succeeded by a more in-depth system profile showing, among other things, what physical construction, training and institutional development measures are needed before turnover can be achieved with confidence. A design and construction phase follows, guided by the system profile and coinciding with the formation and priming of user groups to prepare them for increased operation and maintenance roles, before the system is finally and officially turned over.

The approach is logical enough but in practice the turnover process must take account of a bewildering diversity of factors. Local levels of management intensity and organizational capacity vary greatly; so does the physical condition of systems prior to turnover.

The provincial irrigation services are by no means the sole managers of systems within their present remit: all systems are to some extent jointly managed by agency and user. Many of them are already managed almost exclusively by farmers, water user associations or village officials and require few or no physical adjustments to fit them for turnover. In such cases, the turnover process may be a mere formality.

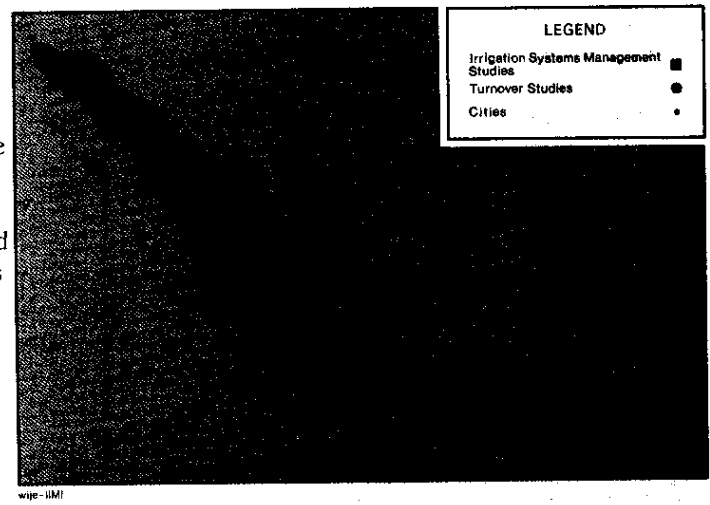
At another extreme, there are many systems which will need radical reconstruction or rehabilitation before they can be considered fit to be turned over and whose users are heavily dependent on official agencies for upkeep and day-to-day management inputs.

Priority tasks for IIMI are to make sure proper account is taken of such diversity in specific cases, while developing all-purpose strategies that can be applied to all the different possible conditions likely to be encountered as the turnover process is extended nationwide.

Redefining the role and profile of official agencies after turnover is another major IIMI concern. Once freed from responsibility for smaller systems and the proportionally high construction and staff costs they entail, such agencies should be in a position to deploy their resources more cost-effectively in the service of larger systems.

But the likelihood is that agency involvement will still be required to help coordinate and advise on the running of small turned-over systems, as well as to supply or oversee contract services to user-managers when the need for major construction or rehabilitation work presses, and to intervene when catastrophes strike that small user groups cannot handle alone.

In view of these and related complications, IIMI's second major task in the turnover program is to monitor and assess the turnover process described above to make sure that uncertainties can be minimized at the earliest possible stage, preferably at system inventory or profile stage. The likely impact of turnover on the official agency involved in each case should receive as much attention as that on the user association.



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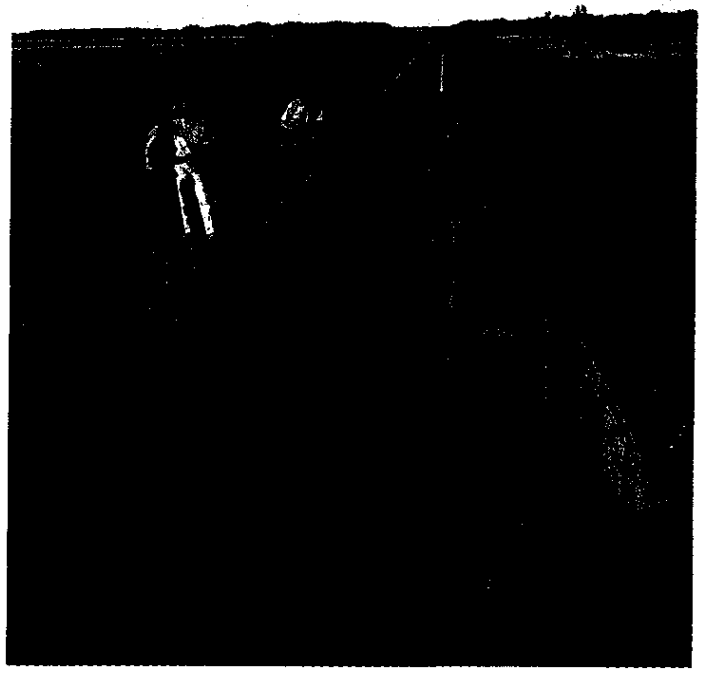
MOROCCO

At the end of October 1988 a Memorandum of Understanding was sealed between IIMI and the Government of the Kingdom of Morocco, providing for the establishment of an IIMI country office in Rabat. IIMI Morocco field operations were officially under way by the start of 1989.

Morocco was targeted as a desirable field of operations during the development of IIMI's Africa Strategy as much on exemplary grounds as for reasons of priority need. The country is not without irrigation problems; untapped water resources are scarce and existing resources must be used more efficiently to meet the food needs of a population whose numbers and income are growing fast.



Even so, management standards in Morocco's approximately one million hectares of irrigation systems are generally high. Irrigation and agriculture are closely integrated, upkeep of main canals in large systems is well regulated and cost-effective, flexible mixed cropping systems are adeptly accommodated within system requirements and water distribution is characteristically even-handed and alert to real needs.

These qualities are among those which comparable systems in other parts of the world commonly lack, while in other respects countries like Pakistan, having a long history of irrigation, hold potentially enriching object lessons for Morocco, though obvious differences of scale are involved. It was therefore premised that opportunities existed for a sharing of experience between irrigation managers in North Africa and other countries, in which IIMI could play a useful link role.

Morocco has no lack of well-trained researchers able to conduct irrigation management investigations to the highest professional standards. A gap is, however, perceived to exist when it comes to adapting and applying the results of such researches to the requirements of irrigation agencies or farmers' groups. Here, too, it is likely that IIMI's experience of similar problems elsewhere could contribute to strengthening Morocco's national capacity for successful irrigation management.

Signposts

IIMI's Morocco office will be located on the premises of the *Service des Experimentations d'Hydraulique Agricole,* a branch of the Ministry of Agriculture and Agrarian Reform with which close liaison is foreseen. One of IIMI's first activities will be to help set up a national consultative committee composed of Moroccan experts who will set the objectives of the country program. Future reports will detail the program as it takes shape but it is likely that important elements in future activities will be investigations of farmer management of irrigation systems and of irrigation service fee arrangements in Morocco.

> ***"One of IIMI's first activities will be to help set up a national consultative committee composed of Moroccan experts who will set the objectives of the country program."***

1988 beginnings

IIMI has already been involved in irrigation management research in Morocco during the months leading up to the agreement of formal terms of reference. Institute staff helped steer and support research done by the Human Sciences department of the Hassan II Agronomic and Veterinary Institute into the impact on farmers of the modernization of traditional irrigation systems in the Upper Tessaout valley. This work began in April 1988 and is expected to continue, with ongoing IIMI involvement, for a year.

IIMI also took an active part in a professional training session held partly at the headquarters of the International Training Center for Water Resources Management (CEFIGRE) which organized the event, partly in Morocco during May and June. IIMI contributed mainly in the subject area of system rehabilitation principles.

NEPAL

Nepal is experiencing major changes in its irrigation sector, stemming from a national program aimed at making the country self-sufficient in its basic needs by the year 2000. Food production must double to meet this target. Irrigation development that increases irrigated area, allows cultivation of an extra crop each year, as well as higher yields per hectare of rice and wheat, are foreseen as most important means to this end.

In addition to the changes the 'basic needs' plan necessitates in the field, a major reassignment of duties and restructuring of institutions for irrigation management is also under way. Responsibilities previously divided between three agencies are now being consolidated under the restructured Department of Irrigation, and the Agriculture Development Bank of Nepal. This realignment, which (though it aggregates powers at policy level) has decentralized management.

IIMI's three year record of collaborative work in Nepal with the Water and Energy Commission Secretariat (WECS) has included many elements of field research relevant to farmer-management of irrigation systems. Now the added dimension of institutional change offers scope for IIMI to link this and other work with the development of innovative approaches to management requirements across a broader range of concerns under the auspices of the Department of Irrigation. Strengthening the ability of implementing agencies to move toward farmer participation and management, comes high on the list of goals.

IIMI's more general role will be to ease the added burdens which major institutional changes must place on Nepal's irrigation agencies.

1988 Activities

Appropriate strategies for upgrading and expanding farmer-managed irrigation systems are the intended outcome of an action research project in a large watershed of Sindhupalchok district. IIMI and WECS with Ford Foundation funding have been working on this project since 1985.

Earlier exploratory work (see *IIMI Annual Report 1987*, page 39 *et seq.*) identified 19 out of 150 systems in the project area that were suitable for assistance. In 1988 this work entered a new phase involving design and construction of physical improvements to selected systems and a concomitant upgrading of management practices, with a view above all to boosting the ability of beneficiary groups to operate and maintain their systems sustainably.

Questions of Scale

A significant finding of recent IIMI investigations into issues for turning over of medium and small scale agency-run systems in Nepal to farmer-management, was that system size was not necessarily a paramount factor in selecting systems for such treatment. Some systems as large as 1000 ha would require very little preparatory work to fit them for turnover while some as small as 50 ha would need a great deal.

There are already large scale systems operating under farmer-management in Nepal and IIMI (in collaboration with the Irrigation Management Center and the Institute of Agricultural and Animal Sciences) has been evaluating several of these for the past two years. Systems diverting water from the Karnali River in the far western tarai and from the Tinau river in Butwal have been studied. The 3500 ha Chhattis Mauja system at Butwal, with irrigated crops year-round, was the focus of work in 1988. The present status of land and water resource utilization and particularly the equity of distribution of — and legal right of access to — these resources were examined in depth along with water supply and demand in sample branches and fields of the system. Decisions at all levels — in meetings with hundreds in attendance as well as those of elected organization leaders — and all operation and maintenance activities have been continuously monitored for a year to evaluate the effectiveness of management.

The ultimate aim of this analytical work is to understand issues of farmer control over the water resource and determination of what is required for effective management. With rapport built in the irrigation community and the detailed information available, this system will be a candidate for peer training of farmers from systems in the process of turnover.

Farmer Learns from Farmer

IIMI's Nepal team, led by Dr. Robert Yoder, has introduced some novel approaches to transferring the acumen of Nepal's more experienced farmer-managers to novice groups in other areas.

One such approach is the organization of study tours which bring farmers unfamiliar and inexperienced with effective management practices to areas where farmer-management of systems is highly developed, so that they can see and learn for themselves, with the guidance of their compatriots and peers, what farmer-management means in everyday terms.

A converse approach, where a team of experienced farmer-managers is given a roving consultancy brief to visit selected systems where management improvement is needed and give informal advice to users has also been tested.

In addition to these approaches, IIMI has brought audiovisual learning technology literally into the picture by commissioning a professionally-made video film about farmer-managed irrigation systems which is now being used as a training and awareness tool within Nepal as well as an information package for general use in IIMI's program development.

Whether or not these measures will fulfil expections remains to be seen and assessed but they are characterisitc of a program-wide IIMI concern for sharing the lessons learned in country programs not only between different groups and sectors within countries but also among irrigation managers as a world community.

The Nepal experience of farmer-management of irrigation systems also forms part of the wider picture of the subject which IIMI is engaged in piecing together within its portfolio of general program concern, from results of work done in many countries around the world (see page 30).

“ . . . the present status of land and water resource utilization and particularly the equity of distribution of - and legal right of access to - these resources were examined in depth . . . ”

Irrigation Coordination

At the request of the United Nations Development Programme and of Nepal's Ministry of Water Resources, IIMI prepared a presentation for the national "Irrigation Sector Coordination Meeting", held in February 1988, offering recommendations for practical application of organization and management concepts relevant to current development of a master plan for Nepal's irrigation subsector. IIMI also contributed a paper to a seminar arranged by the national Planning Commission, attended by more than 60 high-level officials, on the role of low-cost irrigation in increasing agriculture productivity in Nepal.

PAKISTAN

In the departmental restructuring consequent on completion of IIMI's new institutional strategy, the major country program under way in Pakistan is accorded the status of a full Division of the Institute, reflecting the large scale and prominence of its activities in the overall picture of program development.

The uninterrupted 13.5 million ha irrigated area in the Indus River basin is perhaps the largest in the world.

It is supplied by a complex of 43 main canals with a total capacity of nearly 250,000 cusecs. The surface irrigation system is supplemented by extensive public and private sector groundwater utilization: there are more than 15,000 publicly-owned deep, vertical-drainage tube wells and about 250,000 shallow tube wells in private ownership.

Despite this wealth of infrastructure Pakistan, like most countries in or fringing the world's dry temperate zone, lacks enough water to realize the full arable potential of its lands.

The 1988 report of Pakistan's National Commission on Agriculture foresees a 5 percent annual growth in agricultural production to meet targets set for the year 2000, yet growth over the past 25 years has averaged only around 3.5 percent or two-thirds of target levels. Acknowledging that water is agriculture's main limiting factor in Pakistan, the Commission's strategy calls for a one percent annual increase in available irrigation water supplies, to be achieved mainly by increasing the operational efficiency of the country's existing irrigation systems.

IIMI research in Pakistan is addressing a range of irrigation management problems relevant to achieving this objective.

Two new research projects were started up in 1988 and work continued on six existing project initiatives (see *IIMI Annual Report 1987*, page 29 *et seq.* for details of earlier work).

To date, IIMI program activities have been concentrated in Punjab; new staffing and funding prospects make it likely that the program will be extended into Sind and elsewhere in the future.

Distributary Channels: Variability and Equity

Field data collection activities under this project heading were expanded during 1988 to include additional, larger distributaries in the Lower Chenab Canal system. The expansion permits comparisons with previous findings on supply variability and equity of distribution in the smaller channel in the same system surveyed in earlier studies; At the same time it provides an opportunity to test the feasibility of improved methods for assessing secondary canal performance across a wider range of variable circumstances.

The distributaries chosen for study represent significantly different hydrologic environments. The Mananwala Distributary is in a head-end subdivision and its command area is largely underlaid by fresh groundwater, whereas Pir Mahal and Khikhi Distributaries are in a tail-end subdivision where rotation between and within distributaries is commonly practiced and where groundwater is characteristically saline.

Sites selected for detailed monitoring and study along these distributaries included head, middle and tail outlets and watercourse commands. Selection within these categories was made in some cases according to the conventional criterion of absolute distance from the water source, in others according to a criterion developed by IIMI known as *equivalent distance*

which takes account of variable hydraulic conditions and intimately characterizes the variability of flows in the off-takes.

Tests confirmed earlier findings that surface water distribution is substantially inequitable when original design parameters no longer prevail. However, data reveal that when design parameters are re-established, the equity objective is largely met. Data also indicate that under existing physical conditions, as long as discharge at head of a distributary is kept above 70 percent, tailend effects are not proportionally different than at full discharge. But when discharge drops below this range, the relationship between head and tailend distribution collapses; at 50 percent of design discharge, tail outlets draw no water at all.

"Tests confirmed earlier findings that surface water distribution is substantially inequitable when original design parameters no longer prevail."

These findings hold significant management implications for Punjab canal systems. Where equity of distribution remains an operational objective but irrigation demand varies outside a discharge range of 70-100 percent, a major change in design and management of the distributary system is called for.

Practical options available in such cases are being defined under the terms of a separate IIMI research project under the heading of *irrigation operations to accommodate demand* (see below).

Another focus of variability and equity studies was the watercourse improvement program which Pakistan's On-Farm Water Management Directorate has in hand. Here, too, it was shown that factors causing inequity of distributary channel operations were at work. Watercourse lining usually results in the re-establishment of modular flow conditions of outlets where non-modular conditions previously prevailed. Inventory studies in 250 watercourses along six distributaries in the head and tail of the Lower Chenab Canal system also showed up a pronounced bias in the pattern of benefit allocation under the improvement program, in favor of watercourses nearer the upper end of a distributary reach. These were shown to be three times more likely to be targeted for improvement measures than those in the lower half of the reach.

Irrigation Constraints on Crop Production

Crop production in Pakistan is sometimes interrupted or hindered by factors arising from the way irrigation systems are run, factors such as failing water supply or the annual closure of canals for maintenance.

IIMI research focuses on assessing the relative significance of these factors, with special reference in 1988 to annual closures and to early termination of irrigation.

Working alongside Punjab Agriculture Department personnel in farms at eight locations, IIMI researchers simulated (using irrigation deliveries from tube wells) what would happen if the canal closure routinely imposed every January was nullified.

Other studies measured the impact of early termination of irrigation on wheat production by pairing late-irrigated fields with closely similar fields where irrigation was cut to the shorter duration commonly found, under a wide range of growing conditions in 194 locations across four districts in Punjab.

While results of the canal closure test were inconclusive, the late irrigation test showed statistically significant yield increases averaging 0.2 tonnes per hectare in

late-irrigated fields by comparison with fields not receiving late irrigation treatment.

More to the point, yields were also found to be respectably high in terms of the scarcer resource, water. Wheat yields *per unit of water used* on the farms in the survey averaged 0.82 kg/cubic meter, or only one-third lower than California or northern India norms (1.29 and 1.20 kg/cu.m. respectively) which relate to much higher yield per hectare figures, while the top ten percent of Punjabi farmers achieved wheat yields per unit of water averaging 1.33 kg/cu.m.

These surprise results underline the need for an objective performance measure for irrigated agriculture. They also suggest that a good many Punjabi farmers manage available water resources with considerable care: the problem lies in their limited access to these resources in relation to the needs of the area they tend. Since it appears unlikely that this problem will be solved by additional system construction, answers should be sought in improved system management to free up better water supplies at the watercourse head or the farm gate.

