IIMI PAKISTAN

DESIGN TEAM REPORT

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ACKNOWLEDGMENTS

The Design Team for the Pakistan Unit of the International Irrigation Management Institute (IIMI-PAK) spent two very full and productive weeks in Pakistan during November 17 through 30, 1984. During this period, the Team was able to meet and discuss the IIMI concepts and principles and the proposal for IIMI-PAK in depth with the senior officials of all the relevant agencies at ministerial and secretariat levels, and with other officers concerned with field operation, both in the Central Government and in the Provincial Governments of the Punjab, the Sind, and the Northwest Frontier, and with officials of fourteen embassies and international organizations resident in Pakistan.

We are most grateful for and wish to acknowledge with sincere appreciation the very thorough preparation made for the Team's visit and for the generous amount of time and attention given by all those encountered and the virtual unanimity of interest and general endorsement of the basic ideas envisaged for IIMI-PAK.

We wish to give particular tribute to Dr. Amir Muhammed, Chairman of the Pakistan Agricultural Research Council, Secretary to Government in the Agricultural Research Department, and Vice Chairman of the IIMI Board, under whose guidance (1) the plans for the visit were arranged and (2) the officials concerned were informed in advance on the substance of the Team's mission and were prepared to convey their suggestions to the team. We also wish to express our sincere appreciation to Dr. Muhammed Akhtar Bhatti, Principal Scientific Officer, with the assistance of other support staff of the Pakistan Agricultural Research Council who took responsibility for making all the detailed arrangements for travel and appointments with various officials. He accompanied the team throughout its stay and in its discussions with the Pakistan officials, and made sure that all relevant documents and other needed information for the study were readily available. The excellent arrangements, preparation, and logistical support enabled the team in the short space of two week's time to gain insight and information and draw conclusions therefrom that would not have been possible otherwise.

The Design Team

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I. INTRODUCTION AND BACKGROUND

A. General Background

The International Irrigation Management Institute, with headquarters at Digana (via Kandy), Sri Lanka, became operational in June 1984 upon formal ratification of its charter by the Government of Sri Lanka and the assumption of full time duties in residence by its Director General. IIMI is an autonomous, non-profit international organization to conduct research, provide opportunities for professional development, and communicate information about irrigation management.

The importance of irrigation in appropriate amounts and at the right times, and the management of water delivery and disposal in ways which support crop needs and maintain the quality of the soil enivironment, have been attested in many ways. One measure is the massive investment made by developing nations in the development, extension, and improvement of irrigation systems -- by far the largest of the investments being made to achieve food production targets for rapidly growing populations. But the returns to increased crop production have fallen far short of expectations and much below potential levels.

Management of the irrigation system has become a focus of concern, and it is recognized that the entire system must be subject to examination, from the point of diversion of the water source to its conveyance, delivery, application, utilization by crops, and ultimately, disposal. This encompasses the inter-disciplinary participation of irrigation engineers, agricultural scientists, and persons competent to study human behavior and public policy. It seems evident that the answers to relevant problems and constraints should be sought in working with actual irrigation systems rather than under controlled conditions on experiment stations.

From the very outset, Pakistan has been viewed as being in the forefront of interest in the IIMI initiative -- both by the Support Group and the Government of Pakistan. Pakistan put forward a strong case as a candidate for location of the Institute's principal headquarters. The decision of the IIMI Support Group to locate the principal headquarters in Sri Lanka was made with the explicit understanding that a major cooperating and participating program would be developed with Pakistan, which has irrigation systems and conditions complementary to but different in scope and character from those in Sri Lanka. Other collaborative and participating units were envisaged for later development, as well as networks of cooperators in many countries.

B. Basis for the Mission

The first meeting of the IIMI Governing Board re-affirmed the above principles and designated a subcommittee to study and recommend various approaches to international collaboration, including the general shape of a unit in Pakistan. This subcommittee met in Lahore in November, 1983 and its findings were discussed in the second meeting of the Governing Board in June, 1984. The Board then authorized the Director General to send a design team to Pakistan to develop more detailed parameters for the Pakistan unit and to develop the basis for formal action of the Governing Board with respect to its establishment. The Terms of Reference for the team are given in Appendix J.

C. Rationale for Establishing Units of IIMI outside Sri Lanka

The effective management of irrigation systems requires close interaction of disciplines somewhat different from those concerned solely with biological and physical sciences. It includes engineering, agricultural and biological sciences, the behavioral sciences, economics, and public policy and administration. Irrigation systems vary in size from one or two ha to very large integrated systems such as that of the Indus Basin serving over 14 million ha. Furthermore, irrigation is practised under a wide range of ecological conditions, from the humid tropics to very arid areas such as the southern part of the Indus Plain, Egypt, the coastal region of Peru, and many other areas which have widely different cropping patterns and needs. Although they have the common constraint of matching crop requirements with available water supplies equitably and dependably, they differ in how this is to be achieved.

No one country can provide the full range of the above factors, nor the range of political and social structures found in the developing world. Further, irrigation management is greatly dependent upon the operating institutions. While this suggests a great deal of location specificity in irrigation practices and problems, there is growing recognition of management deficiencies and their commonality among many systems. An international effort is needed to understand and alleviate the problems, pooling the best experience from diverse systems in many countries.

There is thus a need to conduct operational research in many different situations with a diagnostic approach in which all relevant disciplines combine their efforts in an inter-disciplinary mode of operation to develop methods, principles, mandates, and approaches to improvements in irrigation management which can be applied to individual irrigation systems.

D. Rationale for Establishing a Major Unit in Pakistan

Four factors are important in the choice of Pakistan as IIMI's first cooperating unit: extent of irrigation, poor system performance, its location in an arid zone, and strong governmental interest in the project.

1. Extent of Irrigation in Pakistan. Pakistan has the largest contiguous irrigation system in the world, spanning over 14 million hectares. The system of primary and secondary canals is about 61,000 km in length, with tertiary-level canals estimated to extend another 1.6 million km. The system consists of 42 command areas and 89,000 watercourses serving an estimated 3.6 million irrigated farms. Principal water supplies come from snow-melt runoff from the Himalayan range with storage in two main reservoirs, Mangla and Tarbela. A third main reservoir, Kalabagh, a six-billion dollar project, is in detailed design stage and is slated for completion in the 1990s. Surface water supplies total about 15.6 million hectare-meters annually. These supplies are supplemented with an estimated 4.4 million hectare-meters from groundwater supplies that are pumped from over 200,000 public and private tubewells. Additional facts on the Indus Basin are presented in Appendix A.

2. Poor System Performance. Two basic factors contribute to poor system performance in Pakistan. First, there are vast problems of drainage and salinity due partly to poor system design and management. Waterlogging at depths less than 1.5 meters affects over 2.5 million hectares[1/], and salinity or sodicity some 2.8 million hectares[2/]. Much of the problem is attributable to physical limitations of soils and slopes, and to a lack of facilities rather than to management. Secondly, irrigated agricultural yields are extremely poor, only about one-third of the potential for wheat, cotton, rice, maize and sugarcane,[3/] and are also low compared with other developing countries.

3. Arid, Temperate Diversified Cropping in Pakistan vs Tropical Rice-based Cropping in Sri Lanka. The set of agro-ecological conditions of Pakistan is fundamentally different from that in Sri Lanka. Pakistan is arid, Sri Lanka has high rainfall; Pakistan is located entirely in the temperate zone, Sri Lanka in the tropics; Pakistan's crops are largely diversified, Sri Lanka is oriented to rice production. The size and complexity of the Indus system also distinguish it from systems in Sri Lanka. These contrasts have resulted in different methods of irrigation management in each country, and are strong arguments for parallel but separate programs of research.

4. Interest by the Government of Pakistan. Pakistan is keenly interested and supportive of establishing a major IIMI unit, as summarized in Chapter III of this report.

1/ The Central Monitoring Organization, Planning Division of WAPDA. Data are for 1979.

2/ M. B. Choudhri, Secondary Salinization in the Indus Plains Pakistan, Soil Survey of Pakistan, Lahore, 1977.

3/ Tariq Husain, "Potential for Irrigated Agricultural Development in Pakistan", IBRD, 1981.

II. PURPOSE OF THE MISSION

The Design Team was commissioned to:

Determine the feasibility of establishing a Pakistan unit of IIMI based upon depth of Government of Pakistan support for this concept, and the prospects of donor support.

Provide a framework for the IIMI Pakistan concept, likely program areas, pattern of operation, institutional collaboration, size of unit, staffing numbers and patterns, physical facility requirements, budgetary needs, and probable sources of income;

Prepare a Report to the Director General of IIMI

Its terms of reference are given in Appendix J.

