PD-AAN-354

UNCLASSIFIED

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

PROJECT PAPER

INDIA

IRRIGATION MANAGEMENT AND TRAINING
(386-0484)

VOLUME II

TECHNICAL SUPPORT SECTION

USAID/INDIA
April, 1983

Limited Distribution

UNCLASSIFIED

Preface

The purpose of Volume II is to provide the technical materials and findings which are important for an understanding of the significance of this project. Some of these materials were developed in the preparation for this project. Others are included to support the need for such a project.

Volume II will have limited distribution and is designed for use by those responsible for the implementation of the project.

Table of Contents

Annex		Page
I	Planning Concepts for a Flexible Irrigation Water Management Strategy in Asia	1 - 24
II	What is Irrigation Water Management	25 - 28
III	The Continuing Irrigation Water Management Policy Dialogue in India	29 - 31
IV	Conceptualization of Irrigation Water Management Training Needs and its Delivery System for India	32 - 46
V	A Conceptual Framework for Designing Training Programs for Improved Water Management	47 - 57
VI	Professional Development Needs for Irrigation Management: Lessons from AID Experiences	58 - 98
VII	Summary of Water Management Synthesis II Project	99 - 110
VIII	Summary of Findings of Organizational Effectiveness of Projects Visited	111 - 119
IX	Relative Costs for Hardware and Software Components of 40 Selected Irrigation Projects	120
X	Brief Summary Description of AID Evaluation of Irrigation Practice Seminars (1956-1970)	121 - 125
XI	Summary Comments of the Report of the High Level Committee on Organizational Set-up of the CAD Program in Major and Medium Irrigation Projects and Creation of a Water Management and Land Development Wing in State Irrigation Departments	126 - 128
XII	Manpower Requirements for Efficient Water Management	129 - 142

XIII	A Survey of Professional Development Training Need for Irrigation Management in India	143 - 158
XIV	Physical and Operational Inadequacies in Canal Systems Cited by Indian Irrigation Officials	159 - 163
XV	Maj r and Minor Irrigation Officials' Perceptions of Operation of the Irrigation System in the Mahi Kadana Projects of Gujarat State, India	164 - 186
XVI	Participants' Evaluation of Diagnostic Analysis Training Workshop at Anand, Gujarat, India	187 - 192
XVII	Participants' Evaluation of Chittorgarh, Rajasthan (India) Irrigation Systems Diagnostic Analysis Workshop	193 - 218
XVIII	Justification for Tamil Nadu Consortium for Irrigation Management Training and Action Research	219 - 220
XIX	Linkages Between the Proposed International Irrigation Management Institute and the Proposed Irrigation Water Management Training and Special Studies Project of U.S.A.I.D.	221 - 222
XX	Action Research Studies	223 - 233
XXI	Water Resources Systems Planning and Management	234 - 255

Annex I

PLANNING CONCEPTS FOR A FLEXIBLE IRRIGATION WATER MANAGEMENT STRATEGY IN ASIA*

Max K. Lowdermilk and
Mark Svendson
ASIA/TR/ARD

I. Introduction

The Asia Bureau Missions have committed a large share of their resources to irrigation for a number of years. In FY 1980, in terms of life of Project costs, 22% of the total Agriculture and Rural Development/Nutrition (ARD/N) budget was allocated to the irrigation sub-sector. In 1981 and 1982, respectively, the percentages increased to 30.2 and 40.5 of the total Planned Budget (ARD/N). In FY 1983, this percentage is estimated at 39.5%[1]. These estimates do not include some irrigation activities in agricultural research and rural development projects.

These levels of investment are in keeping with crucial host country development goals. They reflect the fact that 70% of all irrigated area in the world is in Asia, which also has an estimated 60% of new irrigation capacity. More significantly, 90% of the irrigated area in all developing nations is in Asia, where irrigation is viewed as a potent means for rapidly meeting food demands and accelerating agricultural development.[2]

A realization of the great significance of irrigation in the region led the Bureau to commission an expert irrigation team to study irrigation issues and strategies in five Asian countries in 1980 (a sixth country, Sri Lanka, was added in 1982). The findings of this team were presented to the 1981 strategy meeting of Mission and Bureau staff in Jakarta where high priority was given to a water management-oriented strategy[3]. These events, combined with Mission's recent development of projects in Sri Lanka, India, Pakistan, and Bangladesh, make it appropriate to evolve a set of key concepts and working principles to guide and define a useful irrigation water management strategy. Such a strategy must be flexible in meeting special host country needs. It must also have a built-in learning mechanism to remain relevant in the dynamic context of Asian irrigation development.

---

*This paper was developed by Max K. Lowdermilk, Water Management Advisor for ASIA/TR/ARD-AID Washington in collaboration with Mark Svendsen of the same office. It was added to and improved greatly to substantial reviews by Dr. D. Peterson, Dr. G. Corey, Dr. W. Clyma, Dr. J. Keller, Dr. R. Hooker, Dr. J. Reuss, Dr. M. Skold, Dr. R.K. Sampath, Dr. K. Nobe, Mr. J. Harbeson, Dr. K. McDermott, Dr. G. Levine and many individuals in the Asian Missions.

II. Considerations for Strategy Formulation

Strategy is a frame of reference which provides guidance in developing programs, projects, and activities for the achievement of specific objectives. It provides a means of selecting elements or factors on which to concentrate and to prioritize. An acceptable strategy must ensure that scarce resources, including AID resources, are combined effectively to achieve specified objectives commensurate with the policy directions of the Agency. Strategic issues which might be considered, among others, include: Concentration of AID's resources vs. dispersion of resources; long-term vs. short-term involvement; primary focus on software components vs. focus on large infrastructure hardware; primary focus on farm systems vs. main systems; focus on small to medium systems vs large systems.

Each country has its own set of goals and objectives as well as special conditions and constraints which might be accommodated within AID's own development strategy. These include such things as economic equity, welfare objectives and policies; various natural and human resources; stage or level of development; organizational and institutional differences and many other country or region-specific considerations. For example, some countries will continue to develop new irrigation projects while others will focus on rehabilitation of existing ones. Some countries will do both. But virtually all projects, new or old., need to give more attention to irrigation water management if development goals are to be met.

The purpose of this paper is to suggest a flexible framework for developing a clear and relevant strategy to guide the planning and implementation of AID's irrigation projects in Asia. Such a strategy should be based solidly on the valuable lessons AID has learned over the past 30 years of involvement in irrigation development. It must also draw on the expanding body of knowledge developed through innovative, pilot efforts at improved irrigation system management, and research in a variety of disciplines focusing on water management problems.

Both AID/Washington and the Missions recognize a need for a more focused strategy. A project-by-project approach, or the changing approaches based on personaliities, result in fragmented efforts which do not, over the long run, impact the intended clients significantly nor contribute substantially to knowledge about how to improve projects and maintain systems. There have been few irrigation projects anywhere to date with adequate and reliable built-in learning mechanisms.

The Bureau of Policy and Program Coordination, aware of the need for an AID strategy for irrigation development, in 1979 conducted a pattern analysis study of 25 small and medium scale irrigation projects of AID and the IBRD. The key findings of this study point out the importance of on-farm water management and that

rehabilitation or improvement projects generate faster returns, higher visibility, and greater positive impacts on small commercial farmers than new ones. The study also shows that AID projects have given relatively more focus to the farm level and local institution-building dimensions than have World Bank projects. The study calls for better project design based on careful diagnostic analyses of complex soil and water problems along with improved social, economic, and organizational evaluations to provide objective measures of project costs and returns to farmers and society.

In the late 1960's, AID substantially increased its emphasis on a relatively unexamined concept known as irrigation water management. Prior to the 1970's, the primary concern in irrigation development for both AID and other leaders, as indicated by funding portfolios, was with civil engineering structures to capture, store and convey water. A review of 22 World Bank and 8 AID projects in Asia designed during the 1960-1970 period shows that over 60% of total project costs went for hardware of which canal improvements and dams were predominate[5]. During this period, recognition of serious externalities such as water logging and salinity and problems of cost over-runs and the limited benefits to farmers led to real concern by AID for improving the productive end of the water management system.

AID's first major experience in integrated on-farm management activities was an innovative and far-reaching project in Pakistan, which has been widely acclaimed inside and outside AID as a great success. Unlike many projects, this centrally-funded Pakistan project was designed flexibly which allowed for careful diagnostic analysis, hands-on field training of host country personnel, institutional development, a definite management focus, long-term commitment, and a built-in capacity to document and disseminate lessons learned. The project ensured AID a recognition among international development organizations and host countries as a leader in irrigation water management and has substantially influenced AID's current project design and implementation procedures.

Recent AID-funded work aimed at stimulating and encouraging the formation of tertiary-level farmer organizations in Sri Lanka has continued that effort. This work has also stimulated healthy discussion both within the ranks of the local irrigation bureaucracy and among the various actors involved in managing irrigation water including irrigation officers, politicians and farmers. Such discussion and interaction is essential if improvements made in water management practices are to persist over time.

This work shared some of the critical elements of the Pakistan experience, including an emphasis on developing host country, diagnostic analysis of the existing field situation before beginning implementation ("action research"); and a comprehensive mechanism for evaluating results and making timely corrections while the project was in progress.

These experiences, in addition to those generated by other projects currently being planned or implemented, rank AID among the leaders in international water management improvement work. AID has a sound reputation on which to build, affording it the opportunity to play a leadership role in this important field and exerting influence which far exceeds the actual dollar amount of its investments.

A flexible irrigation strategy must build on past experience but also must be tied to Agency policy. Current Agency policy statement regarding methods of increasing agricultural production and equity for all classes of farmers fits well with the key concepts and emphases needed to improve irrigation. These include: Policy changes which result in improved incentives for production; systematic transfer and adaptation of improved technologies at lower costs; utilization of hard economic data to make projects more effective; the involvement of all affected groups of people to enhance democratic participation and maximize the use of local resources; enhancement of private sector involvement to deliver goods to people more effectively; and the strong focus on institutional and human development[6]. These major policy emphases should undergird irrigation strategy for the 1980's and beyond.

In addition to building on past experience and promoting current AID policy emphases, it is important to build an approach which can provide the maximum benefits in proportion to the scarce economic resources available for investment. Conventional irrigation projects require large sums of capital and are notorious for cost overruns. These projects have an important place in national development and can be cost effective, especially if the time period from design to operation can be shortened. However, past experience suggests that, givn its relatively limited capital resources and its focus on improving production rapidly, AID should emphasize investment which involve rehabilitation and extension of existing systems with new construction, limited to small medium irrigation systems. In both cases, the principal focus should be on the management of water in the system, with construction activities delegated a supportive role.

Moreover, three decades of modern irrigation development is exhausting the sites for developing new large-scale irrigation projects which are economically feasible*. Policy makers and officials in many of these countries are becoming increasingly aware that the future of irrigation development rests with better and more efficient utilization of existing water resources.

The most significant development in irrigation in recent years, in the Asian context, is the greatly improved understanding of

---

* India, however, has a greater potential for new projects than other Asian countries. Most of the new projects, however, will be from small to medium projects designed with the latest knowledge of irrigation water management approaches.

current irrigation water management strategy and, concomitantly, techniques which can be successfully implemented to improve water management. The irrigation scenario over the next decade will not be one of increasingly large dam construction projects, but rather will feature the improved management of water throughout existing irrigation systems. To continue to play a leading role in this area, AID must articulate a strategy that recognizes the central importance of water management in future irrigation development based on past experience, but which can also learn from the variety of innovative approaches to improving water management currently being tried. It must always be kept in mind that the ultimate critics and beneficiaries of the resulting programs are millions of small holders. For them efficient water management can spell the difference between success and failure in agriculture and between abject poverty and a hope for their improved well being.

III. Criteria for an Irrigation Strategy

A strategy should be based on the best technical and management experience and expertise available. Leaders in the farm water management field today seem to agree on at least seven criteria, which should guide AID irrigation development. These criteria promote a flexible irrigation strategy and should be reflected in project design both for new projects and for improvements to existing systems. Such projects should result in:

1. Increased water control and greater reliability of supplies at the farm level relative to the amount and timing of the water required by the crop/soil sub-system.

2. Increased participation of farmers in the planning development, operation and maintenance of tertiary-level systems and in rehabilitation and improvement programs.

3. Improved maintenance and stability of the soil and water resource base over time.

4. Increased cost effectiveness of investments in the system.

5. Increased productivity of water and net farm income to farmers and groups of farmers.

6. Improved equity of water distribution among different classes and groups of farmers.

7. Increased probability that managerial improvements will persist over time.

Water control and reliability of supply are the basis of good water management. Long experience and recent field visits by the Asia Bureau irrigation sector review team suggest that in far too many countries, and on many AID-assisted projects, farmers served by public sector gravity irrigation systems still suffer from too much water as well as periods of critical water shortage. Too many systems still operate like rainfed regimes. Water comes unpredictably and in arbitrary volumes without the end users being able to anticipate supplies as they must to make crucial farm decisions. Farmer participation in a wide variety of planning, operation, maintenance activities is essential if realistic changes are to be made and expected to endure over time.

These criteria are all closely related. Where water is not productively used, the cost effectiveness of the project will suffer. Where farmers do not have adequate control over irrigation water and when deliveries are capricious and unreliable, it is unlikely that they will be persuaded to utilize other inputs in recommended amounts or be motivated to organize for regular maintenance of the farm system. Improved equity of water distribution is necessary aso if the productivity of water is to be increased.

IV. Planning Concepts

Irrigation projects are not only extremely costly, but claims of expected benefits are often exaggerated. This inflation of benefits occurs as planners attempt to project and quantify the improvements which are envisioned for the project These improvements can come in the form of higher yields, higher cropping intensities, increased irrigation efficiencies and expanded irrigated acreage, improved crop quantity, longer growing seasons, more reliable water supplies, control of erosion and induced improvements in agricultural management. Secondary benefits may also accrue from increased economic activity, a shift to higher valued crops, and related benefits from multi-purpose projects such as the production of hydro-power supplies and various recreational uses. Obviously, there is considerable latitude for assembling a variety of combinations and levels of these elements. The reality of the completed project often shows the chosen mix to have been greatly in error.

One important reason for this is that very little attention is usually given to how the new irrigation enterprise should be managed effectively. Consideration given to this aspect of irrigation project design should be at least as great as that devoted to structural design issues. What is known about realistic operation, maintenance, and management modes must be carefully designed into projects at the outset and tested over time to find the proper fit with the system. Since these are largely social considerations, activities (i.e., decision-making, communication, lobbying,

brokering, organizing, and interacting) applied social scientists, management experts, and experienced system operators must work alongside the design engineers and biological scientists in developing and adapting realistic and workable management strategies and systems.

Some of the major planning concepts such a multi-disciplinary team might utilize as building blocks for a flexible strategy include the following which are described subsequently in greater detail:

1. Encourage realism in evaluating the availability of the water resource and the demand on it. Construct or reconstruct with flexibility.

2. Make irrgation management the focus of irrigation development.

3. Use a diagnostic analysis process for developing new projects. Identify the pre-requisites for implementation and operation of the projets and note those which are exogenous to the project. Find methods of satisfying them with the help of external forces such as the Irrigation Department, the government, other foreign assistance lenders, etc.

4. Circumvent the long period from research to development by using a "development-of-solutions" experimental project mode. Utilize existing projects for needed studies where possible in order to shorten and improve the design process.

5. Design into all projects a strong internal monitoring and evaluation mechanism and train personnel to utilize it.

6. Focus heavily on human resource development by front-loading appropriate training into all large project plans (with a focus on short-term, hands-on training in live irrigation systems in contrast to lecture-oriented classroom training).

7. Design basic institutional development components into projects which include:

a) professional training
b) institutional strengthening
c) local participation and organization
d) extension services for farmers
e) private incentives for farmers
f) knowledge transfer mechanisms
g) appropriate policy analysis based on field studies.

8. Develop close collaboration with other international donors where feasible.

9. Encourage long-term commitment to a program of water management improvement and provide for adequate professional staff.

(1) Encourage realism in evaluating the availability of the water resource and the demand on it. Construct or reconstruct with flexibility.

Newly constructed irrigation systems are often burdened with inflated expectations. It is not unusual for major projects to irrigate only one-half to two-thirds of their design command area adequately. On one hand, reservoir or aquifer supply estimates are often overly optimistic. On the other, crop water requirements may be understated, especially for critical periods of maximum transpirational demand. In rice-growing systems, the basic seepage and percolation rate of the puddled rice soils also must be included as a component of basic demand, since it is largely fixed.

The most serious design fault, however, is probably the boundless optimism with which assumptions about distribution system effectiveness and efficiencies are made. The efficiency of the distributional system is a function of both technical factors, such as canal seepage rates, and managerial ones, such as whether system control structures are monitored and operated after sunset, and how long breached bunds are allowed to flow unchecked. History has shown that these losses are apt to be several times those assumed in design.

Where existing systems are being considered for rehabilitation or a program of managerial upgrading, determination of the actual values of water supply, demand, irrigated area, and various measures of water losses and efficiencies for the system as a whole and its major sub-components should be an integral part of the project development and implementation process. These estimates can often be made utilizing existing data collected by the operating agency, supplemented by a brief program of field measurement. This excercise can provide a relatively quick means of assessing baseline system performance and locating the areas of greatest structural and managerial weakness.

In new systems, planners must insure that:

a) the water supply estimate is reliably based on adequate hydrological or hydrogeological information and operations analysis,

b) that crop (and soil) water requirements are accurately predicted using current estimation procedures for evapotranspiration (and seepage and percolation) and locally derived climatological and hydrological data,

c) that forseeable distribution facilities have the physical capability to meet crop/soil demands at any place in the system in a given fraction of years (e.g. 3 of 5 or 9 of 10). For these studies covering at least 20 years are recommended for this purpose[8].

Much of the infrastructure detail, particularly of the intensive parts of the distribution system, will evolve from the more comprehensive local-level analysis as project development proceeds. This is an important concept. Post Hoc experience from a number of countries, ranging from the Philippines to Sri Lanka, has demonstrated the virtual impossibility of designing an effective tertiary distribution network working solely from traditional 50-centimeter or 1-meter interval contour maps.

The most effective way to meet the informational needs of the tertiary level design process is to involve farmers and others with intimate local topographic and social information in the process. In new construction, maximum flexibility must be provided so that resources are not completely committed until sufficient local-level experience has accumulated. Once physical structures are in place, change is difficult and expensive, no matter how inappropriate the structure or its location may be.

Some large and significant training requirements are implied in this concept. Not only must those involved in the design process be trained to apply the principles outlined above, they need to have multi-disciplinary experience such as that outlined in (30 below if they are to be effective.

(2) <u>Make irrigation management the focus of irrigation development</u>

The rationale for an irrigation management focus rather than a focus on the civil works of a new system is based on several considerations. First, rapid and substantial returns on investments and visibility can be obtained by improving existing projects. This is an area of high priority where costs per hectare and per farm are much less than for new projects. On new projects, a focus on management will yield much greater returns earlier[9]. Second, AID has been a pioneer in this area and has accumulated some expertise. Third, the irrigation management component of some projects is still ignored or treated as marginal. Fourth, there are still many in Missions and among contractors who use the term "water management" or "irrigation management" but do not have a comprehensive systems understanding of the concept.

The use of the term "irrigation management" here is to promote the idea that more is managed in an irrigation system than water [10]. People are managed. Information is managed. Other agricultural inputs are managed in interaction with water.

We define irrigation management as the process by which water and other inputs are manipulated and used in the production of food and fiber. The concept focuses on management and is not bound by a narrow disciplinary or professional bias. The purpose here is to improve the productivity of water on the farm and also to achieve the other criteria of increased net income equity, conservation, farmer involvement, and regular maintenance. This, in turn, will result in more cost effective projects. If the criteria are achieved for all classes of farmers, this will lead to rapid agricultural development.

Unfortunately, this approach, as of 1980, had not yet been utilized in many AID and World Bank projects. In a recent analysis of 63 LDC irrigation project documents, it was found that in only two projects was operation and maintenance (O&M) a major focus of project design [11]*. Operation and maintenance was a significant factor in only one of the Middle Eastern projects and in only one of the Southeast Asian projects (See Tables 3 and 4 about relative emphasis on components of irrigation projects). Some LDC's are taking the lead in this matter. India, for example, is now considering establising a cadre for O&M, separated from design and construction, in order to provide incentives for professionals along O&M career paths. Serious questions need to be asked in most countries about the relative importance of improving regular operation and maintenance of these complex man-made systems which will decay without constant care.

3) Diagnostic Analysis

The rationale for the Diagnostic Analysis mode being built into new projects and utilized for the improvement of existing projects is based upon long observation and experience which indicates that many, if not most, irrigation and agricultural personnel do not fully understand how an irrigated farming system works in practice. This is because personnel often have not viewed the system from the farmer's perspective. Until recently, problems related to water management in the lower portions of the system have been almost a "no man's land". This results both from tradition as well as the lack of exposure to new water management perspectives and skills. Few countries today can field an experienced interdisciplinary team of social, biological, and physical scientists or professionals to make a careful diagnosis of system operational characteristics relative to system design standards.

---

* It should be noted that of the 63 projects, 79% were initiated between 1970 and 1979.

A Diagnostic Analysis (DA) process and specific procedures have been developed and tested by the AID Science and Technology Bureau Water Management Synthesis project to provide this experience. This project has also developed technical manuals, training materials, and a training course that is now on video tape, relating how to perform both rapid and detailed diagnostic analysis of irrigation systems. During the early phases of a project, project development and the beginning of project implementation, key staff and AID project managers should receive intensive short-term field-based training in DA techniques. In many places, AID staff managing irrigation projects with host countries have not had prior experience with and do not understand the complexities of these difficult multi-dimensional projects. There is an immediate need for AID to initiate a program to provide professional development opportunities to gain this expertise.

It should be made clear that the farm management focus of the DA process does not ignore the importance of the main irrigation system in providing water supplies. It views the total system in terms of the farmer decision maker and the local irrigation authorities who are involved with day-to-day operations. The productive end of the system is used as a barometer of how well the total system is operating to provide predictable supplies of water for the crop production of all classes of farmers. The problems are diagnosed at the farm level first and the causes are investigated at each control point up the entire system. In the design of new projects, the same principle holds. The distribution system must fully respond to realistic projections of water needs on farmers' fields.

4) Development of Solutions

Along with Diagnostic Analysis, a mode known as Development of Solutions has been developed and tested. This is a means of circumventing the typically long period of research prior to the commencement of improvement of development activities. Needless to say, there are often complex soil, water and other problems which require conventional research to find the right solution. There are, however, many things which cannot be learned in irrigation development without becoming involved early in a "live" system to identify problems and search for solutions under real conditions.

Therefore, we recommend the approach of testing and adapting known technologies to the project environment at the earliest stages of project implementation. In existing systems, this may take the form of a pilot program of action research within the bounds of the project area involving local farmers, irrigation officials and multi-disciplinary team of specialists. Such an effort is allowed a limited time during which to test, introduce, or adapt one or more promising new methodologies. If the project is a new one, an adjacent experimental area in an existing system could serve as the testing ground.

Although the basic infrastructure for water delivery systems utilize established technologies, when employed off the experimental farm they must be custom-tailored to local custom, organizational modes, authority roles, patterns of interaction with irrigation authorities, agricultural practices, rainfall patterns, and the like. The experimental mode means learning from small-scale experience before major mistakes are made and funds committed. Most projects need this built-in flexibility to learn, adapt, and refine procedures. These smaller pilot areas also provide an excellent opportunity for a visible demonstration of what works both for farmers and officials.

To list a few examples, experiments and applied special studies might be used to identify the most useful mode of water allocation, water distribution, appropriate types of small structures, water rates, and farmer organization. Such an approach can prove useful in a relatively short period of time.

Where an experimental project within the project area is not feasible special studies (in adjacent systems) need to be designed into larger projects. Usually one need not wait for water to be supplied on the new project since similar projects exist in most countries. As soon as possible, studies cum trials must be initiated and carried out on the new project lands, involving local farmers to the fullest possible extent.

There is also a significant role for the use of farm-oriented systems modelling in the development of solutions, a methodology which has had success in some countries. If properly utilized, cropping systems models can detect many flaws in potential designs quickly, thus saving valuable time in field testing.

The use of small computers in the design of field channels and small structures is little used to date. If routine and repetitive design functions can be computer-assisted, we can move away from the traditional uniformity in tertiary system design and lay-out designs which are customized to fit local situations. Such a move will also enhance the possibilities for farmer involvement in the design process.

Increasingly, there is a need to discover how irrigation management decision making can be more effective. Computers can also be used advantageously in irrigation system management. In the American West, small computers are commonly used for irrigation scheduling. Pioneering work in main system management involving data collection, evaluation, feedback and control and utilizing computer processing of data has been carried out in the Philippines while Taiwan has been using this technology for a number of years.

(5) Build in strong Monitoring and Evaluation Components

Monitoring and Evaluation of the Diagnostic Analysis process, the Development of Solutions, and project implementation is essential for the improvement of these processes and the documentation of lessons learned. This monitoring and evaluation should be an integral part of the project and the irrigation system.

Monitoring and Evaluation (M&E) is also important in the ongoing management of the irrigation system. In fact, M&E is fundamental to a successful systems operations strategy. Since operation consists of adjusting flows and allocating supplies to best meet local irrigation demands, a continual two-directional flow of information is essential . Many weaknesses in irrigation system operation and maintenance (O&M) can be traced to the lack of an effective system of M&E.

At a higher level, M&E is an important tool in assessing the functioning of the entire structure of the irrigation system. The costs of an o going program of M&E to the irrigation authority are generally low in comparison with the potential benefits associated with more efficient system operation. Training costs to transfer M&E methodologies are also not large, but little has been done in this area. Monitoring and Evaluation initiated at the Development of Solutions stage can be continued or expanded to provide this function on a regular basis. In India, for example, some large projects now conduct on-going internal M&E and the central government of India and the states are considering the development of external, inter-disciplinary project evaluation teams.

(6) Focus heavily on human resource development

AID has had much experience in the strategy of human resource development primarily because it is awarded a high priority in AID policy. No technology is transferred unless people and institutions are developed for its implementation. There can be no change in technology without a commensurate change in human resource capability. Without technology transfer there is little rationale for AID involvement in irrigation vis-a-vis other donors.

Especially in irrigation development, projects need to be planned with appropriate training. Needs for upgraded skills and changes in attitudes and perceptions extend from the farm to the policy-making level. Few countries have professionals who are trained in working together on inter-disciplinary teams and for many this is an uncomfortable mode. Training needs to be field-oriented and must occur early in the life of the project so that it is effective in implementing the current project and not some future one. Finally, this type of training needs to be institutionalized through revision of the formal training programs of engineers, agronomists, economists and others to provide a focus on comprehensive water resources development and water management.[12]

BEST AVAILABLE COPY

The S&T/AGR study by the Water Management Synthesis Project of 63 irrigation projects designed by AID and the World Bank in the 1960s and 1970s, found that training was a major factor in only five of the 63 projects worldwide. Of 40 projects which had cost data, 19 had from very little to some training, but training still represented only three percent of the funds budgeted for the 19 projects. Of 63 projects reviewed worldwide, training received only one percent of the funding[12].

The rationale for a focus on institutional development is that effective "software" is an essential complement to all hardware components of irrigation systems. In the past, attention was often focussed on hardware investments at the expense of the software components such as professional development, management, training, water code and policy reform, and water user organizations. More attention to software components is essential to make the investments in hardware components more effective.

We must make careful, country-specific assessments of professional development training needs and utilize those data in assuring that the necessary training for required staff is done*. There is no "magic" percentage of total funds needed for training, but recent experience and studies indicate the need to sharply increase the amounts currently being allocated in this area.

(7) Stress building institutional capacity in host countries

Evidence indicates that the major needs under institutional development are:-

a) Training professionals: Human development is a means of improving and changing institutions and people. Only a few countries have irrigation personnel who have received water management training, two recent studies indicate the critical need for such training in Asia. The study by IFPRI[13] estimates that for new projects alone, about 6,000 professional staff, 27,000 technicians and 22,000 extension personnel will need to be trained in eight Asian countries alone between 1975 and 1990. These figures do not include the growing demand for retraining existing staff in water management for the improvement of old systems, a critical consideration for the entire developing world. Estimates of the numbers of existing irrigation and agricultural staff needing short and longer term training in irrigation management range from wild estimates of "everyone" to fifty percent of staff working on all systems. Without an objective assessment "guesstimates" will continue to be haphazard.

---

* To our knowledge, none of the USAID host countries in Asia have conducted an assessment of human resource needs for its irrigation sub-sector, in the recent past.

BEST AVAILABLE COPY

Both formal and informal training is required for engineers, agronomists, economists, extension personnel, rural sociologists, public administrators and others. Special short-term training is also needed in Diagnostic Analysis and problem solving techniques. Managers of projects and irrigation sytems need special training in systems operation and in methods for monitoring and evaluation of systems on a regular basis. Extension workers and others need training in water management practices, agronomic practice under irrigation and farmer organization for the improved use of water for crop production. Planners and policy makers also need greater awareness and understanding of advances in water management and in systems design and operation. Short management-oriented seminars can accomplish some of these aims.