"... a good many Punjabi farmers manage available water resources with considerable care: the problem lies in their limited access to these resources in relation to the needs of the area they tend."

Continuation of investigations was taken for *Raby* (dry season) 1988-89 with an expanded scope using a farming system approach which resulted in a shift from single crop to multi-crop and from single field to the whole farm. Detailed planning for data collection during the Raby season was carried out in collaboration with the Punjab Agriculture Department. A report containing findings and analysis relating to irrigation application to crop production was scheduled for publication in 1989.

Irrigation Operations to Accommodate Demand

Very different combinations of crops are often grown on the same irrigated farm during each of Pakistan's two main cropping seasons, Raby and *Kharif* (wet season).

How farmers manage their irrigation operations to meet the variant water demands imposed by these seasonal recombinations and other husbandry-related complications, is the focus of another IIMI project which started in 1987, sited in three watercourse commands along the Lagar Distributary, Farooqabad Subdivision.

Another feature of this area which attracted the researchers' attention was the conjunctive use of groundwater and irrigation water to satisfy crop needs. IIMI has a general interest in establishing the extent to which the use of groundwater can balance inequity in surface water distribution and this question is expected to come to the fore in future research.

1988 results from the three commands under study at different points along the distributary, showed that cropping intensity, or the proportion of the cultivable area planted to irrigated crops, was much higher in head-end than in tail-end locations, apparently reflecting limited access to surface water in the latter. This difference was more pronounced in the Karif season when basmati rice is an important crop. Tail-end farmers plainly find this a worthwhile crop even when grown in small quantities on the reduced cultivable area they can reliably irrigate at that time, yet the signs are that these farmers also make their available surface water go further than do their head-end counterparts.

A modernized irrigation system (the Lower Swat Canal) and a new system (the Chasma Right Bank Canal), both in the NWFP offer opportunities to shift from the traditional rotation system of warabandi operations to demand-based operations, as they have been provided with adequate canal capacity and controls and are not likely to face water supply as a constraint. IIMI studied these two systems and identified the issues which can form the basis of a research project aimed at management interventions for meeting crop water requirements adequately and in a timely manner.

Rehabilitation Strategies

In late 1987 IIMI initiated, at the request of the Punjab Irrigation Department, a baseline study of the Khikhi Distributary prior to implementation of a three-phase channel lining project there. The aim was to enable comparisons to be made before, during and after the rehabilitation process, as a means to assess its impact

on channel performance and perhaps to point to more cost-effective rehabilitation strategies. Another kind of rehabilitation operation, desilting, was scheduled for the same kind of scrutiny in two other distributaries due for this treatment, with a view to comparing the relative benefit gained from lining and desilting operations.

Postponement of some of the rehabilitation programs has delayed completion of the investigative work in parts of the sample range of locations. But early results of studies in a recently desilted stretch of the Lagar Distributary suggest the impact of this maintenance was mixed and relatively short-lived, with some gains in equity of distribution in mid-reach locations but contrary effects further downstream.

Combined Surface and Groundwater Management

IIMI's project work under this heading is to some extent an offshoot of earlier work on reliability, variability and equity in distributary canals (see above). While it was generally recognized that water from public and private tube wells was an important supplement to irrigation water in many places, the exact nature of the interaction was unclear.

A detailed census of wells operating throughout the 7,500 ha command of the Lagar Distributary, was followed by intensive monitoring of 175 privately operated wells selected on the basis of the census results, together with all the public wells in the area.

" A detailed census of wells operating throughout the 7,500 ha command of the Lagar Distributary, was followed by intensive monitoring of 175 privately operated wells . . . "

Monitoring, performed jointly with the Irrigation Research Institute (IRI) of the Punjab Irrigation Department, concentrates on measuring tube well discharge, pump conditions and water quality. IRI researchers will join IIMI in data analysis, an early output of which will be a pilot water budget (incorporating groundwater data) for the entire distributary command aimed at improving overall irrigation system performance.

Interagency Coordination

Because responsibility for activities that affect irrigated agriculture in Pakistan is dispersed among several agencies, national and provincial policy makers have stressed the need for effective coordination of irrigation management as a means to increase agricultural production.

IIMI research is documenting current and past efforts to establish interagency coordination for irrigation management. An institutional analysis of three provincial agencies involved in irrigation, forms part of this work, aimed at identifying strategic managerial requirements for future efforts to remodel institutional behavior and better interaction between official organizations dealing with irrigation.

" IIMI research is documenting current and past efforts to establish interagency coordination for irrigation management. "

In another approach to firming up interagency coordination, IIMI organized an informal seminar series bringing together policy makers and senior officials from several federal and provincial irrigation authorities. In addition, a senior IIMI Associate arranged a two-day retreat held in Saidu Sharif in September for 28 agency officials and IIMI researchers.

Main Channel Researches

Work under the project begun in 1987 on reliability and equity in main channels achieved some noteworthy results in refining the database initially compiled for main and secondary channels in Upper Gugera, by adding data from comparable channels in Lower Gugera, where tail-end water shortages frequently force irrigation officials to rotate deliveries between distributaries to keep the system operational. Two factors were singled out among those that tend to imperil equity: lack of main channel control structures and the degree of attention gate keepers devote to changes in main channel water levels. Since the latter factor is amenable to management interventions, it will become a focus of future comparative study and analysis.

Environmental Stability

Under an agreement executed on August 28, 1988, the Government of The Netherlands committed two-million-dollar equivalent as a grant to IIMI, to be utilized by IIMI-Pakistan on a research project which aims to minimize waterlogging and salinity problems through management interventions in irrigation systems. The grant, over five years, is the largest grant of its kind which IIMI has received to date.

Work on this research project was initiated towards the close of the year to identify potential participating institutions and field locations in the province of the Punjab and Sind where the problems of waterlogging and salinity are of particular concern.

Related to the project, a review and assessment of past and current research in waterlogging and salinity was undertaken and recommendations made for research topics related to irrigation management to be included in the National Research Agenda being developed by the International Waterlogging and Salinity Research Institute of Pakistan.

Information Flow

The collection of data under the more general heading of management of information for irrigation, a project also ongoing since 1987, benefitted from many of the survey-type activities described above. Other new elements added to the information pool included official Punjab Irrigation Department archives, processed and verified in the light of recent data.

"... a review and assessment of past and current research in waterlogging and salinity was undertaken and recommendations made for research topics..."

The aim of this work is to fill recognized data or information gaps that can disable confident planning or adoption of management innovations.

Future plans include an ambitious computerization program and a baseline initiative to apply modern geographic information systems and their analysis to irrigation management.

Prospects

All the country projects described above are expected to continue into 1989, using funding provided by USAID and the International Fund for Agricultural Development.

A keynote of program development in Pakistan in the future will be the extension of successful management innovations into wider realms, for application region-wide. The work planned on the development of geographic information systems and on establishing objective measures of irrigation performance hold special promise in this respect.

PHILIPPINES

Irrigation management in the Philippines has a long and noteworthy record: the country has been the stamping ground of many progressive region-wide management trends. Even so, the performance of irrigation systems in many parts of the Philippines still disappoints optimum expectations.

For many years past, the Philippines has laid heavy stress on increasing rice production; and as national self-sufficiency in that staple became a real prospect, the Philippines realized the need to move forward diversified cropping. IIMI's contribution to this process has taken the form of a collaborative search for novel measures to adapt the management of irrigation systems formerly dedicated wholly to rice, to the production of other crops during the dry season. This development has far to go: at present less than one percent of the country's irrigated area is used for diversified cropping, though mixed cropping under rain-fed conditions is commonplace in many areas.

During 1988 IIMI began working in close collaboration with the International Rice Research Institute (IRRI) in several countries to enlarge practical experience of irrigation management for crop diversification in rice-based systems throughout Asia (see page 33). The Philippines and other major rice-producing countries in Asia have already provided the backdrop for major advances by IIMI and its national partners in this direction, under the terms of a multi-

country project backed by the Asian Development Bank. The IIMI/IRRI collaboration builds on the solid baseline this project's results provide and will add an important extra dimension to future work in the Philippines and elsewhere.

Other important IIMI initiatives described here concern the trend towards sharing of management responsibilities between agency personnel of the Philippines' National Irrigation Administration (NIA) and growing numbers of irrigators' associations, with special emphasis on cost recovery to finance farmer-management or farmer participation sustainably. The search for reliable indicators to help evaluate the performance of irrigation systems is yet another major concern of IIMI's Philippines team. Both these lines of investigation also form part of multi-country mosaics of new knowledge being assembled within the IIMI program.

Irrigation Management for Diversified Crops

IIMI began investigating management possibilities for irrigating non-rice crops in the Philippines in 1985. The project now current started out in 1987. Major partners are the NIA, the Philippines Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and the Department of Agriculture, assisted by grant support from the Asian Development Bank. Various universities and colleges within the Philippines have also been linked into project activities.

"IIMI began investigating management possibilities for irrigating non-rice crops in the Philippines in 1985."

Main lines of enquiry have been directed towards:

* establishing ways to identify parts of systems most adaptable to diversified cropping;
* comparing the profitability and performance of selected crops under irrigated conditions;
* analyzing factors that influence decisions farmers make when preparing their land for irrigated rice in the wet season and for other crops in the dry season;
* developing on-farm irrigation methods for at least one 'upland' crop;
* designing and field-testing operating procedures for diversified cropping in publicly-managed parts of irrigation systems; and
* recommending policies most likely to encourage successful diversified cropping and attract investment in it, backed up by management guidelines.

The research is carried out in parts of several large systems in the islands of Luzon (Ilocos Norte, Nueva Ecija and Tarlac provinces) and Mindanao (South Cotabato province).

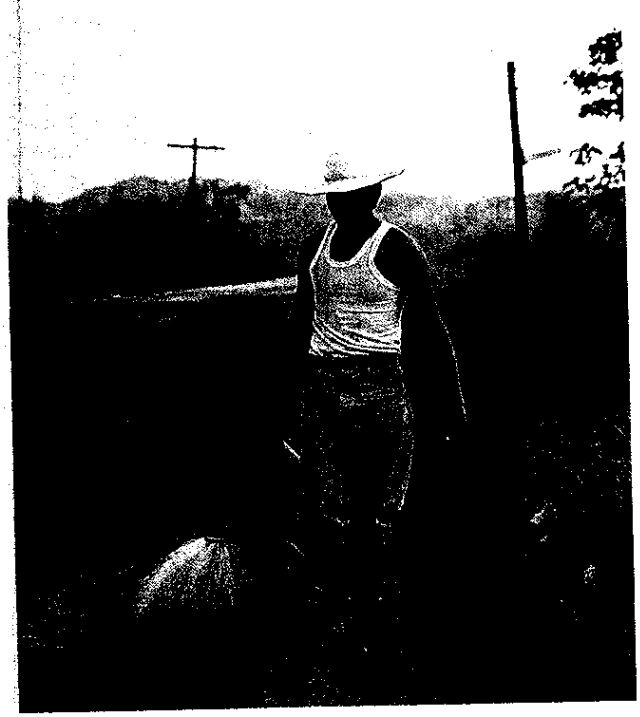
1988 Results

Some of the results of this work were reported in previous *Annual Report* issues.

Current IIMI work to assess land potential and demand for crop diversification is built on an information framework that uses microcomputer-assisted techniques to produce detailed maps of the distribution of land types throughout the country's important irrigated areas. Geographic Information Systems of this kind involve digitization of a variety of existing data, even where these are not abundant, that can be refined or 'ground-truthed' and added to continually in the light of field reports. Different sets of data can be overlaid on the basic map to reveal linkages and interactions between otherwise disparate factors such as (in this case) patterns of rainfall, soil conditions and availability of groundwater at different sites. The system is applied to help identify sites where conditions are favorable for irrigated diversified cropping.

Two microcomputer programs were used in developing the IIMI system, a map analysis package and a computer aided mapping program. Though both have proved useful in identifying parts of

"Current IIMI work to assess land potential and demand for crop diversification is built on an information framework that uses microcomputer-assisted techniques to produce detailed maps of the distribution of land types. . ."



systems suitable for diversified cropping, the latter program, thanks to its capacity to represent unit grid cells as small as 0.3 ha in the output map, had the advantage in terms of precision.

As an operational planning tool, this system is proving its worth but key aspects of the switch to diversified cropping refer more to farmers' attitudes than to geography.

The heavy emphasis laid on rice-cropping by past land-use policies has left its mark on these attitudes. In most cases farmers will grow rice wherever the irrigation water supply permits, especially if a service fee has to be paid for that supply. In areas where dry season rainfall is significant, farmers tend to regard irrigation as an unneccessary refinement for production of crops other than rice: if they are to undergo the expense of irrigation, their inclination is to use it to grow more rice. A frequent result is inefficient use of water for rice and non-rice crops alike. In the IIMI project sites, researchers have been using demonstration farms in a bid to convince farmers that the returns on various irrigated non-rice crops would more than pay for extra water charges. Trials took place over the 1986-87 and the 1987-88 dry seasons and will run again in 1988-89. Early results regarding profitability were mixed but successive rounds of trials show a firmer pattern as farmers and agency officials bring increasing experience and confidence to the task.

In both trial seasons on the Ilocos Norte sites, garlic proved to be the most rewarding alternative crop, particularly in the Bonga River site where farmers were able to apply more farm inputs and withstand price fluctuations. Here, too, farmers were able to exercise better control over the irrigation water supply, an important factor in increasing yields and profitability.

In Tarlac, 1987-88 results of trials with**hybrid corn** showed improving prospects for this crop, measured in terms of higher yields as well as of mean returns to the farmer above variable costs. By the latter criterion, **onions** grown in the Nueva Ecija site out-performed rice in both trial seasons despite a 60 percent drop in onion yields during 1987-88, offset by a sharp (240 percent) increase in the market price of this crop. Even if market prices had been fixed at the previous year's level, the yield reduction would not (it was calculated) have left farmers with any net loss. In the two main South Cotabato sites, trials with**hybrid and native corn** yielded less clear-cut results, with rice still emerging as a more profitable dry-season crop than corn in the Allah River Valley site and more so in the Banga River site, though corn production in the latter area (whether irrigated hybrid corn or rain-fed corn of either type) is generally higher.

On-Farm Factors

Aside from balance-sheet considerations and from the more obvious sources of variable costs taken into account in measuring profitability, irrigated diversified cropping on systems tailored to rice production requires adjustments to land preparation and husbandry practices on the part of the farmer, which may have relatively minor cost implications.

One such adjustment IIMI has investigated is the periodic shift of land from a puddled lowland to an upland soil condition in preparation for alternative crops such as onions. Farmers with more than ten years of experience in mixed-crop farming naturally find this transition less troublesome than others unused to handling more than one crop. Other factors favoring this shift are presence of medium textured soil, availability of labor or draft animals and familiarity with weed control and land preparation practices for upland crops.

Another set of observations was aimed at establishing irrigation methods for onion, corn, garlic and mung bean on rice paddy fields with minimum disruption of the existing paddy configuration. Onion cultivation required no major land or field transformation: whether the crop was grown under mulch or on raised beds with border flooding irrigation (the latter proving the best-yielding combination), all the necessary accessory ditches could be fitted within the existing paddy dikes.

"Another set of observations was aimed at establishing irrigation methods for onion, corn, garlic and mung bean on rice paddy fields..."

The same was true of corn grown by furrow irrigation or basin methods (three applications at two to three week intervals) in sites in South Cotabato, though the shorter furrows made by farmers in the Allah River system in order to fit plots within existing dikes lengthened the time of application to 30 hours/ha. Traditional basin methods, however, took still longer (up to three days for one hectare).

Levelling or furrowing also proved useful in speeding up applications and minimizing waste in garlic trials in the Laoag-Vintar River system. Of the crops under trial, mung bean had more specialized application needs, being prone to damage by waterlogging during the vegetative stage of growth, yet had modest water requirements overall. Those farmers in Ilocos Norte who already grow mung bean, habitually allow the crop to subsist on residual moisture or on the last available irrigation deliveries after the rice harvest, without making special arrangements for further deliveries. Trials confirmed that this approach is probably the most effective in any case.

The density of irrigation ditches on farms where mixed crops are to be irrigated during the dry season can be an important factor: too many or too few ditches in relation to farm size can mean insufficient irrigation on the one hand or waste of water on the other. Results of 1988 investigations aimed at establishing optimum farm ditch density for different sizes of farm and the relationship between farm size and the turnout service area (a major influence on total farm ditch length) showed that farms averaging less than half a hectare in area had a turnout service area of less than three hectares, while for farms between one and two hectares in extent the turnout service area was less than 20 hectares. In each case the ideal farm ditch density was found to be unvarying at around 100 m/ha. These values serve as a useful guide to planning the amount and size of irrigation facilities needed for successful conversion of systems to mixed cropping in dryseasons. They encourage the conclusion that the need for physical preparation of farms for irrigated diversified cropping can be predicted and managed without undue upheaval.