The mission was not constituted to define the IIMI Pakistan program in detail, but rather to outline broad parameters for the proposed Institute, recognizing that details of the programs would be left to the IIMI Pakistan Director and staff, in collaboration with IIMI and Government of Pakistan officials.

III. PAKISTAN'S SUPPORT AND COMMITMENT

Trying to ascertain the extent of Pakistan's basic commitment to and willingness to support the establishment of a cooperating unit of IIMI in Pakistan was given top priority by the Design Team. This issue was explored with various officials at both federal and provincial levels (see Appendix D for a list of the persons, organizations, and agencies contacted). Primary attention was given to senior officials in the respective ministries concerned. Contact was also made with middle and high level personnel in provincial operating departments.

During the mission, it was clear to the Design Team that there had been much advance preparation for the Team's visit. Documents concerning IIMI had been circulated earlier to all concerned agencies. On September 2, 1984, a meeting of a Pakistan "Liaison Committee" consisting of officials from the Federal Ministries of Agriculture, Food and Cooperatives, Water and Power, Science and Technology, Finance (Economic Affairs), Foreign Affairs, and Planning and Development, discussed setting up an IIMI unit in Pakistan. In addition, representatives from provincial irrigation and agriculture related agencies and research institutes and an official of the Water and Power Development Authority (WAPDA) participated in the meeting.

This preparation enabled the Design Team to spend relatively little time in explaining the purpose of the mission, and to respond more effectively to issues such as (1) the relationship between proposed IIMI Pakistan activities and what other organizations and agencies are already doing in

Pakistan, (2) the expectations of and requirements from Pakistan organizations and agencies if IIMI Pakistan would take up its proposed program in Pakistan, (3) prospective linkages between IIMI Pakistan and other organizations and agencies, (4) linkages between IIMI Headquarters and IIMI Pakistan, (5) the sources of funding for the establishment and operation of IIMI Pakistan, (6) the location of the IIMI unit in Pakistan, and (7) the relationship between IIMI Pakistan activities and externally supported projects.

The response of Pakistan officials at both federal and provincial levels, is strongly positive and striking. There is much enthusiasm and high expectation for the Institute. We recognize that once IIMI Pakistan has been established, the degree of enthusiasm may wane even if the expectations do not. But if the steps for IIMI Pakistan establishment are expeditiously pursued, the present positiveness of Government of Pakistan officials will be a strong asset in launching the Institute.

IV. CURRENT STATUS OF PAKISTAN'S IRRIGATION MANAGEMENT RESEARCH, TRAINING, AND INFORMATION EXCHANGE ACTIVITIES[1/]

A. Research

In this ~~three~~ two-part discussion of research, the first refers to the current status of natural science research on irrigation management, the second discusses economic, social and institutional issues, ~~and the third outlines prospective areas of IIMI Pakistan's research program.~~

1. Natural Science Research in Irrigation Management. Five major areas in Pakistan's current irrigation management research are briefly described below.[2/]

a. Hydraulics and infrastructure design. Some of the highest quality research in irrigation management in Pakistan is in the fields of hydraulics and infrastructure design. This research is conducted in laboratories and via prototype modelling of real river, canal headwork, and embankment

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1/ This chapter is based on the observations and discussions of the Design Team during its November 17-30, 1984 visit to Pakistan, supplemented by information from Institutional Profiles (Appendix I) from the Final Report of the USAID Irrigation Systems Management Research Design Team, November, 1984.

2/ Research on a sixth topic, namely, sedimentation problems in irrigation systems, is being undertaken by WAPDA's Monitoring and Evaluation Unit, with funding by the US National Science Foundation. Research on tile drainage is planned for the Drainage and Reclamation Institute and the Sind Agricultural University, both at Tando Jam.

situations. Because irrigation infrastructure in Pakistan is large-scale by world standards, pioneering research has been required to deal satisfactorily with river training, canal design, and water movement control.

Institutions involved with research on hydraulics and infrastructure design include the Irrigation Research Institute which is part of the Punjab Department of Irrigation (Lahore, Nandipur, and Chichoki Mallian Stations), the Irrigation Research Institute in the Sind, and the Center for Excellence in Water Resources Engineering (CEWRE) in Lahore. A National Institute of Hydrology is currently being proposed by the Irrigation, Drainage, and Flood Control Research Council (IDFCRC).

b. Waterlogging and salinity. Research in overcoming waterlogged and saline soils is a second important area in Pakistan. This includes monitoring the effects of the Salinity Control and Reclamation Project (SCARP) tubewells, addition of soil amendments, leaching, and salt tolerance of various crop species and varieties. Institutions involved include WAPDA's Monitoring and Evaluation Unit, the Mona Reclamation Experimental Project (MREP), CEWRE in Lahore, the Drainage and Reclamation Institute of Pakistan (DRIP) in Tando Jam, the Punjab Irrigation Research Institute, and the University of Agriculture at Faisalabad (UAF). An International Institute of Waterlogging and Salinity Control is being established with UNDP aid.

c. Soil-plant-water relationships. Institutions such as the Land and Water Management Unit of the Pakistan Agricultural Research Council (PARC), the Provincial Agricultural Research Institutes, MREP, DRIP, UAF, and the Sind Agricultural University at Tando Jam are researching water requirements for different crops, the relationships between nitrogen and water in crop production, and other agronomic issues.

d. Watercourse improvements. Applied research on different types of lining material and alternative designs for watercourses, including determining their impact on water losses, is being done by MREP, UAF, and the Punjab Water Management Training Institute in Lahore.

e. Technical methods of water distribution. Furrow and border irrigation, as alternatives to basin irrigation, are being studied by MREP and UAF. Sprinkler, drip, and pitcher irrigation are being researched by the Punjab Irrigation Research Institute at Lahore, the Sind Agricultural University at Tando Jam, the Arid Zone Research Institute in Quetta, DRIP at Tando Jam, and IDFCRC in other parts of the country.

2. Social Science Research on Irrigation. The information on economics research given below is taken from the earlier mentioned institutional profiles.

The Applied Economics Research Center (AERC) in Karachi, a National Center of Excellence, offers a Master of Applied Science degree in cooperation with the Economics Department of the University of Karachi. Many of its staff of over 20 professionals have studied abroad and six hold Ph.Ds. Research on economic issues include agriculture and irrigation, water

pricing, factors in successful water management programs, and the Left Bank Outfall Drain. The Center's library is reputedly one of the best in the country.

The Pakistan Institute of Development Economics (PIDE), also a Center of Excellence, comes under the Ministry of Planning and Development. It has 11 senior staff engaged in research, one of whom has studied tubewell water costs, canal irrigation economic rent, and the level and structure of irrigation water charges.

The University of Agriculture at Faisalabad is studying the organization of Water User Associations (WUAs) as self sustaining enterprises and the development of methods for effective farmer adoption of improved water management. The Punjab Water Management Training Institute in Lahore is researching the social impacts of watercourse improvement. The Department of Anthropology at Quaid-I-Azam Univesity in Islamabad undertakes field research. Although it is involved in the USAID sponsored water management research proposal, it has presently not conducted any water-related research.

In Lahore, a proposed multi-disciplinary research project with the Institute of Irrigation Studies at the University of Southampton in the UK on the the management and operation of irrigation systems will involve studying a 2000 ha portion of a "live" irrigation system in the Shahkot area of the Punjab. The project, however, has not yet been funded.

B. Training

Three training institutions were visited by the Design Team, and each is described below.

1. Water Management Training Institute, Lahore. The Water Management Training Institute (WMTI), established in 1974-75, has a multi-disciplinary staff of 11 full-time professionals, instructors, and guest lecturers. Trainees from provinces other than the Punjab and countries such as Indonesia, Nepal, Nigeria, and Sri Lanka have participated in WMTI's courses, and include On Farm Water Management (OFWM) personnel, sub-engineers and supervisors, and WUA chairmen and members. Since emphasis in Pakistan's OFWM is on watercourse construction, cleaning, and maintenance, these form the major focus in the training program. Three courses of 6 to 12 weeks each are offered, while shorter courses are offered in water management and O&M.

The WMTI has, since July 1981, been financed in part by the World Bank (IDA) and the International Fund for Agricultural Development (IFAD). The project involves a total cost over 1984 - 1986 of Rs. 13.7 million, of which $650,000 (equivalent to almost Rs 9.5 million) has been proposed for UNDP financing.

2. Center for Excellence in Water Resources Engineering, Lahore. The Center for Excellence in Water Resources Engineering (CEWRE) grants M.Phil. (two year coursework-cum thesis) and Ph.D (without coursework) degrees in water resources management and hydrology. It has a degree granting link with the Engineering University, Lahore and an academic link on groundwater development with the University of Birmingham, UK.