Farmers also require training in water management and in irrigation agronomy, but this emphasis still remains marginal in far too many projects.

b) Strengthen institutions: In addition to outside training of individual professionals and the short-term in-country training of individuals and teams outlined above, host country institutions must be strengthened through longer-term support and collaboration. Just as irrigation development in this country has proceeded through the efforts of a mix of government agencies (e.g. the Bureau of Reclamation), educational institutions (land grant colleges) and private sector (irrigation ditch companies and private firms), a mix of institutions is also important for irrigation development in Asia. Collaborative programs involving host country research, training and extension institutions and counterpart institutions in the U.S. can play a very useful role in this regard. This type of support also reduces the probability of retrenchment following project completion and helps create a local capacity for self-renewal within the host country.

c) Farmer participation and organization: This is an untapped potential yet is a key to attaining many of the objectives needed in irrigation improvement. Farmer involvement doesn't just happen. It takes place when farmers are reasonably convinced that they will receive visible benefits in the form of greater supplies of water and better water control thus improving production possibilities. There is a need for a policy and a legal framework in many countries which provides the clear government commitment and visible incentives for farmers to organize effectively.

Farmers usually want more discipline and predictability in irrigation systems than is presently provided. More data is needed, however, to ascertain what levels of discipline are needed and desired by both irrigation authorities and farmers. In some countries, such as Sri Lanka, the Philippines, Indonesia and

BEST AVAILABLE COPY

Pakistan, good work is underway. Farmer participation must be built into appropriate project activities from the start. Projects should never attempt to do for farmers what they can do best themselves. Project implementors should not wait until all decisions are made and then provide farmers only a token role in planning and implementing projects. Farmer participation is not only cost effective but also helps farmers learn skills, gain confidence and develop a justified sense that they are the "owners of the project".

Farmer organizational issues are many and complex. Often, therefore planners and program implementors ignore this area and search for ways around the "problem" of involving farmers. In the recent review of 63 projects by the S&T WMS project, it was found that organization of water users into cooperative associations was a significant feature in only 8 projects[14].

In the 1980s, far greater emphasis must be placed on this critical issue which has often been the Achilles heel of irrigation projects. Efforts must be made in all projects to learn everything possible about the most successful modes of farmer involvement for improved water management and continual maintenance of systems. This will require a strong input from applied rural sociologists, social anthropologists, and public administration experts to identify problems, develop and test experimental modes and to play a continuing role in monitoring and evaluation efforts.

d) Extension vehicles to transfer the technology to farmers: Few projects include extension as a component. Public extension programs are weak and ineffective. Farmer water management is an appropriate functional area for agricultural departments, however, there are almost no subject matter specialists in the field. The result is no training of field workers and only weak field activities to support irrigation management projects and programs. Data collected by the S&T/AGR Water Management Synthesis Project[15] indicated that where rehabilitation of systems costs close to $700 per hectare, the total amount budgeted for all extension, farmer and project staff training was only $25 per hectare. The widespread myth still prevails that if water is provided, farmers will automatically organize and learn to utilize water efficiently for higher yields. This simply does not happen in practice without new knowledge inputs. Conversely, unless reliable and timely water supplies are provided, which happens all too rarely now, organizational attempts will meet with limited success. Concurrent efforts in both areas are needed.

e) Private incentives: In public irrigation projects, there should be the strongest focus possible on private incentives. Wherever there are private tubewells, lift pumps or private tanks, they are usually managed efficiently in contrast to public systems. Private land leveling operations to date have been far superior to public land leveling programs in all countries. On many public irrigation systems, the field channels are private property and improvements such as lining, structures and other improvements are

all private goods. The potential role of the private sector and private incentives to producers in large as well as small systems is much greater than is often appreciated. Much policy-oriented research is required in this area[16].

f) Policy analysis: Institutional development, which results in innovative policies creating improved production possibilities for farmers and incentives to those who work with farmers, are needed for changes are taking place primarily because governmentts are discovering that old approaches result in excessive costs and limited returns. Along with demands for increased food supplies, social and political pressures are forcing governments to find ways to make irrigation investments more profitable to both farmers and society. Experience to date suggests that from diagnostic analysis of a system to project completion, a steady stream of applied field research findings reported in simple, clear language can have great impact on policy makers and planners. Systematic efforts are needed to reach those who are influential in policy decisions with creative and viable options which can be implemented.

g) Knowledge transfer: A recent (1976) international symposium[17] on arid land irrigation in developing countries has declared that the most glaring need in improving irrigation systems is the application of the scientific knowledge already available. Experience indicates that the flow of scientific knowledge in this area is slow, erratic, and incomplete. Seldom does one country know what works under what conditions and at what costs in a neighboring country. The approach of developing each new project from scratch is far too costly. There is need for a method of transferring what is known. If this is done systematically, projects will be better designed and yield better economic and social returns. AID should strive to build into each project a low-cost mechanism to identify and document what works under what conditions and at what cost.

(8) Collaboration with other International Agencies

AID has a good record of collaborating with other international development organizations. This is especially important in irrigation endeavors where, in terms of large investments, the internatioal banks are taking the lead. These are areas in which they function well. In other areas, however, such as project implementation, training, institution building and project monitoring and evaluation, they have serious limitations. AID, on the other hand, had some technical field staff and a great deal of experience in farm-level and local institutional development, supported by the technical expertise of the USDA and the American land grant university system. Given the available financial resources of AID compared to those of the Banks, it makes sense to allow the larger donors to handle the more costly hardware elements of major irrigation systems and to collaborate with them on software components such as training,

BEST AVAILABLE COPY

institution building and O&M. AID should continue to be involved in financing both the hard and software of small and medium projects when they are designed appropriately and can be used as prototype systems. AID should, therefore, consider a program of close collaboration where feasible.

This is important because the Banks can utilize their influence on countries for some needed policy or institutional change. In two countries in South Asia, as a result of the World Bank and AID collaboration, changes in water codes for water user associations, the development of a more rational mode of project planning and changes in water revenue rates have resulted. In a recent case, AID conducted the research and policy analysis related to the establishment of legal water user associations and the Bank influenced a host nation to implement a legal ordinance. Such close collaboration should be encouraged where appropriate.

(9) Long term commitment and adequate professional staff

If AID intends to make a serious commitment to irrigation for increased crop production, any such involvement should be planned over a period of not less than 10 to 15 years. To date, in irrigation development there still is far too much thinking and planning on a year-to-year basis. When this situation is combined with a definite lack of trained professional staff, the high staff turnovers in Washington and in the Missions, plus radical staff cutbacks in some areas, it becomes difficult to evolve a long-term stable program which has maximum impact. If such a program is desired, the burden is on AID/Washington to provide the technical and management professionals required. The strategy named in this paper, focusing heavily on human and institutional development and knowledge transfer, depends on high-level commitment in AID/Washington.

AID commitment is demonstrated by the levels and the quality of technical staff made available for the design, implementation and servicing of irrigation projects. Today, both technical and program staff involved in irrigation are thin in numbers, shallow in experience, and often unable to meet the unique demands of managing complex irrigation projects. In the TPCA Report[18] to the Administrator of AID (November 1980) in response to the presidential commission on world hunger, the following statement was made about this problem.

> "The Agency has about $300 million in irrigation projects and in Asia, a long-term program to work on irrigation, yet AID has only six professional irrigation positions available .....AID has emphasized irrigation and water management in all regions for at least the past 20 years. There is a likelihood that this will continue for the next 15 years

under pressure to raise yields. Yet, there is no place within the Agency commitment and thus provide a basis for planning for the core professional staff and outside resources needed to support a long-term effort."

Progress is being made by the Asia Bureau and the USAID Missions. By 1984 the Bureau will be managing projects with total life of project costs of close to $800 million. The Bureau has evolved a strategy which has a high level of long-term policy commitment. In addition, the Bureau has taken the lead in developing a centrally funded Water Management Synthesis II project with the Bureau of Science and Technology. What is needed now is more direct hire professionals in the field and in Washington with technical expertise and experience to help implement the strategy.

The unique project mechanism developed by the Asia and Science and Technology Bureau has far reaching consequences for the Asian area. With the implementation of the Water Management Synthesis II project late in 1982 and its four major components of Technical Assistance, Training, Special Studies and Technology Transfer, AID will have in place a potent means for addressing many of these problems. Other constraints, such as the weak internal support capability will remain, however, and must be dealt with separately. One of the most important roles that this project will perform is that of enlarging the pool of professionals available, both in the United States and abroad, for international irrigation management assignments. The success with which this goal is accomplished, together with the strengthening of LDC irrigation institutions, will shape irrigation project design and management throughout Asia for the rest of the century. Other activities under the project can improve irrigation system design and operation over the shorter run.

These planning concepts have been reviewed by a wide variety of professionals in the field in the process of their preparation. Thus, while they do not represent a complete concensus, they have been subject to a wide range of thinking and inputs. It is hoped that the strategy they define will help to focus irrigation development efforts on those elements identified where the needs for change and the potential impacts are the greatest.

BEST AVAILABLE COPY

1. AID Annual Budget Submission, FY 1984, AID Washington, D.C., June 1982.

2. The President's Science Advisory Committee, The World Food Problem, Volume II, Report of the Panel on the World Food Supply, the White House, May 1967, pp 439-460.

3. Lowdermilk, Max and Keller, Jack. "Irrigation Issues and Investment Strategies for the 1980's," Asia Bureau Strategy Conference. Jakarta, Indonesia, January 12-16, 1981.

4. Bureau of Policy and Program Coordination, AID, Pattern Analysis of Small and Medium-Scale Irrigation Projects (Final (Final Report), volumes I and II by Checchi and Company, Washington, D.C., November 13, 1979.

5. Water Management Synthesis Project, Irrigation Projects Document Review: Executive Summary, WMS Report I, Utah State University Agricultural and Irrigation Engineering, Logan, Utah 84332, February 2982,. pp. 13-15.

6. U.S. Agency for International Development, "A.I.D. Policy Paper. Food and Agricultural Development, "May 1982, Washington, D.C., pp. 2-8.

7. World Bank, The Assault on World Poverty, John Hopkins Press, Washington, D.C., 1975, pp/ 95-96.

8. Private Communication from Dr. Dean Peterson, Utah State University, Logan, Utah, April 1982.

9. Oram, Peter; Zapata, Juan; Alibaruho, George; and Shyamal, Roy, "Investment and Input Requirements for Accelerating Food Productions in Low-Income Countries by 1990," Research Report 10, International Food Policy Research Institute, September 1979, pp. 53-61.

10. Technical Advisory Committee of the Consultative Group on International Agricultural Research, "Report of the TAC Study Team on Water Management Research and Training," Presented at the Los Banos, Philippines Meeting, March 9-17, 1982.

11. Water Management Synthesis Project (Report I), February 1981, Op. Cit., p. 3.

12. Water Management Synthesis Project (Report 10, February 1981), Op. Cit., p. 4.

13. Oram et. al., Op. Cit., p. 63.

14. Water Management Synthesis Project (Report I), February 1981, Op. Cit., p. 5.

15. Ibid

16. See Lowdermilk,Max, "Private Sector Involvement: Irrigation Improvement in Asia - Asia Bureau/TR/ARD.

17. Worthington, E Barton (Editor), Arid Land Irrigation in Developing Countries: Environmental Problems and Effects Based on the Pergamon Press, N.Y. 1977, p. 67.

18. Technical Program Committee Agriculture (AID), "TPCA Response to the Report of the Presidential Commission on World Hunger," Transmitted to the Administrator, AID, November 1980, pp. 23-24.

Table 1. Life of Irrigation Project Planned Estimated Costs and Percentage of the Total Planned Budget for Agriculture, Rural Development and Nutrition Allocated for Irrigation Activities in FY 1984...

(Source: Annual Budget Submissions, 1984)

Country	No of Projects	LOP Planned Costs-Irrigation (000)	Estimated % of Total ARDIN Planned Budget in Irrigation Sub-Sector
*Bangladesh	4	$ 33,849	5
*Burma	-	$ - -	-
India	7	$256,500	45
*Indonesia	4	$ 95,350	23
*Nepal	2	$ 6,000[1]	7
*Philippines	2	$ 10,000[2]	12
Sri Lanka	8	$234,900	68
*Thailand	2	$ 12,700	10
Pakistan	3	$115,000[3]	46
Total	33	$764,299	29

*Denotes Missions which in FY 1982 had no direct hire AID Technique Professional for Irrigation Water Management.

[1]Irrigation activities form a part of an integrated Area Development Project and a Natural Resource Conservation and Utilization Project.

[2]This is an estimte of the irrigation activities in both the farming systems and the various Bicol Area Development Project.

[3]This includes funds from the new economic support funds and an estimate of the irrigation components in the Tribal Area Development Project and the Tubewell Power Project.

Table 2 Percentage of Total Project Costs for Hardware, Software and Administrative and Management in Design, Planning and Implementation for 40 Projects with Cost Data by Donor Agencies.

	Percent of Projects' Costs World Bank	AID
A. Hardware Components		
(Dams, Canals, Drainage, flood control, roads, infrastructure, machinery, vehicles, tubewells and low-lift pumps)	62.7	61.8
B. Software Components		
(Training for staff-extension finances, credit and on-farm improvements)	18.0	25.1
C. Administrative & Management		
(Salaries, consultants, planning, implementation, etc)	19.3	13.1
TOTAL	100.0	100.0

World Bank projects total 24 and total project's cost is $1,806 million. AID projects total 16 with total costs of $401 million.

Table 3 Selected Software Components in 63 Irrigation Projects*

Software Components	Total Projects With Components	Percentage of 63 Projects
1. Training	3	5.7
2. Farm Water Management or On-Farm Development	19	30.2
3. Water User Association or Water Use Allocation	8	12.7
4. Extension	3	5.7
5. System Rehabilitation	11	17.5
6. Soil Conservation	1	1.6
7. Resettlement	9	14.3
8. Land Consolidation	2	3.2
9. Credit	10	15.9
10. Research	7	11.1
11. Operation and Maintenance	2	3.2

*These 63 projects include 32 from the World Bank and 31 from Aid. Ten percent were begun prior to 1970; 79 percent between 1970 and 1979; and the remainder in 1981 and 1982.

Annex II

WHAT IS IRRIGATION WATER MANAGEMENT

There is a need for a more comprehensive understanding of the meaning of irrigation water management. The term is often misunderstood and used almost as a dangerous fad because many international agencies are now willing to invest in water management improvement projects. Irrigation water management is the process by which water is manipulated and used in the production of food and fiber. Water Management also includes the management of water in rainfed areas as well as water artificially provided for perennial irrigated areas but the focus here is on manmade irrigation systems. Irrigation water management is not water resources, dams or reservoirs to capture water, nor canals to convey water, nor codes, laws or institutions to allocate water, nor farmers' organizations, nor soils or cropping systems. It is, however, the way these skills and physical, biological, chemical and social resources are utilized to provide water for improved food and fiber production. Irrigation water management for agriculture requires that six criteria be utilized in the design of new systems and the improvement of existing systems. These are:

- Increased water control and reliability of supplies to the farm level
- Increased productivity of water to farms and farmers
- Improved equity of water distribution among all classes of farmers
- Improved maintenance of soil and water resources over time
- Increased participation of farmers in the operation and maintenance of the farm system
- Increased cost effectiveness of investments in the system.

To achieve the six criteria of successful irrigation water management requires:

- Professionals trained with comprehensive irrigation water management focus backed by institutions which provide incentives and mechanisms to utilize new knowledge and skills in project implementation and system operations.
- A systems approach which links water source, water supply, water application, water use and water removal.
- Team diagnostic analysis and development of solutions, skills and procedures acquired on live systems with farmer involvement used to design, implement and operate systems which fit particular physical and cultural settings. A design approach from the bottom up and back.

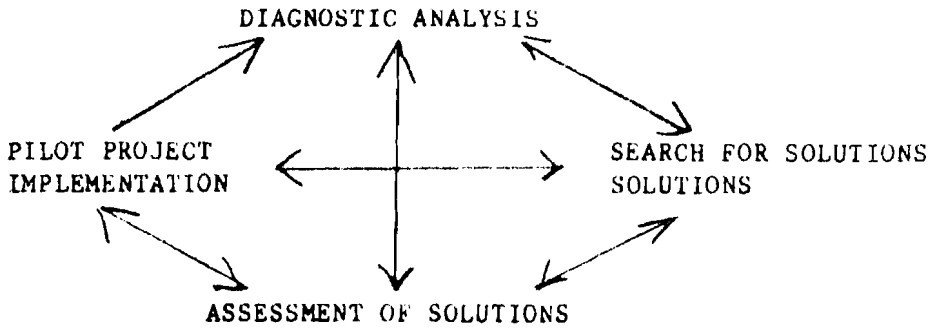
- A solid focus and orientation to the needs of farms and farmers at the productive end of system and farmer involvement in design, implementation, operation and maintenance of the system below the outlet.
- System demonstration areas where farmers are the chief salesmen of useful technologies.
- A marriage relationship between irrigation and agricultural bureaucracies where roles and responsibilities are designed to achieve coordination of activities and integration of timely inputs and services for end users.

Process for Improving Irrigation Water Management

The Action Research-Development Process includes diagnostic analysis, development and assessment of solution to bring benefits to the sub users. There is a growing concensus among professionals involved in comprehensive water management programs that there must be a strong emphasis on action-oriented diagnostic and evaluative research studies by interdisciplinary teams to ascertain how systems are currently functioning in order to identify priority constraints which must be solved in the context of a living laboratory - the command area. Experience on AID projects in the field of irrigation water management in other countries such as Pakistan, Egypt, and Sri Lanka has resulted in evolving a model called an Action Research-Development process for improving irrigation systems and involving farmers. This concept now undergirds AID's Water Management Synthesis Project which has developed training courses using this model. A video course has also been developed which is used to teach this model along with other modules for improvements below the outlet.

The following figure shows the various steps in the research process for improving irrigation systems and lists the key concepts and essential components.

FIG. 3 A RESEARCH PROCESS FOR IMPROVING IRRIGATION SYSTEMS*



Key Concepts

1. Systems Approach
2. Interdisciplinary Research
3. Management Oriented
4. Action Research

Essential Components

1. Client Involvement
2. Communication
3. Team Collaboration
4. Monitoring and Evaluation

A brief outline of each of the four phases with special reference to the relevance of each to the training programs of the project and the special studies is given below:

Diagnostic analysis of an irrigation system is done by an interdisciplinary team of irrigation and agricultural professionals with farmer involvement to understand the system and identify those physical, biological and socio-economic components which are not functioning to meet the system goals. The problems of the system are identified and prioritized for developing system solutions for improving the performance of the system.

The next step is a search for practical solutions by the same team, comprising an engineer, agronomist, economist and an extension professional. An in-depth investigation is carried out into the problem and solutions are worked out on-farm with farmers as cooperators. Those solutions which are cost effective, highly visible and acceptable to farmers are selected, demonstrated and refined. Such demonstrations developed and evaluated over one or more crop seasons will provide a visible demonstration of what water management really is. This will have the greatest impact on the farming community because they develop a sense of ownership through active participation.

The same team makes an assessment of each solution package that has been worked out to ensure farmer acceptance and to identify what completion inputs services are required. Careful analysis of costs and benefits, externalities and institutional infrastructure needs are conducted. The alternative packages evolved are presented to the appropriate agency for policy decisions for implementation.

Finally, there is the phase of program diffusion or wide scale project implementation. This consists of carrying out such improvements in the hardware or software in the system/sub-system under conside ation on a large scale. This is the stage where maximum assistance and help is required from the Government and cooperation from the farmers.

The most interesting feature is a performance evaluation after completion of the action research program and pilot project in order to determine the improvement in the system performance.

Training of professionals in such action studies is most relevant and useful since it provides both a disciplinary subject matter focus and interdisciplinary training with a systems and management orientation. Such training carried out on live systems under farm conditions will go a long way toward infusing confidence among the water management specialists in handling problems and among the farmers on the utility and improvement of water management for increased crop production.

The key concepts and essential components which guide this flexible process are also shown in the above figure. The nature of the problem requires a system approach. The action research and the development components of the model bring together an interdisciplinary team to involve real system problems. The training and research are not carried out in lecture halls or laboratories or on a research farm but on-farm in actual chaks and on real canal systems involving the farmers and irrigation, agriculture, and other agencies under real and complex conditions. The total approach is management-oriented because the focus is on helping the real manager, the farmer as well as the professionals who operate the larger system.

Annex III

THE CONTINUING IRRIGATION WATER MANAGEMENT POLICY DIALOGUE IN INDIA

India is a world leader in irrigated area and new capacity for irrigation. In the past, irrigation development has been dominated by civil engineering with primary focus given to design and construction versus a comprehensive irrigation water management policy which focuses on management of the water resource to the farm level. The problems of achieving an irrigation water management program are not unique to India. This new approach has relevance throughout Asia and in the United States. A set of policy changes are now being made in India as a result of several key factors. First, the cost of operating irrigation systems the usual way has become too high in terms of project cost effectiveness, irrigation efficiencies to the farm level, and therefore the productivity of water. Second, both from the top levels of the GOI and the grassroots, political and social pressures are increasing for improved water control and reliability of water at the farm level. Third, USAID, and other donor agencies have worked closely with Indian colleagues to introduce a water resource management approach for irrigated agriculture.

The key policy issues in this new area of irrigation water management are: The role of the Center versus the States in water resource development, the training and retraining of professionals in agriculture and irrigation in the new field of irrigation water management, the role of end users in the design, implementation, operation, and maintenance of systems; the role of subsidies below the outlet for farm level improvements; the separation of design and construction from operation and maintenance and providing a career ladder for the latter; and establishment of more exacting criteria for project evaluation combined with improved monitoring systems.

Unlike many countries in the region, there is much policy dialogue in India and an open environment in which it takes place. The approach of the Mission has been to identify key places of intervention in areas of policy and program concern to the GOI in irrigation. We have used several (carefully timed) methods to produce policy ferment and change. In this process at certain points we have collaborated closely with the World Bank and Ford Fondation and also worked on a close colleaguial basis with Indian leaders in the policy arena.

Since 1978 much has been accomplished and foundations have been established for a more solid human resource and institutional development emphasis. For example, recently with policy changes such as the command area development program, the development of small commands with rotational supply systems, improvements in water

BEST AVAILABLE COPY

charges, credit policy, etc. have taken place. Special projects have been evolved for small farms, drought-prone, and tribal areas. Recently, the CWC has proposed the creation of a special seat for a member whose responsibility would exclusively be irrigation management and training.

The Mission identified areas of need early and worked through a number of ways to build the water management concept into irrigation projects to the farm level. Lessons learned from early involvements in Gujarat and Rajasthan are being built into new projects.

The Mission in 1980 had a high level irrigation team from the AID/W WMSP to come to India to study irrigation issues and investment strategies for the 1980's. As a result of the dialogues which took place at the Center and in the States, several policy innovations have evolved which will be implemented in AID projects. For example, the GOI now realize the need for long-term professional development for those involved in irrigation water management as well as diagnostic analysis action field studies to identify and resolve problems. The new water management planning concepts in both the AID/W WMSP II and those of Asia/TR are now being built into projects such as Maharashtra Irrigation Technology and Management Project. The State Government of Maharashtra has accepted many of these new concepts together with technical assistance in the medium projects.

The centerpiece project of water management training action field studies now being negotiated with Central and State Governments is a basic human resource and institutional development project. In this project, as well as Maharashtra IT&M, the covenants and agreements are carefully developed to achieve the policy changes required for a successful project.

We are involved with the leadership of both irrigation and agricultural bureaucracies in policy dialogue and have had meetings with the planning commission also.

The methods used to create ferment and achieve policy changes to date in the irrigation subsector are: Dialogue with key leaders; sector study of issues and investment strategies; professional development workshops by WMSP; special meetings with State and Center leaders to make them aware of new irrigation water management approaches (use of lectures by visiting experts, video modules of the WMSP, workshops and discussions) careful design of projects to incorporate new concepts with appropriate covenants and agreements; professional development training workshops; development of a network of key actor. who are provided appropriate papers, technical reports, etc; close collaboration with Ford Foundation and the World Bank.

The Mission supported by Ford Foundation and the World Bank is viewed by the GOI as the major organization to provide technical assistance and other services for the proper mix of hardware and software components of irrigation improvement.

It is realized that AID, U.S. universities and related organizations such as USDA (SCC), Bureau of Reclamation, etc. have been pioneers in irrigation development. AID has attained worldwide stature in promoting irrigation water management which is a new field hardly 30 years old.

The Mission through its impact on policy and programs hopes to strengthen institutions and develop human capital for improving India's capability to design, implement and operate more effective irrigation systems to achieve increased agricultural production and higher levels of rural welfare. We view appropriate irrigation development as the prime mover for rural development.

We have utilized appropriate methods to achieve policy change and are continuing to intervene in a timely manner. Our approach has resulted in developing credibility with irrigation leaders and over the next years we feel the Mission has an unparalleled opportunity to help India develop the institutional capacity needed.

Annex IV

CONCEPTUALIZATION OF IRRIGATION WATER MANAGEMENT TRAINING NEEDS AND ITS DELIVERY SYSTEM FOR INDIA

Kenneth C. Nobe*

Background

There has been a growing awareness in recent years among Indian administrators, professional agency personnel and farmers that in order to make significant progress in efforts to increase agricultural output, ways must be found to increase the efficiency and productivity of irrigation water at the on-farm level. Heretofore, professional personnel primarily employed in the Irrigation Ministry and respective State level Irrigation Departments, who are trained primarily in civil engineering, have only been concerned with the water delivery system above the canal outlets. Delivery of water at the watercourse level and its eventual use in farmers' fields has been considered the farmer's responsibility. These end users have traditionally been given technical assistance from the Ministry of Agriculture and the respective State level Agriculture Departments, supported through research at land-grant type agricultural universities and institutes, and by cadres of extension personnel. At the farmer's level of contact, however, such extension assistance has been almost totally on a single-item basis, e.g. plant protection, improved seed varieties, fertilizer, etc. There is presently no overall extension component packaged as on-farm water management advice.

*Dr. Nobe is Chairman, Department of Economics and Director, International School for Economic Development Studies at Colorado State University, Fort Collins, Colorado, U.S.A. He visited India in January and February 1982, as Chief of Party for a team of specialists invited by the India Mission, U.S. Agency for International Development and the Central Water Commission, Ministry of Irrigation, to advise on the development of a long-term irrigation water management special studies and training project. The views expressed in this paper are his own and do not necessarily reflect the current policy positions of either the U.S. Agency for International Development or the Central Water Commission (CWC).

BEST AVAILABLE COPY

India's Administrative Framework for Irrigation Management

At the central government level, the Ministry of Irrigation is responsible for overseeing the irrigation development in the country. Its technical arm is the Central Water Commission whose main functions are to help the Ministry and the Planning Commission in developing the irrigation components of the five year plans, to scrutinize and approve the technical feasibility of the States' medium and major irrigation projects, and to assist the central government and the States in negotiating for loans from international organizations for irrigation projects.

Since irrigation development is primarily a State responsibility, the construction and operation of major and medium irrigation schemes are essentially the responsibility of State Governments. The organizational arrangements for the construction, operation and maintenance of irrigation projects differ from State to State. In most States, however, project design provides for the construction of all works down to outlets, main drains and watercourses. Farmers are required to construct field channels and drains. In a general sense the Irrigation Departments do not feel directly responsible for the development of irrigation command areas which are left to be done by other State-level Departments such as Agriculture, Soil Conservation, and Revenue.

Currently, the Irrigation Department in all the States is headed by a Chief Engineer, who is operationally in charge of the Department. Under the Chief Engineer, there are Additional Chief Engineers responsible for each division, assisted by Superintending Engineers, Executive Engineers, Assistant Engineers, Junior Engineers and Field Level Workers. In addition to an Irrigation Department, many States have a Command Area Development Authority (CADA) staffed with personnel deputed to them from Irrigation and Agriculture Departments. The main function of CADA is to improve the on-farm water use management aspects of irrigation development in the States.

The Chief Engineer is in charge of all works in the Irrigation Department, including the construction of major and medium irrigation projects. The Additional Chief Engineers look after both construction and maintenance of projects on a zonal basis. In addition, there are groundwater development boards in some States. Usually the investigation and planning of major and medium irrigation works are looked after by investigation and planning wings, each under a Superintending Engineer. The design of major and medium works is supervised by a Central Design Directorate of the Irrigation Department.

Minor irrigation programs are a responsibility of State Agriculture Departments. And, irrigation research institutes or stations carry out the work of analyzing materials, like soil, concrete, etc. not only for Irrigation Departments, but for other Departments also.