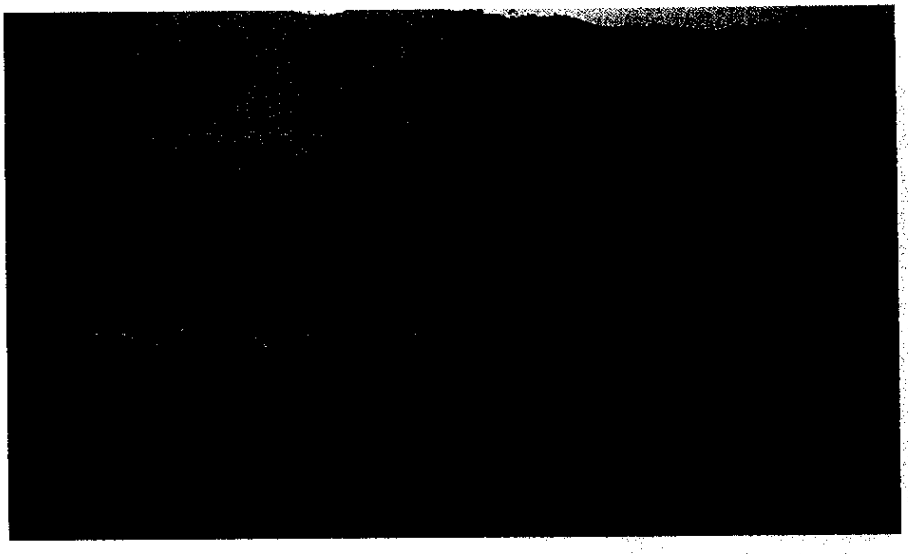
Irrigation Management at System Level

If diversified cropping is to succeed and to win general acceptance as a routine practice, the farm-level adjustments described above must be matched by efficient water regulation on the part of irrigation system managers. Joint IIMI and NIA investigations into parts of the Allah and Banga River systems in South Cotabato showed that water use efficiency differed widely (44 — 85 percent respectively) at sites selected for campaigns to encourage diversified cropping in these neighboring systems. Despite considerable information and training efforts aimed at winning farmers over to more adventurous use of irrigated land, relatively small areas were planted to corn during the 1987-88 dry season in both areas.

"Joint IIMI and NIA investigations into parts of the Allah and Banga River systems in South Cotabato showed that water use efficiency differed widely..."

The situation in the Banga River site, where water use efficiency was high, was nevertheless unfavorable to diversification for the very reason that the water supply to paddy fields was sustained by well-regulated rotations. Some unmeasured inflow was also observed draining into the system from the adjacent Allah River system service area. The small area of corn

that was planted subsisted largely on rainfall and on seepage from nearby paddy fields. Corn was, however, planted in larger quantities in this area as an early third crop during the 1987-88 dry season, suggesting that a third crop could be more widely viable if effective management can be achieved.



In the Allah River site, field observations revealed that actual water deliveries to the service area were greater by 30 percent than the planned deliveries. This discrepancy resulted from errors in the theoretical calibration curve used by system managers to estimate daily discharges entering the system. Combined with high rainfall and adequate river flow during the season in question, this inadvertant surplus induced farmers to plant more rice rather than switch to a crop better suited to dry conditions. IIMI researchers have supplied NIA staff with a corrected calibration curve to use in the future to avoid a repetition of these circumstances. Present conditions may favor rice rather than alternative dry season crops in this particular system, which is relatively new and not yet utilized to its full potential. But such will not be the case for long.

To Sum Up

It is clear from these examples and from experiences elsewhere in the Philippines that crop diversification is by no means a straightforward matter and can require a good deal of perseverance through trial and error. In systems where irrigated diversified cropping was found to be successful, a limited dry-season irrigation water supply and suitable soils for non-rice crops were identified as premium factors. Land and farm preparation for these crops were, on the other hand, shown to be minimal lying well within the average farmer's scope. At system level, there is an evident need to prevent moisture deficits and increase the irrigated area during dry seasons, by providing more suitable control structures and establishing agreed procedures between irrigation agencies and users. Further expansion of irrigated diversified cropping will require more support to farmers in the form of credit, re-lending and guarantee fund programs, post-harvest facilities, extension efforts and farm-to-market infrastructure.

A manual of guidelines for extension workers, dealing with irrigation methods, crop-water relations and production pointers for a range of non-rice crops has been drafted by IIMI for incorporation (after review) into a set of national recommendations for irrigation management in the Philippines.

A National Workshop on irrigation management for diversified cropping was staged jointly by IIMI and PCARRD in late 1988 to review in detail the work described above and other research efforts in this subject area. The workshop also scrutinized the draft guidelines (see above), reviewed in manuscript a forthcoming state-of-the-art publication on water management for crop diversification and produced recommendations for future plans of action. Implications research results hold for government policy and irrigation financing were major topics of debate during the workshop's discussion sessions.

"A National Workshop on irrigation management for diversified cropping was staged jointly by IIMI and PCARRD in late 1988..."

Results also underwent formal review by the Study Advisory Committee, a national body set up to

oversee the project's progress and orientation, and by ADB. These consultations were incomplete by the end of 1988 but early indications are that demand will grow for quick-reference costing and estimating techniques for assessing the financial viability of irrigated diversified cropping in areas new to the practice. Ways and means to cater in advance to diversified cropping when designing new or rehabilitating existing irrigation facilities are also likely to surface as priority needs in the project's final phase.

Other Activities

IIMI researchers in the Philippines also contributed during 1988 to a region-wide survey of design and management for rehabilitation of irrigation systems, funded by the ADB. Results of this multi-country project will be reported in a future *Annual Report* issue.

The NIA has been involved for many years in official moves to make the irrigation sector more self-financing. With NIA and the International Food Policy Research Institute (IFPRI), IIMI began in 1987 to evaluate this process (see the *IIMI Annual Report 1987*, page 48) with a view to passing lessons learned in the Philippines on to other agencies elsewhere. Since sustainable management of financial resources for irrigation is one of IIMI's major thematic concerns, the report on the Philippines experience (now near completion) is expected to form a cornerstone of much future work under this heading. Further investigations in the Philippines which will place special emphasis on farmer participation in irrigation management and its implications in financial (among other) terms are presently being discussed with NIA, NEDA (the National Economic Development Authority) and donor bodies.

IIMI also finalized arrangements for a new project in which staff will take responsibility for the irrigation component in an ongoing USAID-funded project (the Accelerated Agricultural Production Project). Irrigation management research in this context will be aimed at finding ways to boost and steady the supply of irrigation water to farmers by helping farmer irrigation associations to master effective techniques for planning, repairing, operating and maintaining irrigation systems.

SRI LANKA

Sri Lanka's irrigation systems serve just over half a million hectares — a small operation by regional standards yet an important and wieldy model for many issues in irrigation management research and extension. Most (about 58 percent) of the country's irrigated area is managed by the Ministry of Lands and Land Development through its Irrigation Department and Irrigation Management Division. The rest is the responsibility of the Department of Agrarian Services (DAS) in the Ministry of Agricultural Development and Research and the Mahaweli Authority (about 34 percent and 9 percent respectively).

Broadly speaking, the DAS looks after 'minor' systems (with command areas of less than 80 ha) which are run under farmer management or with a significant degree of farmer participation. There are an estimated 20,000 such systems in Sri Lanka today, centered on small reservoirs (tanks) and diversion systems. Most are of considerable antiquity. Many have been restored or rehabilitated by the Irrigation Department during the past eight decades and handed over to DAS for operation and maintenance under varying degrees of user management. In recent years private

Season	Delivery points[a]	Number of observations	Mean delivery (mm)	Standard deviation	Range (mm)	Coefficients of variation
Dewahuwa						
1985 yala	DC	5	686	302	310-1228	44
	DT	14	661	306	301-1321	46
	TO	3	474	172	240-652	36
1985/86 maha	DC	7	1087	171	766-1373	16
	DT	20	956	448	339-2050	47
	TO	17	1129[b]	515	438-2571	46
1986 yala	DC	9	1030	355	412-1809	34
	DT	20	703	394	190-1846	56
	TO	10	570	227	313-1018	40
Kalankutiya (Mahaweli H)						
1985 yala	DC	3	886	96	880-1006	10
	TO	11	755	128	624-1037	17
1985/86 maha	DC	5	688	99	513-797	14
	TO	28	534	192	104-859	36
1986 yala	DC	5	907	100	766-1022	11
	TO	29	757	259	167-1223	34

[a] DC = Head of distributary channel.
DT = Direct turnout from main canal.
TO = Turnout from DC.
[b] Increased by inflow from local runoff.

Source: Miranda and IIMI Irrigation Management for Crop Diversification Group (1988).

voluntary organizations have also been restoring small village systems.

The Mahaweli Authority steers the country's biggest-ever irrigation and hydropower project, under development for the past twenty years in the basin of the Mahaweli River and in major diversions from it. More than 200,000 ha of irrigable area is earmarked for development under this scheme, linked in many cases to farmer resettlement programs. The 120,000 ha of irrigation systems now being fed from this source include 75,000 ha of existing Irrigation Department schemes which formerly lacked enough water for more than one growing season. These schemes remain under Irrigation Department management, while 45,000 ha of new schemes are managed by the Mahaweli Authority itself.

Eight in ten of the Irrigation Department's more than 300 systems serve areas under 1000 ha. Thirty-five of the larger schemes are run in conjunction with the Irrigation Management Division.

This complex subdivision of management and policy responsibilities is likely to pose growing problems in the future, particularly as the rate of new system construction drops and emphasis shifts to the rehabilitation, operation and maintenance of established systems, dominated by those of small or medium size. Related questions of finance and the supply of support services to farmers could also become increasingly hard to tackle without far-reaching institutional reforms and shifts towards less centralized management alongside more unified policy-making.

"... questions of finance and the supply of support services to farmers could also become increasingly hard to tackle without far-reaching institutional reforms..."

IIMI in Sri Lanka

IIMI activities in Sri Lanka during 1988 ranged from short-term and site-specific fieldwork implemented by research fellows to long-running projects located in several different areas. Some of these larger-scale investigations form part of broad comparative and thematic programs of research linked to work in other countries (see previous *Annual Report* editions). Smaller-scale projects that were in their finishing stages or came to term during 1988 included:

* a project entitled **enhancing capacity for professional management of irrigation systems**, which employed interviewing and observation methods derived from techniques used in social anthropology, to assess the differing impact on system efficiency of the organizational approaches taken to irrigation management tasks by two of the country's major agencies, in two test sites;

* a project on **land settlement planning for improved irrigation performance** which examined key irrigation management problems arising on a resettlement site in Kirindi Oya, with emphasis on the impact of settlement policies on farmers' participation in system management, and on frailties in the provision of support facilities to new users;

* field research into the **impact of state intervention on property rights and relations** in two small schemes in southern Sri Lanka;

* an analysis of institutional gaps revealed during a growing season cut short by drought in a new

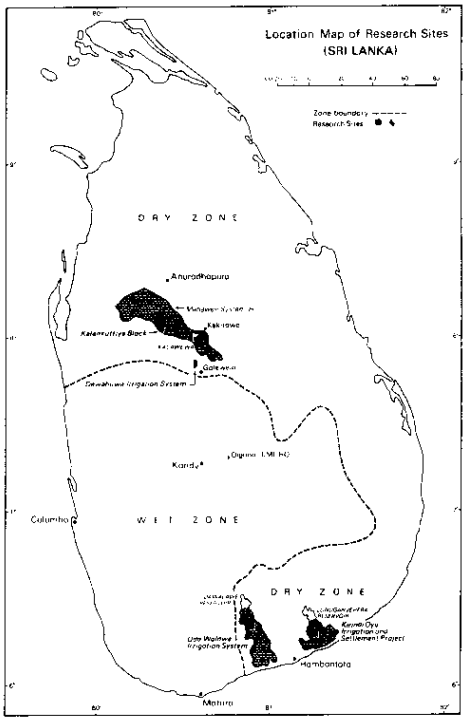
settlement scheme at Kirindi Oya which includes recommendations for improved management of local organizations to provide against similar conditions in the future;

* fieldwork to identify problems arising from a pilot initiative to rehabilitate a field channel at Uda Walawe, and their implications for the sustainability of the rehabilitation plans for the right bank system.

Reports on most of these projects are undergoing review and will fall due for publication in 1989, but many of the partner agencies involved have already started implementing some of the draft recommendations they contain.

Irrigation Management for Crop Diversification: Into Action

Of the larger-scale projects IIMI has ongoing in Sri Lanka, this is the longest-running. Following a research phase that began in 1985 in the Dewahuwa system and in System H, Kalankuttiya Block, the project last year entered a phase of active testing of management interventions aimed at promoting reliability and equity of the irrigation water supply at turnouts along distributaries, and at better sharing of water below turnouts. The intervention approach has been rigorously applied to monitor water delivery to field channels, then to meet at weekly intervals with agency officials and farmers to compare and comment on results and plan the following week's issues. Reports on 1987 and 1988 work and a synthesis of lessons learned are now available.



Another research project on irrigation management and crop diversification began in two southern sites (Kirindi Oya and Uda Walawe) in 1988, under a technical assistance agreement with the Asian Development Bank. Research involves assessments of system performance, interactions between system design and management and the fitness of irrigation institutions (including farmers' associations) and their routine procedures to meet the demands of crop diversification. An important feature of the two project sites is that both include mosaics of upland (well-drained) soils favorable to a wide range of alternative crops and poorly-drained, less adaptable lowland soils. At each site, a complete subsystem distributary canal's command area, together with its field canals, is under investigation. Research in the Kirindi Oya site emphasizes introduction of upland crops into irrigated land during dry seasons, while the focus in Uda Walawe is principally on management of the canal rehabilitation process to enhance system performance and flexibility.

The Irrigation Systems Management Project

IIMI is working with the Irrigation Department, the Irrigation Management Division and with various national research organizations and private consultancy firms in Sri Lanka on aspects of a government project supported by the US Agency for International Development (USAID). This project is aimed at raising the capacity of the agencies to improve, manage and maintain the irrigation systems in their care. The project finances rehabilitation of four major systems in Polonnaruwa District and the right bank of Gal Oya in the Ampara District and includes institution-building elements such as establishing farmers' organizations, improving methods used by agencies to monitor performance and feedback, upgrading management of finances and testing novel approaches to system rehabilitation.

IIMI is guiding the implementation by national organizations and firms in the research component of the project under a cooperative agreement with USAID. IIMI has also completed a review of literature relating to irrigation management in Sri Lanka which identifies important research trends and gaps and suggests future research directions, for the benefit of partners in this project.

❝ IIMI has also completed a review of literature relating to irrigation management in Sri Lanka which identifies important research trends and gaps. . . ❞

Design and Management Interactions

The design of main canals in irrigation systems naturally affects operations and standards of performance throughout these systems. Yet the problems of carrying out field research to identify possible improvements to these features on so large a scale are self-evident. Mathematical models that simulate the real system provide a convenient alternative to field experimentation.

Sri Lanka is the setting for the pilot phase of a regional project concerned with applying mathematical models for the simulation of main canal control operations, as an aid to management decision-making. Achievements under this project are summarized in Chapter 2.

❝ IIMI has also completed a review of literature relating to irrigation management in Sri Lanka which identifies important research trends and gaps. ❞

Analysis of Irrigation Decision-Making Processes

This project is being implemented in Kirindi Oya and Uda Walawe with assistance from the Government of the Netherlands, which assigned an Associate Expert to the task during 1988. It is intended to test the Wageningen Management Approach, a model for analyzing management processes, under Sri Lankan conditions. The model helps evaluate decisions made at every point in the irrigation management process, from the setting of broad objectives by agency executives, through to the delivery of water to specific points in irrigation systems. Country papers describing the results will be finalized in 1989.

Irrigation Investment Policy

This is the subject of a project supported in part by the Japanese International Cooperation Agency with the University of Peradeniya, aimed at chronicling irrigation investments in Sri Lanka since 1948 and evaluating the cost-effectiveness of different kinds of investments over that period. A technical paper on the implications the project results might hold for policy makers in the future, will be prepared in 1989.

ADB Regional Technical Assistance

This is an umbrella project funded by the Asian Development Bank, having three components. One component focuses mainly on the subject areas of design and management interactions in main canal operations, the quality of management decision-making and the impact of problems in these respects on system performance. Activities under this heading therefore coincide with several that have already been mentioned as aspects of field operations in Sri Lanka and of various multi-country or thematic projects.

A second component of the project supports research into dry season irrigation management for crop diversification in Sri Lanka and various other countries (see page 31). The third component is a survey of

policies and practices for financing irrigation services, linked to an analysis of financial management histories of three Sri Lankan irrigation systems. Final results of the case studies and survey will be published in 1989, alongside results of similar investigations under way elsewhere in Asia.

Farmer-Managed Irrigation Systems

This project forms part of IIMI work in many countries under this heading, funded mainly by the technical cooperation ministry of the Federal Republic of Germany (BMZ) and the International Fund for Agricultural Development. Results of IIMI work on this topic as a whole are reported elsewhere (see page 30). Work in Sri Lanka during 1988 took the form of three main field activities, one of which entailed field tests (in Badulla and Kurunegela Districts) of guidelines developed in 1987 for rapidly assessing problems in farmer-managed systems as a basis for designing and monitoring improvements. Another used similar assessments of 30 minor tanks to analyze the FMIS assistance component of a major dry zone agricultural project in Anuradhapura. A subsidiary part of this study was directed towards weighing up the role of NGOs in assisting FMIS components of the Hambantota Intergrated Rural Development Project in the south of the island. Finally, workshop activities united specialists from many implementing agencies and research institutions into a working group charged with reviewing progress made so far towards improved support for farmer managed irrigation systems in Sri Lanka and identifying promising future courses of action.

Future plans

As many of the shorter-term projects described above reach completion, prospects are good for opportunities to develop a new program of field operations in Sri Lanka. The restructuring exercise IIMI put in place following agreement on its medium term strategy entails running these operations as a set of country activities discrete from the main headquarters administration, where before this distinction has been blurred. It is hoped that important elements of a future program could be IIMI participation in refining a more streamlined and integrated policy-making, planning and financing framework for irrigated agriculture in Sri Lanka, and demonstrations of ways and means to use the country's increasingly limited water supply to more productive effect.