The Center was established in 1977 by the Government of Pakistan to provide advanced training in hydrology, irrigation, drainage, waterlogging and salinity, and large dam construction. In addition to the above degree programs, CEWRE has conducted a variety of two week in-service training courses for engineers and has organized four national and international seminars. The Center plans to initiate an International Course on Water Resources Management in 1986 in collaboration with UNESCO.

The CEWRE's 10 faculty members are from a variety of natural science disciplines. The Center currently has no economists or other social scientists on its staff, although it apparently has undertaken some research projects involving economic and social issues. It also has a declared interest in collaborating with other institutions on a variety of topics, including irrigation project management.

3. Punjab Engineering Academy, Lahore. The Punjab Engineering Academy is a recently-created semi-autonomous institution under the Government of the Punjab. Although the Academy offers some technical courses, it was established primarily to provide training in public administration and project management to all entry-level engineers and to middle and senior level engineers in the Punjab. The Academy has seven full-time staff. Visiting professors and WAPDA personnel are also expected to play an important role in their teaching program. The Principal of the Academy is a former Secretary of Irrigation in the Punjab.

The Academy offered its first course, six weeks of in-service training, in October-November 1984. It is also mandated to provide a six-month pre-service training course for new Government of Punjab engineers. Four months of the training will be at the Academy, and two months will involve practical field-level training in the trainees' respective departments.

4. Other training institutions. Short and long term water management training courses are offered at Faisalabad University. These courses serve degree-level agricultural engineers employed on OFWM field teams, sub-engineers and supervisors, and WUA personnel. A water management course is also given for extension specialists.

The WAPDA Academy in Tarbela was established in 1977 to teach basic management principles to WAPDA's professional staff. The Academy was chosen by the World Bank in 1983 to be its Middle East-Asia regional center for project management training. Courses for federal and provincial government employees and foreign participants were started this fall.

OFWM Training Centers have been established or proposed not only in the Punjab, but also in the Sind and NWF provinces.

C. Information Exchange

The Irrigation, Drainage, and Flood Control Research Council (IDFCRC), under the Ministry of Science and Technology, was established in July 1964. One of its functions is to collect and disseminate information on matters relating to water resource development and use in Pakistan. The IDFCRC publishes a monthly newsletter, a bi-annual technical bulletin, bibliographies, and a variety of other publications. The Drainage and Reclamation Institute of Pakistan (DRIP), IDFCRC's in-house research agency, also publishes a newsletter and various project reports.

It was beyond the terms of reference of the Design Team to review the literature on Pakistan irrigation. During our visit, however, we became aware of several bibliographies which we believe would be of direct interest to IIMI Pakistan. Examples include the following:

-A series of 14 IDFCRC bibliographies, many of which are annotated, with the following pertaining to irrigation management: (i) Drip/Trickle Irrigation Systems, Design, and Operation, 1983; (ii) Crop Water Management in Pakistan, 1983; (iii) Irrigation Water Requirements for Various Crops in Pakistan, 1983; (iv) Water Resources Planning, Development, and Management in Pakistan, 1984; and (v) Plant Growth Relationships on Salt-Affected Soils, 1984;

-"Land and Water Development Bibliography, 1983 (DRIP Bibliography No. 2);

-A rather extensive list of "important publications on irrigation research and management" which is included in Dr. Mohammed Akhtar Bhatti's Country Position Paper on Irrigation Research and Management, Islamabad:PARC, 1984.

A proposed Water Management Research Program (WMRP), a component of the Irrigation Systems Management Project, is currently under consideration for funding by USAID. An Information Systems Management Project -- to be handled by IDFCRC -- is proposed under the WMRP. This project involves library development and reference, documentation, and dissemination activities.

V. RECOMMENDATION FOR THE ESTABLISHMENT OF THE PAKISTAN UNIT

Based on its findings reported in the preceding chapters, the Design Team recommends to the IIMI Management and its Governing Board that IIMI Pakistan be established as promptly and expeditiously as possible. We recommend that IIMI Pakistan set up mechanisms for assuring full consultation with concerned persons, agencies, and organizations in Pakistan to develop relevant research programs on key problems in the country.

The focus on relevant problems of Pakistan irrigation system management will naturally generate information and experience which will be relevant to other nations and we anticipate that this will be shared and will become a part of IIMI's store of information out of which methodologies of approach of more general applicability will emerge.

We would not anticipate that IIMI Pakistan should assume regional responsibility initially, but do not exclude this possibility for the future. International involvement by IIMI Pakistan is considered desirable by Government of Pakistan officials; however, bi-lateral donors generally will insist that the funds contributed by them to IIMI Pakistan will be used primarily within the borders of Pakistan.

VI. DESCRIPTION OF IIMI PAKISTAN

A. Purpose and Objectives

IIMI Pakistan would be the second international IIMI unit. Its broad purpose is to enhance Pakistan's capacity to manage irrigation systems, and hence to increase its agricultural production potential. More specifically, the institute's objectives would be the following:

1. To diversify IIMI's research opportunities in a new set of environmental and institutional conditions. Pakistan's arid and temperate climate, the focus on wheat, cotton, and pulses, and the presence of very large-scale irrigation systems (as well as some small traditional systems) provide a range of conditions which make possible research on important issues which could not be addressed effectively in Sri Lanka alone.

2. To synthesize the results of previous and ongoing irrigation research conducted in Pakistan and to collaborate in the formulation of new research agendas. The intensive efforts on the part of national and international agencies in Pakistan have produced a data base which promises to grow exponentially over the next few years. IIMI Pakistan could serve a networking role in digesting this cumulative experience while pointing to new directions for harnessing the resources already slated for irrigation management research. It will also undertake training and information exchange activities.

It is expected that the research methods, practices, and operational approaches developed by IIMI Pakistan will be applicable to countries with similar agro-ecological and social conditions.

B. Governance, Direction, and Administration

IIMI Pakistan will be established as an integral unit of the International Irrigation Management Institute (IIMI), whose governance is prescribed by the IIMI Charter (Appendix G), which Pakistan proposes to accept and ratify.

The Director General of IIMI will be responsible for the overall direction and administration of IIMI Pakistan. Day to day operations will be handled by a Director appointed by IIMI and responsible directly to the Director General of IIMI. The general policy guidelines established by the Governing Board will apply equally to IIMI Pakistan and to IIMI.

Senior, internationally-recruited staff of IIMI Pakistan will be selected in consultation between the Director General of IIMI and the Director of IIMI Pakistan and will be employed on the rolls of IIMI. Common personnel policies will apply to senior employees of IIMI and IIMI Pakistan.

Research Associates, junior professional, and support staff and employees recruited in Pakistan will be employed by and responsible to the Director of IIMI Pakistan. Policies and terms of employment for junior professional and support personnel for IIMI Pakistan will follow the same guidelines as those of IIMI in Sri Lanka but should be consistent with pay and benefits prevalent in Pakistan.

The Governing Board has ultimate authority for the Institute, followed by the Director General of IIMI, and then the Director of IIMI Pakistan. The Director General and the Director, respectively, will determine staff and related policies.

C. Location

The Team considered sites in Punjab, Karachi, Faisalabad, Hyderabad and Islamabad, but for the reasons stated below, none offered a comparable range and extent of advantages as did Lahore.

Lahore is a thriving city which can provide living facilities, amenities, and a good cultural and educational environment for the IIMI staff, both expatriate and locally recruited. It has a wide range of institutions and agencies relevant to IIMI Pakistan. It is the Provincial capital of the Punjab, providing ease of contact with the Ministry of Agriculture and Irrigation and the concerned offices therein. It also houses WAPDA's headquaters.

Other relevant institutions in Lahore include the Centre of Excellence in Water Resources Engineering, Engineering University, Lahore; the On-Farm Water Management Training Institute, the Irrigation Research Institute (IRI), the Land Reclamation Directorate, and the Engineering Academy. Nearby, at IRI's field center at Nandipur, there exists an installation for hydraulics and works modelling. Also nearby at Niazbeg and Jhang, plans are underway for establishing a Waterlogging and Salinity Institute in association with WAPDA.

Lahore is in the heart of the major irrigated region of the Punjab portion of the Indus system, with several suitable field research sites on limited command area segments. It has good access to other irrigated areas of Pakistan by both surface and air transport, as well as to international air transport. Communications by telephone or telex to other parts of Pakistan as well as externally is quite satisfactory.

On the assumption that IIMI Pakistan headquarters would be located in or quite near to Lahore, the Team made a very preliminary reconnaissance of possible sites.

The area around Niazbeg has many attractive features and should be studied carefully along with other alternatives. It is quite close to the city, located on a major canal distributary, and the range of talent in water management related activities being concentrated in the area is reaching what may be termed a "critical mass" level. Located in this area are the On-Farm Water Management Institute, the Irrigation Research Institute of the Provincial Government, and the Engineering Academy. The Waterlogging and Salinity Institute has been proposed for a site in this vicinity. The Team was advised that temporary initial accommodation might be possible at the On-Farm Water Management Training Institute.