Given the above listed separate lines of agency responsibility, disputes over national vs. State level jurisdiction and the type of training needs of the respective professional staffs involved, it should be readily apparent that appropriate technology and better methods of on-farm water use are not effectively reaching most Indian farmer irrigators at the present time. Within this context of present reality, Indian Government administrators and concerned personnel from the major international donor agencies have now reached agreement in principle that an intensive training effort to upgrade the professional skills of personnel in Irrigation and Agriculture Departments in the area of irrigation water management is now of the highest order of priority. The urgency of this effort was recently highlighted in the new 20-point program for the current five year plan announced by the Prime Minister in January 1982 in which improving India's irrigation efficiency was given priority number one.

Key Questions to Answer

Although some mechanisms for training a cadre of skilled personnel in the area of on-farm water management are already underway, e.g. World Bank supported State-level training centers such as the Water and Land Management Institute (WALMI) at Aurangabad, Maharashtra, and the Land Development and Water Management Institute (LDWMI) at Anand, Gujarat, it is deemed necessary to view the training needs in total perspective. Such a perspective must necessarily range upward from engineering technicians and extension workers in direct contact with farmers, to Command Area Development Authority (CADA) and major irrigation project administrators, and finally up to national level personnel in the Ministries of Irrigation and Agriculture. In taking such an overview, there are key questions to answer, as follows:

1. Who shall be trained?
2. In what numbers"
3. In what kind of skills?
4. Who can best do the training?

These questions are addressed briefly in tur.

Who Shall be Trained?

At the outset, it would be desirable to consider the proposition that all Government agency personnel in the chain of command who have a direct role in the irrigation water delivery system - from the watersheds above the major dams, down through the canal system, into the watercourses and eventually ending in individual farmers' fields - must have the kind of professional skills appropriate to whatever level of responsibility each of them has in the system. Specifically, this will include senior officers such as Chief Engineers and Superintending Engineers, middle level officers such as Executive and Assistant Engineers, Junior Engineers and new recruits and field level workers such as operations personnel below the outlet, watercourse extension personnel, land development specialists and agricultural extension specialists. A corollary to this basic proposition is that each professional should have an overall understanding of the total irrigation system, not just detailed knowledge of that component of the system with which he is presently directly concerned. Up to now, little understanding of that system component below the canal outlets is apparent among either Irrigation Engineers or Agricultural Extension specialists. It is worth noting here that at present a field level water management component is not one of the major functions of the extension service. The extension departments neither have the resources nor the personnel for this important function currently. As far as the Irrigation Departments are concerned, there is a tendency among the engineers to regard water distribution as a routine activity, requiring an understanding of water supply parameters but not water demand, since such knowledge is viewed as being of no importance to system repair, maintenance and management decisions.

The short-term training needs focus directly on the total group of professional personnel already on the job - an in-service training effort which, as will be shown below, is of a major order of magnitude. For the longer term, it must be recognized, however, that an interdisciplinary focus on irrigation system management must be included in the university curricula of the engineering and agricultural universities. Those graduates form the manpower pool from which Government agencies concerned with irrigation systems will be recruiting their personnel replacements and to accommodate future growth. Smaller numbers of the latter group of trained personnel will be needed because most of the major planned new projects will likely be in place by the year 2000. It is critical, therefore, that universities begin now to adequately train new engineers and extension workers in the skills that they will need during their

long-term Government careers. But it must be recognized at the outset that considerable lead time is necessarily involved in developing this part of the training system because of the slow rate at which curriculum changes can be incorporated into the ongoing university delivery systems.

The final point to make in regard to "who shall be trained" is that, ultimately, it is the farmers who most need these kinds of water management skills and understanding. All of the professional manpower requirements for agency personnel referenced above are dwarfed by the magnitude of the number of farmers involved in irrigating fields. Unless the agency personnel receive the appropriate training first, however, there is not likely to be much adoption of improved irrigation water management technology and skills at the farmer level. Nor will they undertake the risks involved in adding enough other high cost modern inputs until reliable water deliveries are insured.

In What Numbers?

Recent estimates of the number of professionals in need of appropriate irrigation management training have ranged from 30,000 to 50,000, (not including personnel at the irrigation technician and agricultural diploma holder levels) but there is some doubt as to the reliability of these estimates. While there is general agreement that the number in need of training is very large, there is still a large variance in the available estimates. Therefore, a final determination of the magnitude of these training needs should be based on estimates obtained from agency administrators at the various levels involved in the system.

For the purpose of this initial evaluation effort, however, estimates to the year 1985 prepared by M.N. Venkatesan and presented in a recent professional paper will suffice.[1] His approach in developing these estimates assumed that the smallest units to be managed independently would average 5 million hectares (ha.). According to Venkatesan, 60 million ha. are presently being brought under irrigation, consisting of both surface and groundwater systems, and the potential exists for another 15 million ha. for development in the immediate future.[2]

1/ M.N. Venkatesan, "Manpower Requirements for Efficient Water Management", paper presented at the Afro-Asian Conference, I.C.I.D., Nigeria, 1981.
2/ Ibid. p. 2

In total then, for this exercise, one can assume that there would be the equivalent of 15 total units of 5 million ha. each in operation by 1985. Including both technicians and professional level managers, a total manpower requirement of 171,794 was estimated per unit. Of this total, however, only 8,933 would be assistant engineer level and above.[3] To this direct manpower requirement, are added 250 persons for monitoring and 25 for auditing, or a total of 9,208 per unit.[4] Then, since it was assumed that there are 15 such units to staff, the total estimated professional manpower requirement to 1985 at the assistant engineer level and above is 138,120.

It is worthy of note that this total estimate is larger by several orders of magnitude than the various other estimates made previously by Indian administrators and donor agency personnel. [5] This wide variation in available estimates points to the critical need for getting more accurate estimates, preferably from the various administrative levels involved, per steps taken to have the Central Water Commission (CWC) coordinate this data collection effort. At this point in time, it is impossible to tell at what level the final estimates will fall, so suffice it now to merely say that extremely large numbers of professional personnel are in need of irrigation management training, over and above the even larger training needs for diploma holder support personnel who are in more direct communication with farmers.

In What Kind of Skills?

The most effective irrigation training efforts are action oriented and management focused. They should not be purely lecture oriented. To provide actual hands-on experience, training should be organically linked to the action study programs. The action studies should be conducted on actual operating systems, with problems identified through systematic diagnostic analysis.

3/ Ibid. p. 15

4/ Ibid. p. 17

5/ One possible reason for this discrepancy could be that while the above estimate is based on total system requirements (which include both surface and groundwater projects) the available estimates by Indian administrators and donor agencies appear to be based on the surface irrigation system alone.

The recommended approach to training agency personnel in water management for irrigation begins with a diagnostic analysis of water use problems in the farmers' fields, carried out by an interdisciplinary team. The mechanics of this approach are explained in a paper detailing the Pakistan experience of the Colorado State University On-Farm Water Management Project during the 1970s; and which is extremely relevant to the India situation as well.[6] The three basic kinds of subject matter involved are engineering, agricultural sciences, and a third area of expertise broadly labeled "management", which encompasses the socio-economic, legal, institutional-organizational and extension aspects. At the on-farm level of involvement by professional agency staff, the training inputs are covered via participation of the following team members, identified by discipline: engineering, agronomy, economics and sociology (or extension with a social emphasis).

As the training needs are defined for involved professional personnel at higher levels in the irrigation delivery system, the element of management skills shifts from the narrower focus of farm management as a basic element of the agricultural economics and sociology disciplines to that of program and personnel management in the vein of the kind of training provided in Harvard and elsewhere in Masters of Business Administration (MBA) programs; therefore, a skill input of this type, more likely to be found in such places as the Indian Management Institutes, becomes a necessary ingredient. Due to the unique characteristics of an irrigation system as contrasted to business enterprises operating totally in the private sector, however, MBA type training will not be directly applicable unless modified to take these differences into account. Finally, as one visualizes the mix of skills needed as we move up through the administrative hierarchy, one finds less and less a need for additional detailed skills in engineering (which the government engineers involved already have in any case) or in the agricultural sciences (in which extension workers already have expertise), but with needed increasing proportions of basic interdisciplinary type management skills. For personnel at all levels, the need remains for an understanding of the total irrigation delivery system, beginning at the farmers' field and moving upward to include the canal delivery system and the total watershed.

6/ Max K. Lowdermilk, Wayne Clyma and Alan C. Early, "Physical and Socio-Economic Dynamics of Irrigation in Pakistan", Proceedings: Specialty Conference on Legal, Institution and Social Aspects of Irrigation and Drainage and Water Resources Planning and Management, ASCE, Blacksburg, Virginia, July 26-28, 1979. pp. 827-843.

Specifically, the training needs of various irrigation officials are as follows:

A. Senior officials should be given short-term training the following:

1. Systems analysis of socio-institutional-economic-physical-agricultural-environmental aspects of irrigation systems and projects.

2. Methods of irrigation data collection, storage, processing and analysis.

3. Performance criteria and evaluation methods of the main system and below the canal outlet subsystems.

4. Elements of micro and macroeconomics and their application to irrigation systems, including benefit-cost analysis.

5. Rural sociology concepts and their application to irrigation systems.

6. Water law, institutions and farmer water-use organizations.

7. The role and importance of communication, motivation and leadership styles.

8. Financial aspects of on-farm irrigation management.

9. Management techniques for efficient development and utilization of water resources.

B. Junior and middle level officals should be given longer term training in:

1. Design of irrigation systems (including below the outlet), central structures, elements of hydrology, irrigation and agricultural practices, a general state of the art in irrigation management, scope for improvements and modernizations, monitoring and diagnostic analysis.

2. Water distribution systems analysis - with emphasis on warabandi type user turn rotation arrangements.

3. Agricultural aspects, soil-plant-water relationships, crop-water requirewments, soil conservation and watershed management.

4. Organizational analysis (departmental as well as farmer groups).

5. Performance appraisal, quantitative methods and irrigation economics.

6. Concepts of rural sociology and their applications to irrigation systems.

7. Water logging, salinity and drainage.

8. Field visits and hands-on training at the centers of action studies/demonstration projects.

9. Farm management and economics.

C. Entry Level Operating Staff

1. Rudiments of hydrology, irrigation and agronomical practices and their linkages.

2. Methods of water measurement, laying out field channels, watercourses, operation and maintenance.

3. Elements of social and behavioral sciences, as well as the formation of water users' associations and farmer organizations, etc. (Extension techniques, leaflets, films, audio-visuals, video, etc.)

4. On-farm training for one full crop season, working in an interdisciplinary group.

5. Water logging, salinity and drainage.

On the whole, the training programs should focus on irrigation methodologies which will help farmers in improving their irrigation efficiency. These methodologies are:

1. Diagnostic analysis to identify the problems of irrigation development.

2. Developing the information systems for monitoring of irrigation projects.

3. Scheduling water delivery.

4. Institution development with respect to government agencies, the farmers and the interface between them.

5. Planning and design.

6. Action research and demonstrations.

7. Training.

8. Transfer and diffusion of information about irrigation management projects across regions and countries.[7]

It should be apparent from the above discussion that the curriculum mix for the clientele groups at different administrative levels will necessarily have to change as we move upward through the delivery system. Smaller and smaller groups of government personnel are involved at each successively higher level. This recommended mix change can be shown schematically with a triangle representing the groups to be trained, as in Figure 1 below. In addition, it must be recognized that the lower down in this triangle that training is imparted, the greater the need for inclusion of field studies and exercises, carried out at ongoing irrigation project or demonstration sites.

7/ This list of action elements was suggested by Dr. Robert Chambers of the Ford Foundation during informal discussions in New Delhi in January 1982.

Figure 1. Distribution of Irrigation Water Management Training Needs and Types of Curriculum Inputs Required atr Each Level.

	Type of Curriculum Inputs		
	Engineering	Agricultural Sciences*	Managerial Skills
National Level			
State Level	Less	Less	More
Regional or Within State Level (CADA, etc.)	More	More	Less
Sub-Regional Level (Watercourses and on-farmer's fields)			
Number of Personnel to Train			

*Includes agricultural economics type farm management inputs

Who Can Best Do the Training?

There is presently no major consideration being given to the training needs of diploma level technicians at any of the State WALMI type training centers. Yet, since it is these engineering aides and field level extension workers who have the most direct contact with the farmers, this component of a total training needs program is extremely critical. Given the large number of personnel involved in such an activity, it does not appear likely that the State level training centers could accommodate them, even if physical facilities could be adequately expanded. It therefore appears that the continuing education and extension type short courses presently offered in other subjects at some of the agricultural universities should be utilized to meet this need. It must be recognized, however, that given the present departmentalized and specialized nature of such university programs, a concentrated program of training these future trainers selected from among existing faculty would have to precede any major efforts by these universities to successfully undertake this large training component.

As presently structured, the State level training centers are best equipped to handle the regional level training needs, such as the junior engineers in the Irrigation Departments and the extension

contact agents in the Agriculture Departments. While the newly established training centers at Aurangabad and Anand have organized so as to have interdisciplinary faculty inputs, the older training center near Lucknow is still heavily focused on programs that utilize its existing expertise in soil conservation. All of the existing and proposed centers will require a heavy curriculum input of field demonstration and problem solving which in turn will necessitate a linkage with pilot project field areas for conducting special studies.

The degree to which the training centers can be linked with agricultural universities located in their immediate vicinity will likely depend on whether the center directors report through either the Irrigation or Agriculture Departments. Since the curriculum at the State level centers will necessarily have a heavy agricultural economics input, there is no additional need for other direct inputs of the "managerial skills" component at that level. But such input will be increasingly critical in training programs for personnel at higher and higher levels in the administrative chain.

The State level top administrator level is identified in the above diagram as the point at which the managerial skills input becomes critical, although in practice, key regional level administrators such as project managers and command area development directors should also have this kind of training. And, it goes without saying that the key administrators at the national level in both the Irrigation and Agriculture Ministries should be included in the training program. Such training will be particularly critical for administrators who came up through the technical route, such as in CWC, but will also be useful for Indian Administrative Service personnel who have heretofore had no specialized training for administering irrigation water management programs.

Ideally, training for top level administrators via seminars, workshops and short-to-medium term study programs should be offered through one or more of the Indian Institutes of Management (IIM) who have demonstrated expertise in this area of endeavor. For example, the IIM at Ahmedabad, through its Center for Management in Agriculture, is ideally equipped to take on this responsibility. Since there will be relatively smaller numbers of trainees involved from this administrative level, the Center could probably effectively handle the total workload. In addition, the center could provide a useful service as an input for "training the trainers", both for the State level training institutes and the water management wing of the proposed national staff training college in the Central Water Commission.

BEST AVAILABLE COPY

Under present plans, the proposed water management unit of the CWC national staff training college is situated at the top of the apex of the schematic diagram given in Figure 2. Its most useful functions, however, appear to fall more in the coordination and support role for State level training centers than in major direct involvement in training efforts, per se. Since the proposed unit would not be tied to a representative field study or pilot program area, and since the IIM at Ahmedabad has greater demonstrated expertise in imparting managerial skills, it is difficult to see a direct training role for CWC's institute in either of these two areas. There is, however, a useful role for the unit in providing selected short courses in specialized subjects, and workshops and seminars for CWC personnel and selected senior State level personnel.

Figure 2. Distribution of Irrigation Water Management Training Needs, Relative to Training Units with Comparative Advantages for Different Levels of Needs.

Distribution of agency staff in need of training	Types of institutions to conduct training programs
Nat'l	National Centers (CWC, IARI, etc.)
State	Management Institutes (e.g. IIM at Ahmedabad)
Regional	State-level Training Centers (e.g. WALMI at Anand)
Sub-regional holders and up)	Agricultural Universities
Local on-farm level (primarily diploma holders)	
Farmers	

No. of Personnel in Need of Training

While India had demonstrated capability to put into place a desired mix of service institutions for training most of its in-service personnel, the individuals to be selected to do the training could in certain instances benefit from study periods abroad. Likewise, faculty within those agricultural and engineering universities who are interested in helping to expand their curricula for formal degree programs to include irrigation water management on an interdisciplinary basis could benefit from such opportunities. These non-degree study programs abroad could be completed in one year or less. Such programs of study, tailor-made for each individual, are currently being offered by the International School for Economic Development Studies at Colorado State University and by the Water Management Institute at Utah State University in the United States and perhaps elsewhere in other countries.

Summary and Conclusions

There has been a growing recognition among Indian government administrators and donor agency personnel in recent years that India does have the necessary agricultural resources, particularly water and land for irrigation, necessary for meeting its rapidly expanding food needs to the end of this century and beyond. While long-term plans call for rather large additions to the irrigated acreage within the next two decades, it is now readily apparent that such efforts alone will not likely achieve the projected food increase targets, mainly due to present irrigation systems operating at extremely low levels of efficiency. The key to success, for both new and existing irrigation projects alike, will therefore be to significantly improve the operation and management of total irrigation systems, with particular emphasis given to those segments in the system below the canal outlets. While it has long been recognized that the critical factor in the agricultural output system is the effective use of water in the farmers' fields, public programs have until recently given little emphasis to improving efficiency at that level.

The climate is now right for mounting a major program in personnel training designed to improve the management of India's irrigationf systems. The vehicle chosen is to undertake a large-scale in-service training program for irrigation personnel in the Ministries and Departments of Irrigation and Agriculture. The foregoing preliminary conceptualization of these training needs underlines the fact that the number of professionals immediately in need of additional training is exceedingly large - exceeding 138,000 college degree holders and diploma holder technicians of many times that number.

BEST AVAILABLE COPY

The preceding analysis has shown that in addition to the need for training inputs in irrigation engineering and basic agricultural sciences for all personnel to be trained, there is an overriding need as well for training in system management skills. Unfortunately, the latter is a key area of expertise not heretofore included in formal degree training programs at the university level, either for engineers or agriculturalists.

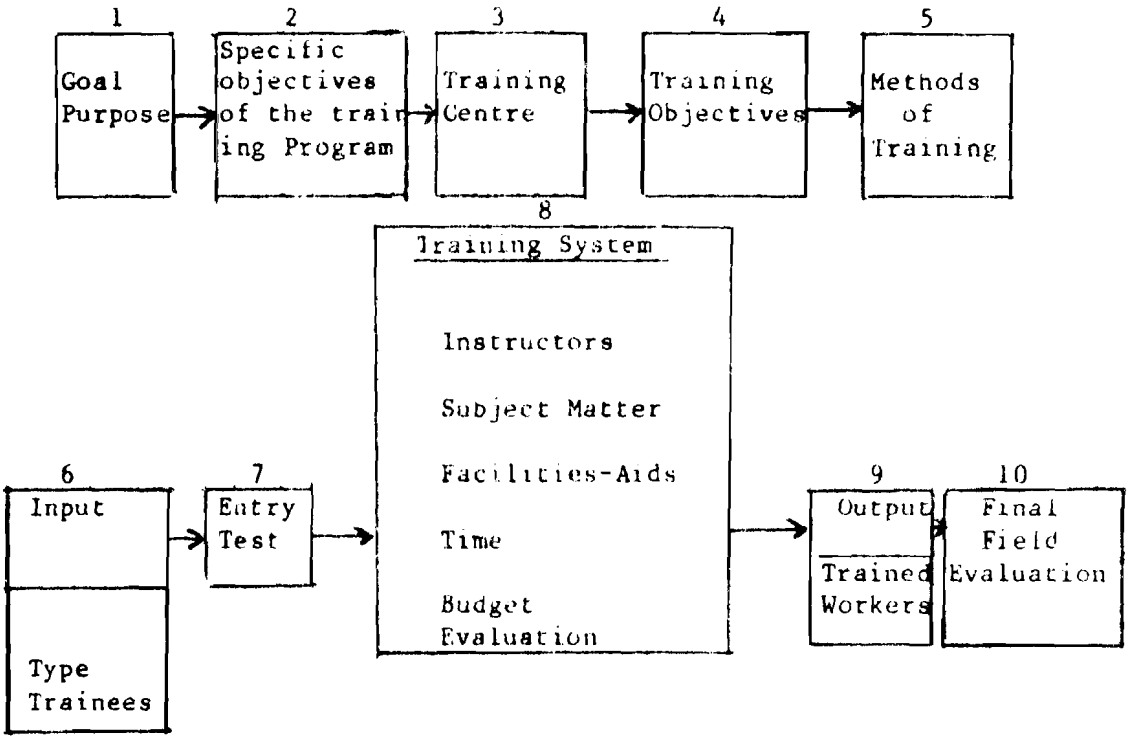
Finally, the foregoing analysis suggests that a number of different types of training units - ranging from agricultural and engineering universities, to management institutes to state and national in-service training centers - should be mobilized to undertake the training programs. There are two basic reasons for the latter recommendation. First, the size of the training job is too large for any single type of training unit to undertake it successfully. Second, since the training input mix necessarily must change as we move up the administrative system from the local to the national level, various types of training units that could be involved have specialized comparative advantages for working with the specific training needs for groups working at differing levels within the irrigation delivery system. The training efforts suggested here, if successfully implemented, will have very significant positive impacts on institutionalizing desired irrigation water management concepts and technologies into policy, planning, design and, most of all, operation and management of India's irrigation systems.

Annex V

A CONCEPTUAL FRAMEWORK FOR DESIGNING TRAINING PROGRAMS FOR IMPROVED WATER MANAGEMENT

By
Max Lowdermilk*

The purpose of this paper is to provide a conceptual framework for a systematic approach to planning a training [1] program in irrigation water management. The diagram immediately following shows the major areas which need to be considered.



* Senior Water Management Advisor, AID, Asia Bureau, Technical Resources, Agriculture and Rural Development, Washington, D.C., 20523. This paper is designed as a tool for conceptualizing and designing short, intensive training programs for professional development in Water Managmement.

[1] There is a clear advantage in designing such programs as "professional development programs (or Centers) in water management" instead of training programs, with classes being composed of "professionals" instead of "trainees".

While a one-way flow is shown, there is clearly a feedback. The design would necessarily provide for continuous monitoring/ evaluation of all areas of training, providing the information of all areas of training, providing the information needed for modifying the program to enhance its effectiveness and efficiency.

The remainder of this paper outlines the elements/components within each of the boxes above. While a program may not include all the components, they need to be considered in a systematic approach to developing a training program. The approach stresses the development of interdisciplinary awareness, understanding and coordination. However, it should not be construed that all participants would be exposed to all components of the program. All participants, for example, would receive training in team work principles and methods; however, for much of the time, the trainees would be divided into disciplinary groups where each group receives specialized (professional development) training in a specific discipline. Both the specific discipline training and the general team work training are carefully integrated and are complementary. The major task for planning is to clearly specify the job requirements of the trainees which they must be able to perform efficiently in the field.

1. Goal and Purpose of Program

The goal of Water Management Improvement Training programs is to increase agricultural production and farm income through improved efficiency of irrigation water use. The purpose is to create in-country capacity to design, implement and evolve programs to improve water use practices through a training program which:

- instills in trainees an appreciation of the benefits stemming from good water use practices;

- provides the trainees with the capacity to determine existing deficiencies and to develop feasible and efficient approaches to their solution; and

- provides the trainees with discipline and team skills and approaches for regular on-going monitoring and evaluation for improved irrigation systems.

2. Specific Objectives of the Training Program:

a) To help professionals understand the principles, processes, and specific field procedures required for diagnostic analysis* of irrigation systems and to learn how systems presently operate in practice.

b) To provide field training experience for skill and knowledge acquisition in the measurement methodologies and procedures of a disciplinary and interdisciplinary nature to identify priority operating constraints in irrigation systems with a focus on the total system from the farm level.

c) To help professionals understand and utilize the processes and procedures of team work for developing solutions to identified problems.

d) To help professionals appreciate positive attitudes and behaviors related to involving farmers working closely with other discipline members in a team approach.

e) To help professionals internalize the importance and the procedures required for intensive field training and learn how to train others involved in on-farm irrigation involvement.

f) To help professionals understand the requirements for field data management procedures and how to implement them for quality control of data.

g) To prepare selected professionals for roles as project managers, monitoring and evaluation of improvement programs, and the training of others.

3. Suggested Training Content:

a) Basic overview of principles of water management

(1) Importance of improved water management.

---

* Diagnostic analysis is a systematic process involving an interdisciplinary team and farmers in a careful analysis of how the system works and an identification of how the system can be improved to provide farmers with water control and other production possibilities.

(2) Study of the water management development process and Volume I of the Monitoring and Evaluation Manual on Diagnostic Analysis of Farm Irrigation Systems* before training program begins.

(3) Review of the Volume II of the above manual on how-to-do field methodologies.

b) Procedures and methods of diagnostic analysis of farm irrigation systems studies.

(1) Basic concepts and principles of diagnostic analysis.

(2) Methods and uses of quick and efficient preliminary reconnaissance studies in diagnostic analysis.

(3) Use of reconnaissance information for the design and testing of a prototype detailed diagnostic analysis field study on a live system.

(4) Basic farm management and team building concepts and principles.

(5) Field pretesting, planning and execution of a detailed diagnostic analysis field study.

(a) Site and sample farm selection methods and exercises.
(b) Validity, reliability and objectivity in field studies.
(c) Planning for field logistics.

(6) Principles and methods of quality data management control.

(7) Principles and methods of farmer involvement in field studies and field supervision related to data collection.

(8) Discipline and interdisciplinary team analysis of data and interpretation methods and principles.

(9) Procedures for synthesis of discipline data for preparation of a team report.

*Lowdermilk, Max; Clyma, Wayne, et al, Monitoring and Evaluation Manual for Diagnostic Analysis of Farm Irrigation Systems Volume I (Systems approach, Concepts, and Principles, Volume II (How to do field methodologies), Water Management Synthesis Project, Colorado State University, Ft. Collins, CO. USA.

c) Specific psycho-motor skills for diagnostic analysis studies

(1) Flow Measurements

(a) Cutthroat flume
(b) Parshall flume
(c) Current meters
(d) Orifices and gates
(e) Pump discharge

(2) Soil Properties

(a) Bulk density
(b) Field capacity
(c) Wilting point
(d) Water content

(1) Gravimetric method
(2) Carbide method
(3) Tensionmeter method
(4) "Feel" and "Touch" method

(e) Soil texture and physical properties
(f) Measurement of infiltration rates of water in soils
(g) Tests for salinity
(h) Tests for chemical properties of soils

(3) Mapping physical systems

(a) Developing base maps of farm command areas
(b) Methods of topographical surveying
(c) Measurements of convergence channel cross sections and slope
(d) Measuring basins, field sizes and geometry of files
(e) Crop survey methods
(f) Location and mapping of field inlets, structures, etc.
(g) Determining and mapping land ownership and tenure patterns.
(h) Determining farm fragmentation
(i) Basic drafting techniques and development of useful overlay maps

BEST AVAILABLE COPY

(4) Production factors

(a) Crops stand and yield analysis methods
(b) Soil sampling procedures
(c) Soil fertility and capability determination
(d) Soil and water salinity determination
(e) Seed viability testing and germination
(f) Seed emergence determination
(g) Seed placement analysis
(h) Fertilizer placement determination
(i) Estimation methods of yields.

(5) Water delivery

(a) Channel loss measurements
(b) Volume and flow rate analysis
(c)Dependability of water control analysis
(d) Determination of water flow characteristics in channels and on fields.
(e) Water budget analysis

(6) Water application

(a) Field application efficiency measurements
(b. Water advance and distribution on field analysis

(7) Water use measurements

(a) Consumptive use
(1) Measurement
(2) Computation

(b) Water stress characteristics on plants and criteria for analysis

(8) Water removal and return flow measurements

(a) Excess water removal
(b) Soil-water content analysis

(9) Farm management data

(a) Farm budgets

(1) Short forms for partial budgets
(2) Long forms for partial budgets

(b) Farm decision making and risk analysis
(c) Cost benefit analysis of lifting water
(d) Analysis of comparitive advantage of various crops mixes.

)10) Questionnaires for field surveys

(a) Development of questionnaires

(1) Key informants
(2) Sample farmers
(3) Minor irrigation officials
(4) Major irrigation officials

(b) Pretesting of questionnaires
(c) Sampling techniques
(d) Administering questionnaires
(e) Interview techniques
(f) Validity, reliability and objectivity methods
(g) Use of unobtrusive measures such as observations
(h) Precoding questionnaire
(i) Criteria for selection and methods of key informants and panels of farmers
(j) Procedures for building credibility with farmers and how to usefully involve them in diagnostic analysis.