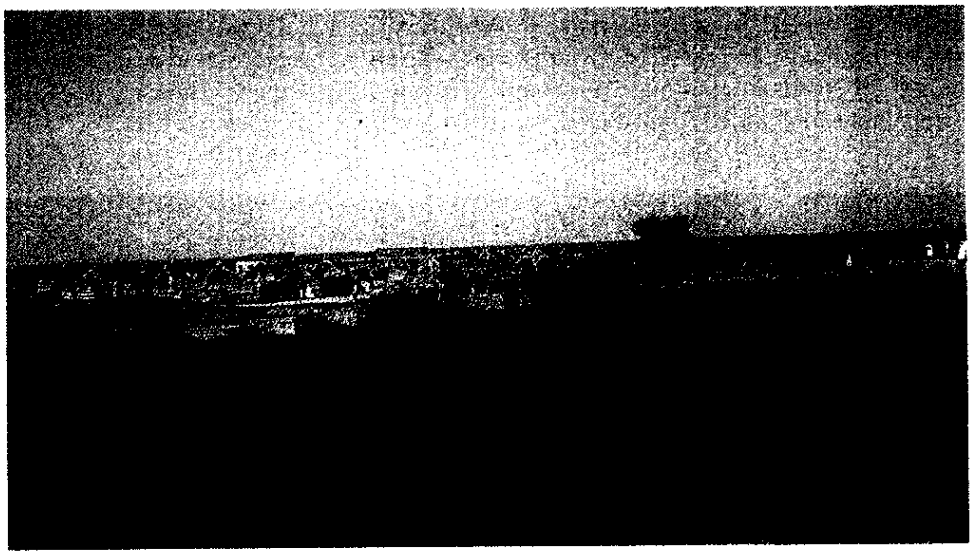
SUDAN

Sudan is one of Africa's leaders in irrigated agriculture, with several very large systems (including the well-known Gezira system) given over to the production of cotton and other export crops. In eastern Sudan there are also many smaller systems fed by complex 'wild flooding' techniques as distinct from the gravity or pump fed systems that characterize the bigger schemes. Mixed cropping is the norm in all these systems and competition for water, labor and other inputs often undermine management planning, particularly under present regulations affecting water allocation and demand management, which are perceived commonly to lack flexibility and inhibit productivity.

In October 1987, the Ford Foundation provided funds to IIMI to cover the cost of establishing a country program in Sudan, subject to agreement with relevant Sudanese authorities on the program's terms of reference and collaboration. Consultations toward this end were held during 1988. (The signature of a Memorandum of Understanding was finalized in February 1989. Shortly after that IIMI established its Sudan country office in Wad Medani.) Future *Annual Report* issues will describe this emerging country program in detail.

With completion of negotiations for representation in Sudan and in West Africa (see below) IIMI is now set to pass the threshold of the opening phase of its long term Africa strategy, first mooted in 1985.

> ***"With completion of negotiations for representation in Sudan and in West Africa IIMI is now set to pass the threshold of its long term Africa strategy..."***



WEST AFRICA

With the opening of its West Africa regional office in Ouagadougou, Burkina Faso, in June 1988, IIMI pioneered a new approach to making its services available in regions where irrigation is a feature of increasing significance to agricultural development in several neighbouring countries, yet not pre-eminent enough to merit individual country programs. Nigeria is a possible exception in West Africa's case: alone, it encloses three quarters as much irrigated land as the rest of the region's countries put together, with potential for expansion to more than twice the present area. Areas currently irrigated in Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali, Mauritania, Niger, Chad, Senegal and Togo amount to about 1.3 million ha, or around 28 percent of the potential irrigable area in these countries.

The relatively low level of irrigation development in most of West Africa can be attributed to:

* the recent date of introduction of irrigation schemes (in most cases less than 40 years ago) into the region;

* heavy past investment in a few costly, high-technology irrigation schemes; and

* disappointing results from most existing schemes.

Explosive population growth in the region is expected to place a heavy strain on productive resources in the future: irrigation is one of the few options offering scope for multiplying production, but water resources are limited and drought-prone in the region's greater part.

Areas irrigated in West Africa are generally small — just 50 to 2500 ha and typically not more than 500 ha. Management responsibilities are characteristically shared between emerging farmers' organizations and parastatal companies which function at every level of agricultural development. The world trend away from public sector intervention in production processes is, however, becoming a feature of development policy in West Africa, affecting not only major inputs like irrigation but also support services such as credit facilities, fertilizer supplies and so on.

Under the new agricultural policies, the region's rural development agencies are gradually preparing to transfer increased management responsibilities to farmers by limiting their own role to planning, coordination and technical assistance to farmer-run organizations.

IIMI's Role

In this inaugural year of activities in West Africa, IIMI's energies were largely absorbed in establishing its operating base and in networking. Liaison was established with regional and national institutions, with a view to tailoring cooperative research and extension efforts to their special objectives. Detailed proposals for work programs along these lines began to be formulated and presented for donor support.

“ By late 1988, programs for Niger, Senegal and Burkina Faso had reached an advanced stage of planning and work was in hand to link the region's anglophone countries. ”

Training is a key element in many of these proposals. By late 1988, programs for Niger, Senegal and Burkina Faso had reached an advanced stage of planning and work was in hand to link the region's anglophone countries (Nigeria in particular) into the programming process as soon as possible. Details of specific project activities will appear in forthcoming IIMI reports.

During 1988, IIMI also took steps to initiate program activities in Nigeria by signing a Memorandum of Agreement with the Institute of Agricultural Research of Ahmadu Bello University (ABU). Under the terms of this agreement, IIMI staff will collaborate with ABU researchers on a 2-year program centering on ways to turn over to farmers increased responsibilities for management of the irrigation schemes in Northern Nigeria.

“ During 1988, IIMI also took steps to initiate program activities in Nigeria by signing a Memorandum of Agreement with the Institute of Agricultural Research of Ahmadu Bello University. ”

THEMATIC AND REGIONAL RESEARCH

This section highlights ongoing and emerging multi-country, generic or theme-related activities. Many of the concerns summarized below fall within the scope of IIMI's newly-formed Programs Division. The division was established in late 1988 as part of IIMI's new organizational structure (see Strategy Preview). Program development under this plan is to proceed along thematic lines identified in relation to priority needs of IIMI's partners and clients as they perceive them, and shortlisted in light of the Institute's own declared mission and present institutional strengths.

The thematic approach is expected to provide a consistent framework for further development of generic and multi-country work already in hand. In addition, selection and development of new projects proposed for implementation in the field or elsewhere will be overseen by the Programs Division with strategic objectives and thematic priorities in mind. This approach will place IIMI in a position to glean from the entire range of its activities further outputs such as digests of overview knowledge under thematic headings, management planning and policy briefs and source-books and various management training tools for wide application.

> ***"The thematic approach is expected to provide a consistent framework for further development of generic and multi-country work..."***

Benchmarks for Performance

Irrigation is assigned a key role in the agricultural development strategies of many nations, yet the performance of irrigation schemes often appears to fall below par. Governments and donor agencies have responded with efforts to improve standards of irrigation management. A reliable and systematic methodology for gauging system performance is needed before and after changes in the management approach have been introduced so that their worth can be judged objectively.

Recent studies show that the rate of expansion of the world's irrigated area has fallen from more than two percent a year in the 1970s to less than one percent a year during 1980 - 1985. Over the latter period, figures for Asia show that investment by multilateral banks in irrigation schemes has also declined sharply and its emphasis has veered away from new construction toward rehabilitation and maintenance projects. This shift heightens the need for better ways to classify and quantify irrigation services, the impact of the investments that lie behind them and the chains of cause and effect that trace exactly how they can bring about gains in agricultural production.

IIMI is working with the International Food Policy Research Institute (IFPRI) on a four-year project aimed at fulfilling this need. The project is being developed in two, two-year phases. The first phase will concentrate on developing a conceptual framework and methodology for assessing irrigation performance, the second on applying these means in various locations in Asia and Africa.

> ***"IIMI is working with the International Food Policy Research Institute (IFPRI) on a four-year project... . The first phase will concentrate on developing a conceptual framework and methodology for assessing irrigation performance..."***

In September, the Ford Foundation awarded grant support for phase one activities on the basis of an outline proposal. A subsequent meeting in Washington in October agreed on more detailed workplans and schedules for activities planned in 1989. These and other details of the project will appear in future reports.

Applications of Computer Simulation in Support of Management

Computational techniques offer a considerable

potential for enhancing the quality of decision-making by managers of irrigation systems. Aided by a computer simulation of the system's physical characteristics, a manager may test and compare the outcome of various alternative "scenarios". The implications of a specific management policy, or of a particular class of operational decision, can thus be ascertained without incurring the costs and problems associated with performing such trials in real-life situations.

IIMI aims to develop gradually a range of computing methods that will be suitable for these purposes: accurately representing the hydraulics of water systems, easy to use, adapted to the kinds of computer equipment now becoming available at system management level, and capable of issuing guidance in practical management terms.

Sri Lanka is the setting for the pilot phase of a regional project concerned with applying mathematical models for the simulation of main canal control operations, as an aid to management decision-making. In 1988 IIMI, in collaboration with France's *Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets* (CEMAGREF) and the Sri Lankan Irrigation Department, commenced building a mathematical model of the Kirindi Oya Right Bank Main Canal in southern Sri Lanka. The model simulates the hydraulics and operational features of the canal under a wide range of steady and unsteady flow conditions, with a view to testing design and management innovations without disrupting normal system operations. Hydraulic and topographical measurements to calibrate the model to the field conditions were successfully carried out in June (see *IIMI Review*, August 1988, page 18). A working paper describing the methodology used and the preliminary results has been submitted for publication.
A feature of the model development, being carried out with funding support from the Government of France, is the inclusion of user-friendly interfaces that will enable system managers to swiftly learn its use and apply this novel management approach to their planning and management tasks. In July an irrigation

"The model simulates the hydraulics and operational features of the canal under a wide range of steady and unsteady flow conditions. . ."

engineer involved in operations of the canal in question visited systems in France and Morocco where similar techniques are used, on a familiarization tour organized by IIMI and *Centre de Formation Internationale a la Gestion des Ressources en Eau* (CEFIGRE). A staff member each from IIMI and CEMAGREF also accepted an invitation of CEFIGRE to make a presentation of the Kirindi Oya model at its Training Course entitled **Modernization of Irrigation Systems: Design and Operation** held in Bangkok, Thailand in November-December. A Study Advisory Committee, comprising of international specialists in the fields of irrigation and hydraulics, was constituted to ensure the scientific quality of the research. It met twice in 1988 and Project Progress Reports were submitted for review at each of them.

Another flow simulation software package, MISTRAL, made available to IIMI by *Societe Grenobloise d'Etudes et d'Applications Hydrauliques* (SOGREAH), was used to model the operation of the Kalankuttiya Branch Canal in Mahaweli System H in north central Sri Lanka. A working paper describing this application was published.

Extension of activities related to the use of simulation modeling in support of irrigation management to IIMI field operations in other countries is projected from 1989 onwards. For this reason, responsibility for this project was transferred to IIMI's Programs Division in early 1989.

Farmer-Managed Irrigation Systems

1988 saw the start of a three-year program of research aimed at helping governmental agencies and national non-governmental organizations (NGOs) in several countries to develop and evaluate new ways and means to deliver practical support to the farmer-managed irrigation sector. High policy priority is being placed on this sector in many countries, yet practical implementation is often racked with difficulties. The work IIMI and its national partners are engaged in to help counter these difficulties is supported by grants made available by the International Fund for Agricultural Development (IFAD) and the *Bundesministerium fur Wirtshaftliche Zusammenarbeit* (BMZ) of the Federal Republic of Germany.

The countries which provide the setting for project activities under this program are Sri Lanka, Thailand, Bhutan, Pakistan, Bangladesh and Morocco. Mention of work done in countries where IIMI has country programs has already been made in Chapter 1. Activities in Nepal also have an important bearing on the state of knowledge (see page 10), though these activities are maintained outside the terms of reference of the multi-country IFAD/BMZ project.

Under those terms, IIMI's project team work with national research institutes or implementing agencies, or both, is aimed at:

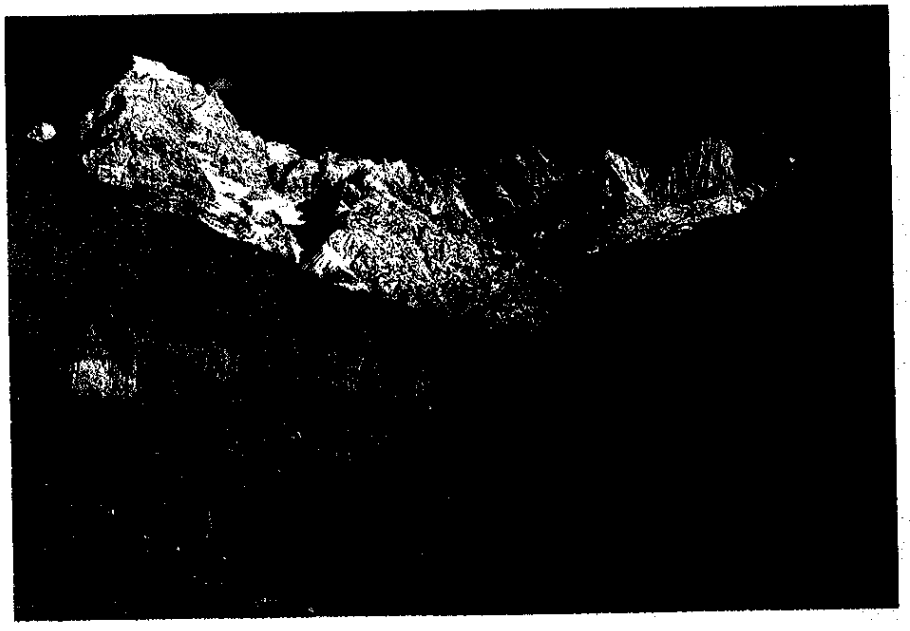
* documenting existing practices and evaluating management problems in assisting farmer-managed irrigation systems (FMIS);
* developing and testing alternative intervention strategies to this end;
* producing case study materials that illustrate and interpret successful alternative strategies for the benefit of policy makers, managers and researchers involved in FMIS assistance programs;
* establishing (for the benefit of the same groups) easy-to-use methodologies for diagnosing problems in current FMIS assistance approaches.

Direct IIMI participation in fieldwork towards these objectives is backed up by an **FMIS Network** served and linked by IIMI publications ranging from a current awareness bulletin (the *FMIS Newsletter,* issued three times a year) to proceedings of workshops and meetings touching on FMIS. A number of study tours and workshops are also organized by IIMI within the network. The FMIS Network enables lessons learned in the field to be widely shared among professionals involved in FMIS support.

1988 Fieldwork outputs

In Sri Lanka, rapid assessment methodologies for identifying FMIS problems and opportunities, developed by IIMI in 1987 on the site of the Badulla Integrated Rural Development Project, were subjected to field tests in Badulla and in Kurunegala. The draft assessment guidelines were later used as a background paper for a national workshop on assessment methods and subsequently published as an IIMI Working Paper.

Methods partly based on these guidelines were also used in a field study of 30 small reservoir systems in Anuradhapura to scrutinize FMIS assistance components of an important dry zone agricultural project. Preliminary findings are to be published and discussed with Ministry of Agriculture officials in 1989. A related study in Hambantota focused on the role of NGOs in providing organizational assistance to



farmer-irrigators involved in an Integrated Rural Development Project there. To steer further work along these lines in Sri Lanka, a Working Group of senior agency officials, research principals and NGO representatives was inaugurated at a workshop staged by IIMI late in 1987 in cooperation with the Agrarian Research and Training Institute. A sub-committee chaired by DAS was formed to develop a pilot study on the ongoing Village Irrigation Rehabilitation Project in Kurunegala District: it met twice in 1988 and is planning a field study to begin early next year in the district.

In northern **Thailand** IIMI assisted the IFAD-supported Peoples' Irrigation Project in Chiang Mai Province. Under this project, reservoirs are to be constructed to augment water supplies to sizeable farmer-managed diversion systems downstream. These systems will retain their autonomy but will be required to liaise with the Royal Irrigation Department, which will control the reservoirs. IIMI is promoting better exchange of information between the project's implementing agencies and researchers from Chiang Mai University presently engaged in studies of FMIS federations. It is also working to draw the attention of the Thailand Research on Irrigation Management Network to innovative elements in this project, with a view to attracting further research.

In **Bhutan** IIMI began planning a training program in rapid assessment methods and steps towards a national research program on irrigation management, with special emphasis on the IFAD-financed Punakha Wangdi Project.

> ***"In Bhutan IIMI began planning a training program in rapid assessment methods and steps towards a national research program on irrigation management. . ."***

In **Morocco**, field studies began in one of four locations identified as representative of different kinds of systems under the care of the *Office Regional de Mise en Valeur Agricole* (ORMVA) du Haouz, which lately expanded to take over a number of farmer-managed systems of recent establishment. Results of this study, which is being conducted by a faculty member of the Hassan II Agronomic and Veterinary Institute in close collaboration with ORMVA-Haouz, will appear in future IIMI reports.

During 1988, activities in **Pakistan** and in **Bangladesh** were at early stages of planning. In Pakistan IIMI aims to collaborate in a project in the Chitral District of North West Frontier Province which will rehabilitate about 80 farmer-managed irrigation systems and construct a similar number of new schemes.

1988 Network Outputs

Three issues of the *FMIS Newsletter* reached a mailing list of more than 400 readers toward the end of 1988: reader response has been positive and the mailing list is showing rapid growth. The FMIS Advisory Committee which steers and unifies fieldwork and network activities met in Bangkok in March to review priorities and plan future activities.

Six study tours (funded separately by the United Nations Development Programme) were mounted for 14 professionals engaged in FMIS concerns, as a means for them to compare their approach to their tasks with those adopted elsewhere. These visits are reported in the newsletter. IIMI also provided back-up to network members by participating in a research planning workshop in Pakistan, in connection with a five-country study of small-scale irrigation in South Asia organized by the Centre for Integrated Rural Development for Asia and the Pacific (CIRDAP). IIMI staff also visited a research project in Uttar Pradesh, India, to offer advice on selection of project sites and research methodologies.

IIMI participated in a major conference in Bologna, Italy, on the *Sociology of Irrigation.* Six publications were issued by and through the network (see Annex II) and eleven more titles are scheduled for publication in 1989.

Future activities under this project are expected to include new fieldwork in Bangladesh and Pakistan and a further series of workshops in several countries leading to production of a handbook on FMIS assistance strategies.