Much of the international staff might choose to establish their residences on the Gulberg or Forman Christian College portions of the city which offer the best choice in housing and schooling. Therefore, we recommend consideration of a headquarters location on a side of Lahore which permits easy access to these areas and which avoids the necessity of lengthy commuting. The Niazbeg area is within easy access of Gulberg and Forman Christian College.

It was estimated that the cost of land in the vicinity of Niazbeg would not be in excess of $25,000 per acre. It is highly desirable if as much as 5-10 acres of land could be provided so as to take care of the requirements visualized in the early years and to provide room for possible expansion of functions in the future.

D. Proposed Program

It is neither our intention nor within our scope of work to present a blueprint for the IIMI Pakistan program. This would be done by IIMI Pakistan Direction and staff in collaboration with related agencies. We can, however, give illustrative examples of how these concepts in the IIMI Pakistan program could be translated into research programs. It is envisioned that mutually agreed upon management interventions will be introduced within small and carefully selected areas of the irrigation systems, and that the impact of those interventions on the equity of water distribution and on the efficiency of water use for crop production will be determined.

The team discussed frequently the utility of working in 1000 to 2500 ha command units served by a minor and 7-12 watercourses. Management interventions could include changes in water delivery scheduling once provision was made for an increased density of water control devices. Another intervention could be at the farm level where an increased number of agricultural extension personnel could be introduced with increased emphasis then placed on water management extension, and on more intensive application of yield-increasing technology and inputs, made possible by more dependable water supplies.

The field research would be carried out on locations in irrigation systems in several of the provinces rather than at the IIMI Pakistan headquarters. Sites would be selected by the Director and staff in consultation with the irrigation and agriculture authorities after the Institute becomes operational. The Team suggests that small command areas served by a minor and several watercourses (1500 ha, more or less), might be selected where there is potential for high yields with good management and on which improved management might make a significant impact. Such units should have potential for devising and testing various forms of interventions for increasing flexibility in water control and delivery both on site and upstream.

IIMI Pakistan's program should be directed towards introducing management changes designed to obtain increases in agricultural productivity through better management of all factors of agricultural production. Two challenges that the Institute might address are discussed below.

First, we see potential payoff in being able to inject more flexibility in delivery of surface water supplies above the outlet. Many people who have observed Pakistan's irrigation systems feel that given the design of the system there is little opportunity for changed patterns of management, ie. flexibility in operations. This may or may not be so, but it is clear that virtually no research efforts have been directed towards understanding the impact of different management practices upstream of the outlet. IIMI could address this issue.

Second, large potential benefits could come from the concept of "beyond watercourse improvement". This would involve developing strategies to translate water savings from the On-Farm Water Management programs to increased agricultural output. This aspect of water savings has not been addressed by the institutions and current programs underway in Pakistan, but the need for it is widely recognized by concerned agencies such as the On-Farm Water Management Directorates, the Agricultural Extension Directorates, WAPDA, and by donors such as USAID, IBRD, and ADB that are funding ambitious programs in watercourse improvement. In this regard, IIMI Pakistan could make a significant contribution by conducting action research programs.

Initial choice of location should be where the potential for change exists, i.e., IIMI Pakistan should not begin work on the tail reaches of an irrigation system where water supplies are clearly inadequate, or in a portion of a system where drainage is impeded and waterlogging is a severe constraint.

Field research sites should not be restricted to too narrow a range of conditions. The Team suggests that a minimum of two sites should be selected initially, one in the Punjab and one in the Sind, where substantial differences exists in climate, cropping pattern, soil salinity, and potential supplemental groundwater use. The team feels confident that suitable field sites for research can be identified, and that staff from the provincial irrigation and provincial agriculture departments will participate in joint research projects.

E. Staffing

The following types of staff are envisioned for IIMI Pakistan:

- Senior scientific staff, recruited internationally from a variety of disciplines (e.g., irrigation engineering, agricultural sciences, social sciences, and management sciences), both long-term residential staff in Pakistan and short-term consultants. Initially, these should number 5-7 individuals;

- Research Associates, and junior professional personnel to be recruited as IIMI Pakistan staff from within Pakistan, from a variety of disciplines, to work collaboratively with the senior scientific staff in developing, implementing, and reporting results from the specific research projects. These individuals may number 20 to 30.

- Research Scholars, such as Masters and Ph.D. students and post-doctoral fellows, from both within and outside Pakistan, undertaking collaborative research.

- Field Assistants, to help with implementing projects and data collection;

- Data Processing Assistants, to help with processing data and performing data analysis;

- Clerical and administrative assistants, and other support staff.

For budgeting purposes, the following senior staffing levels are proposed:

Person-years

1985	1986	1987	1988	1989
1.5	5	7	7	9

Total staff, including junior professionals, field assistants, administrative, clerical, and support personnel will be about 60.

Senior international staff should be recruited by IIMI consistent with policy guidelines and terms of employment at headquarters. Junior professional staff and support staff of IIMI Pakistan should be selected and employed under guidance of the Director, also following IIMI policies at headquarters, but taking into account specific details appropriate to conditions in Pakistan.

F. Facility Requirements

1. Buildings. IIMI Pakistan will require facilities similar to those of the principal headquarters in Sri Lanka, except that some functions such as information services, documentation, preparation of training materials, and

assembly and preparation of data banks need not be fully duplicated. The staff and facilities projected allow for growth and facility expansion over time.

These estimates are based on the principal headquarters in Sri Lanka, assuming that the number of international and local staff would be about 75% to 80% that planned for Sri Lanka. The total space requirements estimated for the Sri Lankan headquarters for offices, staff conference rooms, seminar and classrooms, service facilities, information and publication, library, communications, computer facilities, snack bar, and covered parking totals approximately 40,000 square feet (including an average allowance of 30% for corridors, vestibules, toilets, and common areas). For the Pakistan headquarters, an estimated floor space of 30,000 square feet is needed.

In addition, hostel and guest accommodations will be needed for conferences, trainees, and visiting scientists. Approximately forty single rooms, with bath, of about 200 square feet each, along with common and recreational rooms, kitchen and dining facilities (and allowance of 25% for toilets, corridors, stairways and for varandah and other common areas) would require approximately 15,000 square feet.

Thus, the total building requirements at IIMI Pakistan headquarters are estimated at approximately 45,000 square feet. Taking an estimated cost of US $23.00 per square foot at 1986 prices, the total cost of the buildings would be $1,035,000. This cost does not include land or furnishings.

Field site facilities would be more modest and should be mobile. Where feasible, guest houses and nearby training centers should be utilized. However, there should be IIMI facilities at each site for office and work space, data processing shops for fabricating water control devices, and other related needs. The estimated cost for each site is $75,000 to $100,000.

2. Land. Approximately 5 to 10 acres should be sought for the Pakistan headquarters and about one acre at each field site. We recommend that IIMI Pakistan not attempt to operate an experiment station at headquarters but that the research be centered on operating irrigation systems. At headquarters, three acres would probably suffice for the buildings and associated facilities. However, an additional 5 to 10 acres would provide for future physical expansion and program needs including fabricating and testing of new devices.

G. Linkages and Collaboration

There are three types of institutions involved in irrigation-related work in Pakistan: (1) Provincial Irrigation Departments (PIDs), Provincial Agricultural Departments (PADs), ~~and related~~ agencies in irrigation and agriculture that have responsibilities for water delivery from the reservoirs to farmers' fields and for agricultural programs affecting crop production; (2) federal agencies such as WAPDA, PARC and IDFCRC; (3) universities; and (4) provincial agricultural research institutes.

PIDs and PADs are directly concerned with operation of the irrigation systems. Although PID responsibility legally extends below the outlet (which serves an area averaging 175 ha), in practice the PIDs are only concerned with water delivery to that point. PADs run programs in watercourse improvement (the On-Farm Water Management Directorates), extension, and research, all of which could impact upon irrigation system performance.

WAPDA is a large and efficiently run institution having both water and power responsibilities. Although it controls reservoir operations and plans for major irrigation developments, WAPDA has no responsibility for irrigation system management. Its research is a very small and almost insignificant part of the WAPDA mandate, but WAPDA is responsible for the Mona Reclamation Experiment Station and a similar, but smaller experiment station planned for Hyderabad, Sind, the "Lower Indus Mona" (LIM). Both Mona and LIM will be strongly supported by the USAID-sponsored water management research project. Because WAPDA does not deal with irrigation system management, and because the USAID project is so large (in excess of $17 million over four years) and is principally directed to WAPDA, it is not likely that WAPDA will be among the agencies most closely associated with IIMI Pakistan.