(11) Data management and analysis

(a) Methods of statistical analysis and design for analysis
(b) Developing useful data summary forms
(c) Procedures for data management from the field to coding and analysis of data
(d) Data analysis

(1) Hand calculators
(2) Computers

(e) Sampling frames, procedures and problems

(12) Survey administration and analysis

(a) Procedures and concepts for mapping of social systems
(b) Selection of key informants and sample farms
(c) Procedures for developing credibility with farmer clients and irrigation authorities
(d) Uses of field diaries
(e) Dejure versus defacto analysis of water laws and system operation codes
(f) Methods for conflict and power/influence analysis of farmers on command areas

(d) Applied research skills for search for solutions of priority problems identified in diagnostic analysis field studies

(1) Land leveling

(a) Determination of field levels
(b) Calculation of cut and fill and volume calculations of soil
(c) Equipment use and maintenance
(d) System design for more efficient irrigation practices
(e) Evaluation methods

(2) Crop trials and testing

(a) Experimental plot design methods
(b) Statistical methods
(c) Design of fertility, moisture, irrigation method trials
(d) Monitoring/evaluation

(3) Farm layout and channel design

(a) Channel design including cross sections, slope and length
(b) Structures including turnouts, junctions and drops
(c) Field and farm layout for improved irrigation and labour efficiency
(d) Regular monitoring methods

(4) Improved irrigation method design for various farm and crop conditions

(a) Basin
(b) Border
(c) Furrows
(d) Other

4. Training Objectives

(Each concept, skill or new attitude to be taught should be clearly and specifically stated in a behaviorial objective in terms of the learner.)

Examples

a) To acquire the skills required to install a cutthroat flume correctly
b) To develop a base map of a farm conveyance system
c) To take a soil moisture sample and determine water content by the gravimetric method
d) (Reader add own objectives)

5. Methods of Training

a) Field method exercises and demonstrations
b) Lear by doing in the field
c) Panel and group discussions
d) Films and slides
e) Reconnaissance field tours
f) Role playing
g) Case studies
h) Lecture

(Note that the lecture method is given last priority and the learn-by-doing-in-the-field is given top priority.)

6. Input-Type Trainees:*

(a) Senior irrigation personnel including managers of projects, executive and deputy engineers, deputy directors of Agriculture, Economics and Extension.

(b) Technical field staff
(c) Field supervisors of technical staff
(d) Trainers
(e) Researchers
(f) Gain advance information on all participants related to:

(1) Age
(2) Rank
(3) Degrees obtained
(4) Previous field experience
(5) Expectations
(6) Specific present job assignment information and information about future job expectations.

7. Entry Test:

(a) Document and keep visible on a wall throughout the training course, expectations of the professionals as related to the training program.

(b) Entry assessment of all participants related to:

(1) Basic understanding of their own discipline skills
(2) Prior understanding of basic concepts of course
(3) Understanding of water management as a concept and its dimensions.
(4) Basic professional attitudes about work and relationships with farmers.

(Tests for professionals are often perceived as intimidating. Therefore, each trainer must utilize, with skill, methods to make the assessments needed. This can be successfully done by each trainer and by the team of trainers using methods which are not threatening.). Utilize assessment as a type of benchmark to use for purposes of altering course to meet specific needs and for the final evaluation of the training. Use the professional attitudinal assessment method to tap basic attitudes which are essential for effective field work experience.

---

* Experience indicates that at a given training workshops for professional development in water management it is more efficient in staff time to focus on a single type group to assure that training is targeted to their needs and the particular jobs for which they are to be responsible.

8. <u>Training System</u>:

a) Instructors: Type, number, tasks, how long (specify).
b) Subject matter: Work out in general blocked sections in a sequence which builds on where the trainers are and what they are to learn.
c) Equipment, facilities, aids required (draw up complete list from chak required to transportation needs to eating and sleeping facilities.)
d) Time frame: (See Indicative Time Frame on schedule in Annex I) Decide on the blocks of time, the division of time between major sections, time to be spent in class, field on tour and even the time to be utilized for social and recreational activities. Remember, adult professionals want to know where they are going and what they are expected to learn. The only way to motivate adults is to base the training on their needs and to build on their interests.
e) Consider all budget needs and develop budgets allowing for cost overruns.
f) Design simple and quick continuous evaluation mechanisms into the course for immediate feedback for improving training and meeting specific needs:

(1) Self evaluation of trainers on a weekly or biweekly basis.
(2) Group evaluation twice during the training programs - i.e., midway through program and the end of the program.
(3) Evaluation of specific skills performed in the field on a skill-by-skill basis. Continue to train for that skill until each has mastered it and can effectively teach another the same skill.

Annex VI

PROFESSIONAL DEVELOPMENT NEEDS FOR IRRIGATION MANAGEMENT: LESSONS FROM AID EXPERIENCES

By
Max K. Lowdermilk*

> "The quality of human agents is underrated. Population quality and knowledge matter. A good number of low-income countries have a positive record in improving population quality and in acquiring useful knowledge. These achievements imply favorable economic prospects provided they are not dissipated by politics and government policies that discriminate against agriculture. As Alfred Marshall wrote, 'Knowledge is the most powerful engine of production; it enables us to subdue nature and satisfy our wants."
>
> (Theodore W. Shultz, 1981, pp. 16-17.)

Introduction

One of the most challenging aspects of irrigation development today is that of improving both the quality and quantity of the human capital involved. We have always known that irrigated agriculture requires much larger capital inputs than other forms of agriculture. To make that capital cost effective, we are just learning that good irrigation projects require large inputs of quality human resources. If we agree with Dr. Theodore Shultz that

> "The most important economic resource in the world consists of the acquired abilities of people -- their education, skills, and health." (Shultz, 1981, preface)

then we must organize some of the conventional priorities of irrigation development. If human capital is indeed more important than simply more financial capital for larger schemes, more hardware, including dams and canals, and even more cropland irrigated, what does this mean to our deliberations here? What role should investments in human capital and institutional development play

---

* (The views expressed in this paper are those of the author). Presented at Expert Consultation on Training and Water Management, Food and Agricultural Organization of the United Nations. Senior Water Management Advisor, Asia Bureau, Technical Resources Office, Division of Agriculture and Rural Development, Agency for International Development, Washington D.C.

in the water management revolution of the 1980s? My organization, the Agency for International Development's policy is to focus more on the development of human resources and institutional capabilities in the 1980s. (USAID, May 1982, p. 2.) We have found in our studies in several countries that the major problems of Irrigation Systems are not so much technical, but are more in the areas of institutional and human problems.

The purpose of this paper is to share some of AID's experiences with host countries in training programs related to irrigation management. Some of the basic lessons learned in AID's current strategies are highlighted. It is hoped that some of these lessons, combined with your experiences, will result in mutual exchanges and useful recommendations.

Please note that two terms are used deliberately in this paper. Professional development is often used instead of training because it is more appropriate for adults who are professionals. It is also less intimidating. Most of all the term expresses continuous learning by all persons involved at each level of complex irrigation systems, from the policy makers to the farmers. Would that we would relate to farmers more as adult professionals? Also, would that we would begin to focus more on farmer training needs? Farmers who manage complex farm systems need continual upgrading in their levels of information, knowledge, and skills as well as other actors involved in several organizations dealing ;with irrigated farming.

Irrigation management is used, from time to time, to include the terms "water management", "irrigation water management", and "on-farm water management". This is simply to remind us that our concern is with every level of the irrigation system and that we need to incorporate all the relevant disciplines and professions required to design and operate systems for increased agricultural production. Irrigation management also includes our concern for all inputs and services complementary to water for increased crop production. A broad term is sometimes needed because, as a colleague has recently stated, "No one seems to be observing, analyzing, keeping track of, thinking or worrying about the irrigation system as a whole". (Corey, 1982.) Perhaps it's because we do not yet know how to do this. This problem indicates a real need for the team approach required for training and action programs.

A. Rationale for Increased Concern for Professional Development Related to Irrigation in the 1980s

There appear to be four major interrelated factors creating interest in both expanding and improving the human capital component of irrigation.

1. As irrigation development has become absolutely essential to solving the world food problem, the criteria for successful irrigation projects have become more exacting.

To meet these new criteria will require more and better personnel in the design, implementation, operation, utilization, and maintenance of irrigation systems. No longer will donor agencies, planning commissions, politicians, or farmers view success simply in terms of reservoir size, kilometers of canals, potential command area, or even actual area irrigated. Now attention is being directed to yields per unit of land. One day, as costs continue to accelerate, success will be evaluated in terms of crop yields per unit of water. As we move closer to the productive farm end of the system, we realize the need for much more non-enginerring expertise. Agronomists, extension workers, farm management or water resources-oriented economists, and other social sciences, are required. Basic engineering is not the fundamental problem, although design methods and standards can be improved both above and below the outlet. The real need is for cadres of professionals who understand the system in relation to the agricultural production process. One of the most essential areas of training to complement basic professional training is that of teamwork and how to work well with farmers. Irrigation development is not only an engine for rural development but it has become as complex as the rural development process itself. Wiener, for example (1976, p. 25) states that irrigation investments should be made on the basis of how they enhance rural development in terms of increased production, employment generation and higher levels or rural welfare. To begin to meet the new criteria for successful irrigation projects, such as increased water control, productivity, equity, conservation, farmer involvement, and project cost effectiveness, requires much greater expertise in both quantity and quality than in the past. Some scholars estimate two and three times the current levels of manpower are needed to operate and maintain most gravity systems when considerations are made for both above and below the command level outlet.

2. Investments for new irrigation projects are so large that there is a problem of mobilizing adequate skilled managers and other human resources.

Worldwide investments for irrigation for the 1980s may range from $100 to $150 billion, depending on what and whose assumptions are used. It is likely that 75 percent of this total will be utilized for new systems. For example, a recent report indicates that India will invest $2.5 to $3 billion per year between 1980 and 1985 (Sixth Plan) of which 90 percent will be used for new projects (TAC Report, 1981, p. 12). In some countries with large investments in new and existing projects there is keen competition between large irrigation authorities (such as WAPDA* in Pakistan and Mahawali in Sri Lanka) and agricultural departments involved in water management. Then of course, the Middle East oil rich countries are siphoning off irrigation-related expertise. For example, in Pakistan and Sri Lanka, this is a most critical problem. A few years ago in Pakistan, an agricultural engineer could hardly find a job. Today universities are unable to meet the demand for agricultural engineers.

In many countries there is a shortage of staff for both new and old projects. At one Pakistan university in 1975 only about 20 agricultural engineers were enrolled but by 1981 120 or more were enrolled with inadequate teaching staff! Operation and maintenance programs often suffer due to the lack of budgets and adequate staff. In few low-income nations are there any trained staff working directly with farmers on a regular basis to improve water use through better irrigation practices. How do we begin to reverse this trend? First, we need to know the magnitude of the problem in each country.

Presently there is little data in any country which even suggests what the magnitude of the training task might be. Except on a project-by-project basis, it is almost anyone's guess how many, of what level, and what type of personnel need training. One estimate for 36 countries for the period 1975 to 1990 indicates that a total of 62,646 persons need to be trained for new projects. This includes 6,187 professionals, 30,983 technicians, and 25,476 extension workers that are needed, at a total cost of about $284 million. (ORAM, et al., 1979, pp. 63-64). We do not know, however, if this estimate is high or low. I note from this study that eight Asian countries could use 86 percent of these trained persons. The

study also shows that India, alone, could use 69 percent of the total for its gigantic program, but this is likely a conservative estimate. Another estimate for India, based on the manpower needs for units of five million hectares, is almost 140,000 trained persons by 1985. (Venkatesan, 1980, p. 14).

The Sir Charles Pereira Team Report to the Technical Advisory Committee of the Consulative Group on International Agricultural Research estimated the need for 2,000 to 3,000 irrigation and agricultural field scientists for each of the great alluvial plains per year. (TAC Report, 1979, p. 10.) Though a useful report in some respects, it tells us little about the specific training needs of professionals other than engineers and agronomists.

In the field of professional development for irrigation management, one of the priority needs is to develop the means to assist countries to conduct in-depth assessments of training in terms of type, levels, quantity, and quality of manpower needed to the year 2000. Leaders in at least three Asian countries have stated that a primary need is to have an objective manpower inventory based on the new irrigation management approach. Until we have more data, we are unable to make rational decisions on allocations of funds for training. What evidence we do have about allocations of funds for training is not too encouraging. For example, in a recent analysis of 63 irrigation projects by an AID contractor, it was found that only three projects gave a strong focus to training. Of the total budget for these 63 projects, only about one percent was allocated for the training of both staff and farmers (WMSP, 1982, p. 4). Data from the 63 projects, of which about 80 percent were begun in the 1970s, suggest that software investments in irrigation development are lagging. Experience indicates that when money is tight and time is short, training is often relegated to a marginal place. The AID study also shows that for the 63 projects the average expenditure for training staff and farmers plus extension services was about $25 per hectare. This is to be compared to the high cost of new and rehabilitated project costs per hectare. Though we have little hard data on training needs, let us remember Wiener's (1976, p. 22) statement that

> "Irrigation not only requires much larger capital inputs than other agricultural methods but also the heaviest inputs in trained and experienced human resources. With few exceptions, the most critical scarce resources in the low income nations are management talent or professional and sub-professional manpower".

3. A major reason for improved professional development is the low level of performance of irrigation systems.

Time will not permit a review of the deficiencies documented in hundreds of studies and many conference reports over the last ten years. The state of the art in irrigation field studies has advanced greatly. With few exceptions in Asia, these studies using performance criteria of water control, irrigation efficiencies, crop yields, stability of the environment, equity, and cost effectiveness, show that irrigation systems fall far short of potential. They always fall short of design expectations and the norm is for designers to blame another professional group or farmers for poor system performance. Donor agencies and host country planners are very concerned about the poor performance of present systems. With new projects often taking 20 to 30 years to complete at costs as high as $200 million for 100,000 hectares, there is the view among some that new systems not be built until we learn how to make existing systems more productive (See Wiener, 1976). In several countries the cost of newly equipped irrigated areas is over $4000/hectare with major improvements running from $1000 to $1500 per hectare. (ORAM, et al., 1979. p. 59). If we could improve existing systems perhaps we could learn much to improve new system design (Smerdon, 1980).

4. The new irrigation management approach, which involves professionals from several disciplines using systems approaches, will require improved quality and quantity of expertise.

These new approaches have much in common. They focus on systems, diagnostic analysis using interdisciplinary teams; action research on live systems, monitoring and evaluation, farmer involvement, on-farm improvements and other key principles. Let me suggest that the tasks implied by this new emphasis create a great demand for new types of training and radical modifications in existing training approaches from universities to in-service programs in many countries. To date there are few places where this type of training is available. The need for new cadres and new approaches is great.

For example, in some countries there are plans and discussions about creating cadres of water distribution specialists, water utilization extension staff, and interdisciplinary planning and monitoring units. In Sri Lanka and the Philippines there are new cadres of irrigation organizers used to organize farmers for collective action and water user groups. Suggestions have also

been made for diagnostic analysis teams for project appraisal; problem identification and development of solutions; regular system monitoring; and evaluation of projects. A major question being asked in many countries is: Where can the trainers be trained for both old and new areas of need? Selected institutions in some of the high income nations may play an initial role. But for the long term, local in-country capacity should be developed. Today there are few places where adequate interdisciplinary hands-on training and field experiences are possible for irrigation and agricultural professionals. There are some good discipline courses for engineers, agriculturalists, and perhaps economists, but few where one can gain experience actually diagnosing systems using a team approach. Now that a role is emerging for social and behavioral scientists, management scientists, water law, and other expertise, where will they be trained? Many studies in India and Pakistan indicate that the main performance problems are often human, social, or organizational. It is interesting, however, that in these countries there are few or virtually no social scientists excepting economists involved full-time in irrigation development. A foremost question is how to get universities anywhere to begin to focus on some cross discipline courses and gain an understanding and appreciation of the roles of other disciplines. It is the feeling of some of us that a major problem blocking progress is the rigid casteism of various professional groups.

Also in the dynamic field of irrigation management, there are new specialized skills related to design, management, and research for which intensive training is needed. Some of these include river basin modeling, flood warning systems, ground-water simulation modeling, information systems for canal water allocation and other areas where computer software is making rapid advances. We should also include special social science areas of training. Some of these are water law, environmental impact, farmer involvement, training technologies, etc.

B. Basic Lessons Learned about Professional Development Related to Irrigation from Selected AID Experiences

As we consider new strategies for professional development, one useful approach is to examine what we have learned over the past few years. AID's strategy for irrigation training has gradually evolved to a point that we now have a more clear policy and a program which highlights human resource development. One study shows that in the 1970s, AID's investments for training in 16 irrigation projects

amounted to about four percent of total investments for irrigation as compared to less than one percent of the total budget for 24 World Bank projects. In the 1980s, we feel that this should be increased but due to lack of reliable data we don't know how much (See Table 1 in Annex).

The purpose of this review is to examine key experiences and distill major lessons learned. An attempt is made to examine both successes and failures, remembering that in training, as in life, we also learn much from our failures.

1. The Near East and South Asia Irrigation Practice Seminars, 1956-1670

Beginning in 1956, AID, with host countries in the Near East and South Asia regions staged eight major seminars. The stated purpose was to create interest and better understanding of the subject of water management with a focus on water use. The 1973 evaluation report states:

> "The basic objective of the seminar series remained the same throughout the period of its activity. The very serious problems of ineffectiveness of capital investment and poor water use practice still exist. Poor water use is not restricted to new capital intensive projects, but occurs pervasively on old and new projects whether traditional or modern". (Peterson, 1973).

The key actors in these seminars were host country officials who presented papers, conducted field trips, and held discussions on wide-ranging subjects such as design of major and minor systems, conjunctive use, water logging, and salinity, irrigation practices, water law, and farmer involvement. An effort was made to give each seminar as much political status as possible. The average seminar attendance was about 45 and a total of 376 non-U.S. participants taking part in the eight seminars. Each seminar issued a set of recommendations which formed part of the proceedings.

The 1973 evaluation report suggests some of the strengths and weaknesses of these seminars which were forerunners to countless other seminars by FAO and others on irrigation water management (Peterson, 1973).

In terms of contributions, it was found that for some policy makers and senior officials, there was an increase in awareness and understanding of on-farm water use, drainage

problems, role of farmers, technology transfer, and the need for agriculturalists and engineers to begin to work together. Several participants reported in 1973 that the seminars had contributed ideas that resulted in new planning procedures, improved coordination between irrigation and agriculture, more focus on land development, water user problems, and more emphasis on legislative changes needed.

The major lesson learned, which has relevance for professional development, is that for limited purposes, such as creating awareness and understanding, exposure to new ideas, providing participants opportunities for involvement, and developing group consciousness, seminars are useful. Evidently such working seminars are useful for policy level officials and knowledge transfer.

Stated weaknesses of the irrigation seminars include: Country reports often did not get at real issues; a lack of follow-up to the seminars; and the predominance of civil engineers. It is evident that such seminars are not efficient means to help participants internalize 'earning or to change behavior significantly. (Lynton and Pareck, 1978, pp. 143).

Nevertheless, there are two key areas where similar seminars are needed today. First, there is a need to help policy makers and senior officials become more aware of the new concepts and requisites for improved irrigation management projects. Sometimes we overlook this audience and focus our attention and training on middle or lower level personnel. Recently in two professional development workshops 86 percent of the participants reported that water management training would be of little use to them until their leaders understood its importance and allowed them to utilize their new knowledge and skills. They expressed the need for special orientation of policy makers and other leaders. Recently we have experimented with using specially prepared video presentations for busy policy makers in four Asian countries. These mini-workshops seem to have a great potentiual. One of AID's projects is designing some mini-courses and presentations for this crucial audience which is often overlooked. Secondly, well structured and focused workshops are needed for water management technology and knowledge transfer. As was stated at the International Symposium on Arid Land Irrigation, Alexandria, Egypt, 1976, the most glaring need is for better means to transfer scientific knowledge. (Worthington, 1977, p. 67). Much is being learned about irrigation management but, to date, there has been little systematic effort to disseminate this information to those who will use it.

There are a number of information services and network newsletters available but, as the TAC Report (1982, p. 28) states, for irrigation management we need a system that is more interdisciplinary and international, more concerned with management issues, more focused on developing country needs, more linked to action research, and which would have greater coverage. Our experience has been that under current systems it is only a few top people who receive technical materials. Could there be a clearing house for useful low cost information for professionals involved in operations and project development? Often irrigation professionals know more about irrigation developments in the Western United States than about developments across their own borders. In the Asian region, there are many lessons being learned and technologies being developed which are not being transferred properly. FAO continues to play a key role in this area of knowledge transfer, but that role could and should be expanded.

2. The Pakistan On-Farm Water Management Projects

AID's first major project with a focus on water management was initiated by a contract with Colorado State University in 1968. This was the forerunner of other Pakistan projects in which the USAID Mission is now involved. Much has been written about this long-term innovative project which has helped Pakistan develop a national program.

The basic lessons learned about training include several principles and several tough issues which still are not resolved. Also, a major conceptual framework evolved in Pakistan which is now used as a tool for the design of training activities and irrigation projects.

a. Training Principles

The first principle is that to develop effective training programs requires careful analysis and much time. This is especially true in countries where the irrigation management focus is new. Prior to the initiation of any formal training program in Pakistan, diagnostic analysis studies were made of the irrigation system and experiments were developed to find useful solutions to prioritized problems. Before initiating any training activity, one should first answer the question as to why training is needed. Is it to provide more productive work, better services to farmers, better job performance, to save time and money, or what? The Pakistan experience provided time to analyze the training needs for that particular context. Prior to any formal program, hundreds of professionals participated in on-the-job training in the field

with expatriate and Pakistani professionals. This helped determine training needs as we analyzed problems, standards of field performance, organizational needs, new roles and activities, and equipment needs. Other methods used with our Pakistani colleagues were brainstorming sessions, discussions, informal talks, observations, and surveys.

Professional trainers suggest that one of the weakest links in the total training process is that first task of defining the training program. (Lynton and Pareck, 1981, p. 5. and Craig, 1967, pp. 16-21). Everywhere we need to place more emphasis on the problem of program definition. We have all seen some training programs begun without careful analysis and definition of the program. Th.s is a definite danger when training becomes a fad.

A second principle is the crucial importance of institutional commitment necessary for a successful training program. We all seem to acknowledge this principal mentally but not always in practice. In Pakistan training was not initiated until various organizations needed more and new types of expertise. In other words, a demand created postions for trained people. For example, as the Water and Power Development Authority became more involved in research and demonstrations related to water management, new positions were created for agricultural engineers, agronomists, rural sociologists, economists, and extension workers. Likewise, in the integrated rural development program, a demand was created for many new water management positions.

Institutional commitment is needed because without incentives for training and the promise of a future for professionals much training is a waste. Examples of lack of commitment is where participants are sent to a training program who are within a month of retirement. In another case some of the training staff appointed to an Institute were either rejects or ready for retirement. It is not uncommon for staff to be sent to training as either a punishment or as a vacation without any expectation to utilize their new skills in an on-going program.

Institutional commitment has to do with proper selection of participants, by the organization which employs them to meet needs of the organization, and involvement in the post training evaluation on the job by the organization which needed the training. Dr. Pareek, a training expert of the Indian Institute of Management, says that the focus of training needs is on a person on-the-job in

the organization. The difference sought from training is what the people learn that they now apply on the job. (Lynton and Pareck, 1981, p. 15).

Another innovation of the Pakistan program was the way potential leaders were selected for overseas graduate work and returned to guaranteed positions in the water management program. Candidates for this training were selected on the basis of a long period of field work and on-the-job training. Graduate work for over 30 colleagues was designed around special research problems. Upon completion of coursework, they returned to Pakistan to do their field research and complete and defend a thesis. This assured that their research was relevant and that they would return to the water management organization which sent them. Today these individuals are playing a lead role in research, training, program implementation, and policy related to irrigation management in their country.

A fourth principle is the careful linking of research to training and to an on-going development program where training is conducted in a living laboratory. The rationale for linking research to training is the need to have living cases based on local data for training. Training should be heavily biased toward field exercises and training materials should evolve from local situations. At the National Water Management Center in Lahore, special studies linked to training have been useful.

The living lab concept is talked about in many places, but it appears that training programs over time in Pakistan and elsewhere have become more academic and depend more heavily on conventional training methods with lectures predominating. We still have a long way to go to perfect our training methods. The TAC Report (1982, p. 22) also suggests that "current training is based in the classroom rather than field realities". Research on training methods shows that traditional methods such as lectures for imparting knowledge and exhortations or capsuled courses actually do not create changed behavior back on the job. (Lynton and Pareck, 1981, p. 58) (See Table 4). The academic strategy used in many Irrigation Training Centers assumes wrongly that content and understanding can be "passed on" effectively by those who know to those who need to know. It is falsely thought that those who learn can translate abstract generalizations into improving job performance. Those who have experience in training realize that immediately after a lecture less than 50 percent of the content is remembered. Two months later, less than 20-25 percent is recalled and studies show those who have this level of recall are usually not the most intelligent. If we want changed behavior the lecture is the most ineffective method. Most of irrigation water management is learning in the field under real farm conditions (Lynton and Pareck, 1981, p. 140).

The fifth principle relates to principle number two but needs special emphasis. Training is not a panacea for all the performance deficiencies we find in irrigation systems. We must learn to examine these deficiencies in terms of the following questions: Is this really a training need? Is this a deficiency that can be corrected by training of some type? Is it a training problem at all? What are the alternatives to more training? (Craig, 1967, p. 41). For example, some deficiencies can likely be solved by better management objectives; an improved organizational structure; better management procedures, including communication and monitoring; more control structures; better policies for staff recruitment, promotions, and salary; improved financial support; water rates; and a better legal system.

Let us also remember that when someone learns a new skill there is no guarantee that he or she will ever use it on the job for improved performance. We know of too many cases where professionals were trained in one specialized area like dam design who was transferred to another like ground water development immediately after training. There are many alternatives to formal training which should always be explored. For example, with the large numbers of professionals to be trained and the value of on-the-job training, this mode should be used much more for junior staff.

In addition to these five major principles there are four major issues which need to be resolved in Pakistan and elsewhere. These include the question of curricula reform in universities, cross discipline training, the marginality of farmer training and the lack of cooperation between agricultural and irrigation departments in training and other activities.

The long-run solution to many training problems for irrigation management lies with the universities. There will always be a need for short term non-academic training and continuous professional development but most would agree that there is a need to get more water management content into university curricula. In many universities the philosophy, curricula, and the methods of instruction need to be radically changed if the training is to be relevant with present irrigation development needs. In many countries there are ample data, technical manuals, and other resources which are not being utilized for developing text books and training materials for university use. Over time a country's total training needs in irrigation will not be adequately met until both engineering and agricultural universities become involved directly with relevant training programs. Almost nowhere are there adequate

opportunities in universities for cross discipline exposure and understanding of the methods and perspectives of other disciplines involved in irrigation development. A prominent senior irrigation engineer of India recently remarked.

> "We must recognize the multidisciplinary nature of the training needed which is more than engineering. Solving water management should, in addition to engineering principles, include economics, extension, rural sociology, law, institution building, etc. Let us not view the training task simply as one of engineering. What is needed is a team approach to training. (Venkatesan, 1981).

There are a few indicative approaches which deserve some attention. The Agricultural University at Faisilabad in Pakistan has its own water management development area where professors and students conduct special studies and improvements in a living command area laboratory. This exposure is gradually involving several departments which are working together in a small command area. But except for agricultural engineers, the university to date is not producing water resource economists and professionals equipped to analyze the critical social organizational problems of irrigation management. We need civil engineers who understand soil-plant-water relationships and are sensitive to the consequences of their designs and operations on farmer behavior. As Chambers has said, "a challenge for the 1980s is to find ways to train professionals in an interdisciplinary mode". (Chambers, 1980). To achieve this requires much more imagination, different methods, and a totally different philosophy. It is doubtful if this will ever be done by workshops, conferences, seminars, or other traditional methods. It requires professionals of different disciplines working together in labs, simulation games, or field exercises (Chambers, 1980, p. 34) where the major emphasis is on field training.

Several universities in India are now offering a post graduate degree in water resource management. Several universities in India are also now involved in the slow process of revising undergraduate curricula. Some universities are becoming more involved with field research. Major universites in India with Government organizations are developing a technical advisory council for irrigation research. The purpose of the council is to tap professional expertise available in the universities and to involve them in training and solving irrigation problems.

Another issue that has become clear in Pakistan and most countries is that farmer training in water use management in practice is still very marginal or simply non-existent. The FAP expert consultation on Farm Water Management at Beltsville, Maryland, in May 1980, rightly highlighted the need for education and training to be directed to the farmers. (FAO, 1980, p. 13). AID's Asia Bureau studies in six countries of Asia indicate that there is virtually no extension and farmer training including that of the training and visitation approval related to irrigation anywhere. For example, in two recent field studies in two states of India, 90 percent of the farmers interviewed reported that the only information or advice related to water use and irrigation practices usually come from fellow farmers. (WMSP Reports, 1982). Studies of extension workers' levels of knowledge about basic irrigation principles and methods compared to studies of farmers show that extension workers often know less than farmers. (Lowdermilk, 1976.*) Except for some small extension experiments in Pakistan, little progress has been made in this area. Farmers need to learn more about how, when, and how much to irrigate, as well as other behaviors. Experience indicates that until farmers have a better and more reliable supply of water there is little need to train them. Also, I suspect we have never known how to take improved irrigation practices developed in Western countries and modify them to fit problems of small farmers facing severe constraints. Most irrigation practices recommendations suggest technologies and procedures which are simply too sophisticated -- such as water management, moisture sampling, siphon irrigation, advance and recession curves, dead level fields, etc. We may be able to identify weaknesses in current practices but I doubt that we yet know enough to develop a good training program for small farmers. Even U.S.A. farmers often don't measure their water and still apply it inefficiently using only rough rules of thumb.