Managing Irrigation for Crop Diversification

Throughout Asia, rice is the single largest contributor to agricultural Gross Domestic Product. It ranks foremost among primary wage goods; it attracts more producers and is grown over a larger total agricultural

area than any other crop. Some 90 percent of all the world's rice is produced and consumed within Asia.

The world market price for rice, however, has fallen by almost 50 percent in recent years and shows few signs of recovering to earlier levels. This market slump actually reflects the dramatic success of improved rice technologies associated with the 'Green Revolution' in Asia and developed by national and international rice research institutes in the region, notably the International Rice Research Institute (IRRI). Once burdened with heavy rice import costs, most humid tropical Asian countries have now achieved near self sufficiency in rice production.

"The world market price for rice, however, has fallen by almost 50 percent in recent years and shows few signs of recovering to earlier levels."

According to recent reports by the World Bank and other international bodies, partial diversification along side with rice is now imperative if agriculture is to continue to play a major part in economic growth and if rural income is to be sustained in these countries

Realizing the wisdom of these conclusions, many countries in Asia have begun to encourage such diversification by promoting the growing of non-rice crops in those areas where, and during those seasons when, such crops are most likely to succeed. Existing knowledge indicated that the greatest potential lay in irrigated areas with well-drained soils during dry seasons and the Philippines was singled out as an example of a country where such conditions existed in abundance.

In 1985, the Asian Development Bank (ADB) and the Government of the Philippines asked IIMI to begin research in the Philippines to assist irrigation agencies in identifying important constraints and potentials to producing irrigated non-rice crops outside the main rice growing seasons, and in finding ways to counter or sidestep these constraints. Similar projects were later initiated by IIMI and national partners in Sri Lanka and Indonesia. Under the terms of an ADB Regional Technical Assistance agreement and grant made available early in 1988, this work came to fruition in the preparation of a major synthesis report to the ADB on results and conclusions in all these countries.

The report, published in 1989, shows that constraints on irrigated diversified cropping are legion. An entire generation of irrigation managers has been trained to work within the parameters of irrigation systems purposely designed for rice-growing under wet conditions in predominantly heavy soils. Agricultural development policies have likewise evolved exclusively to support rice production and marketing.

Nevertheless, with the crucial help of research and training bodies in the countries concerned, the transition is underway and is being made with growing confidence. In many cases, IIMI and its partners have passed the stage of assessing the obstacles and are now testing practical management •

World prices of major primary commodities (in 1985 constant US$/ton).

	Year					
Crop	1970	1980	1985	1990	1995	2000
Sugar	222	604	90	322	265	253
Wheat	172	182	173	147	136	133
Maize	160	120	112	100	85	94
Palm oil	712	557	501	374	450	420
Cocount oil	1088	643	590	428	500	482
Cotton	173	196	132	137	165	165
Rubber	126	155	92	96	108	110
Rice	395	414	216	233	214	206

Source: Schuh and Barghouti (1987)

innovations to take advantage of this potential based on results of action research.

As the results demonstrate, the cost of irrigated crop diversification in terms of new water, labor, cash and other inputs can sometimes be higher than expected. Above all, the switch requires extra managerial inputs. An alternative exists in the joint sharing of management responsibilities with farmers. This aspect of the question ties in closely with other work IIMI is conducting on farmer management of irrigation systems (see above). However, irrigated crop diversification has the potential of increasing rice farmers' income. There are non-rice crops grown in each country showing higher and consistent profitability as compared with rice.

"There are non-rice crops grown in each country showing higher and consistent profitability as compared with rice."

Peer Partnership: IIMI and IRRI

The work described above forms an important basis (among others) for IIMI's role in a challenging new multi-country project on rice-based systems embarked on in 1987 in close partnership with the International Rice Research Institute (IRRI). IRRI's pioneer work on agronomic aspects of rice production in Asia has been a powerful driving force behind a phenomenal surge in the region's agricultural productivity during the past 25 years. This expertise is now being teamed with IIMI's experience in irrigation management for crop diversification and other major concerns in various rice-producing countries.

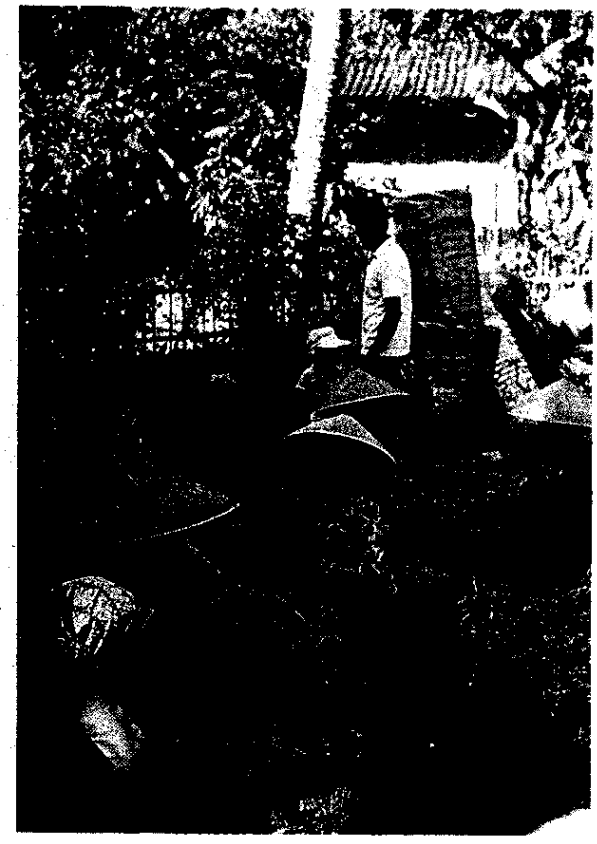
The Rockefeller Foundation awarded grants to both institutes in 1987 to support a three-year program of joint fieldwork in Indonesia, the Philippines and Bangladesh aimed at finding new approaches to irrigation management in rice-based farming systems. By linking the comparative strengths of IIMI and IRRI into a unified program, the initiative is also intended to set a significant precedent for closer cooperation between international agricultural research centers, demonstrating that the total gain from such collaboration can prove greater than the sum of its parts.

"By linking the comparative strengths of IIMI and IRRI into a unified program, the initiative is also intended to set a significant precedent for closer cooperation between international agricultural research centers. . ."

The general aims of the IIMI/IRRI project are to:

* identify important obstacles to, and preconditions for, cropping changes in irrigated rice-based farming systems;
* measure the impact of different levels of irrigation system performance on the scope for such changes;
* develop new, practical ways and means to manage irrigation water delivery and utilize leftover water for growing non-rice crops outside the main rice cropping season;
* tackle the agronomic and institutional innovations such novel approaches may bring about;
* make results of field investigations known to the policy-makers, planners and managers who can put them to practical use elsewhere;
* boost opportunities for professional training in irrigation management for crop diversification by providing graduate research associateships and fellowships; and
* pursue longer-term links between the two institutes in other fields of mutual concern.

The objectives of joint action by IIMI and IRRI and the division of labor between IIMI and IRRI research team members vary under different country circumstances. In **Indonesia** the initial task of IIMI and its national partner, the Department of Public Works, is to develop and test irrigation system management strategies that take into account variations in the physical environment, crop demand and water availability. Closely linked to these efforts is the work of IRRI and Indonesia's Agency for Agricultural



Research and Development on assessing current on-farm water management practices, farmers' attitudes to crop selection and supply factors influencing such practices and attitudes.

Consultations with Indonesian bodies such as the University of Gadjah Mada, Sukamandi Research Institute for Food Crops and the Soils Research Institute, Bogor (in addition to the main governmental bodies mentioned above) to establish agreement on project workplans, sites and infrastructure, absorbed much of IIMI's and IRRI's attention during 1988. By the end of the year, more than 15 research activities under the general headings described above were underway, mostly by seconded national agency staff and research associates.

The main study sites are Java's Maneungteung Irrigation System, served by a weir on the Cisanggarung River near Cikeusik, and Ciwaringin, an inland system near Cirebon. IIMI and the Department of Public Works have already established a measurement program for monitoring discharges and system operation in Maneungteung. Earlier work under another project has bequeathed to the IIMI/IRRI team a substantial database recording irrigation management activities in Ciwaringin over the past two years.

Results of the new, combined work in Indonesia will be presented and discussed at a national review and planning workshop scheduled for early 1989. An interesting spin-off of the joint approach has been greater interaction between the Departments of Irrigation and Agriculture within Cirebon Wilayah, resulting in improved annual irrigation planning in the area.

In the **Philippines**, host country to IRRI's headquarters operation, the first major action so far accomplished is the selection of research sites and the establishment of working relations and joint training agreements and workplans with the National Irrigation Administration, the Department of Agriculture and other public bodies involved in the project.

IIMI's share in the work in the Philippines will have, among its emphases:

* irrigation management procedures for diversified mixed cropping;

* physical water control requirement for irrigated crop diversification at the main system level;

* drainage requirements for irrigated crop diversification; and

* water resources augmentation.

Unlike IIMI's work, which is entrusted mainly to research fellows and scholars, IRRI's project tasks in the Philippines are being performed mainly by regular institute specialists in collaboration with the national Bureau of Soils and Water Management and the Philippine Rice Research Institute. These tasks include:

* analysis of physical control requirements (at tertiary and farm levels) for effective water use in a mixed cropping system;

* farmers' decision-making processes related to irrigated crop diversification; and

* land conversion for irrigated crop diversification.

Coordination among IIMI, IRRI and their respective institutional partners is achieved by means of regular field meetings and visits. Full meetings of all parties involved in the IIMI/IRRI project took place on three occasions in 1988 and a year-end review and planning workshop for the project was held in December; results were reported in early 1989.

Work in **Bangladesh** is at an earlier stage than in Indonesia or the Philippines, principally for want (till late in the year) of an established IIMI country office to provide project supervision. In the past, however, IRRI has been involved in collaborative work with the Bangladesh Water Development Board and the Bangladesh Rice Research Institute, and joint IIMI/IRRI work will build on this relationship once the IIMI field operation is in place.

Training opportunities and consultant visits have been an important feature of work in all three countries. A major omnibus workshop is foreseen in 1990 to present the entire range of research results. Meanwhile, detailed progress reports will appear in 1989 issues of IIMI serial publications.

> ***"Training opportunities and consultant visits have been an important feature of work in all three countries."***

Interactions: Irrigation System Design and Management

To what extent does irrigation system design affect system management and *vice versa?* This question, closely linked to the IFPRI/IIMI work on performance assessment, mentioned above, is being tackled in a series of studies designed by IIMI in consultation with the World Bank early in 1988.

> ***"To what extent does irrigation system design affect system management and vice versa?"***

Lack of standardized data sets and performance indicators places sore constraints on the kind of thematic or comparative research which IIMI is committed to undertaking on behalf of the irrigation management community. Existing literature uses different, often incompatible, parameters and so provides no reliable key to the effects of different environments and technologies on the way irrigation systems behave and perform.

Fourteen categories of standardized data sets are envisaged in the terms of reference agreed with the World Bank: some of the data are expected to become available through the routine data-gathering of national management agencies but some supplementary field studies will also be needed to appraise existing database support resources, to collect additional data and to interpret results.

IIMI is to pilot the first of such studies in two systems in Malaysia during 1989 and it is hoped that sites in India will be added to the range of study locations in due course.

Financing Systems to Last

Management of financial resources for system sustainability is a prominent theme of IIMI's institutional strategy. It is also one of the major aspects of work conducted (mainly in Sri Lanka) during 1988 within the framework of a Regional Technical Assistance program funded by the Asian Development Bank.

Governments are finding the costs of operating and maintaining irrigation systems increasingly hard to meet and there is avid interest on the part of many of IIMI's national collaborating agencies in successful policies and practices aimed at sharing these costs with system users according to their demands on the system and their means.

Work in Sri Lanka took the form of field studies in three systems under the control of different agencies,

> ***"Governments are finding the costs of operating and maintaining irrigation systems increasingly hard to meet. . ."***

and a national case study. The field studies focussed in each case on:

* procedures and organizational arrangements for system operation and maintenance within the managing agency;

* the scale and breakdown of current operation and maintenance spending;

* the size of capital in proportion to recurring costs;

* mechanisms used to ensure that operation and maintenance matches the needs and views of water users.

Where farmers pay irrigation service fees, IIMI examined how far fee levels are determined by the nature of the institution involved, the relationship between levels of fee and levels of benefit to the farmer and the characteristics of the farms under scrutiny. Finally, where operation and maintenance activities are judged to be effective, IIMI was concerned to identify the strategic factors that make them so.

The national case study aimed to investigate general policies for covering the cost of providing and maintaining irrigation services. Sources of support were classified and procedures for allocating irrigation resources evaluated.

A full report on this work formed part of IIMI's final report to the Asian Development Bank in early 1989 and details will appear in future *Annual Report* and *IIMI Review* issues. Further work along these lines in several countries is a strong likelihood in view of its strategic importance.

Management Training: A Fresh Approach

Training has always been an important aspect of IIMI's work. In the past, the Institute concentrated on its professional development program offering researchers from many different countries opportunities to strengthen their irrigation management skills through individual training — participation, in other words, in fieldwork as research associates or fellows, in on-the-job training and in training courses, workshops and conferences.

These means to training ends are of proven worth and the incipient *IIMI Strategy* foresees little change in them as a set of useful methods for spreading first-hand knowledge of modern irrigation management issues and techniques. In the *Strategy* there is, however, a new emphasis on management training as an essential key to attaining the organization's declared objectives, in particular to bringing about a 'management revolution' in irrigation, through the introduction of fresh management ideas to help change the attitudes of irrigation managers.

"In the Strategy there is, however, a new emphasis on management training as an essential key to attaining the organization's declared objectives."

The innovative research which IIMI sees as its primary service to its partners and clients will be of little account unless its results are extended into practical action on a more-than-local scale. In order to stimulate the adoption of new irrigation management technologies, IIMI considers it important to assist countries — from the very start — to assess their irrigation management training needs, to strengthen their training capacity, to develop appropriate training methods and materials, to establish reliable channels for spreading knowledge, and to design up-to-the-minute curricula for institutions offering training courses in irrigation management.

During 1988, IIMI began to provide assistance in planning and implementing training programs in response to requests from countries under a project sponsored by the US Agency for International Development (USAID) and known as ISPAN, or *Irrigation Systems Project for Asia and the Near East.*

In connection with this work, USAID agreed in 1988 to finance the recruitment into IIMI of a full-time training specialist; this post was filled at the end of the year. Working with professional specialists in all the Divisions, IIMI's training specialist will design an all-purpose workplan for management training. A key element of this approach will be consultation with national organizations to identify professional categories and functions in irrigation management institutions with a view to flagging the most important target groups and their respective training needs.

IIMI's training efforts under this scheme will be directed towards transferring a modern management outlook to trainees, no less than technical know-how. Training in this scenario becomes an aspect of institution-building and management programming for progressive change rather than a passive pooling of knowledge.

Training courses, fellowships and special awards,

workshops and conferences held during 1988 as part of IIMI's management training program are listed in Annex III.

Information: Beyond Project Reporting

Information support, mainly in the form of documentation services and printed project reports, is an essential requirement of all research organizations and the donor bodies which back them. At its present stage of development, IIMI has amassed more new knowledge in these forms than can be simply committed to the library shelf for future reference. IIMI's mission to inform today's and tomorrow's irrigation managers requires ever more interactive information modes to keep established partners and clients in the mainstream of current awareness, as well as a policy of information 'outreach' to proselytize modern information management concepts among new specialist and special-interest constituencies as well as in the public media which increasingly influence the policies of development funding agencies.

In line with this realization and with its institutional strategy IIMI began a major reorganization of its information facilities during 1988. This included an evaluation of the Institute's information programs not only in the light of the needs mentioned above but also with a view to strengthening the capacity of IIMI country offices to produce appropriate information and training materials (particularly in national languages) and to linking IIMI's information operation to those of other institutions in the CGIAR system and similar bodies.

"IIMI's mission to inform today's and tomorrow's irrigation managers requires ever more interactive information modes to keep established partners and clients in the mainstream of current awareness."

More than 30 publications (including issues of serials, newsletters and bulletins) were produced by IIMI during 1988: see the publications list in Annex II.

Apart from work in print, IIMI is also developing an enlarged capacity for work in other media (particularly audio-visual and broadcast media) with special emphasis on the production of training materials. During 1988, a public relations and media arm was added to the Institute's Information Office.

STRATEGY PREVIEW

Two major accomplishments for IIMI during 1988 were the development of a long term strategy and the development and enactment of a new organizational structure to reflect this strategy. Culminating over 15 months of work, the process of developing the strategy provided an opportunity for the staff to review the reasons for IIMI's existence and what it was intended to accomplish. The resulting document, (*The Strategy of the International Irrigation Management Institute*), clarifies IIMI's identity as well as its purposes and objectives. This section previews the strategy's essential elements (see accompanying figures).

The strategy process began with a reconsideration and finalization of the Institute's mission statement.

Figure 1

Several key words within the statement help focus the Institute's work. First, IIMI places emphasis on measuring, understanding, and improving the *performance* of irrigation systems. IIMI aims to strengthen *national efforts;* it does not intend to undertake independent research, but to work closely with national organizations.

Within this context there are six immediate users of IIMI's services and outputs (Figure 2). While farmers and farming communities are the ultimate beneficiaries of IIMI's efforts, they are served through IIMI's support to these six groups.

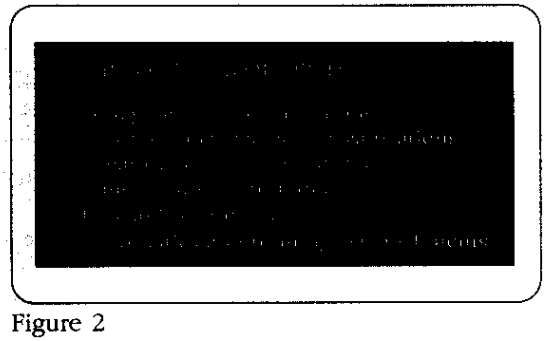


Figure 2

The Institute also carefully considered the many definitions of irrigation management and its domain. Ultimately, IIMI settled on a broad definition, to ensure others understood IIMI was interested in more than the distribution of water. Specifically, the definition encompasses the broad effects and consequences of introducing an irrigation system into rural societies in developing countries (Figure 3).