PARC works directly with provincial agricultural research bodies as well as managing in-house research programs through dependent federal research institutes. The National Agricultural Research Center near Islamabad is an example of the latter. However, water-related research has not received high priority in PARC. While PARC may have an interest in including elements of the IIMI Pakistan approach in its research program, it is also not likely to be IIMI Pakistan's most closely linked agency.

IDFCRC is a relatively small institution (less than 50 professionals) with a mandate to coordinate and fund research in several aspects of irrigation. Under the research component of the USAID-sponsored water management research project, IDFCRC will receive over $500,000 to serve as a focal point for information systems in water management for Pakistan. IIMI Pakistan should explore collaborating with IDFCRC in that program.

Except for the Center of Excellence in Water Resources, and to a limited extent, the University of Agriculture at Faisalabad, the role of universities in water management research is extremely limited due to their priority in teaching. Professional staff engage in water-related research only on an ad hoc basis. This does not preclude individuals at these and other institutions from working collaboratively with IIMI Pakistan, however, and IIMI should be able to support university or center sponsored research, especially through graduate students from those institutions.

Appendix I to this report is a compilation of institutional profiles of 20 organizations in Pakistan involved with aspects of irrigation research. IIMI Pakistan may seek to collaborate with several of these institutions, not specifically mentioned above, in carrying out parts of the IIMI Pakistan program.

IIMI Pakistan should plan its programs primarily in collaboration with the PIDs and PADs since these agencies have direct responsibility in irrigation system management. Both have expressed strong interest in working with IIMI Pakistan and the Team received ample assurances that they will work with the Institute. In Punjab, but not in the other Provinces, PIDs and PADs come under the same Minister. Our meeting with him was a joint working session also attended by the Secretaries of the two departments in which there was strong expression of commitment and collaboration to IIMI Pakistan, and also strong indications of coordination between the irrigation and agricultural departments. Similarly, in Sind and NWFP, joint and constructive meetings were held with irrigation and agriculture officials both attending.

H. Consultation Mechanism

A Consultative Committee comprised of selected representatives of the principal concerned agencies (see Appendix I for a list and description of agencies active in irrigation research in Pakistan) will meet periodically with the IIMI Pakistan Director. Committee selection will be done by the Director of IIMI Pakistan in consultation with local agencies and with the Director General of IIMI. The purpose of the Consultative Committee will be to provide local counsel to IIMI Pakistan regarding program content.

Among other things, the Consultative Committee members will be expected to:

- Put forward their ideas on priority topics for research;

- Provide reactions to research project proposals prepared for possible implementation in Pakistan;

- Make suggestions on and react to possible training and information dissemination activities that may be undertaken by IIMI Pakistan;

- Facilitate liaison between IIMI Pakistan and represented agencies.

Final decisions on the nature of IIMI Pakistan's research, training and publication activities will be made by the IIMI Pakistan Director and staff, with approvals, as necessary, by IIMI's Director General and Board of Governors.

I. Budget Requirements

The Design Team can give only an approximate estimate of the budget requirements for the establishment and operation of IIMI Pakistan over the first few years. The budget is based upon staffing levels proposed in Section E of this ~~chapter~~ report. In arriving at these estimates, the team has taken into consideration the experience of some other international agricultural research institutes, with allowance for the specific

characteristics of IIMI Pakistan and its anticipated operations. The Team has also reviewed some of the basic plans and projections for the headquarters in Sri Lanka.

1. Recurring Operational Budget. The Team suggests that it would be prudent to anticipate a minimum requirement of $1,250,000 per year (1985 dollars) for recurring operational costs over the first few years. This would provide for a basic core of internationally-recruited senior staff of five to seven professionals, including a Director, supported by four to six senior staff. It would also provide for a reasonable level of locally-recruited scientific and professional staff, locally-recruited administrative, fiscal and clerical staff, and field assistants. It would allow for modest levels of funding for research associates and research scholars. The budget provides for travel and operating support costs.

During at least the first year, staff would be recruited and join on a phased basis. The amount of funds required for salaries and salary-related benefits would not reach full operational level until some time has elapsed. Thus, a relatively higher proportion of the above could be used during this initial period for start-up expenses for supplies and equipment, including office furniture and equipment (furniture, typewriters and word processors, photo-copy equipment, micro computers, etc.), vehicles, audio-visual equipment, shop equipment, etc. As IIMI Pakistan becomes fully operational, equipment replacement and supplies would be incorporated in the annual budgets.

We visualize that the program and the support for IIMI Pakistan may grow above this minimum level in subsequent years, and suggest that approximately $275,000 (1986 dollars) be taken as a planning figure for the cost of each additional senior staff member to cover salary and salary related costs for the professional and the supporting staff, and for operating expenses associated with such program expansion.

More detailed and precise budgets would be developed as the Institute becomes operational and actual experience with its operation is accumulated.

2. Non-recurring Capital Budget. The Government of Pakistan anticipates the provision of the land and buildings for the headquarters of IIMI Pakistan and for support of the field operations. An estimated $2.0 million should be budgetted for this purpose. The space, facility and furnishings requirements have been extrapolated from plans for the headquarters in Sri Lanka.

Total costs are summarized as follows:

Headquarters	$1,035,000
Land	$200,000
Furnishings	$200,000
Field Sites	$300,000
	$1,735,000
Contingencies	$165,000
	$1,900,000
SAY	$2,000,000

J. Method and Prospects of Financing

It is anticipated that IIMI will cover the costs of salary and related costs of the Director of IIMI Pakistan from its core budget. IIMI will also provide a portion of the support costs for the Director's office. The total contribution from this source is estimated at approximately $250,000 per year.

The remainder of the recurring costs for other staff, and operations may be sought from bi-lateral source funds alloted for support to Pakistan. The amounts contributed to IIMI Pakistan could be negotiated with each donor agency, with the full support of the Government of Pakistan.

The Team received verbal assurances from the Government of Pakistan, through the Secretary General of the Economic Affairs Division (EAD), that, based on consideration of and formal approval of the IIMI Pakistan proposal concept, it would encourage and enlist the support of bilateral and multilateral donors. The EAD Secretary General indicated that because of the importance of IIMI Pakistan and the relatively small funding amounts required, the question of additionality of funds was not an issue, and that a portion of the already pledged bilateral support could be re-channeled for IIMI Pakistan. This principle could be formally communicated at the appropriate time.

In Islamabad, the Team held meetings with officials of three of the multilateral agencies and with 11 of the bilateral assistance agencies to discuss the IIMI Pakistan initiative, and discussed the proposal for financing the major portion of the IIMI Pakistan budget through bilateral assistance. Some of the donors were already familiar with the general outlines of the proposed Institute and indicated that, in principle, they were prepared, with policy approval from the Government of Pakistan, to participate. Others, while receptive, were interested in learning more about IIMI Pakistan, and had not had sufficient previous background to indicate their degree of participation, if any. The Team emphasizes that follow-up by EAD and by IIMI will be necessary to firm up financial commitments with each prospective donor, but that the prospects of financing in the above manner are very favorable. A summary of the discussions with prospective donors is contained in Appendix F.

(3) Institutional Collaboration

It is recommended that IIMI Pakistan conduct work primarily with the provincial agencies in irrigation and agriculture that have governmental responsibility for agricultural production, i.e., the Provincial Irrigation Departments and the Provincial Agricultural Departments. IIMI Pakistan should also cooperate and collaborate with agencies such as WAPDA, PARC, IDFCRC, the Universities, and with local government, district and union councils, and others, in carrying out its programs.

Appropriate linkages between IIMI Pakistan and a designated agency in the Government of Pakistan would be established as is the case of international centers in the CGIAR network. Because of the longstanding relationship between the Agricultural Research Division (ARD) of the Ministry of Food and Agriculture and IIMI, ARD would be a logical choice as the principal administrative linkage between IIMI Pakistan and the Government of Pakistan.

(4) Size of Institute and Staffing

In keeping with the model established for IIMI in Sri Lanka, the size of the headquarters unit will be relatively light. We recommend an international staff initially numbering 5-7 professionals. Their backgrounds will encompass expertise in engineering, agronomy, agricultural economics, and the social sciences. We envision a locally-hired staff of 40-50 including scientists, engineers, technical staff, and support services staff. Similar to other international institutes, IIMI Pakistan should plan for graduate assistants, post doctoral fellows and others. Although not on the IIMI Pakistan payroll, a certain number of professionals and technicians from the related agencies will collaborate with IIMI Pakistan staff on field research projects.