A final issue that influences water management programs in most places is the lack of cooperation between agriculture and irrigation. For example, in Pakistan the Irrigation Department does not participate in the Water Management Program. As long as this state exists, there is a limit on how much improvement

---

* Lowdermilk, Max K.; Johnson, Sam H.; Early, Alan: The Need for a Water Management Extension Service in Pakistan. Bulletin of IDECR Council, Vol. 6, No. 1, June 1976.

can be realized by work at the farm level. Even in countries beginning to develop training programs, there are few places where engineers and agriculturalists are trained together for even part of the time.

b. A Process for Improving Irrigation Systems

One of the major lessons learned in Pakistan was the discovery of a definite workable process for irrigation development. This systematic approach known as a research-development process, is flexible but provides focus to the four phases and several key concepts. (See Figure 1). This process which grew out of field work was first described in 1977 by Clyma, Lowdermilk and Corey (1977). It has been used as a tool in developing projects, conducting project appraisals, and in developing training programs. A graduate level interdisciplinary course and an intensive summer field training course has been developed at Colorado State University using this model. Dr. Wayne Clyma and I have also developed this course on video training and field manuals have been developed on some of these key concepts and phases of the process. These are diagnostic analyses, development of solutions and project implementation. (Skogerboe, Lowdermilk, et al., 1982). At this point, I want to highlight the fact that, based on our experiences in Pakistan and later in other countries, this conceptual framework contains the key factors involved in improving irrigation systems. For example, before a formal training program is established, there is an adequate system diagnostic analysis conducted to understand the system and its performance deficiencies. Second, various technologies are tested in the field to evolve useful solutions. Third, there is a careful assessment of alternative solutions to identify training needs, institutional capabilities, cost and benefits, and socio-environmental externalities and impacts.

Prior to implementing a pilot project, as in Pakistan, a training program is carefully defined. By then there is known institutional demand for training and an understanding of what should be included in the training to improve performance in specific field activities. We feel that prior to any implementation program this is a process that will save time and funds. Too often we make unrealistic guesses about available manpower and often start new programs with no training.

It is our experience, in working with many professional groups, that a systems understanding is required by all professionals along with specific discipline training. In keeping with the systems approach, professionals need to work

together in teams to solve system problems. All training should have a focus on the consequences of system performance on farms and farmers. As farmer clients become involved in the process of system improvement, there is a need for staff to understand and be able to communicate effectively with them. A key concept in the research-development process is working with and learning from farmers. It has only recently been realized that professionals have much to learn from farmers (Lowdermilk, 1980). All professionals also need a management orientation. Note that training and institution building are linked because one way to improve institutions is to have a means to create a better quality of human resources. Action field research in this process is important at each phase. Since irrigation systems are dynamic and changing they also require careful monitoring and evaluation as shown in Figure 1.

This process can be used for the total irrigation system or for parts of the system. It provides a flexible built-in memory system and is based on a learning principle. Recently diagnostic analysis training programs based on this process have been demonstrated in Egypt, the U.S., India and Sri Lanka.

3. The Egyptian Water Use Management Project

Though this unique project of the Ministry of Irrigation will be described in more detail at this consultation by Dr. Everett Richardson, it fits with AID's process of learning about professional development. Since I was involved in this project I will be making a few training comments. The purpose of the project is to improve agricultural production in three areas of the old lands of Egypt by identification of priority problems and developing alternative solutions which the GOE can implement on a larger scale for a national program. The key activities of the project include professional development, special interdisciplinary action studies, demonstrations and trials, organization of farmers, institution building, and other facets of comprehensive irrigation management.

This project is significant in many respects but one is that it has provided a field test of the research/development process. The process itself has been greatly refined and improved by the Egyptian experience. Some of the major lessons learned about professional development in this water use management project are described briefly.

First, since comprehensive irrigation management using the interdisciplinary team approach for diagnostic analysis and development of solutions was new to Egypt it was decided to heavily front-load the project with appropriate professional development. Instead of the typical one or two percent of the project budget allocated for training, about 10 percent of the total budget for this project was used for professional development. The stated purpose was to build a strong cadre early which could implement diagnostic analysis and the development of solutions in the field and develop leadership and institutional capability for a sustained national program.

Second, it was found that Egyptian colleagues, though highly trained in an academic sense, had not been exposed to farm level field problems. This need is documented in countries other than Egypt by the TAC Report prepared by Sir Charles Pereira and his team (TAC Report, 1979, pp. 33-37). It was interesting that the Pereira team also did not find any organization where fully appropriate training was available for the applied work needed in irrigation. When our Egyptian colleagues began to see value in field studies and gained positive feedback from farmer clients they became convinced of the living lab concept. As they gained experience in diagnostic analysis, they began to realize that research agenda should evolve from basic farm and farmer needs rather than from office session of developing long lists of research interests by experts. Now these ground truth research priorities from the major and minor systems are being accepted by policy makers as the real needs of Egyptian farmers.

Third, a significant step was taken in Egypt when professional development was viewed in the design of the project as one of the major means for organizational development or change. For example, the first focus was on creating awareness and understanding in the ministries and among the highest officials of the cooperating organizations. Special tours were arranged to visit Pakistan and other countries to observe similar programs initiated earlier. The senior staff of the project were trained in the U.S. where a special interdisciplinary course was used along with discipline training and field trips. Although most of the senior Egyptian colleagues had Ph.D.s they still had a desire to upgrade professional training in certain discipline areas. Subsequently, less senior project professionals came to take an intensive hands-on summer course. The most outstanding were selected and were trained so that the course could be institutionalized in Egypt. Unlike in many projects, it was realized early in Egypt, by the project leaders, that

professional development is also a continuous process. A training officer was appointed and a comprehensive professional development program was developed which provided salary incentives for continuous training; incentives were given for professional papers, and opportunities to attend professional meetings to present papers; and encouragement to attend relevant workshops and short courses. Special in-house staff training meetings and special workshops have been a feature of this project from the beginning. A major innovation, which has relevance to some countries, is the use of specialized video courses offered for academic credit. For example, in Egypt, there was request for extra courses related to ground-water problems and design issues. These courses from Colorado State University were made available to the project on video tapes and the University of Cairo provided the academic credit.

Video has many potential uses in irrigation development. Academic courses can be offered to staff who work during the days. Special programs could be developed for continuous professional development of staff spread around a country. In some countries video is being used for transferring information to farmers.

The Egyptian project has also confirmed a widely accepted view of organizational and institutional change, which is that to change organizations requires a strong educational strategy. It is changed personnel especially leaders who create progressive changes in organizations. (Abramson, 1978, p. 9). This means that, initially training with a focus on awareness and understanding, needs to be targeted to the top leaders. This principle should be adopted more in our organizational development strategies. It is simply not enough to simply plug training in at any level and hope for results. I believe that in many countries a priority audience are those who make the big decision and develop policy. Note in Table 3 that from 80 to 90 percent of a group of Indian participants in a training program reported that high level national policy makers, state irrigation officials and Directors of Agriculture should have training first.

Finally another finding was the rapid acceptance of the interdisciplinary mode in a country where engineers have 5000 years of accomplishments and therefore the highest of status now realize the importance of working together to identify and solve real world problems. For example, in some preliminary surveys in India, over 80 percent of 76 engineers and agriculturalists reporting desired more interdisciplinary training as compared to discipline training. All the engineers in this survey reported that agricultural economists have a role to play in irrigation management. Over 70 percent reported that other social scientists should also play a role. This is a giant step forward. (Skold and Sen, 1982)

Although there are perhaps 30 or 35 short courses now taught on irrigation, most of these are specialized and heavily discipline oriented. Some are so lecture centered that they are largely irrelevant in terms of teaching skills or knowledge for changed behavior. I tend to agree with the 1982 TAC Report (1982, p. 26) that the training currently available falls far short of what is required in style, content, and scale. Too little training involves in-depth field exposure. In our demonstration training courses in Egypt, India, and Sri Lanka we find that the majority of professionals actually want more field experience. They also want to learn more from other disciplines through team work than we expected.

In evaluations of participants in the various types of training offered, there was clear evidence that not only are new skills needed but also new knowledge and new professional attitudes. We know much more about skill training than training for new attitudes and values concerning new roles, willingness to change attitudes, desire for personal and professional growth. We should never, however, discount the qualitative aspects of training such as attitudes which provide the basis for motivation and high levels of professionalism and commitment to farmers and development. Today Egypt has a large number of experienced and motivated professionals who know how to do irrigation management improvement in the field involving farmers for their benefits. The Egyptian Irrigation Water Management project, through its unique strategies, has also changed the basic attitudes of policy makers regarding water management. Changes far beyond our expectations have taken place in Egypt which has the longest and most proud engineering tradition.

4 The Water Management Synthesis Project

As AID began to gear up more for irrigation development in the late 1970s, a special project was developed known as Water Management Synthesis. The purpose of this project is to begin to synthesize some of the worldwide lessons being learned in special studies, technology development, and training. The project also provides services to USAID Missions and host countries upon request. Other activities involve appraisal of projects, identification of technologies with potential transfer value, traditional system analysis, and irrigation subsector studies of seven countries, six of which were in Asia. Training materials, technical manuals, and planning guides are developed along with a newsletter and made widely available around the world. This project's contributions will be discussed in more detail at this consultation, especially since it has been greatly expanded from less than $2 million to over $20 million in a second phase. I will describe only one particular type of training tested and refined under the WMSP with which I was

involved. The project was under contract to develop, package and demonstrate the diagnostic analysis (DA) mode of training in three places overseas. After refinement of the DA model the training concepts, training manuals, materials, and aids are to be made available for use. This is only one training mode, among others, recommended in the 1982 TAC Report (TAC Report, 1982, p. 35). In the new Synthesis Project it is only one of about four or five training courses to be made available.

I will outline the main features of the DA model for professional development training. As noted earlier in Pakistan we evolved the research development process from field experiences. From this beginning we experimented with several types of short "hands-on" training courses for irrigation professionals.

The diagnostic analysis mode is used to help teams of professionals to quickly understand an irrigation system, document the values, and to identify and prioritize the major performance constraints and their causes by doing field studies. This approach then leads to alternative choices or options for decisions about interventions to improve the systems under study. The course provides the concepts, principles, procedures, and how-to-do methods and skills for disciplinary and interdisciplinary analyses of irrigation systems. The training is done on live systems where useful data are collected, analyzed, synthesized, and made available to the project for improvement activities. The assumption is that once problems and the specific factors which cause the problems are known, solutions can be found in most countries. Another assumption of this training is that professionals have never had the opportunity to examine the problems of water supply, water delivery and water use in a team approach. Most had never realized the value of a systems approach which examined physical, biological, social, organizational, and economic factors involved.

The question is asked: Who needs this type of training? Thus far we have identified a large number of audiences who need all or part of this course. Table 3 in the annex shows how course participants answer this question. The vast majority (76 to 90 percent) reported that all types of professionals involved in command area improvement projects need diagnostic analysis training. About 65 percent reported that all new engineering graduates entering irrigation departments need this type of training. In addition, most of the participants felt that a short one to four day workshop, to provide high level officials with an understanding of the value of diagnostic analysis, would be useful.

Based upon experience in four countries we feel that this course can be used most effectively for training separate interdisciplinary cadres for project appraisal, system monitoring, and project evaluation. We also think that new recruits in irrigation and agricultural who will be working on irrigatin projects need the skills and knowledge that such a course offers. Those who distribute water and those who work directly with farmers can also benefit from the course.

This professional development workshop is arranged by the USAID Mission, the host country and the Water Management Synthesis Project (WMSP) Training Coordinator in the area where field studies are needed. The aim is to have participants who currently work in irrigation projects. Also we want a balance of disciplines such as engineers, agronomists, economists, and extension staff, because a major focus of the workshop is learning to work on teams in the field using systems approaches.

Week one is typically devoted to concepts, principles, and procedures of diagnostic analysis. Training manuals are provided which describe these and all the discipline and interdiscpline methods used. Video is used to reinforce the learning as are small group sessions. Since the major content of the course comes from the actual system to be studied, background presentations are given by local authorities on the local farming systems and the irrigation system. Video is used to provide overview presentations by the discipline leaders on the role and methods of each discipline (that is the civil, engineer, agricultural engineer, economist, and the extension specialist) in diagnostic analysis. A number of team exercises are used to develop and maintain open feedback from the participants. Discussions, films, demonstrations, small work groups and other methods are used, while lectures are kept to a minimum.

In the second week the trainers and members of their disciplines go to the field and, while learning how-to-do methods, make an initial reconnaissance of a command area below the outlet. Data are collected pertaining to the main system related to seasonal water supplies, availability of water, methods of allocation, decision making processes involved to deliver water to the outlet. Measurements are made on water delivery to the minor, conveyance losses, field application efficiencies, crop stands and crop quality. Information is collected from the farmers and minor officials about the operation of the system and their major constraints. The object here is to focus on skills and procedures while collecting real data and gaining an understanding of the magnitude and causes of major constraints. The information collected during the reconnaissance phase is then analyzed and presented by the

participants to the workshop. This information is then used to develop the detailed diagnostic analysis (DA) studies which will be done by interdisciplinary teams now that each team member has learned his particular responsibilities.

The third week is used to focus on discipline field methods and skills as well as to introduce teamwork and how to do DA in an interdisciplinary mode. Much time is taken to define roles and to develop the means for good communication and collaboration with each other and with farmer clients. Again video is used along with materials from the manuals, handouts, group meetings, and discussions. Teams are chosen, and using the reconnaissance data, each team begins to plan a detailed study of a system where key activities are arranged around the operation of the canal system, the operation of the on-farm water control system, the crop production system, farmer and organizational factors, and resource allocation. Each team learns by doing the field methods idnvolved; joint planning approaches; team building principles; selection of sample sites; and the assignment and execution of logistics and field activities. Cooperation is absolutely essential because one team member provides data needed by another team member. For the detailed study, the teams are completely in charge of all equipment, logistics, schedules, and even the arrangement of meals.

The fourth and fifth weeks the teams implement detailed diagnostic analysis studies, analyze and synthesize the data into an interdisciplinary report.

The final week is used to finalize data analysis and preparation of team reports for presentation.

It should be noted that the coordinators of the training are host country leaders and that their roles and the roles of trainers change progressively throughout the workshop. They begin as instructors and demonstrators and by week three they assume a role of advisors and consultants. It is our experience that in a five to six week period, the teams can then do DA on their own. Other types of training are needed but where professionals know their basic discipline skills, as in many countries, much can now be accomplished in a short period. The matter of saving time is also a crucial consideration.

The value of this mode of training is best judged by the participants' own evaluations. Two recent evaluation reports of DA workshops are available for your use. In summary, the participants gained much from the hands-on field-oriented training using the team approach. Many reported that this was their first opportunity to undserstand the irrigation system as a system. They reported not only that they learned new skills but that the experience had increased their knowledge and caused changes in their attitudes about p essionals, their disciplines, and work with the f .

BEST AVAILABLE COPY

The participants also ranked other types of special training programs they would like to have at some future date. In order, these were the following: system monitoring, project evaluation, implementing development of projects, water use practices, principles and methods of farmer involvement, design and construction of on-farm structures. Some of these problem areas will be taken as the basis of several future training courses the Water Management Synthesis project will develop.

5. AID program with Agrarian Research and Training Institute Colombo, Sri Lanka and Cornell University

The training activities of the Agrarian Research and Training Institute in Colombo add important lessons to AID's experience. In conjunction with Cornell University, ARTI has now trained and fielded two batches of 30 Institutional Organizers (IOs) in the Gal Oya system water management improvement project. This is similar to the irrigation organizer mode used successfully in the Philipppines. The IOs play a key role in the project by helping organize farmers into irrigator groups to assist in the planning and implementation of rehabilitation work on the systems, the management of water deliveries in certain portions of the system, and maintenance of selected portions of the field channel network.

The task of the IOs was to assist farmers in identifying their own problems and their own resources, both physical and human, while an organizational structure evolved naturally. The role of the IOs was to facilitate this process, and not to direct or teach or "organize" in the traditional sense.

Obviously, a traditional classroom-based teacher-centered training methodology would have been inappropriate in such a situation. It was found that trainees could not learn "participation" simply by hearing lectures. The training was designed with participatory teaching and learning approaches. Through the training methodology is still evolving, certain key elements stand out. One is that the training is strongly field oriented. Several weeks of field experience in the project area where they will work on a regular basis are built in to the training similar to that of the diagnostic analysis mode. In addition participants play an important role in shaping the training program as it progresses and feedback from them is continually solicited. (Svendson, 1982).

6. AID's Asia Bureau's Concern for an Irrigation Strategy With a Software Focus

As stated at the beginning of this paper, AID continues its long interest in human resource development linked with institutional development. Successful institutional development in irrigation depends largely on persons trained in apprpriate management and technical skills. Our experience is that institutional development takes time. Training takes time because appropriate modes must be evolved and trainers must be developed. Training must be selective in that it meets country needs. It should be complementary and build on to existing programs where possible. Also there should be flexibility because irrigation needs in every country are changing rapidly. (USAID, 1982).

In evolving a strategy for the 1980s, the Asia Bureau commissioned a team to conduct irrigation sector studies in six Asian countries. The purpose was to identify the major irrigation issues and investment strategies for the 1980s. Somewhat to our surprise, professional development training was given top priority in all countries. There is now an awareness of the need to retain personnel and to train new personnel in relation to current needs in irrigation development.

There is still, however, a lack of awareness about the need for institutional reforms to assure that those trained are allowed to utilize their skills more fully. Incentive systems for professinal development are still weak in most countries. Until there is a more favorable institutional environment in some countries, training alone will not be of much value. In fact, where professionals are not rewarded and allowed to use their new skills and knowledge training may be a waste.

The country studies in Asia were used as a basis of discussion in the Missions and in AID/Washington's Asia Bureau. It was decided that the irrigation subsector would receive top priority in our planning, it is hoped, over a ten-year period. As an indication of our priority in 1983 in terms of life-of-project costs, we will use about 40 percent of our agricultural, rural development, and nutrition budget for irrigation. In order to improve project design, we have evolved a set of planning concepts for a flexibile irrigation water management strategy in Asia where 90 percent of AID's activities are located. These planning concepts pesented without elaboration will give you an idea of our major emphasis in the years ahead. Most of these concepts imply areas of training required.

a. Make irrigation management the focus of irrigation development.

b. Encourage realism in evaluating the availability of the water resources and the demand on it. Improve design and construct or reconstruct with flexibility.

c. Use the diagnostic analysis mode in appraisals for new projects and evaluating existing systems for improvement.

d. Use the development of solutions mode of applied action research to test and demonstrate known technologies.

e. Build in strong monitoring and evaluation components in all projects.

f. Focus heavily on human resource development with a focus on field orientation in training.

g. Stress building institutional capacity in host countries by training professionals, strengthening institutions, farmer training, participation, and organization. Focus on extension vehicles to transfer technology to farmers. Promotion of private incentives and policy analysis.

h. Close collaboration with other international agencies.

As these planning concepts imply (Lowdermilk and Svendson, 1982), we feel that a software strategy is needed which stresses improved planning, design, and operation of systems. This will require focus on system appraisals, action research to identify and solve problems involving team approaches and farmer involvement. Human and institutional development lie at the heart of the task.

In terms of collaboration with other international agencies, AID has a good record in Asia and also with agencies such as FAO. We see our role primarily in developing prototype systems and in building up institutional capacity of host countries to improve design, implementation and operation of irrigation systems. We are therefore seeking a good balance of soft and hardware in each project. In a few areas of irrigation development, we feel that we have a comparative advantage in that AID can access the expertise from our Department of Agriculture and the USA university system.* Especially in the software areas there is much scope for cooperation.

The new planning concepts are being implemented in new institution building projects in Pakistan, Bangladesh, and India. For example, in Pakistan there is now a project to strengthen training, research, and monitoring in a national program. Also there is a subproject for farmer involvement and some new projects which have irrigation components being developed for the tribal areas. In Bangladesh there is now a project for action and training which will be the forerunner of other activities. Presently in India, we and our colleagues are designing one of our largest professional development and special studies projects. This project though still in the design stage will help support a national staff training institute, three or four state training centers, water management training in several universities, and training linked with special studies in two Indian institutes of management. The Government of India is giving training and other institutional changes a high priority in their large irrigation developments in the 1980s.

A key building block of our Asian strategy is the Water Management Synthesis II project which the Bureaus of Asia and Science & Technology have jointly developed and funded. In relation to professional development, this expanded project will provide technical assistance to help countries identify training needs and assist with training projects. In addition, the project will focus much attention on developing new sources and modes of training related to monitoring of systems, water use training for farmers, farm organizations, and special training for policy makers. The project is open to developing or making possible other types of training. The project will also develop training manuals and training aids for these courses as well as focus on special action studies, technology transfer, and the provision of technical assistance to USAID Missions and host countries around the world.*

Dr. Worth Fitzgerald, of AID's Science and Technology Bureau will provide more information on the Water Management Synthesis II project.

This rather long account of AID's major experiences in professional development is concluded with a summary of lessons learned and some recommended actions for your consideration.

---

*Among other innovations in this unique project the focus on building and utilizing international expertise across regions and countries for multiplying efforts is somewhat novel for AID. In several countries such as India, Pakistan, Egypt, Sri Lanka, Philippines, etc., expertise in comprehensive water management has and is evolving. This expertise needs to be used to increase efforts where possible.

7. Summary of Major Lessons Learned and Recommended Actions

Lessons Learned

a. Human resource development is a major need for implementing successful irrigation programs	Creation of some means to convince Government heads and policy makers of this
b. Investments for training are far from adequate in relation to new projects and existing projects.	Conduct an assessment of projects in relation to training needs
c. The need for more awareness and understanding of irrigation management needs by policy makers and senior officials.	Special materials and approaches to provide them with awareness and understanding
d. The need for transfer of knowledge and technology on a systematic basis.	Creation of a clearing house and systematically conduct irrigation management technology transfer working seminars
e. The need for diagnostic analysis studies of the irrigation needs (inc. training) and developing solutions to major problems before initiating a formal training effort.	Recognition that both local leaders and expatriates should base training progress on real rather than assumed needs
f. The critical need for institutional commitment for training and utilization of new skills.	Identify the commitment needed prior to training
g. Careful selection of participants for professional development.	Develop criteria for objective selection
h. Importance of linking training with special action studies and using a hands-on training approach under live field conditions.	Recommend an organic linkage between special action studies and training that will strengthen both

i. Over time in most training programs, there is a tendency to revert back to dependence on the lecture and other traditinal methods which are not effective.	Recommend that a study be done of the most effective training methods for irrigation management at various levels
j, Training is no panacea for all the performance deficiencies of irrigation systems and without other facilities, incentives, and actions, it is often a waste.	Recommend that training is only one tool and requires institutional support to make it useful
k. For the long run the universities must meet the major professional training needs but are very slow in introducing reforms in structure and content of curricula.	Recognize universities as target audiences and create means to reach them on a regular basis. Provide special consultants to interested universities. Make special fellowships available for university staff to develop text books and teaching materials.
l. Need to focus on ways by which professionals of one discipline can gain experience with the methods and approaches of other disciplines.	Promote interdisciplinary as well as discipline training in water management literature and meetings
m. Water management extension to improve on-farm water use is still largely neglected because we probably don't yet know how to adapt technologies to small farm conditions.	Promote special studies which will develop and test out on small farms improved appropriate practices
n. The research-development process provides a conceptual framework to AID preparation for developing a training program relevant to country needs.	Test and refine this and other processes

o.	Where water management is new to a country or a region projects should be front loaded with appropriate training.	Studies on the returns from investments in human capital
p.	In many countries irrigation and agricultural officials are well-trained in terms of academics and theory but have not had much experience in applied field work under farmer conditions.	Promote "hands-on" training and special action field studies under farmer conditions
q.	Professional development training needs to be viewed as a major means for creating organizational development.	Promote professional development as a strategy for organizational change
r.	The interdisciplinary mode is needed in training and due emphasis should be given to knowledge and attitudes as well as skills.	In training programs provide means to gain experience in working across disciplines. Also focus on knowledge and attitudes which are often the sources of behavior change.
s.	The diagnostic analysis mode of training is needed at many levels of the irrigation system to provide a systems understanding and to identify major performance deficiencies and their causes.	Promote more DA training and research
t.	The team approach to monitoring and evaluation of irrigation projects and systems is needed, also teams representing relevant disciplines, should be used in the design, appraisal, and implementation of projects.	Promote the use of regular monitoring for improved management. Develop field manuals for monitoring and evaluation. Develop new courses on system monitoring
u.	Greatly improved monitoring of existing systems on a regular basis is needed as well as monitoring and evaluation of new irrigation projects.	Promote the use of regular monitoring for improved management. Develop field manuals for monitoring and evaluation.

TABLE 1.
*Comparison of Training Methods and Selected Training Objectives for Irrigation Managers

		Training Methods					
		Field	Simul.	Lab	Cases	Seminar	Lecture
1.	Realistic understanding of Job Requirements	High	V. High	High	High	Low	Low
2.	Internalizing new knowledge about job	High	High	V. High	High	Low	V. Low
3.	Learning how to think about Irrigation Systems	High	High	V. High	High	High	Low
4.	Gaining new ideas and methods on how to do the job better	High	Low	V. High	High	High	High
5.	Changing behaviour in operation	High	High	V. High	High	Low	Low
6.	Developing an attitude of team work	High	High	High	High	High	Low
7.	Ability to step back and think about the job as a whole	High	V. High	-	V. High	High	High
8.	To participate in intensive active learning	High	High	-	V. High	Low	Low

*Modified from Rolf P. Lynton and Udai Pareck (1978), p.142.

Table 2

Common Areas of Professional Development Training Needs for Irrigation Management Improvement

The Need	Suggested Type of Training	Duration
Farming Training	by trained extension workers who know water management	Continuous
Water Management Extension Cadre	university and short courses with hands-on experience working with farmers	Long and short term
Water Distribution Cadre	diagnostic analysis training with skills related to job and how to interact with the farmers	short term
Irrigation Monitoring Unit (interdisciplinary)	diagnostic analysis, hands-on course in methods	4-6 weeks
Project Evaluation Unit (interdisciplinary)	diagnostic analysis methods, data analysis, and synthesis	4-6 weeks
Research - Special d Studies Cadres (team approach)	diagnostic analysis methods plus team approach to development of solutions	10-12 weeks
Specialized Discipline Research Examples: Ground water simulation modeling, flood forecasting, river basin modeling, systems design, water law, farmer organization, etc.	long term specialized degree or non-degree training	1-4 years
Planning Unit (interdisciplinary)	diagnostic analysis process for understanding of system and appraisal purposes - understanding of non-irrigation aspects and need for flexible operations	3-4 weeks

Design

Major Systems	crop water requirements, control structures, measuring devices, utilization of farmer information for design, using local data for design	4-5 weeks
Minor Systems	crop water requirements, control structures, measuring devices, utilization of farmer information for design, using local data for design	4-5 weeks
Farm System	specialized training on small structures, land leveling, working with farmers using local data	4-5 weeks

Operation and Maintenance Staff

Major Officals	information systems, crop water requirements monitoring and use of data for discussion, two-way communications with farmers	2 weeks
Minor Officials	water distribution, farmers' needs, measuring control devices, communication with farmers	6 weeks
Farm System	water use practices, organization, O&M, links with authorities	1 week
Policy Makers	awareness and understanding of systems approach and uses of monitoring evaluation and special studies for policy reform	1 week

Table 3

Professional Participants' Views of Relevance of Diagnostic Analysis Training for Various Water Management Personnel

(Workshops at Anand, Gujarat, Feb.16-March 1981 and at Chatoorgarh, Rajasthan, Jan. 19-Feb. 20, 1982)

A. "Would you recommend diagnostic analysis types of professional development for the following types of professionals?"

Number of professionals participating: Gujarat 16
Rajasthan 29
45

Type Personnel	Yes	Perhaps	No	Don't Know	No Resp.
	Percentages				
1. Command Area Development (CAD) Field Staff	90.0	4.4	0.0	4.4	2.2
2. All Irrig.Dept.Personnel	69.0	15.5	11.1	2.2	2.2
3. All New Eng.Graduates Entering Irrig.Depts.	64.5	22.2	11.1	2.2	0.0
4. Extension Staff Involved in CAD Programs	82.2	13.3	2.2	0.0	0.0
5. Agronomists Involved in CAD Programs	89.0	6.7	2.2	0.0	0.0
6. Economists Involved in CAD Programs	75.6	20.0	2.2	2.2	0.0
7. Officers with Similar Positions to Yours	75.6	6.7	13.3	2.2	2.2

B. "Would you recommend short one to four day workshops for top officials and policy makers associated with irrigation water management development to bring them up to date with the new approaches of how to diagnose, plan, and improve irrigation systems?" (Note: This question was only asked of the 29 participants at the Rajasthan, India, Professional Development Workshop.)