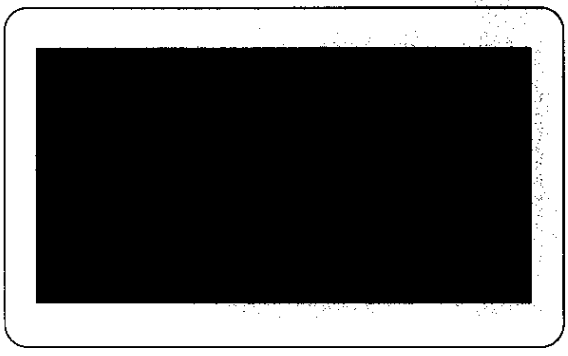


Figure 3

From there IIMI moved to potential program elements. The Institute has defined two categorizations — "principles" and "themes". The resulting five principles are to be permanent fixtures of the Institute's projects and activities (Figure 4).

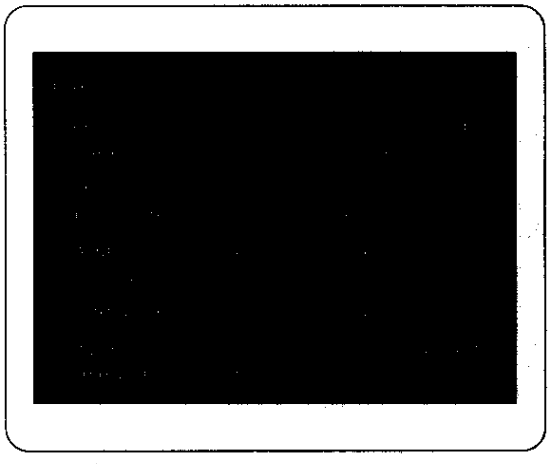


Figure 4

However, the seven strategic themes (Figure 5) identified in the document are intended to be flexible. This will allow IIMI to respond to new needs or issues that arise as the Institute evolves. But it is necessary to limit the number of research issues to those where IIMI has a comparative advantage.

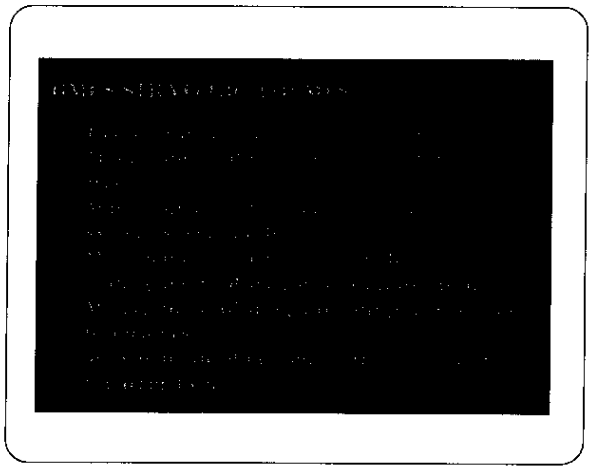


Figure 5

The strategy defines IIMI's activities — what it will do — in terms of five work areas (Figure 6). If carried out by itself, site-specific research would lead to fragmented programs, and thus it requires the necessary complement of thematic research. Adaptive research is also necessary. It is not enough to understand irrigation processes: IIMI must work with the managers of organizations to assist in implementing irrigation innovations.

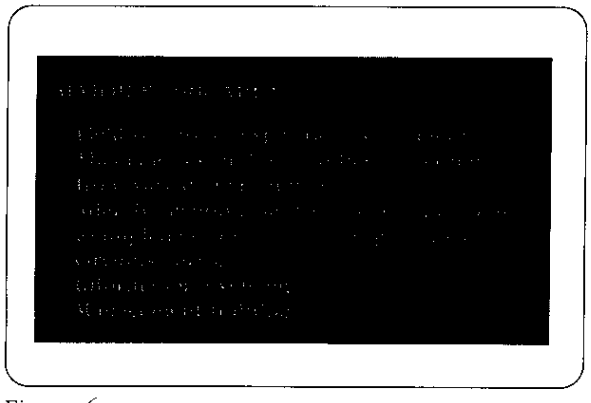


Figure 6

This then leads to the question of where IIMI will carry out its program activities. It has been widely accepted that IIMI must work in a decentralized fashion to account for the site-specific nature of irrigation. But that carries with it the danger of working in too many countries. Thus the Strategy document provides five geographic zones (Figure 7). IIMI is currently working in three of those zones, but plans to initiate exploratory activities in Latin America within the next five years.

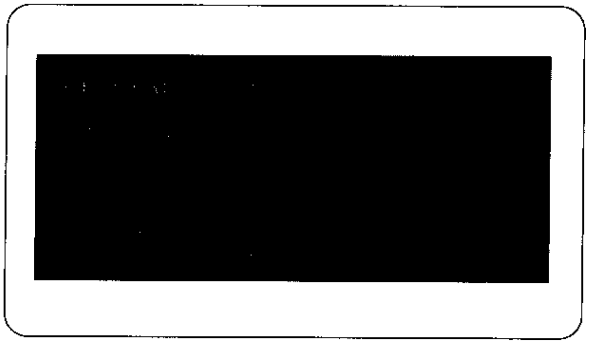


Figure 7

In the early years it was necessary to make relatively quick decisions to get the Institute and its work off the ground. IIMI, however, can now afford to move cautiously in choosing new countries. The strategy defines several prerequisites for working in a given country (Figure 8) as well as a framework for each country unit (Figure 9).

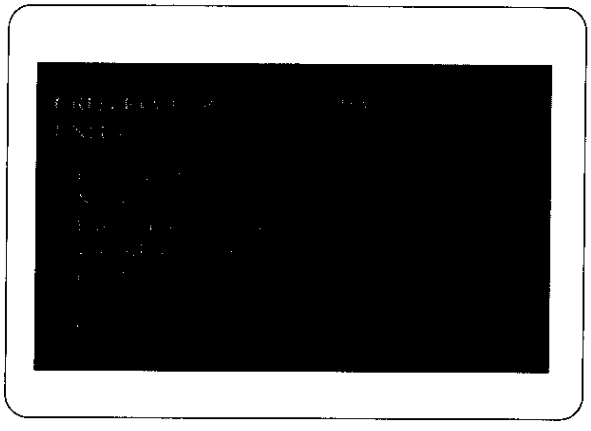


Figure 8

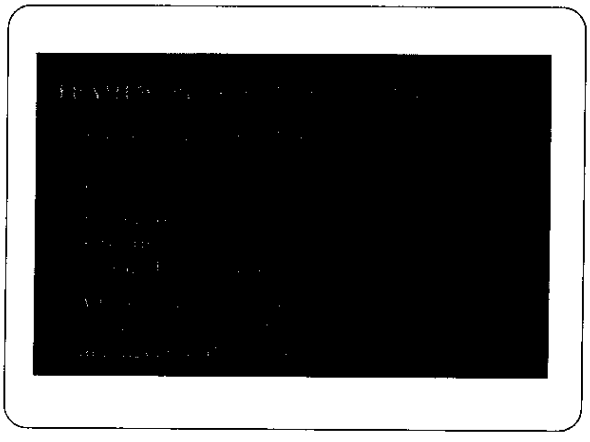


Figure 9

Last, the strategy defines a set of values that characterize all of IIMI's activities (Figure 10).

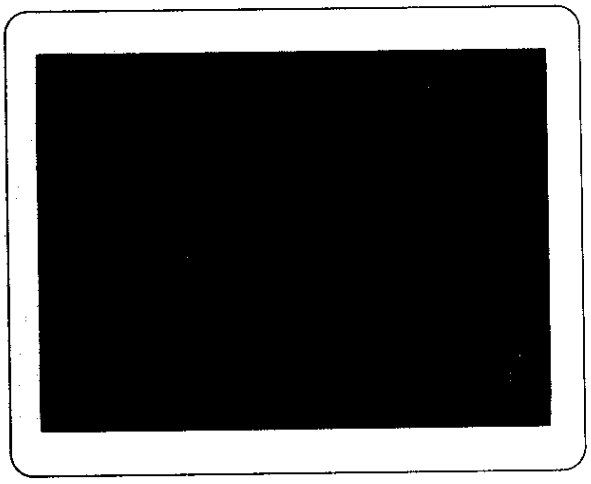


Figure 10

Once the strategy had been clearly defined, the desirable organizational structure fell quickly into place (Figure 11). Four divisions have resulted: Programs, Field Operations, Pakistan, and Finance and Administration. The Pakistan Division is set apart from the other Divisions because of that country's size and special characteristics. The structure was fully implemented in December 1988.

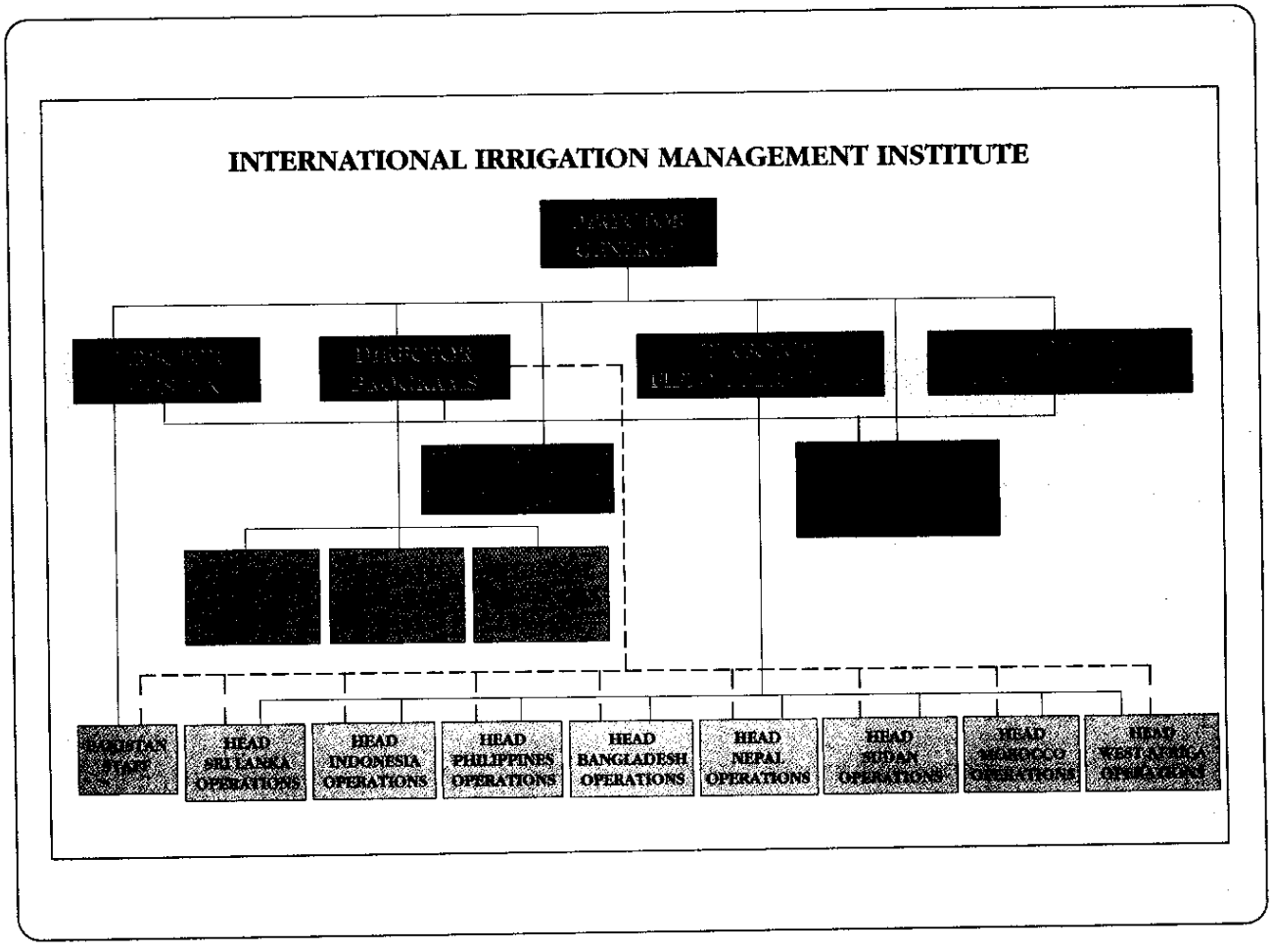


Figure 11

FINANCE AND ADMINISTRATION

Financially 1988 was a successful year. IIMI generated US$2.046 millionin unrestricted income, US$0.380 million in indirect cost recoveries, and US$3.479 million in restricted support to meet annual expenditures of US$5.377 million, thus ending the year with a net surplus of US$428,000after adjusting for 1988 capital commitments and allocating US$100,000 to reserves. This surplus arose mainly from an unanticipated increase in income due largely to higher interest revenues, and from thefact that certain expenditures envisaged for 1988 were deferred to 1989.

The US$2.046 million in unrestricted income received in 1988 budgetbreaks down as shown in Table 1. Details of indirect cost recoveries are shown in Table 2.

Table 1. Unrestricted income received for 1988.

DONORS	FUNDS RECEIVED FOR 1988 (US$)
UNRESTRICTED GRANTS	
Ford Foundation	400,000
France	128,845
Canada	161,896
Japan	74,911
Rockefeller Brothers Fund	25,000
Tides Foundation	10,000
United States	300,000
World Bank	750,000
Sub Total	1,850,652
INTEREST AND OTHER INCOME	195,781
Total	2,046,433

Source: 1988 Report of the Auditors.

Table 2. Statement of indirect cost recoveries - 1988 (US$).

INDIRECT COST RECOVERIES			
ADB	-	Indonesia Phase II	16,572
ADB	-	Philippines Phase II	10,049
ADB	-	Regional TA	39,467
FORD	-	Bangladesh	6,601
FORD	-	India	3,567
FORD	-	Indonesia Phase II	8,681
FORD	-	Sudan	16,004
USAID	-	ISM Sri Lanka	15,977
USAID	-	ISPAN	9,221
USAID	-	West Africa	44,075
IIMI	-	Pakistan	210,000
Total			380,214

Source: 1988 Report of the Auditors.

Tables 3 and 4 show the breakdown of total 1988 expenditures oUS$ 5.377 million by expense categories and by organizational units. In both cases, the 1988 actual expenditures are compared with the 1988budget as revised and approved by IIMI's Board in June 1988.

Table 3. Expenditures by expense categories, 1988 (US$ '000).

	REVISED APPROVED BUDGET 1988	ACTUAL EXPENDI-TURE 1988	DIFFERENCE (OVER)/ UNDER EXPENDITURE
International staff salaries & benefits	1,801	1,837	(36)
Consultants	363	157	206
National staff salaries & benefits	824	686	138
International travel	400	381	19
National travel	235	257	(22)
Office & research supplies	1,104	755	349
Workshops & study tours	63	44	19
Professional Development	119	26	93
Publication & Dissemination	90	92	(2)
Vehicle/Equipment	730	681	49
Indirect Cost	453	380	73
Contract research	339	81	258
Contingencies	70		70
	6,591	5,377	1,214

Source of actual expenditure: 1988 Report of the Auditors.

Table 4. Expenditures by organizational units, 1988 (US$ '000).

	Revised approved budget 1988	Actual expendi- 1988	Difference (over)/ under exp.
FIELD OPERATIONS			
Director, Field Operations	280	142	138
Sri Lanka	1,106	481	625
Indonesia	471	389	82
Philippines	334	239	95
Nepal	165	159	6
India	138	23	115
Bangladesh	181	34	147
West Africa	210	321	(111)
Morocco	45	9	36
Sudan	132	96	36
Pakistan	1,594	1,164	430

Table 4. (continued)

	Revised approved budget 1988	Actual expendi- 1988	Difference (over)/ under exp.
PROGRAMS			
Director, Programs	50	16	34
Training, Thematic Research & Regional Projects	323	807	(484)
Information Office -	213	321	(108)
Library	51	28	23
GOVERNING BOARD	107	187	(80)
DIRECTOR GENERAL'S OFFICE	376	211	165
Technical Support Unit	54	-	54
FINANCE & ADMINISTRATION DIVISION :			
Accts.,Pur.,Pers.,Admin.,Travel & Transport	337	387	(50)
Rent and Utilities	110	41	69
Telephone, Telex & Postage	100	115	(15)
Liaison Office	39	41	(2)
Maintenance, Housing & Stores	175	166	9
Total	6,591	5,377	1,214

Source of actual expenditure: 1988 Report of the Auditors.

RESTRICTED PROJECTS

As reflected in Table 5, 1988 was a successful year for restricted projects as some 12 projects with a value of just over US$4 million were approved during the year. Expenditure of $3.47 million on restricted projects in 1988 are shown in Table 6.

Table 5. Restricted Projects approved in 1988

Donor	Project *	US$
ADB	Indonesia Phase II	600,000
ADB	Regional TA	350,000
AFDB	General Support African Programs	120,006
BMZ	Assistance to Farmer-Managed Irrigation	580,000
FORD	Ahmadu Bello University Collaboration	20,000
FORD	Nepal	200,000
FRANCE	Trust Fund for Staff Secondment	87,850
NETHERLANDS	Waterlogging and Salinity Project, Pakistan	1,915,000

Table 5. (continued)

Donor	Project *	US$
IDRC	Consultant for information program	21,100
IFAD	Assitance to Farmer-Managed Irrigation	150,000
JICA	Basic Irrigation Economics Project	4,006
UNDP	Strategy Workshop	34,967
	Total	4,082,929

* See Annex I for project descriptions.