(5) Linkage to IIMI Headquarters in Sri Lanka

As an integral part of IIMI, IIMI Pakistan should be under the overall governance and policy direction of the IIMI Governing Board. The Director General of IIMI, based at headquarters, will have a deputy, the Director of IIMI Pakistan, resident in Pakistan, who will be responsible to the Director General, and through him to the Board for the day-to-day management of IIMI Pakistan. Appropriate books of account will be kept by IIMI Pakistan with respect to funds expended so as to be accountable to IIMI and to meet the reporting requirements of the supporting agencies.

(6) Mechanisms for Consultation with Government of Pakistan Agencies

The Director of IIMI Pakistan will expect to have advice and guidance from a suitable consultative group of Pakistan's government and professional people in developing and carrying out IIMI Pakistan's program of work. A technical consultative committee composed of Pakistani officials should be established to provide consultation to IIMI Pakistan programs. The group should have representation from the principal institutions in the country concerned with irrigation management.

(7) Budget and Sources of support for IIMI Pakistan

It is estimated that initial costs will be approximately:
- $1.2 to 2 million dollars per year for operational programs.
- about $2.0 million dollars in non-recurring capital costs.

IIMI Pakistan, in close cooperation with the government of Pakistan, will seek funding from four sources:

a. Between $200,000 and $300,000 per year will be allocated to IIMI Pakistan from IIMI headquarters in Sri Lanka;

b. At least $1 million dollars per year will be needed as operational core support for salaries and operational expenses. This will be obtained from a consortium of bilateral and multilateral donors, many of whom have indicated a strong interest in IIMI Pakistan and a willingness to consider making a contribution. Contributions would, over the short run, not be additional to the development assistance donors are now providing to Pakistan.

c. On the order of $2.0 million dollars in non-recurring costs will be needed for buildings and other facilities at the headquarters and field sites. The Government of Pakistan will assume this obligation. The Government of Sri Lanka is financing construction of the headquarters site in that country through a World Bank (IDA) Credit. Pakistan may wish to follow a similar procedure.

d. Once operational, IIMI Pakistan may choose to accept bilateral or multilateral funds to conduct specific projects as agreed upon with those donors.

Response to Points Raised by the Working Group and reported in the Minutes of the Governing Board Meeting of June 1984

The Team's response to these points is embodied in the various parts of this report, and is summarized below:

1. The team accepts the name for the Pakistan unit as "The International Irrigation Management Institute, Pakistan".

2. The team agrees with the recommendation that the Director of IIMI, Pakistan be appointed by the IIMI Director General and that he should be responsible to the Director General in the management of IIMI Pakistan. It is presumed also that the Board, or at least the Board Chairman, will be consulted in the appointment to this key senior management position. We found full acceptance of this procedure on the part of Pakistan officials.

3. The team agrees with the proposal that IIMI headquarters provide a core budget of $200,000 to $250,000 per year. In our report and discussions we have used the figures $200,000 to $300,000, which we think is consistent with this recommendation. We also have assumed that the salary and salary-related benefits for the Director of IIMI Pakistan would be included in this allocation.

4. The Team fully agrees with the principle that a consultative mechanism is needed to help provide proper liaison between IIMI Pakistan and the persons and agencies concerned with Pakistan's irrigation system and its operation and with irrigated agriculture. We have discussed this question in Chapter VI (J) of this report in which we expand on our suggestions as to its role and the participation of and interaction with the Director and staff of IIMI Pakistan. The term "Consultative Committee" may be preferable to that of "Advisory Committee".

5. We suggest that the chairmanship of the Consultative Committee be left open and that the Director of IIMI Pakistan be involved prominently in determining the committee's composition, in consultation with Pakistan officials. We do not think that the Board Chairman should be the appointing officer.

6. The Team agrees fully that IIMI Pakistan must work in collaboration with national irrigation projects and with national and provincial irrigation institutions, agencies, and officials.

7. The team does not fully agree that an implementing committee separate from the consultative committee should necessarily be constituted. We are concerned that too many tiers of committees might become cumbersome and perhaps impede rather than facilitate active research. We suggest that this question be kept open and only such committees set up which can be expected to facilitate the work of the unit.

8. The eighth point with respect to method and prospects of funding has been addressed in Chapter VI (J) above.

VIII. AGREEMENTS AND UNDERSTANDINGS

A formal Memorandum of Agreement entered into by mutual understanding between IIMI and the Government of Pakistan, establishing the legal basis for its operation as an autonomous, international, non-profit, research, educational, and training organization will be necessary as a prerequisite to the establishment of IIMI Pakistan. This agreement should outline the character and structure of IIMI and the Pakistan Unit, its general purposes and activities, its governance, its powers, the establishment of its juridical personality, the acceptance and ratification of IIMI's charter, the agreements, privileges, immunities, and obligations of the respective parties, procedures for settlement of disputes, and provisions for modification, amendment, and termination. Most of the general provisions of

such an agreement, which would be similar in most respects to that entered into with the headquarters host country, have been discussed verbally with Pakistani officials. A draft copy is attached as Appendix H which could serve as a starting point for formal negotiations.

IX. STEPS REQUIRED FOR IMPLEMENTATION

This chapter of the report describes the actions necessary to obtain approval and funding for IIMI Pakistan. Actions will be necessary on three inter-related fronts: IIMI, the Government of Pakistan, and Donors. These are described below.

A. IIMI

(1) Approval of this report by the IIMI Director General.

(2) Transmittal to the IIMI Board of Governors with his recommendation for their consideration and approval. Since this report contains the Draft Memorandum of Agreement between IIMI and the Government of Pakistan (Appendix H), the Board would in principle be approving the substance of the Draft Memorandum of Agreement by virtue of its approval of this report. It is suggested that the Board delegate to the Chairman of the Board, or to the IIMI Director General, authorization to enter into negotiations with the Government of Pakistan regarding the Memorandum of Agreement, and to sign on behalf of IIMI.

(3) Preparation of the proposal to establish IIMI Pakistan for submission to the Government of Pakistan through ARD. The proposal does not need to be long, but contents should include: IIMI Pakistan purpose, objectives, and justification on the basis of national and international impact; anticipated benefits; type of work to be conducted; institutional collaboration; and detailed costs.

(4) In parallel with the proposal, IIMI would submit the draft Memorandum of Agreement to the Government of Pakistan and would interact with the Government to obtain an agreed-upon final document.

Steps (1) and (2) should be completed by early February 1985. Step (3) should be completed in January 1985 so that the lengthy Government of Pakistan approval process can be initiated. Submission of the draft Memorandum of Agreement should be done as soon as Board authorization is obtained.

B. Government of Pakistan

The Government of Pakistan will act upon two items: the proposal prepared by IIMI for the establishment of IIMI Pakistan, contents of which are suggested above (section A.(3) of this chapter) and the Memorandum of Agreement to be prepared through collaboration of both parties. Following receipt of the IIMI Pakistan proposal, the Government of Pakistan will undertake the following steps to obtain approval:

(1) Preparation of a PC-2 for concept clearance. This would be done by the Agricultural Research Division (ARD) which sponsors the proposal before the Government.

(2) The PC-2 will go before a concept clearing committee in the Planning and Development Department. Once cleared at this level, a detailed PC-1 is prepared. The PC-1 has widespread distribution at both Federal and Provincial levels. Comments are received by ARD and incorporated. If significant changes are required, this would be done in consultation with IIMI.

(3) The finalized PC-1 is submitted to the Planning Commission which prepares a working paper which eventually goes for approval before the Central Development Working Party chaired by the Secretary General of Planning and Development.

(4) Because the proposal will be in excess of Rs. 30 million (about $2. million dollars), the working paper goes to the Executive Committee for the National Economic Council (ECNEC) for final approval. ECNEC generally meets on a quarterly basis.

Steps (1) to (4) above can be expected to take from 3-5 months at best, and longer if complications arise. In extraordinary cases, anticipatory approval from the ECNEC Chairman may be secured. Without anticipatory approval, the earliest IIMI Pakistan could be approved would be June 1985. This assumes a late January submission of the proposal and a four-month approval process.

The draft Memorandum of Agreement will be submitted by IIMI through ARD to the Ministry of Foreign Affairs. The Agreement will require ratification by the Cabinet. This process can be expected to take 2 months and presumably would be considered in parallel with that of the PC-1 and PC-2 process described above.

C. Donors

The Government of Pakistan through EAD will be expected to seek out donor support for IIMI Pakistan. The design team met with representatives of 11 embassies in Islamabad and with representatives of 3 multi-lateral donors. A report of these visits is given as Appendix F, a report which has been shared with the Government of Pakistan. That report should be used by EAD as one basis for follow-up among those contacted.

In principle, EAD has verbally endorsed the concept that non-additional bilateral assistance may be employed in support of IIMI Pakistan. Potential donors will require written affirmation of the principle. The precise format of funding channels remains to be worked out among the donors, the Government of Pakistan, and IIMI Pakistan.