1. National Level Policy Makers	83.0	14.0	0.0	0 0	3.0
2. CWC Members	76.0	17.0	0.0	0.0	7.0
3. CAD Commissioners	93.0	7.0	0.0	0.0	0.0
4. State Level Secretaries of Irrigation, Chief and Supt. Engineers	76.0	17.0	3.5	3.5	0.0
5. Directors and Joint Directors of Agriculture	93.0	7.0	0.0	0.0	0.0

Table 4

RELATIVE COSTS FOR HARDWARE AND SOFTWARE COMPONENTS OF 40 IRRIGATION PROJECT FUNDED BY THE WORLD BANK AND AID WITH ASIA PROJECTS SEPERATED OUT

Components	Total Cost of all Projects and Percentages $2200(m)	% (100)	Total Cost of all WB Projects $1806(m)	% (100)	Total Cost of all AID Projects $401(m)	% (100)	Total Cost Asian World Bank $1635(m)	% (100)	Total Cost Asian AID $302 (m)	% (100)
A. Hardware	$ Mil		$ Mil		$ Mil		$ Mil		$ Mil	
1. Dams	131	(5.9)	131	(7.3)	0	(0	115	(7.0)	0	(0.0)
2. Canals	154	(34.2)	654	(36.4)	100	(25.0)	571	(34.9)	94	(31.1)
3. Flood Control	25	(1.1)	12	(.7)	13	(3.2)	12	(.7)	13	(4.3)
4. Machinery and Vehicles	138	(6.3)	84	(4.7)	54	(13.5)	81	(4.9)	44	(14.6)
5. Roads and other Infrastructure	166	(7.5)	119	(6.6)	47	(11.7)	94	(5.7)	18	(6.0)
6. Tubewells	25	(1.1)	23	(1.3)	2	(.5)	23	(1.4)	0	(0.0)
7. Low Lift pumps	38	(1.7)	6	(.3)	32	(8.0)	6	(.4)	7	(2.3)
8. Drainage	105	(4.8)	103	(5.7)	2	(.5)	94	(5.7)	2	(.7)
B. Software										
1. On-farm Water Management	368	(16.7)	311	(17.2)	57	(14.2)	310	(19.0)	50	(16.6)
2. Training	30	(1.4)	15	(.8)	15	(3.7)	15	(.9)	14	(4.6)
3. Credit	27	(1.2)	0	(0)	27	(6.7)	0	(0.0)	24	(7.9)
4. Admin. & Management	400	(18.1)	348	(19.3)	52	(13.0)	314	(19.2)	36	(11.9)

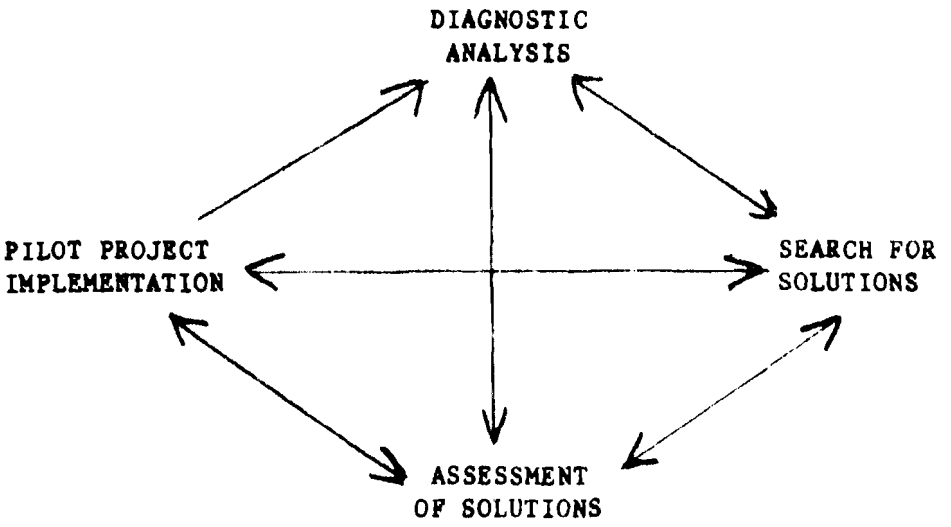
SOURCE: IRRIGATION PROJECTS DOCUMENT REVIEW: Executive Summary, Water Management Synthesis Project, Report Number 1. February 1981 Utah State University, Logan, Utah

Note: Respectively, World Bank and AID Asian project costs are 90.5 and 75.3% of total project costs. Ten percent of the total projects were begun between 1963 and 1969, 79% between 1970 and 1979 and the remainder in 1980 and 1981.

Figure 1

A RESEARCH PROCESS

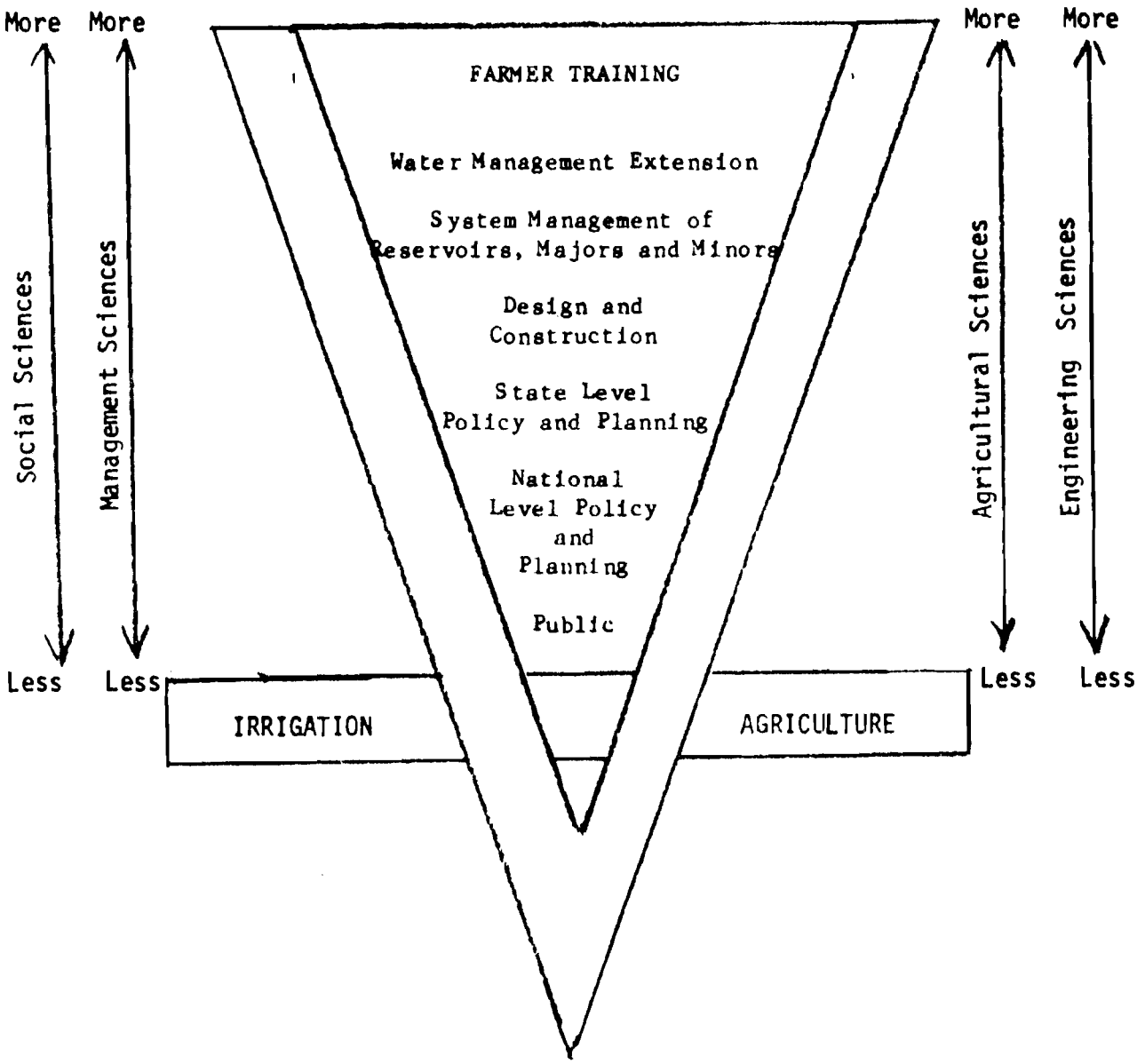
IMPROVING IRRIGATION SYSTEMS



KEY CONCEPTS	ESSENTIAL COMPONENTS
1. SYSTEMS APPROACH	1. CLIENT INVOLVEMENT
2. INTERDISCIPLINARY RESEARCH	2. COMMUNICATION
3. ON-FARM CLIENT FOCUS	3. TEAM COLLABORATION
4. HOST-COUNTRY INVOLVEMENT	4. TRAINING
5. MANAGEMENT ORIENTED	5. INSTITUTIONAL BUILDING
6. ACTION RESEARCH	6. MONITORING AND EVALUATION

Figure 2

Idealized View of Types of Training and Emphases Needed



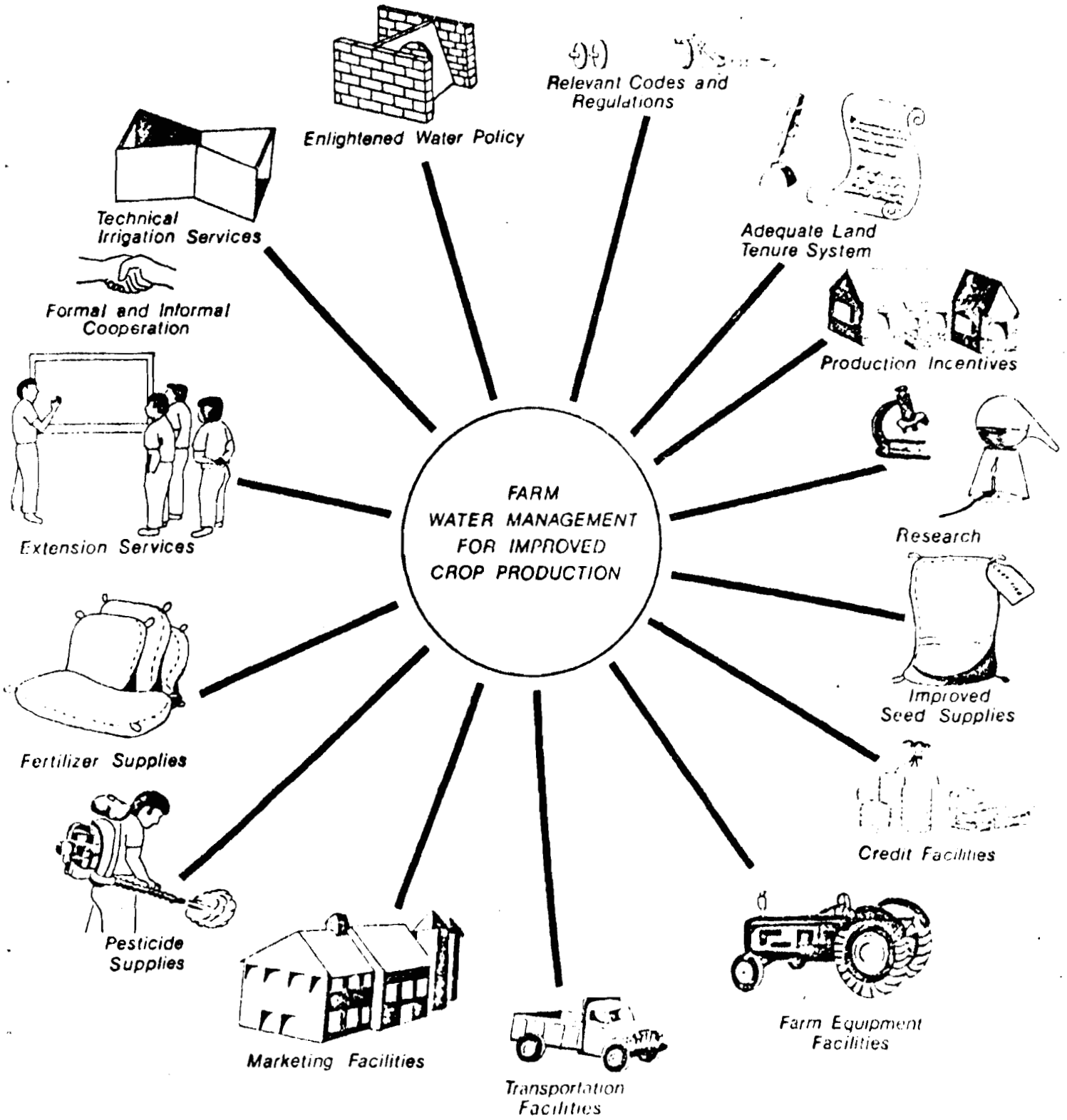


Figure 3: Institutional infrastructure linkages at the farm level to provide improved production possibilities.

BEST AVAILABLE COPY

References

1. Abramson, Robert, An Integrated Approach to Organization Development and Performance Improvement Planning. Kunovian Press, West Hartford, Conn., 1978.

2. AID, "Project Paper for Water Management Sunthesis II Project,"Project Number 931-1007 - Bureau of Science and Technology and Asia Bureau Joint Funded Project 1982-1987.

3. Berry, Leonard; Ford, Richard; Hosier, Richard, The Impact of Irrigation on Development: Issues For A Comprehensive Evaluation Study, Office of Evaluation, Bureau for Program and Policy Coordination, AID Washington, October 1980.

4. Bottrall, Anthony F., Comparative Study of the Management and Origin of Irrigation Projects, World Bank Staff Working Paper 458, World Bank, Washington, May 1981.

5. Corey, Gilbert, Private Communication, June 3, 1982.

6. Chambers, Robert, "In Search of a Water Revolution: Questions for Managing Irrigation in the 1980s" in Report of a Planning Workshop in Irrigation Water Management, The International Rice Research Institute, Las Banos, Philippines, 1980.

7. Craig, Robert L. and Bittel, Lester R. Ceditors, Training and Development Handbook, American Society for Training and Development, McGraw Hill Book Company, New York 1967.

8. FAO, Report on the Expert Consultation on Farm Water Management, FAO of United Nations, held at Beltsville, USA, 13-15 May 1980 - mimeographed 1980.

9. FAO, "FAO's Support Programme for Farm Water Management," September 29, 1980.

10. Levine, Gilbert, "Concepts and Strategies for Water Management", Paper presented at the workshop on Water Management in Sri Lanka. Agrarian Research and Training Institute, Colombo, Sri Lanka, January 20-22, 1982 (mimeographed).

11. Lowdermilk, Max and Svendsen, Mark, "Planning Concepts for a Flexible Irrigation Water Management Strategy in Asia," Asia Bureau Technical Resources, AID, Washington, August 1982.

12. Lowdermilk, Max, et al., Farmer Involvement, a Key to Improving Farm Irrigation Systems, Handbook No. 2 Planning Guide, Water Management Synthesis Project, Colorado State University, 1981.

13. Lowdermilk, Max K., Early, Alan, and Johnson, Sam III, "Need for Water Management Extension Service in Pakistan." Irrigation Drainage, Flood Control Council Bulletin, 1976.

14. Lynton, Rolf P. and Praeek, Ubai, Training for Development, Kumolian Press, West Hartford, Connecticut, 1978.

15. Oram, Peter, et al., Investment and Input Requirements for Accelerating Food Production in Low Income Countries by 1990. International Food Policy Research Institute Research Report No. 10, September 1979, Washington, D.C.

16. Report to the Technical Advisory Committee of the Consultative Group on International Agricultural Research, "Opportunities for Income of World Fund Production from the Irrigated Lands of Developing Countries," I.D.R.C., Ottawa, April 1979.

17. Report of the TAC Study Team on Water Management Research and Training to the Consultative Group on International Agricultural Research, Technical Advisory Committee, Los Banos, March 9-17, 1982.

18. Peterson, D., Evaluation of the AID-Near East South Asia Irrigation Practices Seminars 1956-1970", for AID Washington under Contract AID/Asia 597, March 1973.

19. Shultz, Theodore W., Investing in People: The Economics of Population Quality, University of California Press, Berkeley, 1981

20. Skogerboa, Gaylord V., Lowdermilk, Max K., Spauling, Edward W. and Houtoluoma, Jacob E., Development Process for Improving Irrigation Water Management, Water Supply and Management, Vol. 6, No. 4, pp. 329-342, 1982.

21. Skold, Melvin D. and Sen, B., "A Survey of the Need for Professional Development Training for Irrigation Management in India," Preliminary, unpublished mimeographed May 14, 1982.

22. Smerdon, Ernest T. and Hiler, Edward A., Energy in Irrigation in Developing Countries, an anlaysis of energy factors to be included in a national fund policy. Proposed for AID, Project Number 930-0091, December 1980.

23. USAID, "AID Policy Paper: Food and Agricultural Development", U.S. Agency for International Development, Washington, D.C., May 1982.

24. Venkatesan, M.N., "Manpower Requirements for Efficient Water Management", Paper presented at the Afro-Asian Conference I.C.I.D., Nigeria, 1981.

25. Water Management Synthesis Project Evaluation Reports of Professional Development Workshops held at Gujarat and Rajasthan States, India. Colorado State University (mimeographed), 1982.

26. Water Management Synthesis Project, "Irrigation Projects Document Review: Executive Summary". WMS Report 1, Utah State University, Agricultural and Irrigation Engineering, Logan, Utah, February 1981.

27. Wiener, Aaron, The Role of Water in Development, McGraw-Hill Book Company, New York, 1972.

28. Wiener, A., "The World Food Situation and Irrigation Programmes", ICID Bulletin, January 1976.

29. Worthington, E. Barton (editor), Arid Land Irrigation in Developing Countries, based on the International Symposium, February 16-21, 1976, at Alexandria, Egypt. Pergamon Press, New York 1977.

Svendson, Mark (Personal communication, September 10, 1982)

Annex VII

SUMMARY OF WATER MANAGEMENT SYNTHHESIS II PROJECT [1]
(Science and Technology Bureau -
AID, Washington, D.C.)

1. Project Concept

The project concept can be simply described as a field oriented approach for the development of an efficient and effective mechanism to systematically obtain, retrieve, disseminate and diffuse transferable lessons learned from past, present and future field experience from around the world in irrigation water management.

2. Project Goal and Purpose

The Project goal is to create institutional capability for increased agricultural production and higher farm income for participating farmers; the purpose is to provide host countries and missions with TA, expertise, training, special studies, and the transfer of technology which will enable host countries to improve the economic efficiency of irrigation water use.

3. Project Output

Principal project outputs will be:

a. A better understanding and appreciation by relevant host country policy makers, planners, managers and implementors of the importance of:

(1) improving irrigation water management;
(2) farmer participation in any scheme which aims to improve water management;
(3) an interdisciplinary systems approach to such management, including the integration of water control and agronomics into water managaement systems;
(4) the relationships between water users, government agencies, and the social and environmental milieu within which both groups operate; and
(5) constantly improving institutional capabilities of organilzations involved in irrigation water management training programs of which 8 to 10 will be in Asia. These problem solving, field oriented training programs will be conducted on a continuing basis.

b. An institutionalized means for the systematic gathering, evaluating, catologuing, assessing and disseminating of both field-based lessons learned (technologies) and other promising technologies which have not yet been field tested. This will be done through special studies, technology transfer workshops, newsletters, special planning guides and technical manuals. Two of the three workshops for Transfer of Water Management Technologies will be held in Asia.

Project output is discussed in more detail under the Key Project Component section below.

4. Project Inputs

Project inputs are detailed under the Financial Analysis section below and are also discussed under the Key Project Component section. They will not be discussed here.

5. Linkages/Assumption

Inputs-Outputs: The Linkages between inputs and outputs are direct and address what would otherwise be a critical assumption: an understanding and appreciation of the importance of improving water management and organizational changes and, more than anything else, the attainment of the project outputs will depend upon the experience and quality of the contractor, the reason for insisting on a predominant capability waiver.

WMSP II will provide technical assistance to missions which is a critical need as experienced by missions. Each mission will do forward planning, on an annual basis, to identify the services desired from the contractor. Projections of mission needs have already begun and will be continued.

The end of project status will find varying levels of institutionalized training programs achieved from country to country, ranging from attainment to the beginning of the process. The status will depend much on the point in time that the project services were proided and the conditions in the recipient countries.

Outputs-Purposes: Although it will work primarily through host country agencies, a basic tenet of the project is that the farmer is the client and end user of the innovations and delivery systems established. The project cannot achieve its final purpose (or goal) if farmers are not responsive to the new approaches developed, which is first and foremost, a function of the project's effectiveness in institution building to provide for innovations which have profitability for farmers. The project designm which calls for a systems appro ch by a contractor who possesses the needed expertise and field experience, will do much to ensure the required profitability.

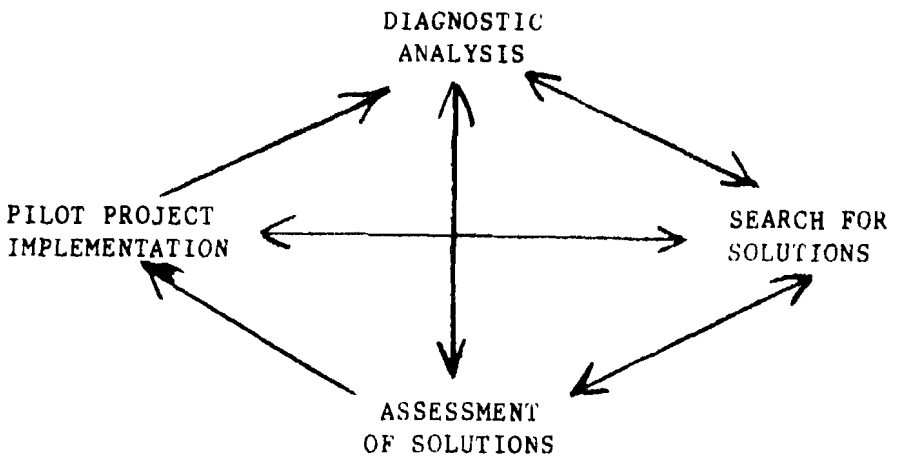
However, this may not be enough. Farmer costs of constructing, operating and maintaining the improved irrigation system have to be taken into account. For mission projects which the WMSP II would help design, these costs will be included in the design analysis. And for mission projects already under implementation, it is realistic to assume that this aspect would also have received appropriate attention. Assistance to countries will include helping to create more positive policies which will create a favorable environment for project success.

While the output-purpose linkage is not as strong and direct as that betwen inputs and outputs, it presents little risk since the contractor would not generally enter a country unless it is deemed that the project would be both profitable to farmers and economically viable.

FIGURE - 1

A RESEARCH PROCESS

IMPROVING IRRIGATION SYSTEMS [2]



KEY CONCEPTS

1. SYSTEMS APPROACH
2. INTERDISCIPLINARY RESEARCH.
3. ON-FARM CLIENT FOCUS
4. HOST-COUNTRY INVOLVEMENT
5. MANAGEMENT ORIENTED
6. ACTION RESEARCH

ESSENTIAL COMPONENTS

1. CLIENT INVOLVEMENT
2. COMMUNICATION
3. TEAM COLLABORATION
4. TRAINING
5. INSTITUTIONAL BUILDING
6. MONITORING AND EVALUATION

6. Key Project Components and Their Relationships

The four major components comprising this field-oriented project, Training, Technical Assistance, Special Studies and Technology Transfer, are highly interrelated and mutually reinforcing. For example, the technologies and procedures made available for systematic transfer under the Technology Transfer component will be utilized to strengthen the Training component. Likewise, the training activities also become mechanism for further technology transfer, absorption, and diffusion. The diagnostic problem solving studies under the Special Studies component will provide input into Training as well as Technology Transfer. The Technical Assistance component supports the other components since it will focus on such things as problem solving, assistance in training, program design, institution building and project appraisals. Some important principles are built into the project design. First, as suggested above, there is complementarity betwen components; what is learned in one component provides feedback or input for another component. Second, the project is one of long-term involvement which provides the contractor incentives for acquiring and maintaining top level expertise. Thirdly, these components and the related activities are such that the staff of the project are fully involved in project work activities and are not waiting for short-term TA assignments. The conceptual framework and pohilosophy that undergirds this project is shown in Figure 1. Note that a systems approach is used to diagnose, resolve and assess the solutions prior to implementing a project. The key components are shown along with essential components. This process and approach is central to the concept of the project, its key components and the project activities.

7. Description of Project Components

a. Training - Human Resource Development: The need for several types of training is well documented. The five countries visited by the expert irrigation team gave the highest priority to training.[3]. The current problem, however, is that while training is clearly perceived as being needed, there is very limited understanding that water management is a young science even in the U.S. and requires special expertise in systems approaches. Conventional training in engineering, agronomy, economics, extension and other science is not adequate. There is a growing need to reorient training in order to prepare the cadres needed to implement successful projects. Utah State University, involved through the WMSP contractor, has developed an international irrigation centre which offers short courses in water management. Cornell University, under the RADS project, has developed an interdisciplinary team training model which is currently being

tested. The model was recently tested successfully in Egypt and India and it has been requested by Sri Lanka and Bangladesh and again by India. This and other types of training should be introduced throughout Asia. Currently, the Indian Government based on their positive evaluation of the Gujarat WMSP training program in Feb-March 1981, has requested that the course be taught again for project personnel in Rajasthan State.

A mechanism is needed that would:

- assist missions in "front loading" new projects with quick and effective in-service training for project execution personnel and farmers;

- assist missions and host countries in training cadres for monitoring and evaluating irrigation sytems and projects;

- assist missions in helping host countries design appropriate training programs, including those for the training of trainers;

- assist with identifying available training materials which are increasingly made available from AID, FAO, other technical assistance organizations, and other projects;

- help host countries develop relevant training curricula and materials to reform formal training in colleges and universities;

- develop short, intensive hands-on training programs in-country and at selected U.S. universities, for policy makers, project managers, researchers and project implementors in how to diagnose and improve systems;

- assist in developing selection criteria and providing selected formal training at institutions in the U.S. to provide leadership in key areas. A one or two semester non-degree type of training is recommended for certain technical specialities for some countries to help them develop the initial capacity to institutionalize their own training programs.

To meet the water management training needs the project would:

(1) Develop, define and demonstrate training programs in ten locations and three new water management training courses, such as Watercourse Rehabilitation Methods and Procedures; Management Skills for Improved O&M of Sytems; Organizing and Guiding Water User Associations and Extension Training in Systems Approaches to Water Management.

(2) Conduct up to ten on-site field training courses in Monitoring and Evaluation of Irrigation Systems in host countries of which seven will be in Asia.

(3) Refine the WMSP Diagnostic Analysis Training course and implement it in six countries of the Asian region.

(4) Conduct or make available each year one regular intensive (6 to 8 weeks) summer training program in the U.S. irrigated regions for selected host country project and mission personnel to meet specific needs (several countries need to train trainers before they can develop their own in-country training programs.)

(5) Train cadres of trainers for host country water management training programs, both in-country and the U.S., on a short-term, non-degree basis.

(6) Evaluate existing training material and courses worldwide and maintain a library (listing and supply) of those considered to be of value to AID Missions and LDCs.

(7) Develop appropriate linkages with FAO, CGIAR, and other international organizations involved in training in order to share experiences, refine approaches, transfer lessons learned and to collaborate, where feasible.

b. Technical Assistance: Missions have identified the need for technical assistance in a number of water management areas. The need was also identified by the expert team fielded by the WMSP. The revised project would provide the following under the technical assistance component:

(1) Expertise in water management for short-term technical assistance which may include assistance in project design and development, etc. (Pool is to include expertise from the contractor staff, outside organizations in USA and other countries.)

(2) An up-to-date roster of expertise in USA with experience in comprehensive systems approaches utilizing hard and software component to water management improvement and an evaluation of their performance in consulting.

(3) An inventory of professionals within the developing countries which have demonstrated abilities in farm water management and which can be made available for consulting within or outside their countries. (Focus will be given to building up this cadre within countries and regions.)

(4) Long-term technical assistance, for"up to two years" duration, primarily with an integrated physical and social science approach may be provided in special cases when missions desire to buy into the project. Much of the knowledge about the mix of physical and social organizational aspects of water use that we now have available came about because of long-term technical assistance to on-going projects. The On-Farm Water Management Program in Pakistan went on for more than a decade, with American AID-funded experts posted there for up to four years at a time.