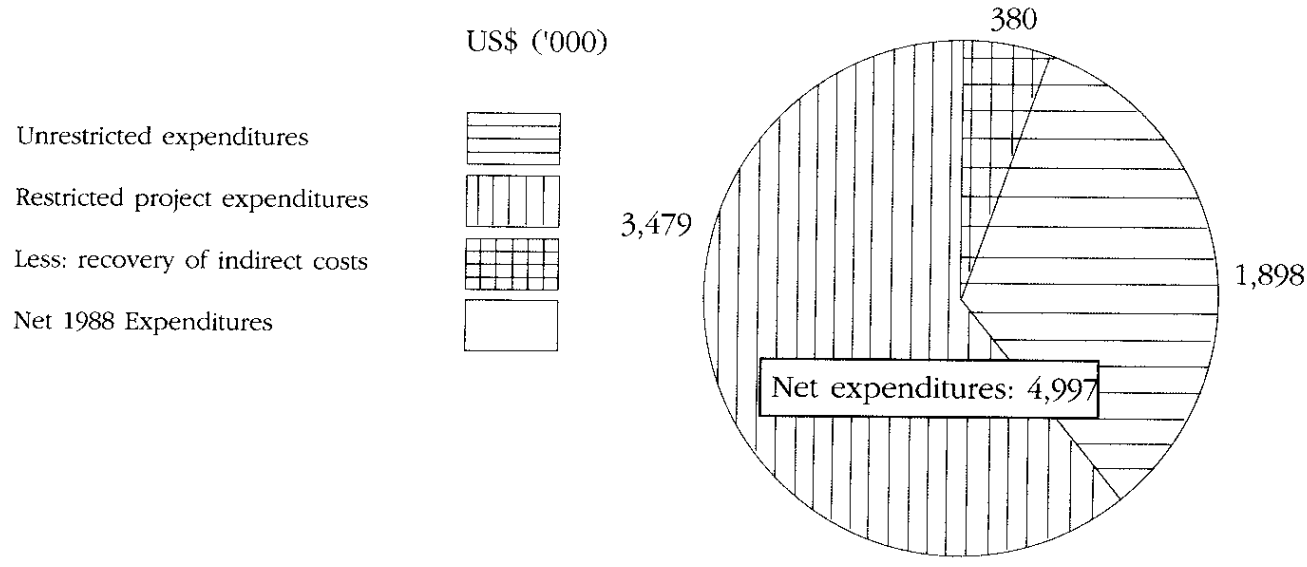
Table 6. Restricted project expenditure in 1988

Donor	Project *	Total US$
ADB	Indonesia Phase II	222,048
ADB	Philippines Phase II	140,291
ADB	Regional TA	263,333
ADB	Sri Lanka TA	155,056
FORD	Africa	109,252
FORD	Bangladesh	34,095
FORD	IFPRI/IIMI Project	25,138
FORD	India	23,121
FORD	Indonesia Study	5,086
FORD	Indonesia Phase II	84,173
FORD	Nepal	66,921
FORD	Professional Development	32,607
FORD	Sudan	96,022
FRANCE	Trust Fund for Staff Secondment	65,934
FRANCE	Simulation Model	55,164
IFAD	Nepal	92,333
IFAD	Pakistan	528,258
IFAD/BMZ	Assistance to Farmer-Managed Irrigation	179,349
NETHERLANDS	Staff Secondment	119,673
ROCKEFELLER	IIMI/IRRI Project	327,358
ROCKEFELLER	Pakistan Workshop	13,448
UNDP	FMIS Workshop	30,444
UNDP	Strategy Workshop	34,967
USAID	ISM Sri Lanka	47,930
USAID	ISPAN	45,640
USAID	ODI News Letter	35,714
USAID	Pakistan	425,635
USAID	West Africa	220,002
Total		3,478,992

Source: 1988 Report of the Auditors.

* See Annex I for project descriptions.

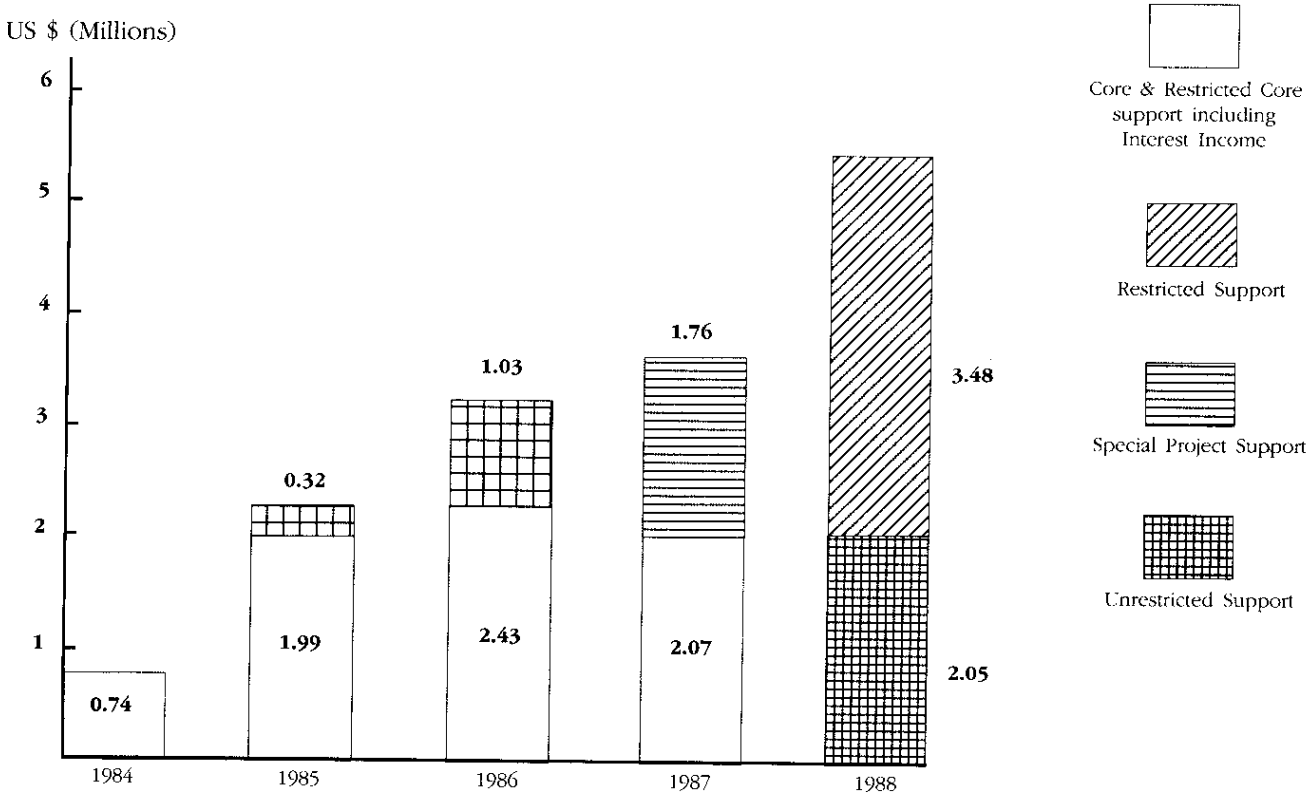
1988 Net Expenditures



1988 Net Income

The following figure shows IIMI's net income of $5.53 million from unrestricted and restricted project sources for the year 1988 in comparison with net income for the years 1984, 1985, 1986 and 1987.

The growth of IIMI's finances – 1984 to 1988.



STATEMENT OF ASSETS, LIABILITIES AND FUND BALANCES (BALANCE SHEET)

IIMI's consolidated balance sheet as of 31 December 1988 shown below reflects the increase in restricted projects received in 1988 (accountsreceivable from donors having increased by about US$1.89 million from 31 December 1987). IIMI's total assets stood at just over US$12.0 million on 31 December 1988 whereas total assets were US$9.9 million on 31December 1987.

STATEMENT OF ASSETS, LIABILITIES AND FUND BALANCES

AS OF 31 DECEMBER 1988

	US$ 1988	US$ 1987		US$ 1988	US$ 1987
ASSETS			LIABILITIES		
Cash and Short Term Deposits	2,683,386	3,316,489	Accounts Payable and Other Liabilities	414,447	206,381
Accounts Receivable:					
Donors	6,916,379	5,022,067	Grants applicable to succeeding years	8,211,567	7,488,383
International staff	39,568	16,431			
National staff	4,879	16,602			
Advances to Field Operating Units and Projects	236,188	98,668			
			FUND BALANCES		
Advances & Prepaid Expenses	122,498	102,968			
Other Int'l Receivables	77,385	62,241	Investments in Non-Expendable Assets	1,962,631	1,306,727
Other Local Receivables	13,514	506			
			Operating Surplus	1,019,688	591,208
Property and Equipment	1,962,631	1,306,727			
			Reserves	448,095	350,000
	12,056,428	9,942,699		12,056,428	9,942,699

Source: 1988 Report of the Auditors.

ANNEX I
1988 RESTRICTED PROJECTS

(Refer to tables 5 and 6 for consolidated financial information on restricted projects.)

Project/Purpose	Funding	Amount * Source	Duration
STUDY ON IRRIGATION MANAGEMENT IN INDONESIA PHASE II To identify changes which would promote more 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.	ASIAN DEVELOPMENT BANK	600,000	2 years
STUDY ON IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPS IN THE PHILIPPINES PHASE II To strengthen the long-term viability of Philippine 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
STUDY ON IRRIGATION SYSTEMS, REHABILITATION AND IMPROVED OPERATIONS AND MANAGEMENT To strengthen the long-term viability of irrigation systems by identifying improvements that can be made in systems management and in operations and maintenance for systems that are mainly rice-based, and which also are suitable for some diversified cropping.	ASIAN DEVELOPMENT BANK	350,000	14 months
STUDY OF IRRIGATION MANAGEMENT AND CROP DIVERSIFICATION - KIRINDI OYA AND UDA WALAWE RESEARCH SITES To identify means to increase use of existing land, water and infrastructure resources through improvements in the processes of design, rehabilitation, systems management, and operation and maintenance with particular attention to crop diversification.	ASIAN DEVELOPMENT BANK	350,000	26 months
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 Africa region.	FORD FOUNDATION New York	500,000	2 years
SUPPORT TO BANGLADESH FOR RESEARCH AND TRAINING IN IRRIGATION SYSTEMS To strengthen the capacity of relevant institutions and personnel in Bangladesh to manage irrigation systems and irrigation development.	FORD FOUNDATION Dhaka	450,000	3 years

ANNEX I (continued.)

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. To undertake research in Indonesia and the Philippines on irrigation investments 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 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.	FORD FOUNDATION Delhi	200,000	2 years
ANALYSIS OF IRRIGATION RESEARCH FINDINGS IN INDONESIA To support collaborative research with the Gadjah Mada University to recalibrate irrigation measurement devices in selected irrigation schemes in Java.	FORD FOUNDATION Jakarta	26,200	18 months
EFFICIENT IRRIGATION MANAGEMENT & SYSTEM TRANSFER PROJECT To identify changes which would promote more 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.	FORD FOUNDATION Jakarta	300,000	30 months
ESTABLISHMENT OF RESEARCH PLANNING AND IMPLEMENTATION UNIT ON IRRIGATION MANAGEMENT IN NEPAL To support 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.	FORD FOUNDATION Delhi	200,000	3 years
STUDY ON FARMER-MANAGED IRRIGATION IN NORTHERN NIGERIA Research on farmer-managed irrigation in Northern Nigeria in collaboration with Ahmadu Bello University.	FORD FOUNDATION Dakar	20,000	2 years
FELLOWSHIP SUPPORT FOR IMPROVED IRRIGATION MANAGEMENT To support post-doctoral research on irrigation-related settlement planning, and pre-doctoral research to develop a model that would simulate the functioning of a small tank irrigation system.	FORD FOUNDATION New York	46,300	3 years
SUPPORT FOR ESTABLISHING A PROGRAM IN SUDAN Partial support to establish an irrigation management program in Sudan.	FORD FOUNDATION Cairo	495,000	2 years

ANNEX I (continued.)

TRUST FUND	FRANCE	87,850	1 year
Government of France - Trust fund for staff secondment.			
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.			
RESEARCH ON 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 providing technological and scientific support to the 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 and training on improved management techniques and operational methods for "irrigation systems, in collaboration with agencies and on-going " projects in Pakistan and other countries with similar irrigation environments.			
ASSISTANCE TO FARMER-MANAGED IRRIGATION SYSTEMS	IFAD	120,000	3 years
To support a research program in farmer-managed irrigation systems.			
ASSISTANCE TO FARMER-MANAGED IRRIGATION SYSTEMS	BMZ	520,000	3 years
STAFF SECONDMENT	NETHERLANDS	340,350	3 years
Support from Government of Netherlands for staff secondment.			
STUDY ON MANAGING IRRIGATION SYSTEMS TO MINIMIZE WATERLOGGING AND SALINITY PROBLEMS	NETHERLANDS	2,200,000	5 years
Support to IIMI Pakistan to implement in collaboration with national agencies, a program of applied research on waterlogging and salinity. Research will focus on irrigation strategies designed to prevent the occurrences of waterlogging and salinity.			
IIMI/IRRI COLLABORATION ON IRRIGATION MANAGEMENT FOR RICE-BASED FARMING SYSTEMS	ROCKEFELLER FOUNDATION	1,200,000	3 years
To conduct collaborative research with IRRI on 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	13,448	10 months
To cover costs of publication and distribution of the proceedings of the workshop entitled Social Science Perspectives on Managing Agricultural Technology.			
FARMER-MANAGED IRRIGATION SYSTEMS NETWORK (FMIS)	UNDP	39,000	4 days
To support network activities in FMIS research.			

ANNEX I (continued.)

SUPPORT FOR STRATEGY WORKSHOP To support a workshop to discuss IIMI strategy with representatives of IIMI's client agencies.	UNDP	34,967	2 days
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 Sri Lankan national capacity for irrigation management 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 support IIMI Pakistan in its efforts to strenghten Pakistan's 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 Institute's programs in the West Africa 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 Agricultural Development
BMZ = Bundes Ministerium fur Wirtschaftliche Zusammenarbeit

ANNEX II
1988 PUBLICATIONS

Working Papers

Svendsen, Mark. Sustainability in irrigated agriculture. International Irrigation Management Institute. Working Paper No. 4. 14p. (January).

Stanbury, Pamela. 1988. Land settlement planning issues in irrigation management: A review of experiences in Sri Lanka. International Irrigation Management Institute, Working Paper No. 5. 36p. (March).

Groenfeldt, David, Alwis, Joe and Perera, Jayantha. Strategies for improving minor irrigation systems in Sri Lanka. International Irrigation Management Institute. Working Paper No. 6. 42p. (March).

Merrey, Douglas J. and Jinapala, K. On physical remodeling and institutions strengthening: An evaluation of the implications of the pilot field channel experience of the rehabilitation project at Uda Walawe, Sri Lanka. International Irrigation Management Institute. Working Paper No. 7. 17p. (July).

Berthery, Daniel, Sally, Hilmy and Arumugam, Jayantha, Mathematical modelling of irrigation canal systems: Part I. Presentation of the "Mistral-Simura" Software package. Part II. Application of "Mistral-Simutra" to the Kalankuttiya branch canal (Mahaweli system H), Sri Lanka. International Irrigation Management Institute. Working Paper No. 9. 78p. (December).

Monographs

Martin, Edward D. Irrigation management in Nepal: Paper from a national seminar. Kathmandu Nepal. International Irrigation Management Institute. 188p. (February).

International Irrigation Management Institute. Irrigation

ANNEX II (continued.)

Management in Nepal: Research papers from a National Seminar, Bharatpur, Nepal, 4-6 June 1987. International Irrigation Management Institute (Nepal). 138p. (May).

International Irrigation Management Institute/Philippines Council for Agriculture, Foresty and Natural Resources Research and Development. State of the art and abstract bibliography: Water management for crop diversification in irrigated rice-base cropping systems. Series No 5/1988. 96p. (August).

SERIALS

Annual Report

International Irrigation Management Institute. Annual Report 1987. 97p. (October).

IIMI Review

International Irrigation Management Institute. IIMI Review Vol. 2 No. 1. 18p. (April).

International Irrigation Management Institute. IIMI Review Vol. 2 No. 2. 28p. (August).

Newsletters

International Irrigation Management Institute. – IMIN Bibliography: Documents in the Irrigation Management Information Network. International Irrigation Management Institute. (IMIN) database. Vol. 1 No. 2. 61p. (January).

International Irrigation Management Institute. Farmer managed irrigation systems network. FMIS Newsletter No. 3. 28p. (April).

International Irrigation Management Institute. Farmer managed irrigation systems network. FMIS Newsletter 4. 28p. (May).

ODI-IIMI Irrigation Management Network Newsletter. ODI/IIMI Irrigation Management Network Paper 88/1a. (June).

International Irrigation Management Institute. Farmer managed irrigation systems network. FMIS Newsletter 5. 24p. (November).

ODI-IIMI Irrigation Management Network Newsletter. 23p. ODI/IIMI Irrigation Management Network Paper 88/2a. (December).

GOVERNANCE DOCUMENTS

International Irrigation Management Institute. Program & Budget for 1989. 92p. (September).

International Irrigation Management Institute. The Strategy of the International Irrigation Management Institute. 66p. (September/Draft).

Occasional Papers

Merrey, Douglas J, Rao, P.S. and Martin, Edward D. Irrigation management research in Sri Lanka: A review of selected literature. International Irrigation Management Institute. Occasional Paper No. 1. 52p. (June).

Yoder, Robert, Pradhan, Prachanda and Martin, Edward D. Recommendations or consideration in the development of Nepal's irrigation master plan. International Irrigation Management Institute. Occasional Paper No. 2. 20p. (June).

ODI/IIMI Publications Series

ODI-IIMI. Register of members. 176p. ODI/IIMI Irrigation Management Network. (June).