APPENDIX A

IRRIGATION MANAGEMENT IN THE INDUS BASIN1/

The management of irrigation water in the Indus Basin is influenced strongly by the special characteristics of the river plain. Before the present system of irrigation management is briefly sketched, a flavor of the historical development and special features of the Indus Basin is provided.

I. Special features of the Indus Basin

The area irrigated by the Indus River and its tributaries in Pakistan represents the largest contiguous irrigated area in the world. The Indus Basin command area of about 35 million acres contributes 80 percent of the nation's total agricultural production.2/

Irrigation has been practised along the streams and rivers of the country for centuries. With the advent of British rule in the mid-1800's, efforts to develop the Indus Basin's irrigation potential were undertaken. These efforts involved the development of an extensive irrigation system, in which the water supply was adequate to irrigate only a fraction of any one of the settler farmer's holdings. Since land revenues were based on landholding size, this sytem design provided not only widespread protection from famine, but also an effective means for mobilizing revenue to finance the costs of government. The administrative and operational requirements for the irrigation system were at the same time kept to a minimum. An additional feature of the basic irrigation infrastructure in the Indus Basin

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1/ This appendix is based on the observations and discussions of the Design Team during its November 17-30, 1984 visit to Pakistan, supplemented by information provided in the following references. The principal source of information is Potential for Irrigated Agricultural Development in Pakistan, Agricultural Division "A", South Asia Projects, World Bank, July 1981. Other sources are (1) Review of Comparative Agricultural Performance in East and West Punjab, Irrigation I Division, South Asia Projects, World Bank, September 1983; (2) Dean F. Peterson, Pakistan USAID Long-Range Study Options for Water Resources, Islamabad, April 1984; (3) Funding Requirements for Adequate Irrigation System Operation and Maintenance in Pakistan, report of the USAID Mission to Pakistan, Sacramento: Development Alternatives, Inc., May 1984; and (4) Muhammed Akhtar Bhatti, Country Paper on Irrigation Research and Management, Islamabad: Pakistan Agricultural Research Council, 1984.

2/ Slightly over 70 percent of Pakistan's cultivated area is irrigated. The percentage varies widely among provinces: NWFP-36, Baluchistan-38, Sind-60 and Punjab-87.

is that it was designed exclusively from t he viewpoint of distributing available water supplies among large number of farmers, and not also from the standpoint of meeting the demands for irrigation water represented by crops.

At the time of Partition, the boundary between the independent nation states of Pakistan and India cut directly across the rivers that formerly had served most of the irrigated lands in Pakistan. The 1960 Indus Water Treaty gave the supplies of the three eastern rivers (Sutlej, Beas, and Ravi) to India and the supplies of the three northern rivers (Chenab, Jhelum and Indus) to Pakistan. The problem of water supply replacement and augmentation in Pakistan for the areas formerly served by the rivers which were diverted to India was solved by the construction of two major storage dams (Mangla on the upper Jhelum River, Tarbela on the Indus River) and a series of eight link canals that transport water from the northern rivers to the three rivers in the south whose water supply was cut off following Partition.

Within this historical context, six special features of the irrigation environment in the Indus Basin are now briefly described.

A. Irrigation in the Indus Basin is large-scale.

Besides representing the largest contiguous irrigated area in the world, the Indus Basin lays claim to the world's largest (Tarbela) and third largest (Mangla) earth-filled dams. Twenty major headworks and barrages divert irrigation water into 48 principal canals. The capacity of these canals ranges from 483 to 15,500 cusecs. The cusec capacity of nine of the canals exceeds 10,000, and for only one canal is the cusec capacity less than 1,000.1/

The areas commanded by the principal canals range from 43 thousand acres to over 3 million acres. About three-fourths of the canals irrigate 500 thousand acres or more, and almost one-third of the canals irrigate more than 1 million acres each (Table 1).2/

1/ These cusec data are for only 36 of the 48 canals, as reflected in the footnote to Table 1.

2/ Fundamental to IIMI's conceptualization of research is the idea that research attention is to be focussed on "whole" irrigation systems, not at only one level within the systems. At various times during our visit, the Design Team contemplated the appropriate definition of an "irrigation system" in the Indus Basin. Ordinarily, a fundamental characteristic of an irrigation system is that it have its own independent water supply. Because the Indus River and its tributaries supply water through an integrated network of conveyance channels serving the Basin's 35 million acre command area, it is possible to conceive of the whole Basin as one irrigation system. From the standpoint of research manageability, it would be much more convenient to conceive of a watercourse irrigating 3-500

TABLE 1.

COMMAND AREAS IRRIGATED BY MAJOR CANALS AND THEIR ASSOCIATED WATER DELIVERY CHANNELS, INDUS BASIN a/

Range in the command areas irrigated (millions of acres)	Percent of the canals in the Indus Basin
< 0.25	10.8
0.25-0.49	16.2
0.50-0.74	24.4
0.75-0.99	18.9
1.00-1.49	16.2
1.50-2.00	5.4
> 2.00	8.1

a/ The command areas reflected in the table pertain to the sum of the perennial and non-perennial areas for the 36 canals in the Upper and Lower Indus Plains reported in Potential for Irrigated Agricultural Development in Pakistan, Agricultural Division "A", South Asia Projects, World Bank, July 1981, p 52.

B. Inadequate drainage has contributed to substantial waterlogging and salinity problems in the Indus Basin.

The original design of infrastructure in the Indus Basin did not call for drainage facilities. As irrigation water was applied over time, the watertable level increased. The watertable build-up was accentuated because of the shallow gradient in the Indus Basin (an average fall of about 1 foot for every 5000 feet of distance).

[footnote 2, cont. from previous page]
acres as an irrigation system. If all research resources were concentrated on the watercourse, however, the issue of water allocation decisions within the main irrigation system would be completely overlooked. The level at which an "irrigation system" is conceived to exist in IIMI-PAK's research program is something that will have to be determined later. An interim perspective could be to define an "irrigation system" at a level between the watercourse and the headwork for the canal which supplies water to the watercourse. It is conceivable that, in the early research, one or two minors might be selected for concentrated research attention, and that water measurements would be made at sampled points upstream from the field site(s) to the canal headworks. Doing the latter would provide a mechanism for beginning to capture something of the "whole system" concept in IIMI-PAK's research.

The waterlogged area (defined as the area in which the groundwater table is within 1.5 meters of the ground surface) is reported to have covered 2.5 million ha. in Indus Basin in 1977. The percentage of waterlogged area varies much across the provinces, ranging from 30 in NWFP, to 43 in the Punjab, and to 76 in Sind and Baluchistan.

Associated with the waterlogged conditions has been the build up of saline and sodic conditions. About 2.8 million ha. of the Indus Basin is reported to have been affected by salinity and sodicity in 1977. Again, the percentages vary much among the provinces (NWFP-13, Punjab-23, and Sind and Baluchistan-69).

Through Salinity Control and Reclamation Projects (SCARP's) and other programs, steps have been and continue to be taken to help overcome the problem of waterlogging and salinity.

C. Irrigation and drainage in the Indus Basin are facilitated by the presence and use of a large number of tubewells.

In the late 1950's, virtually all of the water used in Pakistan for irrigation was from canals. Since that time, about 13,000 public tubewells and an estimated 200,000 private tubewells have been introduced. In the late 1970's, about 25 percent of the total irrigation water supplied in Pakistan is estimated to have been from tubewells. Of the total tubewell pumpage, about one fifth is from public tubewells.

Tubewells lower the level of the groundwater table and, in fresh groundwater (FGW) zones, they provide supplemental water for irrigation. Almost all wells in FGW zones are located adjacent to and discharge into surface irrigation channels, usually near the mogha.

D. Most of the Indus Basin is arid, with a rather large proportion of the rainfall being monsoonal.

Pakistan lies at the western end of the South Asia monsoon belt. The climate is mostly arid, with an average annual precipitation in the southwest of only 4 inches. Precipitation gradually increases as one moves northeastward across the Indus Plain, and at the northern end it is as much as 20 inches per year.

From 60 to 70 percent of the precipitation comes during the monsoon season - - often in torrential showers. The monsoon season generally spans across June to September, with July and August usually the wettest months.

E. In the Indus Basin, cropping patterns tend to be diverse and cropping intensities and yields tend to be low.

A flavor of the diversity in the irrigated crops grown in the Indus Basin is reflected in the following percentages of total cropped area represented by the various crops (crop combinations) in 1980-81: wheat .36; rice and cotton .10 to .11 each; gram and pulses .07; sugar and

millet/sorghum, and maize .04 each; oilseeds .03; other .22. In much of the Basin, several different crops are often grown in close proximity to one another. This includes crops whose water requirements may differ from one another rather substantially.