(5) A systematic self evaluation of the technical assistance performed under the project.

c. Special Studies: Missions often have specific needs for short-term studies in connection with project development and operation. The two lead universities of the contractor under WMSP have evolved methodologies for quick and effective diagnostic analysis of irrigation systems and their components. A course with training manuals has been developed for this type of analysis. Recent experience in several countries suggests that where adequate diagnostic analysis preceded, or was a key component in projects, progress in improving water and crop management has been rapid. Careful identification of the problems at the farm level and the testing and evalution of appropriate solutions also delineate institutional changes needed thoughout the system. This project will use the diagnostic analysis mode and conduct special studies[4]. Possible examples are:

(1) Special field problem identification studies requested by the missions and the bureaus involved with heavy host country involvement. These could range from specific technical problems to investigations of how to deliver water management technology to farmers.

(2) Provision of an interdisciplinary team of irrigation experts to irrigation issues and investment strategies for planning purposes of regional bureaus or host countries on a country request basis.

(3) Analysis of projects to help AID track project costs and benefits, identify lessons learned, and ascertain transfer technologies from various types of projects. This analysis initiated under the WMSP needs to provide more in-depth economic data for use in planning and review of projects and for help in evolving improved policies in host countries.

(4) Cost effective studies of comparative organizational and technical methods for delivering water from the canal distribution to farmers' fields. Technical examples might include unlined, partially lined, completely lined and underground conveyance systems with varying degrees of structures. Organizational methods might include a design system, a Warabundi rigid rotation system and other types of allocation, local organizations of farmers for rehabilitation projects and new irrigation projets.

(5) Provide team of technical experts to periodically monitor four or five USAID field projects. This experimental effort would be to determine if this type of technical supervision wold be a worthwhile management tool.

(6) Studies of farmer participation as a resource in project predesign and design.

(7) Conduct other irrigation related special studies requested by AID.

(8) Special studies to identify issues and investment strategies for irrigation in countries requesting this service.

d. Technology Tanster: Technologies for improving water management are known.[5] In recent years, a number of organizational procedures and approaches have been found effective. Currently, each project tends to be a case study and one project or country is not familiar with technologies and approaches which can be transferred and adapted to other projects or countries at low cost. It is highly inefficient and costly for each project or country to reinvent the proverbial wheel and not learn from lessons of others in the region. Utah State University, one of the two lead universities for the contractor between 1956-1970, developed and implemented a mechanism for knowledge transfer in irrigation. A similar mechanism is perhaps more relevant now that more is known about water management technology and procedures for improving systems. As lessons are learned, institutional changes begin to take place as seen in several countries recently. Consequently, there is a need for:

- systematically building into all projects a memory mechanism to identify technologies and procedures with likely transfer potential across the region;

- developing a means to meet the water management knowledge transfer needs in the LDC's;

- establishing regional on-going water management improvement seminars/workshops that would meet regularly, in an Asian country, with the specific objective of transferring water management knowledge.[6]

The technology transfer and institutional development component of WMSP II will provide the following:

(1) an up-to-date inventory of significant non-country specific technologies, technical reports and training materials for systematic worldwide transfer to users through the AID, S&T, DIU system;

(2) specific planning guides, concept papers, field technical manuals and audiovisual materials for systematic transfer of selected proved technologies to technical personnel, planners, extension workers and farmers;

(3) an-up-to-date network for key irrigation water management professionals in developing countries who are provided with water management information (i.e., the WMSP newsletter) and technical materials upon request, and help link this networks;

(4) special working seminars for key scientists and policy makers in Asia, designed to document and share in usable forms those technologies and procedures which work well in any area and have transfer potential; special mobile mini-workshops designed for key policy makers in each country of Asia and AID officials to help create awareness for institutional change and understanding of the advances in water management which contribute to successful projects;

(5) an up-to-date bibliography of available training materials which focuses on the software aspects of water management; materials are to be identified, obtained, abstracted, entered into bibliographies and the AID, S&T, Data Bank and made known through a newsletter;

(6) cooperation, coordination and linkage of all activities, where feasible, with leading regional and international organizations and other universities involved in water management;

(7) cooperation with and assistance to private contractors with AID contracts related to irrigation water management to help them build up their capabilities and resolve problems they are facing in the field.

There is currently substantial international interest in improving the efficiency of water use. Some international organizations are conducting productive research on the topic and a few donors are assisting in projects to improve water management. It seems clear that there is a need for a permanent technology tranfer mechanism of the nature described, to gather lessons learned from whatever source and access them to any interested party. While such a mechanism could be institutionalized within AID, it is not clear that this is the most feasible place for it. An important task of the contractor will be that of recommending where the mechanism should be located and how to establish linkages between it and other organizations to systematically provide inputs.

REFERENCES

1. Science and Technology Bureau of AID: Water Management Synthesis II Project Paper. August 2, 1982.

2. Clyma, Wayne; Lowdermilk, Max K.; Corey, Gilbert L.: A Reserarch Development Process for Improvement of On-Farm Water Management. Colorado State University, Fort Collins, Colorado, 1977.

3. Water Management Synthesis Project: Irrigation Development Options and Investment Strategies for the 1980's (six country reports: India, Pakistan, Bangladesh, Nepal, Thailand, Sri Lanka), 1982. Available from Water Management Synthesis Project, Utah State University, Logan, Utah.

4. Water Management Synthesis Project: Diagnostic Analysis Workshop. Bulletin by WMSP, January 1983, issued by WMSP, Colorado State University.

5. Wiener, Aaron: The Role of Water in Development. McGraw-Hill Press, New York, 1975.

Annex VIII

SUMMARY OF FINDINGS OF ORGANIZATIONAL EFFECTIVENESS OF PROJECTS VISITED*

Discussions with irrigation officials at the central and state government levels reveal an awareness of the large challenge and problems of irrigation development in the 1980's. First, there is an awareness of water management reaching to the farm level and the need for water management training or staff development at all levels of the irrigation system from the reservoirs to the farm. Secondly, there is a felt need for greatly improved monitoring and evaluation approaches within and of the system which will provide feedback to decision centers in the delivery of water and also to state and central government decision centers to improve the operation of projects and systems, planning, and policy-making. Thirdly, the GOI is aware of the need for greater uniformity in CADA organizations, irrigation rules and regulations, land development policies, and also in water management training across the states. Fourthly, the Center (GOI) will likely plan a stronger role in policy decisions and provision of certain facilities for research, monitoring, training, water codes, water price policies and other irrigation matters in the future.

Since water is primarily a state subject, it is important that the Center clearly delineate its role and provide strong policy commitment, guidelines and facilities for the states. The proposed separation of design and construction from operation and maintenance and the creation of a strong career structure for water management will go a long way towards giving prestige and status to an area long neglected.

Increasingly, the organizational effectiveness of irrigation projects and programs in India needs to be evaluated in terms of:

- -- increased predictability of delivery of water
- -- increased productivity of water
- -- improved maintenance of a valuable resource and improvement program
- -- improved ability of cost-effectiveness and recovery of investments.
- -- investment of the farmers in the farm systems.

---

* From Irrigation Development Options and Investment Strategies for the 1980s. (India), USAID-WMSP Report 6.

Until recently, as in most countries of the region, irrigation organizations had been developed which did not take into consideration the soil, topographical, water-plant relationships or social factors in the projects they designed and constructed. The reasons for this are inadequate training of personnel and/or lack of experience in dealing with construction and maintenance of such systems. India has found, as many countries have, that, with increased population pressures creating more demands on irrigated agriculture, along with the high costs of irrigation development and improvement, approaches must be evolved which will result in more efficient and cost-effective water management at the farm level.

Farmers in a democracy like India are now demanding more predictability and control of water for increased crop production. Farmers, in general, want more organizational control and discipline for water as a reliable agricultural input. Both the complexity and scale of systems are such that the basic challenge of all organizations involved is of Himalayan proportions.

There is ample evidence, especially where there are private tubewells and open wells, that farmers who have water control know the value of water, as evidenced by the way they manage water as an input, purchase it, and maintain their field channels for improved distribution. Where water is a public good and the technology is indivisible, except in some strong warabundi schemes in northern India, there is ample evidence of inadequate organization in terms of coordination and integration to provide adequate delivery of water and equitable distribution, as well as maintenance of public outlets, collective farm structures, and farm channels.

In terms of several selected organizational dimensions, a tentative breakdown of organizational effectiveness of projects visited is presented in Table 2. The table was developed from both observations and information received during the several field visits.

Synthesis of Effectiveness

Several general observations are synthesized from this table showing various dimensions of organizations of projects visited:

1. The structure of the CADA organization is generally accepted. However, there is still a search to find the most effective organizational model. The most impressive organizational structure, in terms of workable coordination of agencies and integration of services is that of the Chambal Project. Perhaps this is due to the longer exprience, low

turnover of staff, and the ability of the authority to exert pressure for policy decision-making for field operations. The clear lines of authority under good leadership and an authority budget make this an effective approach.

2. There is a need felt to link all aspects of management of water delivery from the reservoir, distribution at the outlet, and on-farm use, rather than to continue to attempt to operate as though these units exist as separate entities.

3. As irrigation organizations with engineering expertise and long experience move closer to the farm level, it is apparent that the problems become more complex and the work less prestigeous. Few staff are equipped by expertise or experience to handle the tough organizational and human problems of adequate delivery, equitable allocation, on-farm improvements, and direct services to farmers. It is doubtful if many truly interdisciplinary teams could be assembled easily in India to properly analyze problems at this level, develop appropriate solutions, and implement and monitor improvement, which farmers will maintain adequately on a continuing basis. In the absence of other approaches, the engineering approach to technology and the administrators' use of regulations have been tried as a means to achieve farmer involvement, but have not been successful. In brief, there are several areas of need which should be addressed in the development of future manpower, for work in water management.

a. General inability of all but a few officials to understand the total irrigation system from the reservoir to the farm, as one which must be closely coordinated, linked organically, and managed as a total system, instead of three or more systems.

b. Except for a few officials at both central and state levels, a widespread lack of understanding about what water management is, as well as a lack of understanding of how and why the present system works as it does, from the canals to the farm level.

c. A long traditional inability on the part of irrigation engineers and others to understand and appreciate the role of other disciplines in the design and operation of all aspects of a complex irrigation system.

d. The strong assumption that most problems in the delivery, distribution, application and removal of what can be solved with more technology and more regulations, combined with widespread paternalistic beliefs about what farmers can and will do.

4. Farmers want more predictable supplies than rainfall and, with this certainty, they desire improved organizational approaches to achieve discipline in the distribution of water. Farmers need improved services at the farm level which, if provided adequately, will create more credibility in government. An example is that many fields leveled by bulldozers and graders are far from level for good field application. Methods need to be developed to gain more involvement and cooperation, once adequate water is assured. Farmers need both incentives and discipline, but compulsion alone will not produce results. Land consolidation and enforced cropping patterns will likely not work anywhere; however, more flexibile approaches and adequate incentives will, if implemented properly. Few farmers have realized or have yet seen the full benefits possible from a comprehensive set of improved on-farm practices.

5. Maintenance of the systems at canal, distributary, outlets, and on-farm levels, in general, range from only fair to very poor. As one reviews project budgets, one gains the impression that maintenance is given a very low priority at all policy levels. One wonders it this is a reflection of the low level of prestige and "prosperity" in maintenance activities. Without farmer cooperation, no improvements will last long anywhere.

6. Except in a few projects like Chambal, where only a beginning has been made with the use of a special CADA and mobile Magistrates or the rotation scheme in Rohtak, there is not sufficient concern for enforcing existing codes which are adequate to cover offenses, such as stealing water, damage of structures, upkeep and maintenance of farm channels.

7. Monitoring of the system on a regular and systematic basis appears to take place only on the main canals and on rotation systems where farmer demands are used as a basis for supply of water. On rotation systems, measuring devices are located at the heads of watercourses. The commissioner at Chambal suggests correctly that measuring devices and communication systems should be used for regular monitoring of tails of systems to ascertain how well the system is functioning.

8. Everywhere, the extension aspect of water management is weak for several reasons. First, in most CAD areas, the T&V system is not completely under the CADA as in Chambal. Secondly, the Agriculture Department, unlike te Irrigation Department, works through the Panchayat Samities and does not have a direct line organization for quick decision-making. Thirdly, nowhere are there subject matter specialists backing

up extension workers with training in on-farm water management improvement. The Irrigation Department organizes farmers for the rotation system but the extension gets caught up in Panchayat politics and the larger, more powerful farmers capture their services. A study needs to be made of the operational sizes of farms versus the legal sizes because superficial field information suggests that the operational units of joint farms are much larger than the units recorded by the Land Revenue Department. If this is true, then the eight hectare outlet command approach in all places should be questioned. Each outlet requires higher costs and increased demand on thin administrative resources. Also, the operational size of farm units may suggest problems of larger and more powerful farmers taking inequitable supplies of water and not cooperating in on-farm improvements because they know that existing rules and codes will not be enforced. Some of the best managed irrigation schemes in Asia, such as those in Taiwan, Japan, and Korea, combine strict discipline and swift punishment of offenders with flexibility for farmer involvement.

9. At all levels of government, there is a longstanding paternalistic view that farmers will not cooperate. The view is that programs therefore must be designed to regulate them and provide services for them. When predictable and creditable water supplies and services are provided, then there is a need to identify the adequate mix of "the carrot and the stick." To date, paternalism plus inadequate services and a "soft approach" have yielded little farmer involvement. Farmers usually will only organize when they perceive it is in their best interests to do so and not because they are commanded to organize. Fourthly, few attempts have been made to involve farmers in the design, planning and implementation of farm-level projects which are meant to benefit them. It is doubtful that Indian farmers are all that different from Pakistani farmers who have provided labor to develop their own improved watercourse with assistance from engineers.

10. The warabundi organization is a useful tool for predictable water deliveries in each of scarce canal supplies. While this tool for improved regularity in supplies has become widely accepted in northern states, in other areas there appears to be a lack of understanding of the basic requirements of the warabundi system. The model exists in the Punjab and Haryana and the procedures involved in its implementation should be made widely available in India. Project leaders in the south should consult more with colleagues in the north about the warabundi system, its prerequisites, and methods for implementation. At the farm level, this system should be instituted and maintainted because it is a proven indigenous

method which has been tested for over a hundred years in northern India. Visits to the Punjab and Haryana indicate that the warabundi rotation system is working. Where farmers have more predictable and regular water supplies, they tend to cooperate more in on-farm improvement programs. The organizational structure of some projects in the north is more well-knit with more carefully delineated responsibilities and more trained staff than in most other areas of India. Long tradition in the north has evolved a good organizational tool which reduces some of the paternalistic procedures now being used in most CADA organizations other areas.

In summary, India has gained much experience in irrigation development. The rotation system, the outlets to serve small command areas, and the new policies proposed are all positive innovations. Government officials and project personnel are well aware of areas for improvement, especially in software innovations. India has developed much expertise and experience in hardware development and is willing to experiment. The 1980's will provide a challenge to personnel at all levels to evolve software approaches which will work in the conditions in India (see Training section)., Hardware approaches have outrun the ability to develop software approaches, and, unless the latter are improved radically, the CADA's and other projects may face the problem suggested by one high-level official, i.e., widespread discontent that the CADA investments are not returning adequate economic and social benefits to millions of farmers in India who, in total, will continue to present a formidable pressure group on policy-makers and political leaders. India, however, is involved in one of the world's largest experiments in irrigation improvement. These efforts should be supported and carefully evaluated, not only for continued improvements, but for lessons from which other countries can profit.

TABLE 1. Comparative Summary of Technical Information for Project Visited.

Item	Mahi	Pungam	Pana	Project Kadana (Pilot)	Fatewadi (River Run)	Kiwal (Lift)	Gudha
Type of Project	Med. surface with storage	Med. surface with storage	Med. surface with storage	Med. surface with storage	Med. surface river run	Minor lift	Maj. surface with storage
Extent of water-course lining	None	Pipe to 4 fields	To outlet	None	None	None	Experimental Sections
Farm outlet level (acres)	37-70	6-20	20	20	100-400	20-40	20-100
Control to on-farm system (nukka)	Screw gates with flume	Pipe valve	Slide gate	Screw gate with flume	None	Mud dams	None
Control to water-course	-	Pipe valve	Screw gate with flume	Screw gate with flume	None	None	None
Command acres per cfs based on continuous delivery	40-80	120	100	80	60 (paddy only)	70	75
Apparent irrigation intensity - rabi					10%	15%	
Rotation between distributaries	Continuous	Continuous	Yes	None	Yes	None	14 days/ month
Rotation between outlets and distributaries	Pucca[1]	Continuous	Kutcha[2]	Pucca	None	Kutcha	14 days/ month
Rotation between farmers	Pucca	Kutcha	Kutcha	Pucca	Field to Field	Kutcha	Kutcha
Soils and topography	Deep sandy loam flat	Sandy clay loam flat	Sandy loam hilly	Sandy loam flat	Sandy salty and black cotton	Black cotton 6"-24" rolling	Well drained sandy loam mostly

[1] Pucca means disciplined and firm

[2] Kutcha indicates loose and releaxed.

Table 1. (Continued)

Item	Chambal	Nada (Sukhomjari)	UP Public Tubewells	Project UP Public Tubewells	Gujarat Tubewell	Maharashtra Dugwell	Haryana @ Rohtak
Type of Project	Major surface with storage	Minor small tanks	Deep tubewell	Deep tubewell	Shallow tubewell	Dugwell	Large surface river run
Extent of water-course lining	Very limited	To within 200 ft of each field	Pipe	to outlet	Pipe to fields	Pipe to fields	Some with 50% rule[3]
Farm outlet level (acres)	50-15-	2-4 ac	18	30-60	1-2	1-2	40
Control to on-farm system (nukka)	Some	Alfalfa valve	Screw gate	Mud plug	Bolted plate	Bolted plate	Slide gate gate
Control to water-course	None	Valve with wier	Direct from TW	Direct from TW	Direct from pump	Direct from pump	Submerged orifice
Command acres per cfs based on continuous dilivery	167	50-60	250[4]	350[4]	-	100[5]	800
Apparent irrig. intensity - rabi	-	100[6]	20%	10%	-	100%	33%
Rotation between distributaries	21 days/ months	None	None	Yes	Yes	Yes	Yes
Rotation between outlets and distributaries	21 days/ month	Pucca	Pucca	Kutcha	Pucca	Pucca	Pucca Warabandi
Rotation between farmers	Kutcha	Pucca	Kutcha	Kutcha	Pucca	Pucca	Pucca Warabandi
Soils and Topography	Black cotton w/15% mild salinity	Deep silt loam hilly	Silty loam flat	Silty loam flat	Deep sandy loam flat	Black cotton 24" deep	Silt loam

[3] lining in all sections, running about 50% lime [4] based on adequate electricity to pump 16 hrs/day (now, only 4-6 hrs/day) [5] only plan to pump 5-6 hrs/day [6] two irrigation during rabi.

Table 2. Quick Evaluation of Project Organization: Projects Visited in Field Trips.

Dimensions	S. P. Nalco Pilot Project	Tawa Command	Bodhna	Fatehpur Proposed Project (During ADB help)	Khola Water Lift Project	Gada Project Organization (During ADB Preparation)	Gurai	Harpal Sagar under Irrigation II a Project
I. Structure	[illegible] Irrigation has [illegible] to Agriculture works through Panchayat Samiti, reports involved in politics	CADA type (same)	CADA type (same)	Desire to develop CADA still use typical structure	Under Govt. Engineering Irrigation Department	Irrigation Department operation wants to develop CADA approach-Irrigation ADB work is a do subject	Highly structured organization at top with connected CADA leader. They view this as a model authority devoted to CADA and can approximately move on decisions	Arrangement Time Department on the farm level. Not but up on CADA basis
II. Coordination	Large because field works outside CADA [illegible] authority. Involved in Panchayat system. Irrigation department	Very large. Irrigation SEE, Extension, credit, Irrigation re possible to B be work. Farmers request water, deputy engineer makes decisions. Field channels by SEE properly designed. Enough to do II. Irrigation people complain about SEE help. All agree but blame each other. Lack of good coordination	Very large organization of Irrigation SEE, Extension department, and credit. Very group oriented. CADA has no real control over extension agency. Interrelationship between agriculture and irrigation is salary marks	Irrigation alone delivers water to outlets to rotation and to tanks. Extension works separately	Large. The project started during a drought period. [illegible] land development corporation identified and laid out channels and did only II rough land leveling	Have to coordinate project on Chambal but agricultural engineers feel they will not be utilized at farm level after to cutting dam and improving canals. Prior to improvement people irrigation appropriately, [illegible] of farm outlough & difference of views about planning and implementation of program. Officials were to blame of planning at top down	Regular meetings each Monday to discuss issues and get action. Lines of authority appear clear; coordinate Irrigation department, land development authority, credit, research and supplies. A regular magistrate and extension staff at the top are experienced. Started coordination in 1969-- have a single budget, extension is under the CADA-- average turnover of personnel is 3-5 years	Little coordination with other departments. Operate separately, i.e., extension, etc
III. Irrigation farm level	Fair at level to meet field [illegible] of water [illegible]. Big gains works to the farmers and demand [illegible] and other [illegible] crop assessments	Intermediate poor at work. No agency handles improved irrigation practices. [illegible] due to [illegible]. Recovery rate is more 10-15 percent. Field channels not complete after two years	Poor after two years field channels poorly designed, incomplete, and poor circuit. Competition not working. Pay practitioner for farm channel is very poor. II. [illegible] rough leveling. Reports of [illegible] Irrigation Department, in filling and Irrigation Department requests	Poor. Irrigation department only delivers water	Poor coordination. Some [illegible] were poorly selected [illegible]. Rural [illegible] are evident	Have to engage a Irrigation Land Development [illegible] and Extension. A map is mysterious to be sure to do crease [illegible] who damage structures, steal water, and who do not follow rules	Farmers appear to be fairly well integrated. Facilitated of agricultural engineers. It is that they do not have much role in design of systems, therefore have to move the system out after. It is both. Drainage system does work but due to poor design and maintenance	Wants pay Irrigation Department the work is [illegible] [illegible] such as a [illegible] of [illegible], of [illegible], of [illegible] of [illegible]. Great for [illegible] lining by Agricultural Refinery Development Corporation is available. Extension is not closely integrated into project
IV. Incentive for [illegible] system [illegible] command	Good. [illegible] farmers prefer to [illegible] reduces headroom problem and conflict. Actual [illegible] points 100, 200 and 400 each observed	Many farmers desire and request [illegible], to move major [illegible] to water problem: [illegible] and field channels	None	None--only proposed	[illegible] system	None to implement	Some often have implemented-- will focus more to future	Very good. [illegible] working and [illegible] have more problem [illegible]
V. Performance								
a. Canals	Fair	Poor	Poor	Poor	No canals	Poor	Fair	Good
b. Distributary	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Poor
c. Outlets	Good	Poor	Poor	Very poor	Poor, broken	Poor, broken	Poor--some broken	Good
d. Farm level	Poor	Worse than poor	Very poor	None	Very Poor	None	Poor--many structures broken	Good
VI. Environment (Costs & Benefits)	Fair on rotation system	Some farmers [illegible] discipline and use irrigation to collect revenue	Rules not enforced for [illegible] water. Manager [illegible] farmers report want more discipline	None	None	[illegible] farmers have not [illegible] [illegible] [illegible] farm first large	Little enforcement but mostly [illegible] handling on canals. Man will focus more on [illegible] at farm level very little [illegible]	Enforcement good [illegible] and water
VII. Monitoring								
Main System	Daily reports of canal levels	Daily reports of canal levels	Daily reports	Daily reports	Little daily	Daily reports	Daily reports twice	Daily
Distributing Level	Checkers--canal monitoring	Canal monitoring	Canal	Canal	Canal	Canal	Monitor	Daily
Outlets	Checkers--canal monitoring	Checkers but farmers operate system, many structures	Checkers but farmers operate	Check some, gates destroyed, farmers open and operate outlets	None	Almost none	Canal	
Farm System	Canal visits of ID	None	None	None	None	None	Very little but wants to start monitoring and measurements at [illegible] which report back system	By farmers
VIII. Farm level	Fair but WM canal [illegible] allow supervision to farmer structures, also [illegible] under pressure by Panchayats, no CADS trained WM	No indication there is organization. Some trained but apart		No indication of any	None	None	Fair--trials and little training to WM	Poor to fair
IX. Officials Attitudes	Extremely paternalistic do for and to but not with	"Farmers will not cooperate" "Don't know the value of water" Paternalistic		"Farmers will cooperate etc. etc. (need a project)"	Poor--don't pay, don't [illegible] cooperate private paternalistic	Very paternalistic, must force for now, must do for them, don't cooperate	This is an issue here. Some have typical paternalistic [illegible]. Others feel that farmers can and will play a role if adequate water is supplied and incentives offered	More positive attitude
X. Farmers Organization	Irrigation groups and for contact farmer Pole	None	Paternalistic "Farmers must to be told"		None	None		Will Cooperate

[1]CADA--Command Area Development Authority, TOR--training and Visitation Extension System, SEE--Soil Conservation Service, LI--Lined Leveling

Best Available Document

RELATIVE COSTS FOR HARDWARE AND SOFTWARE COMPONENTS OF 40 SELECTED IRRIGATION PROJECTS
FUNDED BY THE WORLD BANK AND AID WITH ASIA PROJECTS SEPARATED OUT

Components	Total Cost of all projects and percentages $2200(m)	% (100)	Total Cost of all WB projects $1806(m)	% (100)	Total Cost of all AID projects $401(m)	% (100)	Total Cost Asian World Bank $1635(m)	% (100)	Total Cost Asian AID $302(m)	% (100)	Break down for India: India WB $784 (m)	% (100)	India AID $126(m)	% (100)
A. Hardware														
	$ Mil		$Mil		$Mil									
1. Dams	131	(5.9)	131	(7.3)	0	(0)	115	(0.0)	0	(0.0)	36	4.6	0	0.0
2. Canals	754	(34.2)	654	(36.4)	100	(25.0)	571	(34.9)	94	(31.1)	311	39.7	23	18.3
3. Flood Control	25	(1.1)	12	(.7)	13	(3.2)	12	(.7)	13	(4.3)	4	0.1	0	0.0
4. Machinery & Vehicles	138	(6.3)	84	(4.7)	54	(13.5)	81	(4.9)	44	(14.6)	27	3.4	14	11.1
5. Roads & other infrastructure	166	(7.5)	119	(6.6)	47	(11.7)	94	(5.7)	18	(6.0)	66	8.4	12	9.5
6. Tubewells	25	(1.1)	23	(1.3)	2	(.5)	23	(1.4)	0	(0.0)	23	2.9	0	0.0
7. Low lift pumps	38	(1.7)	6	(.3)	32	(8.0)	6	(4)	7	(2.3)	4	0.1	0	0.0
8. Drainage	105	(4.8)	103	(5.7)	2	(.5)	94	(5.7)	2	(.7)	40	5.1	0	0.0
B. Software														
1. On-farm water management	368	(16.7)	311	(17.2)	57	(14.2)	310	(19.0)	50	(16.6)	153	19.5	43	34.1
2. Training	30	(1.4)	15	(.8)	15	(3.7)	15	(.9)	14	(4.6)	10	1.2	6	4.8
3. Credit	27	(1.2)	0	(0)	27	(6.7)	0	(0.0)	24	(7.9)	0	0.0	11	8.7
4. Admin. and management	400	(18.1)	348	(19.3)	52	(13.0)	314	(19.2)	36	(11.9)	110	14.0	17	13.5

Annex X

BRIEF SUMMARY DESCRIPTION OF AID
EVALUATION OF IRRIGATION PRACTICE SEMINARS (1956-1970)*

The purpose of this annex is to provide a brief overview of AID's first efforts to transfer knowledge in two regions related to improved irrigation development. There is little doubt that the seminars held in the Middle East and South Asian regions were instrumental in creating substantial institutional change in irrigation development. The major results of the seminars, as reported by participants in the 1973 AID evaluation, are provided in this summary.

The need for such a mechanism for systematic transfer of water management improvement technologies is created in the 1980's than earlier, due to the knowledge gained and the impetus for water management projects in irrigated regions around the world. Such seminars provide one means of helping to change national policy and the allocation of resources toward solving the problems of inefficient use of irrigation water.

The following description is taken from the 1973 Evaluation Report:

> "Beginning in 1956, AID jointly with a host country in the Near East and South Asia, staged a series of seminars on irrigation practice. They were held biennially until 1970 at various locations in the regions. In his 'Preface' to the first seminar report, Carl M. Forsberg, the seminar leader, stated the seminar's purpose:
>
> ....as a means of creating interest and developing a better understanding of the subject of water use.....

Forsberg cited the large capital expenditures being committed to irrigation water supply works and the concurrent difficulty of implementing good irrigation on the farm as reasons for making the effort to hold the seminar. He stated:

> ....Spending for large-scale works to develop and distribute water for irrigation has reached the magnitude of billions of both local currency and foreign exchange during the past decade.