Burton, M. Improving water management in developing countries: A question of training. 12p. ODI/IIMI Irrigation Management Network Paper 88/1b. (June).

Ferrer, A.M. and Lucero, L.C. Developing partnership in the management of irrigation systems. 18p. ODI/IIMI Irrigation Management Network Paper 88/1c. (June).

Ait-Kadi, M. Major features of Moroccan large-scale irrigation projects. 24p. ODI/IIMI Irrigation Management Network Paper 88/1d (June).

Lenton, R. Strategy development in IIMI: The International Irrigation Management Institute-Four years of development. 23p. ODI/IIMI Irrigation Management Network Paper 88/1e. (June).

Reddy, Ventaka M. Development of well irrigation in canal commands: The prospects and some emerging issues. 23p. ODI/IIMI Irrigation Management Network Paper 88/2b. (December).

Khan, L.R. Environmental aspects of groundwater development in Bangladesh: An overview. 21p. ODI/IIMI Irrigation Management Network Paper 88/2c. (December).

Berkoff, D.J.W. Irrigation Management in South India: The approach of the national water management project. 24p. ODI/IIMI Irrigation Management Network Paper 88/2d. (December).

Moore, Mick. Maintenance before management: A new strategy for small scale irrigation tanks in Sri Lanka? 11p. ODI/IIMI Irrigation Management Network Paper 88/2e. (December).

Ranjan, Sampath K. Some comments on measures of inequity in irrigation distribution. 13p. ODI/IIMI Irrigation Management Network Paper 88/2f. (December).

STAFF EXTERNAL PUBLICATIONS (A SELECTION)

Higgins, G.M, Dieleman, P.J. and Abernethy, C.L. Trends in irrigation development, and their implications for hydrologists and water resources engineers. In Hydrological Science Journal. Vol. 33. No. 1. 43p. (February).

Hussain Tariq, and Vander Velde, Edward J. Intervention and innovation in farmer-managed irrigation systems in northern Pakistan. Paper presented at the VII World Congress for Rural Sociology, Bologna, Italy, June 26-July 2, 1988. (July).

Abernethy C. L. The concept of flexibility in irrigation systems. Conference on irrigation system evaluation and water management. Wuhan, China. (September).

Bhatti, M.A., Wolf, J.M., and Thorne, M.D. Impact of late irrigation on wheat production in the central Punjab of Pakistan. Paper presented at the International Winter meeting of the American Society of Agricultural Engineers, in Illinois, December 13-16, 1988. (December).

PROJECT REPORTS (RESTRICTED)

International Irrigation Management Institute. Irrigation management and crop diversification (Sri Lanka). Inception Report on the Technical Assistance Study (TA 846 SRI). Sri Lanka/ Asian Development Bank (ADB)/IIMI. 108p. (March).

International Irrigation Management Institute. Efficient irrigation management and system turnover. Inception Report on the Technical Assistance Study (7A 937 INO). Directorate of Irrigation 1 (Indonesia)/Asian Development Bank (ADB)/Ford Foundation/ IIMI. 72 p. (March).

International Irrigation Management Institute. Irrigation management for diversified crops. Second Progress Report on the Technical Assistance Study (TA 859 PH1). International Irrigation Management Institute (Philippines). 59p. (March).

International Irrigation Management Institute. Study on irrigation systems rehabilitation and improved operations and management. Interim Report for the Asian Development Bank (ADB RETA 5273). International Irrigation Management Institute (August).

International Irrigation Management Institute. Irrigation management for diversified crops. Interim Report on the Technical Assistance Study (TA 859 PH1). International Irrigation Management Institute (Philippines). 172 p. (September).

International Irrigation Management Institute. Efficient irrigation management and system turnover. Interim Report on the Technical Assistance Study (7A 937 INO.) Directorate of Irrigation 1 (Indonesia)/Asian Development Bank/Ford Foundation/IIMI. 164 p. (September).

International Irrigation Management Institute. Irrigation Management and Crop Diversification (Sri Lanka). Progress Report on the Technical Assistance Study (TA 846 SRI). Sri Lanka/Asian Development Bank (ADB/IIMI). 153p. (October).

ANNEX III
1988 AWARDS

A. Post-doctoral Fellowships

Name	Dates	Research Topic	Location
M. Akhtar Bhatti	November 1986 – November 1988	Irrigation Constraints to Crop Production in Central Punjab	Pakistan
N. Raby	August 1986 – July 1988	Irrigation Agency Processes	Sri Lanka
P. Stanbury	September 1987 – December 1988	Land Settlement Planning for Improved Irrigation Performance	Sri Lanka

B. Special Award

Name	Dates	Case Study Topic	Location
P. Weerakkody	June 1988 – August 1988	Coordination as a Means for Improved Water Management	Sri Lanka

C. 1988 Ph. D. Research Fellowships.

Name	Dates	Thesis Research Topic	Location
Sigit Supadmo Arif	November 1988 – November 1990	Increasing Production of Ill-Drained Rice Area through Drainage System Improvement and Crop Diversification	Indonesia
Muhammad Nawaz Bhutta	April 1987 – September 1989	Effect of Varying Discharges on the Equity of Water Distribution in Irrigation Systems	Pakistan
Adriano Esguerra	October 1988 – September 1989	Adaptability of Rice Irrigation Facilities/ Structures for Diversified Cropping	Philippines
Robert Johnson	September 1988 – March 1990	Private Tube Well Development as an Alternative to Public Management of Groundwater Levels in Pakistan	Pakistan
Muchjidin Mawardi	March 1988 – March 1990	Management Improvement of Government Managed Irrigation System	Indonesia
Tolentino B. Moya	May 1988 – April 1990	Diversifying Irrigation Systems	Philippines
Rodolfo A. Natividad	June 1988 – May 1989	Management and Operation of an Irrigation System for Mixed Cropping	Philippines
Odile Oswald	July 1987 – July 1989	An Expert System for the Diagnosis of Tank Irrigation Systems.	India

ANNEX III (continued.)

Andrew Stone	January December	1988 1988	Public Institutional Management : Interagency Coordination	Pakistan
Sukirno	March March	1988 1990	Decision Making Analysis on the Planning and Updating of Diversified Crop in Irrigated Paddy Field	Indonesia

D. 1988 Master's degree scholarships.

Name	Dates		Thesis Research Topic	Location
Syed Mehtab Ali	May May	1988 1989	Identification of Appropriate Performance Indicators	Pakistan
Muhammed Azhar	January August	1988 1988	Simulation of Schedules for Maximizing Wheat Yield	Pakistan
David Cero	November May	1988 1989	Agroclimatic Factors Assessment for Rice-Based Irrigation System Management and Diversification.	Philippines
Reynold Gumtang	October March	1988 1989	Effect of Soils and Land Use Patterns on Stream Flow Characteristics	Philippines
Hermingildo Gutierrez	September March	1988 1989	A Corporate Strategy for the Upper Pampang a River Integrated Irrigation System	Philippines

ANNEX IV
1988 AGREEMENTS

Organization	Purpose
Bangladesh:	
The Bangladesh Agricultural Research Council (BARC)	To establish a unit of the International Irrigation Management Institute in Bangladesh.
Burkina Faso:	
The Government of Burkina Faso	For the establishment of a regional unit of IIMI.
France:	
Centre National du Machinisme Agricole, du Genie Rural, des Faux et des Forets (CEMAGREF)	For the implementation of a simulation model of the Kirindi Oya Right Bank Main Canal.
Morocco:	
The Government of Morocco	To establish a unit of the International Irrigation Management Institute in Rabat.
Nigeria:	
Ahmadu Bello University	To collaborate on research on farmer management of irrigation systems.
Pakistan:	
Centre of Excellence in Water Resources Engineering.	To cooperate in research on irrigation management.
University of Engineering and Technology. Lahore	To cooperate in research on irrigation management.
Royal Netherlands Embassy, Islamabad	To implement a program of investigation entitled: "Managing Irrigation Systems to Minimize Waterlogging and Salinity Problems".
Sri Lanka:	
Postgraduate Institute of Agriculture. Peradeniya	To collaborate in post-graduate training of nominees from Sri Lanka in the field of irrigation management.
USA:	
International Food Policy Research Institute (IFPRI)	To intensify IIMI's and IFPRI's collaboration on irrigation-related issues.

ANNEX V
1988 WORKSHOPS AND CONFERENCES

1. **Workshop and Conferences Organized by IIMI**

Title	Date	Location
IIMI Strategy Workshop	18-19 April	Digana, Sri Lanka
Guidelines for Rapid Assessment of Minor Irrigation Systems	15 August	Digana, Sri Lanka
National Workshop on Irrigation Management for Crop Diversification	5-7 October	Cavite, Philippines
Organizational and Planning Workshop for a Research Network on Irrigation Management for Diversified Cropping in Rice-Based Systems.	30 November-3 December	Bangkok, Thailand

2. **Selected workshops and conferences at which IIMI was represented**

Sustainability in Natural Resources, University of Minnesota, Minneapolis, USA, 28-30 March.

Ford Foundation, Rural Poverty and Governance Meeting, Bangalore, India, 10-15 April.

ISPAN Regional Irrigation Management Workshop, Kathmandu, Nepal, 24-29 April.

Research Planning Workshop on Policy Related Issues in Indian Irrigation, sponsored by IFPRI and hosted by Tamil Nadu Agricultural University, Ootacamund, India, 26-28 April.

Consultative Group on International Agricultural Research Berlin Meeting, 16-20 May.

Gerald Lacey Memorial Lecture, ICID, British Section, London, UK, 23 May.

International Water Resources Association, IVth World Congress, Ottawa, Canada, 29 May - 3 June.

Seminar on Irrigated Water Management - Strategies of Farmer Participation, Colombo, Sri Lanka, 20 June.

International Conference on Irrigation Systems Evaluation and Water Management, Wuhun University of Hydraulic and Electrical Engineering, Wuhun, China, September.

International Executive Council of the International Commission on Irrigation and Drainage, Dubrovnik, Yugoslavia, September.

Workshop on Human Resource Development Through Training, International Potato Center, Lima, Peru, 12-16 September.

Consultative Group on International Agricultural Research Centers' Week, Washington, D.C., 30 October - 4 November.

Training Course on Modernization of Irrigation Schemes: Design and Operations, organized by CEFIGRE, Bangkok, Thailand, 29-30 November.

ANNEX VI
STAFF (As of 31 December, 1988)

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Dr. Roberto L. Lenton
Director General

Ms. Manel Gunewardena
Senior Executive Assistant to the Director General

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Director, Field Operations

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Dr. Donald E. Parker
Head, Bangladesh Field Operations

Indonesia (Jarkarta and Bandung)

Dr. Hammond Murray-Rust
Head, Indonesia Field Operations

Dr. Douglas L. Vermillion
Irrigation Specialist

Mr. M.E. Busro
Senior Technical Advisor

Ir. Adriza
Data Analyst

Ir. Ganjar Kurnia
Social Scientist

Mr. Helmi
Field Assistant

Ir. K. Paulus
Field Assistant

Ir. Supriadji
Field Assistant

Morocco (Rabat)

Mr. Jean Verdier
Head, Morocco Field Operations

Nepal (Kathmandu)

Dr. Robert Yoder
Head, Nepal Field Operations

Dr. Prachanda Pradhan
Irrigation Specialist

ANNEX VI (continued.)

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Irrigation Specialist

Dr. Edward Martin
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PAKISTAN DIVISION (LAHORE)

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Irrigation Specialist

Mr. M. Badruddin
Senior Principal Irrigation Engineer

Dr. M. Akhtar Bhatti
Principal Irrigation Engineer

Mr. Rana M. Afaq
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Mr. M. Nawaz Bhutta
Research Fellow

Mr. Robert Johnson
Research Fellow

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Mr. Tariq Shahzad
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Field Research Engineer

Mr. Mohammad Saleem
Field Research Social Scientist

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Field Research Engineer

Mr. Haroon Anwar
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Dr. Zenete M. P. da S. Franca
Training Specialist

ANNEX VI (continued.)

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Irrigation Specialist

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Dr. Mark Svendsen
Irrigation Specialist
(Based at IFPRI, Washington on joint apointment by IIMI and IFPRI)

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Travel Officer

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Personnel Officer

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Club & Catering Manager

Mr. Raj Dharmakirthi
Senior Electronics Systems Engineer

Dr. Tudor de Silva
Medical Officer

Ms. Susie Dias
Housing Officer

Mr. Charles Hoffman
Co-Principal, Digana International School

Ms. Eileen Hoffman
Co-Principal, Digana International School

Mr. S. Kodipilarachichi
Clinic Administrator

Mr. K.S.C. Perera
Maintenance Engineer

Mr. R.K.D.H. Ratnayake
Stores Officer

Mr. S. Senniappan
Supplies Officer

Mr. C.W. Weeraratne
Liaison Officer, Colombo

ANNEX VII
CONSULTANTS

NAME	MISSION
Dr. Marietta Andriano	To provide socio-economic expertise on the economics of crop diversification.
Mr. Raj Bhatia	To develop and implement a computerized accounting and budgeting system.
Dr. Asit Biswas	To help develop a strategy and plan for IIMI's Information Program.
Mr. John Colmey	To assist in the preparation of varous IIMI reports and publications.
Corporate Consultant Group (Pvt) Limited	To establish a management information system.
Prof. J.A. Gunawardene	To improve IIMI's national and international telecommunication systems.
Mr. Alex Gunasekera	To assist in computer software development and training.
Dr. William Gormbley	To assist in preparing a competitive, comprehensive set of benefits and allowances for IIMI's internationally recruited staff.
Mr. Altaf Hussein	To undertake preparatory work in Washington to initiate IIMI's Sudan activities.
Dr. Sam Johnson	To assist in project development in Indonesia.
Ms. Inge Jungeling	To inventory the role of NGO's in planning and implementing programs to improve minor irrigation systems in Sri Lanka.

Prof. A.A. Kampfraath	To assist in the preparation of a detailed report concerning the impact of management on irrigation system canal regulation.
Dr. Gil Levine	To propose action research to develop managerial innovations regarding the equity of water distribution in Pakistan; to help formulate a strategy for IIMI in Pakistan; and to assist in program development in Nepal and Bangladesh.
Dr. Dulce Miranda	To assist in international recruitment.
Mr. Ken Novak	To put IIMI on line within the CGNET electronic mail system.
Ms. Laurie Richardson	To assist in international recruitment.
Dr. Namika Raby	To undertake studies of resource mobilization and management decision making for irrigation systems performance.
Dr. Leslie Small	To prepare a draft proposal for assessing Irrigation Systems performance.
Ms. Susan Thompson	To undertake a literature review on water wholesaling.
Mr. Kapila Wimaladharma	To produce, in collaboration with IIMI staff, a hard copy and computer file of a bibliography listing all relevant works, published and unpublished, concerning minor irrigation in Sri Lanka.

ANNEX VIII
IIMI ADDRESSES

HEADQUARTERS

64 Lotus Road
Colombo 1, Sri Lanka

Telephone : (01 within Sri Lanka;94-1 from overseas) 546561 (5 lines) 544580 (4 lines)

Telex : 22318 or 22907 IIMI HQ CE

Fax : (01 within Sri Lanka; 94-1 from overseas) 544584

E-Mail : IIMI (10074:CGUO22)

P. O. Box : P. O. Box 2075, Colombo, Sri Lanka

BANGLADESH

House 43
Road 23
Banani
Dhaka-1000, Bangladesh

Telephone : 880-2-411690

Telex : 642940 ADAB BJ Attn: IIMI/ Dhaka

INDONESIA

Mail: P. O. Box 435 KBY, Jakarta 12001

Office: Directorate of Irrigation I
J1. Patimura 20/7, Kebayoran Baru
Jakarta Selatan

Telephone : (021 within Indonesia;62-21 from overseas) 773285

Telex : 61894 FF JKT IA (Attn. IIMI)

E-Mail : 141:TCN301 (Attn.IIMI: C/o , Ford Foundation, Jakarta

MOROCCO

IIMI, C/O SEHA, 461
Avenue Hassan II,
Al Akkari, Rabat,
Morocco

Telephone : (7) 922 03 and 912 04

Telex : DERMARA 32705 (Quote "IIMI")

Fax : (212-7) 63566 (Att. IIMI C/o Mrs. K. Kabbaj, UNDP)

NEPAL

P O Box 3975
Kathmandu, Nepal

Telephone : (977-01) 228775

Telex : 2321 BASS NP (Attn:IIMI) Alt & Saturdays: 2262 NARANI NP (Attn: YODER 524859)

Fax : (00) 9771 5245 09

E-Mail : IIMI-Nepal (157:CGI106)

THE PHILIPPINES

IIMI OFFICE, NIA Compound,
IIC Bldg, EDSA,
Quezon City, Metro Manila,
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Telephone : (094 within the Philippines;63-2 from overseas) 961593 or 999346

Telex : Mon-Fri 40860 PARRS PM ATTN:IIMI
Fri-Sun 1.00pm
22456 IRI PH
40890 RICE PM

ANNEX VIII (continued.)

Fax : (63-2)-817-8470 (c/o Water Management Dept)

E-Mail : CGI401 (c/o Water Management Dept)

PAKISTAN

1-B Danepur Road
GOR I, Lahore

Telephone : (042 within Pakistan;92-42 from overseas) 305810, 302842,302924

Telex : 44926 IIMIP PK

Fax : 92-42-869194

E-Mail : IIMI-PAK (157:CGI220)

SUDAN

Hydraulics Research Station,
P. O. Box 318,Wad Medani,
Sudan

Telephone : Wad Medani 2448
Alt c/o Ford Fnd.
249-11-43474
(08:30 to 14:30)

Telex : 50013 HRS SD
50009 TXBOWD SD (c/o Mr. Monshid, HRS)
Alt. Khartoum: 23024 SNASH SD

WEST AFRICA

BP 5373
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Telephone : (226) 308489

Telex : 0978 5381 SAFGRAD BF

Fax : 226-31-06-18

E-Mail : IMI-BF.TEST74 (CGU033)