The cropping intensity in the overall Indus Basin as well as in West Punjab is between 110 and 120 percent. This is 20 to 30 percent lower than in neighboring East Punjab.

Several decades ago, the yields of the major crops in East and West Punjab were not greatly different from one another. In recent years, however, the growth in crop yields in West Punjab has lagged behind. Average yields in 1978-80 in the West Punjab, as percentages of those in the East Punjab for example, are as follows: wheat 60, rice 52, cotton 83, gram 40 and sugarcane 91.

F. There is a substantial sediment load in the Indus Basin irrigation water.

The heavy sediment load in the Indus Basin irrigation water gives rise to the deposition of silt in reservoirs, which reduces the storage capacity and the prospective length of useful life of the reservoirs. Silt deposited in the water conveyance network reduces the capacity of the network to deliver the design quantities of water and impedes the movement of water through the water delivery network.

II.Irrigation Management1/

Decisions on the allocation of water among provinces are made in the political arena. WAPDA is responsible for impounding and releasing irrigation water at the headworks of irrigation canals. The provincial irrigation departments (PID's) are responsible for distributing the water through the canal-branch-distributary- minor channel network and supplying the water to the watercourses (at the moghas) from which farmers receive their irrigation water. Farmers are responsible for operating and maintaining the watercourses. If disputes on water use arise which cannot be settled by the irrigators or their village-elders, the disputes are referred to the PID's for resolution.

There are relatively few water control devices in the Indus irrigation network. Fixed opening gates are apparently present at the heads of branches and distributaries (in NWFP apparently at the heads of minors as well). The moghas are not gated. Cross regulators in the irrigation

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1/ See Richard B. Reidinger, Institutional Rationing of Canal Water in Northern India: Conflict Between Traditional Patterns) and Modern Needs, Economic Development and Cultural Change, XXIII(1): 79-104, October 1974 for an insightful account of irrigation management in northern India.

channels are rather few and far between. In the Sind, for example, the distances between regulators on main canals average about 15 miles, on branch canals about 10 miles, and on distributaries and minors about 20 miles.

Most of the time, irrigation channels run at full-supply level. This, implies water moves throughout the system with no operations interventions. When water supplies become short, it is at least in principle possible to close certain gates and rotate water among distributaries (minors).

The possibilities for management intervention in the main irrigation systems in the Indus Basin may be rather limited, however, because of the small number of water control structures in the main systems; and the lack of gates at the head of watercourses, and the limited design capacity of the canals (they were originally designed to irrigate 2-300 acres per cusec, and they usually run full)

At the tertiary level, much attention is given in Pakistan to On Farm Water Management (OFWM) and Water User Associations (WUA's). The primary emphasis with both OFWM and WUA's is on infrastructural rather than managerial improvement. WUA's are formed in order to achieve a priori agreement that watercourse improvement is needed and to obtain financial pledges to meet the irrigators' share of the improvement cost (47%). Through the OFWM program, watercourses are reconstructed (with attention to possible realignment and lining), cleaned, and maintained. Efforts are made to encourage irrigators to undertake precision land levelling.

In the Punjab, nominal attention is given to a need for WUA's to also become involved with operational decisions on watercourses, but until now there and elsewhere relatively little seems to have been done along this line. Further, although the PID's formally are responsible for water distribution down to the level of the farm, they normally do not exercise that responsibility beyond the mogha (except as they are called in to resolve water disputes among irrigators). What this implies, then, is the almost complete absence at this time of government initiatives concerning the allocation and distribution of irrigation water among water users.

Whether the role of WUA's should in the future be extended beyond watercourse improvement -- to also include watercourse management -- depends on the strength and effectiveness of the current warabandi system. The warabandi procedure is intended to provide the mechanism for allocating water fairly and effectively among the irrigators on particular watercourses.

We believe the warabandi system is a high priority topic for research.1/ Of particular interest is determining its effectiveness as a communication device between farmers and the PID's and as an instrument for achieving efficient and equitable distribution of water along watercourses. To the extent that the warabandi system is already functioning well, it would be inadvisable for WUA's to assume a water management role along watercourses. If the warabandi system is not functioning well, a decision would need to be taken on whether to try to help build it up, or whether an attempt should be made to introduce a new institution (WUA's) to undertake the management of water along watercourses.

1/ For an excellent discussion on the warabandi system in India, see S.P. Malhotra, The Warabandi and Its Infrastructure, (Pub. No. 157), New Delhi: Central Board of Irrigation and Power, April 1982.

Appendix B.

The Design Team Members and Their Credentials

Ralph Cummings, Emeritus Professor, N.C. State University, Raleigh NC., USA. Agricultural Research and Educational Administrator, B.S.in Agriculture, N.C. State University and Ph.D. in Soil Science, Ohio State University. Served six years in teaching and research in Soil Science and Agronomy, Cornell University, 18 years with N.C. State University in agricultural research and educational administration, 12 years with Rockefeller Foundation, six years with Ford Foundation, and over five years as Chairman of the Technical Advisory Committee of the Consultative Group on International Agricultural Research. Had 18 years residence assignments in tropical developing countries including directorship of IRRI and ICRISAT. Has participated in numerous study and advisory missions in Africa, Asia, Europe, and Latin America, including a short period as Acting Director General of IIMI.

James M. Wolf, is an Agricultural Engineer and staff member of Development Alternatives, Inc. in Sacramento California. He holds BS and Ph.D degrees from Cornell University in Agronomy and Agricultural Engineering, respectively. His MS degree is from the University of California at Davis in Water Science and Engineering. Dr. Wolf, has held resident assignments in Brazil, where he worked on irrigation research and in Venezuela where he worked for an international center and had responsibility to develop a field research program for MS-level students. He has had operational irrigation experience on a large corporate farm in California. Since 1977, he has worked as a consultant and has carried out numerous short-term assignments throughout the world. Among these are seven trips on assignment to Pakistan in the past two years.

Nanita E. Tapay is a sociologist and has worked as a researcher in Irrigation Water Management at IRRI. Has conducted a multidisciplinary action research studies in Systems Irrigation Management with emphasis on the socioeconomic issues and social benefits to farmers. Dr. Tapay has undertaken organizational studies and the evaluation of farmer participation in Irrigation Water User Associations. She obtained her BSA degree major in Agricultural Economics and MS in Community Development from the University of the Philippines at Los Banos. Received her Ph.D degree in Sociology from Colorado State University. Dr. Tapay has been a training coordinator of the IWM Training Program at IRRI.

Donald C. Taylor is Professor of Economics at South Dakota State University, Brookings, South Dakota, USA. He has a BS degree in General Agriculture from Cornell University and a Ph.D. in Agricultural Economics from the University of Minnesota. Taylor spent the first 15 years of his professional career living and working in Asia. This included two to five year periods in each of Lebanon (Beirut), India (Bangalore), Indonesia (Bogor), and Malaysia (Serdang). As an Associate of the Agricultural Development Council (ADC), Taylor taught and undertook research -- with a special focus on irrigation economics and management -- in each of the countries where he worked. He established an ADC Asian Irrigation Communication Network which involved the publishing of 10 newsletters for irrigation practitioners and researchers in the region and helped organize and carry out seven international workshops and seminars on irrigation management and policy in Asia. He has also written extensively on various aspects of irrigation development and use in Asia.

Appendix C

PROGRAMME

IIMI "Design Team" visit to Pakistan
November 17-30, 1984

Da	Day	Time (hrs.)	Proposed Activities
-11-84	Saturday	1445	- Arrival and stay at Islamabad (Holiday Inn).
18-1 -84	Sunday	0800	- Briefing by the Chairman PARC/ Secretary ARD.
		0930	- Call on Raja Sikandar Zaman. Federal Minister for Water and Power and other senior officials.
		1030	- Meeting with Maj. General Agha Manzoor Rauf, Add. Secretary (Water) and Mr. Naveed Ali Nasir, Joint Secretary (Water).
		1230-1330	- Lunch by PARC.
		1400	- Call on Dr. M.A. Kazi, Advisor to President for Science & Technology and other senior officials.
		1530	- Meeting with Mr. F.I. Malik, Joint Secretary, Economic Affairs Division and other senior officials.
19-11-84	Monday	0900	- Call on Vice Admiral M. Fazil Janjua, Federal Minister for Food, Agriculture & Cooperatives and other senior officials.
		1000	- Meeting with Mr. Manzoor Ahmad, Add. Secretary and Mr. A.M. Kango, Joint Secretary (OFWM).
		1100	- Meeting with Mr. V.A. Jafarey, Secretary General, Planning and Development and other senior officials.
		1230-1400	———— Lunch break ————
		1430	- Meeting with USAID

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