---

*Source: NESA Irrigation Practices Seminars 1956 - 1970: An Evaluation (1973) by Dean F. Peterson, AID Washington, Contract AID/Asia 597, March 1973.

Most countries of the region have large programs, developed by their own engineering forces, or by consulting firms, or both.

Unfortunately, however, very little thought and effort is being placed on the use of irrigation water on the farms. The policy of neglecting the agricultural phase of irrigation can lead only to ruin, both for the farmers in waterlogged and eroded soil and poor crops and to a nation in abandoned structures and investments.

The 1973 report goes on to state:

"The basic objective of the seminar series remained the same throughout the period of its activity. The very serious problems of ineffectiveness of capital investment and a poor water use practice still exist. Poor water use is not restricted to new capital-intensive projects, but occurs pervasively on old and new projects whether traditional or modern. It is an obstacle both to gaining economic returns on capital investment for new irrigation works and to effective use of agricultural inputs of new varieties, fertilizer and mechanization of traditional systems. Some progress has been made, nevertheless and the evidence demonstrates that the seminar series was significant in contributing to that progress.

"Organizational and operation of the seminars was somewhat typical for international seminars. In each case a senior U.S. expert visited the countries several months in advance and helped develop the program based on problems and accomplishments found in each country and on a consideration of what practically might be stated in a formal paper by country experts and administrators at the policy level in delegations. During the actual sessions, papers and discussions were left to the country delegates. U.S. experts played a secondary resource role as technical advisors and remained in the background of the discussions. The goal was to stimulate discussion of real problems and solutions rather than to instruct. The hope for product was policy exchange and institutional development, but exchange of technical information was also an important part of the strategy. Efforts were made to give the seminar as much status in the political hierarchy of each country as practical. Over the period, the participating countries were encouraged to assume increasing responsibility for organizing and financing the seminars.

"The eight seminars were held at the following times and places: Ismir, Turkey, 1956; Tehran, Iran, 1958; Lahore, Pakistan, 1960, Ankara, Turkey, 1962; New Delhi, India 1964; Amman, Jordan, 1966; Lahore, Pakistan, 1968; Kabul, Afghanistan, 1970. Sixteen countries participated in one or more seminars. These included Afghanistan, Cyprus, Greece, India, Iran, Iraq, Jordan, Lebanon, Nepal, Pakistan, Turkey, Saudi Arabia, Sri Lanka (Ceylon), Sudan,

BEST AVAILABLE COPY

Syria and UAR. The usual attendance was seven or eight countries, the most was fifteen and least, six. Average attendance, exclusive of U.S. personnel averaged between 16 and 17. The total number of non-U.S. participating country attendance 376. Because some delegates participated in more than one seminar, the total number of different individuals from participating countries totaled 309.

"Over a period of eight seminars, this was a small number of participants from the LDCs. In the proposed project, plans are made for involving larger numbers of LDC participants.

"According to the evaluation in 1973, the seminars issued a number of recommendations dealing with suggested policy and programs. As part of the evaluation, attempt was made to assess the degree to which these recommendations had been implemented in the various countries visited. Based on a study of the recommendations, a list of 13 evaluative topics was developed. This list included such topics as technical programs, institutional developments and arrangements, educational programs, legal developments and research. The evaluation reported in 1973 that, in general, all countries still have a long way to go to implement the recommendations. Some have farther to go than others. Turkey may have a reached a 'break-through' stage and this stage is probably being approached in India. Generally, the problems of on-farm water management are not yet being dealt with adequately by civil irrigation engineers responsible for overall project design, nor have the farm-service institutions set up to provide on-farm technical services and credit been adequately developed. On the other hand, good starts have been made and the needs have been recognized, not only by the countries themselves, but by international lending agencies, also. That the momentum now exists in most of the countries to carry the movement through is unquestionable."

Table 1 indicates some of the major results of the irrigation practice seminars. These are significant and helped to lay the foundation for many of the developments taking place today in Asia and other regions. AID and its staff involved in irrigation gained much visibility and credibility through these seminars at low cost.

The mechanism can be improved and made more useful in the 1980's. The United States is well qualified to provide leadership for this international exchange of water management knowledge at a time when on-farm water management is being accepted as one of the major constraints to continued agricultural programs in many developing countries. AID could easily cooperate with other international organizations in these seminars.

BEST AVAILABLE COPY

Table 1

MAJOR RESULTS REPORTED FROM THE IRRIGATION PRACTICE SEMINARS (1956 - 1970)

	INNOVATION OR CHANGE	COUNTRY
1.	Increased awareness and understanding of on-farm water use	All countries participating
2.	Instrumental in helping develop a coordinated national program with an on-farm focus	Turkey, India
3.	Influential in getting government to focus on land development, water user associations and needed legislative changes.	Turkey, Afghanistan, India
4.	Helped Irrigation Department to focus more on drainage problems	Iran, Afghanistan
5.	Provided first awareness and understanding of taking the farmer into account in irrigation development	Pakistan Afghanistan
6.	Convinced the government that something could be done about water rights without coming into conflict with Islamic laws	Afghanistan Pakistan
7.	Provided awareness and understanding priority focus in irrigation must be on improvement of farm conveyance systems	All countries
8.	1964 seminar led directly to the command area development program	India
9.	Changed planning procedures in Irrigation Department and sequence of planning - now proceeded from the field to the water supply, rather than the reverse	Nepal

10.	Helped us gain confidence that certain technical improvements could also be accomplished in our countries.	All countries
11.	Helped engineers see need to work more closely with agriculturalists and other disciplines.	Sri Lanka

Though much progress has been made since 1973, countries in the developing world need support as they institutionalize water management in their agricultural sector development programs.

Annex XI

SUMMARY COMMENTS OF THE REPORT OF THE HIGH LEVEL COMMITTEE ON ORGANIZATIONAL SET-UP OF THE CAD PROGRAM IN MAJOR AND MEDIUM IRRIGATION PROJECTS

AND

CREATION OF A WATER MANAGEMENT AND LAND DEVELOPMENT WING IN STATE IRRIGATION DEPARTMENTS*

This brief summary provides some information on a potential policy innovation which could have an important impact on irrigation management in India.

At the State Irrigation Ministers Conference held at Bangalore in October 1980, the resolution was passed recommending strengthening of the CADAs and building of a strong cadre of water managers. The Ministry of Irrigation in June 1981 constituted a high level committee to examine this question in detail. The committee made the following significant recommendations:

1. That the CADA be a wing of the Irrigation Department and established as the project wing under a senior level secretary. That the CAD wing of the Irrigation Department be under the State Minister of Irrigation.

2. That the multidisciplinary technical inputs required be made available to the State Irrigation Departments and a new Water Management and Land Development Wing be constituted in the State Irrigation Departments.

3. That the proposed Water Management and Land Development Wing should be created for operations and maintenance of canals under major and medium irrigation projects and for bigger minor irrigation projects with CCA of more than 500 hectares each.

4. That training institutes for various levels of training be set up at the national and state levels.

5. That the CAD organizations be permanent entities with career cadres of irrigation and extension staff.

---

*Government of India, Ministry of Irrigaton (CAD and WM Division) New Delhi, December 1982

These recommendations were made after much study of the relative merits and shortcomings of the present arrangements for operation, maintenance of irrigation systems and CAD.

In addition, the committee has recommended that special deputation and other allowances, such aas project allowance, free housing, special area allowance and CAD allowance be provided to staff. It is realized that these jobs require some incentives to attract and hold quality staff. (pg.35)

The committee also recommended special studies, monitoring of systems, development of technical manuals, procedural manuals and guidelines for operational staff. (pg.72)

It is recommended that agronomists, agricultural economists, rural sociologists, work on the team and be located on the same premises as the other water management staff (pg.40). The discipline roles have been worked out but little thought has been given to the process of team building.

Mention is made of services required from Indian Institute of Technology, agricultural universities (pg.42) and the Indian Institutes of Management. For example: "The Institute of Management at Ahmedabad has a well established center for management in agriculture where therefore has focused primarily on macro issues of irrigation development and problems of the agricultural sector in general" (pg.41).

The committee strongly recommends water management training be provided in the followng areas:

1. Irrigation engineering
2. Agricultural engineering
3. Agronomy
4. Agricultural extension
5. Water resources and farm management economics
6. Water management (interdisciplinary)
7. Diagnostic analysis in the field (team or interdisciplinary) (pg.42)

Finally, there is recommended the need for a national center to support state institutes and to "train central government officers and for imparting advance training to officers from all over the country, for training trainers and for introducing new approaches based on experience all over the world." (pg.42)

The need for farmer training is also strongly recommended in the areas of improved irrigation practices, improved cropping patterns and use of inputs and in developing better means for allocation of water. The committee suggests that "the use of modern media like video, television, be used by each CADA and the water management wings. Also irrigation demonstrations and fairs are recommended on a yearly basis in the command areas."

These recommendations come at a time when India plans to gear up to focus more on training and special studies. The proposed USAID project has been designed to help implement these recommendations and other crucial software technologies.

Annex XII

MANPOWER REQUIREMENTS FOR EFFICIENT WATER MANAGEMENT

By

M.N.Venkatesan
Chairman
Narmada Control Authority
New Delhi - India

ABSTRACT

In the developing countries wasteful irrigation practices and incredibly low yields persist, resulting in lack of basic necessities of food, shelter and clothing. The four large granaries of the developing world, lying in the Upper Ganga, the Indus, the Euphrates-Tigris and the Nile basin at present produce an average yield as low as 1.57/ha. With the population explosion in the developing countries, the forecasts of demand for foodgrains by the turn of the century reveal the need for doubling of our present production. The rate of growth of irrigation potential will definitely be far behind the growth of population. The only method therefore of achieving this target by the end of the century would be through increased productivity by improved operation of irrigation systems along with other essential inputs needed for a modernised system of agriculture.

In spite of the appreciable increase in the area brought under irrigation in India since Independence (1947) it cannot be said that we are making the most efficient use of water for irrigation. Many of our irrigation systems are operating sub-optimally. We have yet to go a long way before we can evolve ideal methods of water distribution to optimise increased agricultural production under various eco-systems. The results of research carried out in our Agricultural Institutions and Universities need to be adopted quickly in our production programme for maximising the production/hectare of land irrigated. This calls for the creation of a suitable administrative and social organisation for effective use of irrigation water. To ensure that the farmer is able to get the required quantity of water at the right time, it will be necessary to build and maintain physical structures for providing water but also a separate mechanism for ensuring fair allocation and efficient use of water by the farmers.

Experience of working of irrigation systems over the last 7 or 8 years has revealed a number of coordination problems among the various departments of Irrigation, Agriculture, Agricultural Extension, Marketing etc. This has resulted in inefficient water management and consequent loss of production. There is a need therefore to create a proper organisational arrangement to bring the desired interaction among different groups of Irrigation Engineers, Agronomists, Agro-economists etc. Such a multidisciplinary organisation would, apart from attracting the best of talent, be multidimensional in its approach and ensure the optimum utilisation of irrigation water for achieving increased productivity.

The requirements of personnel for such an organisation is likely to be large. It would also be necessary to afford them the right kind of training to enable them to handle water management problems as an integral package of all inputs to the agricultural production process. Over and above all, it is essential to ensure adequate feedback regarding the system performance, the outputs with the help of monitoring and diagnostic analysis teams at the lower level overseen by a performance monitoring group.

MANPOWER REQUIREMENTS FOR EFFICIENT WATER MANAGEMENT

1. Introduction

Of the 1.4 billion people--one third of the world's population--more than 85% have a per capita annual income of less than 300 U.S. dollars. Strikingly, of the 550 million people in the world now living in absolute poverty, over 400 million live in the big cities; Addis Ababa, Cairo, Teheran, Bombay, Delhi, Calcutta, Bangkok and Jakarta. These cities are bursting at the seams under the pressure of indigent migrants who flee to the cities in the hope of escaping rural poverty.

By 1990, according to International Food Policy Research Institute estimates, there will be a deficit of 120 million tonnes in stable food stuffs (rice, wheat and coarse cereals) in the developing countries. It is clear that for all the developing countries of the Indian Ocean region there will be a major shortfall of staple food production well before 1990. No nation can be said to be truly independent if it has to depend on donor countries for meeting its food requirements. Surplus production of a few exporting countries could serve only in extreme emergencies to tide over the impact of national calamities, but there should be no illusion that the world's food security can be ensured continually by the abundant harvest from a few developed countries. This will mean that massive foodgrain imports will have to be resorted to if the developing countries do not take immediate action on the development of irrigation on a scale unparalleled, leading to a substantial increase in food grain production.

2. Irrigation in India

At the time of launching of the First Five Year Plan in 1951, a gross area of 22.6 million hectares was under irrigation. Since then more than 500 major and medium irrigation projects and a few thousand minor irrigation projects have been taken up and substantially completed. As a result, the irrigation potential has touched a figure of nearly 60 million hectares. The overall additional irrigation potential targetted during the current Five Year Plan 1978-83 is 15 million hectares with an outlay of Rs. 70 billion. Such massive investments will continue till we achieve the ultimate estimated potential of 113 million hectares. With the increasing costs of the projects, the restraints on our resources as well as the fact that the projects to be taken up are located in more difficult and inaccessible areas, it would take quite some time before we reach the target.

Against the present production of about 130 million tonnes of foodgrains in a good year, the demands around 1985 are estimated by

the National Commission on Agriculture to be between 150 and 163 million tonnes. Similar forecasts of food production based on the increase in population have revealed that by 2000 A.D. India will have to produce around 230 million tonnes of foodgrains to become self-sufficient.

3. Irrigation Targets

It can be safely assumed that the next few decades will see a very large expansion of India's irrigated area. A doubling of the present acreage in the next 20 years would be well within currently estimated limits; and would be no greater than the rate of expansion since Independence, during which time the area under irrigation has increased substantially. The likely need to provision almost one and a half times the present population by the early years of the twenty first century will encourage a high priority to be given to realising the potential. In addition, it is now being seen that the margin of cultivation has recently been extended to land which should not be under crops at all but rather put under pasture or trees so as to conserve a valuable and for all practical purposes a non-renewable resource, top soil and thereby to protect the (long run) income of the local population. If this submarginal land is taken out of crops, a compensating increase in foodgrain production elsewhere will be required.

4. Productivity

Using production of rice per hectare as in index of the productivity of agricultural projects in South East Asian countries, the Regional Water and Land Development and Management Office of the FAO at Bangkok has classified 19 rice producing countries of South East Asia under five groups in descending order of the production attained by them. In Japan and the Republic of Korea where advanced water management techniques and agricultural practices, progressive land reforms and improved irrigation infrastructural facilities are provided, the yield level attained has been more than 5 tonnes per hectare. Taiwan and West Malaysia follow with a yield level of rice ranging from 3 to 5 tonnes per hectare. India in spite of her enormous resources and large area brought under irrigation ranks only in the fourth category with a yield of less than 2 tonnes per hectare.

5. Problem in India's Irrigated Agriculture

The low crop-yields in canal-irrigated agriculture can only be explained as due partly to engineering inefficiency, partly to unreliability in canal supplies and because of poor on-farm use of water. The preoccupation with creation of new irrigation potential has left unattended, the need for optimum utilisation of the already created potential by proper crop-land-water management. In 1975, about 4.6 million hectares of irrigation potential created with an

outlay of over Rs.20 billion remained unutilised. Even in areas where the irrigation potential is said to have been utilised, the deficiencies in the procedures adopted in planning, design, construction, operation and maintenance of the irrigation systems have resulted in unreliable and inequitable supplies and inefficient use of water. A very rough survey revealed that about 25% of the irrigation systems, measured in terms of potential irrigated land, operate at about 70% capacity utilisation. These systems require mainly canal and channel lining to bring them up to full capacity utilisation. The remaining 75% of the systems operate at about 25% of the capacity and require drastic improvements in both management and physical facilities to bring them up to a reasonable level of utilisation. The total loss has been estimated at 62% of the water at the headgate. If the losses could be reduced by 10%, the saving would amount to very roughly 20 million acre feet which is the equivalent of about three additional Bhakra Dams or six times the Shasta Dam, the key stone of California's Central Valley Project. This means that 40-50% more land could be irrigated from the same initial supply of water. Also the heavy seepage and operation losses and lack of suitable drains have resulted in water logging, salt imbalance and erratic and inadequate supplies at the tail ends of the irrigation network.

6. Steps Taken by the Government

On the eve of the Fifth Five Year Plan i.e., 1973, a review was carried out to identify the deficiencies in the development of command areas of irrigation projects and to consider measures for maximising agricultural production in such areas. A number of policies and measure both in the realm of irrigation engineering and agricultural development were proposed. Programs like fixing and enforcing of suitable cropping patterns, strengthening of extension, training and demonstration, planning and ensuring the supply of inputs etc. were considered essential for effective and efficient utilisation of the irrigation potential created in the command areas. The need for an integrated area development approach was also recognised, requiring action in several disciplines like irrigation, soil conservation, agricultural extension and cooperation, along with support from credit and services organisations. To coordinate the different disciplines at various levels, Command Area Development Authorities were established covering over 50 major irrigation projects and an area of 12.5 million hectares.

7. The Problem

Though the command area development concept has been a breakthrough from the traditional approach, judged in terms of the increase in agricultural production and ensuring equitable and reliable supplies of irrigation water, it has not matched the expectations. Evaluation studies carried out on a number of major irrigation projects have brought to light amongst others, certain basic

BEST AVAILABLE COPY

deficiencies in the irrigation systems which have led to inefficient water use and poor productivity. These are:-

(1) Failure to carry out performance studies of systems from time to time;
(2) Poor water management; and
(3) Inadequate linkage between the various functional units.

A major reason for the poor performance of the irrigation system is the lack of feedback regarding the system performance, the outputs. This would mean that output monitoring of large irrigation systems should become a routine feature. Such an output orientation would enable us to have a continuous and rigorous information system focussed on outputs so that the performance of the system with respect to its objectives can be known and controlled. This will in turn result in a rigorous management system wherein it will be possible to not only measure the inputs but also the actual performance and the capacity utilisation of any irrigation system. What is being practised today in the field of irrigation in developing countries is the administrative mode of operation with control and information on inputs only. The task before these nations is to implement a transformation from an administrative to a managerial mode of operation of the irrigation system so that one would be able to answer the question viz. how well are these systems performing?

8. Performance of Irrigation System

The performance of existing irrigation systems could be improved by the following methods:-

(1) Integrated management of all public sector inputs to the agricultural production process irrigation, seeds, fertilizers, extension, marketing, credit, land levelling, land consolidation etc.
(2) Accountability for results - for increased output of yields and irrigated land which can only be imposed if control over all inputs is integrated under one management.
(3) Decentralised management of specific agricultural areas to enable managers to understand local problems and implement on the spot solutions to these problems.

9. The Organisation

It is thus seen that the techniques for optimum utilisation of irrigation water and achieving maximum productivity are multidimensional and require a multidisciplinary approach for their implementation. A proper organizational arrangement to bring efficient interaction among different groups of Irrigation Engineers, Agricultural Engineers, Agronomists, Agroeconomists etc. has always been a long felt necessity. An Agricultural Management Cadre has to

be built up which will have at the lower levels specialists in different disciplines such as irrigation, agriculture, economics etc. and at the higher level viz., Managers and other personnel who, while being a specialist in a particular discipline will have a clear understanding of the role the other disciplines will have to play for efficient management. Such a cadre built up in each State would attract the best talent in the respective disciplines in view of the vast avenues of promotion in the field of Agricultural Management. Over and above all the creation of such a unified cadre in respect of agricultural development in the State as a whole would lead to:-

(1) Clearly defined agricultural (productivity) and social (equity) objectives.

(2) A professional scheme management which is made accountable to the Government.

(3) Overall management in the hands of trained multidisciplinary staff.

(4) A separate cadre for irrigation management as opposed to the different kinds of arrangement existing at present.

(5) A meticulously planned framework for distribution procedures, founded on detailed field observations of farmers' water management practices.

(6) Participation of representative farmers in the planning of seasonal water schedules and the monitoring of day to day releases; within this agreed framework, strict rules governing water distribution by official staff within seasonal schedules and powerful sanctions against misappropriation of water.

(7) Regular contact between officials and local water user's groups for training and consultation, combined with the delegation of increasing responsibilities to junior officials and farmers' representatives over time.

(8) Accountability for outputs, a feature lacking today in the CADA set up.

(9) Monitoring and diagnostic analysis into the yield and identification of deficiencies so as to rectify them in time.

(10) Supply of feedback information to the State as well as Central Government to forewarn them to take necessary steps for overcoming shortages or other problems; and

(11) Taking up of action research programs with the object of testing and developing improved institutions and management procedures capable of being extended sucessfully over a large area.

10. The Hierarchy

For achieving the most efficient performance, the organization will have to operate in a considerably different mode than the typical

bureaucratic structure. This new mode is best described as "parametric organisational structure" and "heuristic managerial process". In a parametric organisational structure, higher authorities only set the broad conditions or parameters under which the operating units work, leaving the determination of the variables up to the latter's discretion. Thus the higher authorities provide lump-sum budget allocation, with minimal line item specifications, broad rules and operating procedures and mutually determined output targets. How the putput targets are to be reached within these parameters is left to the operating agency. The higher authority intervenes only when the system fails - i.e. when actual outputs are significantly below projected outputs.

Heuristic management explicitly recognises that in most development efforts it is impossible to define in advance of the action precisely what problems will be encountered, much less to program solutions to these problems. The discovery of problems and the creation of solution to these problems is a function of experience of "learning by doing".

The above can best be achieved by a "corporate" body which is not tied down under civil service rules and regulations and other bureaucratic regulatory procedures. It will however, have to be realised that this cannot be totally self-financing. There is a need for public support to the organisation while it maintains its independence in thought and action.

11. Methodology

The above can be achieved by a three-tiered structure as detailed below:-

(1) A State level corporate body for policy guidance in respect of agricultural (productivity) and social (equity) objectives and over all coordination.

(2) A regional body for execution which is made accountable to the local Government and to the farmer clients with an overall management in the hands of a multidisciplinary team.

(3) A grass root level organisation in charge of a territory for ensuring the participation of representative farmer and in the management of the agricultural areas and for carrying out the day to day activities.

To carry out diagnostic analysis as well as monitor the performance, an independent monitoring organisation may be set up for even two or three sets of teritorial groups who would continuously acquire information about the functioning as well as the outputs of the system.

A peformance auditing division set up for the whole State would look after the performance of the various systems in the State as a whole and report direct to the State as well as the Federal Government regarding various issues such as crop areas and yields seasonwise and cropwise.

12. The Structure

Figure 1 illustrates the organisational structure of such a State Agriculture Management Corporation.

13. Structural Break-up

All the irrigated area in the State shall come under the purview of the State corporate body headed by General Manager. For purposes of illustration it may be assumed that this body is responsible for a total irrigated area in the State of say 5 million hectares. This body shall be directly responsible to the State Government and shall have the fullest cooperation and assistance in respect of personnel, technical know-how etc. of the Departments of Irrigation, Agriculture, Economics, Statistics and Sociology.

The State will be divided into 20 regional centers mapped out so as to obtain the greatest possible homogenity of soil types and topography, other agro-climatic conditions and social variables. Each region will be headed by a Regional Manager with the requisite multidisciplinary staff to assist him.

Each regional center will be divided into ten territories, each having a basic management unit of 25000 ha of irrigated land. Each territory will be a self-standing management team responsible for all agricultural inputs in its area and accountable for output targets mutually agreed upon with the higher authorities.

Each territorial division will consist of three field units:

(1) The Irrigation System Group (ISG) which is responsible for irrigation management from the point of water input into the area (at the distributary in the case of territorial units; at the headgate of the irrigation system in case of regional units) to the farmgate...to the individual farmer with the correct quantity of water at the correct time.

(2) The Crop System Group (CCS) - in charge of inputs comprising timely provision of seeds, fertilisers, pesticides, land levelling, credit and extension.

(3) The Agricultural Output Group (AOG) which is in charge of crop storage, processing and marketing.

The other crucial elements in the structure are the Performance Monitoring and Analysis Division at the regional level and the

and the performance auditing at the apex level. The former monitors the progress of the territorial units towards their objectives and helps diagnose problems as they arise. The latter as it were "watches the watchers" by corroborating monitoring reports through independent checks of a sample of these reports.

Performance monitoring is only concerned with results - with the relationship between outputs and expectations. If performance monitoring shows that the outputs are not in accord with projections, this fact triggers a more detailed research and analysis effort. The Monitoring Division thus should only attempt to answer three basic output questions:-

(1) How much area was cultivated with different crops?
(2) What portion of this area was irrigated, at what times?
(3) What were the yields, by crops? Did the yields increase according to projections?

If the answer is no, the diagnostic team will have to go into action and find out why? Who failed to deliver the goods? Were the projections unrealistic? etc.

14. Manpower Requirements

Figure 2 illustrates the manpower requirements at different levels of the corporation in charge of a total irrigated area of about 5 million hectares.

It will be seen from the above that the personnel required for Agricultural Management for 5 million hectares is as below:

General Manager	1
Senior Managers	20
Managers	221
Assistant Managers	3723
Technicians	7200
Staff	10464

The annual expenditure on establishments of the above order works out to Rs.21.15 crores.

The manpower requirements for the monitoring effort will depend largely on the sample size in each strata. On an average of 30 samples in each strata, for monitoring 5 million hectares, a total of about 250 persons together with a supporting staff of about 500 i.e., a total of 750 persons would be required. The number of personnel for performance auditing is likely to be about 10% of the personnel for monitoring.

Inclusive of the operating cost of the Agriculture Management & Monitoring Divisions the total cost is likely to be well within Rs.250 million annually. This works to a cost of Rs.50/ha of irrigated land in respect of Agricultural Management and Monitoring only.

For purposes of carrying out the maintenance and running of the irrigation system as well as carrying out any minor structural modifications, a separate group of Irrigation Engineers will be posted to work under the General Manager of the system. The cost of running and maintenance of the system including the establishment required for the same will be met out of the O&M cost of canals for which the State Governments have agreed to provide a sum of Rs.50/ha of irrigated land. Any major structural changes, modernisation, lining etc., if taken up for improving the efficiency of the system will have to be carried out by the Irrigation Department of the State and will not come under the purview of the Agricultural Management Corporation.

15. The 64$ Question

As already stated the Agricultural Management Corporation is not self-supporting and will have to depend on public support. The questions that arise are numerous and will need to be probed into in depth. The alternatives open to the developing nations are only two. Do we continue to produce at the same rate/ha of irrigated land or at a slightly increased rate and widen the gap between demand and supply which is bound to increase sharply by the turn of the century? This will mean that either millions will have to go hungry or we will have to resort to massive import of foodgrains. Or do we adopt modern methods of agricultural management and increase our productivity by 100% so that we are self-sufficient in the matter of food? Obviously, the answer lies in the latter so that the increasing population in our country by the turn of the century is adequately fed with our own resources.

A pertinent query at this stage would be as to how far are we sure that by adopting the type of agricultural management indicated, we will be in a position to improve our productivity. There is no doubt that while efficient management is a major input, the necessary hardware such as modification of existing systems, lining of canals, provision of cross regulation and other structures, measurement devices, introduction of rotational water system etc. will have to be carried out alongside to ensure increased productivity. Many developing countries are already engaged in these tasks with or without the technical and financial assistance of international lending agencies. It is expected that the performance of the irrigation system would improve

substantially by these improvements to the systems. Various developing and smaller nations such as Taiwan, Israel, Korea, Philippines etc. have in addition to improvements in the hardware, been able to achieve a very high productivity by the efficient management of the systems. There is therefore no doubt whatsoever that the introduction of an Agricultural Management Cadre along the lines indicated above is a step in the right direction for achieving a higher productivity. The question of how the additional cost on this account will be met with will be one for the Governments to decide. There is however, no gainsaying the fact that the cost of Rs.50/ha for the Agricultural Management would be a very small percentage of the increased benefit which the farmer would obtain as a direct result thereof.

16. Training

There is a great dearth of suitable trained personnel in the developing countries in the field of Agricultural Management. Training to upgrade manpower capabilities in this field is a key to an efficient interface between hardware and software in the projects from the planning stage through to implementation and operation. The type of training to be given will be dependent on the level of the personnel e.g., at the technician and Assistant Manager level, the training will have to be of a more detailed nature lasting over a period of about a year during which period the junior staff master the basics in the different disciplines and are also made aware of the need for interaction of the different disciplines for efficient agricultural management. At the middle and senior levels, the personnel would be required to attend refresher courses to update their know-how and to become conversant with the latest trends in the different disciplines. There is a great need for establishing an International Training Institute in Agricultural Management for the developing countries where experts drawn from different advanced nations could provide the requisite know-how and training to the personnel from the developing countries. The location of the training institute will have to be chosen carefully keeping in view the advance made by the country in the field of irrigation, the facilities available and the replicability of the training by the trainee in his own country on return.

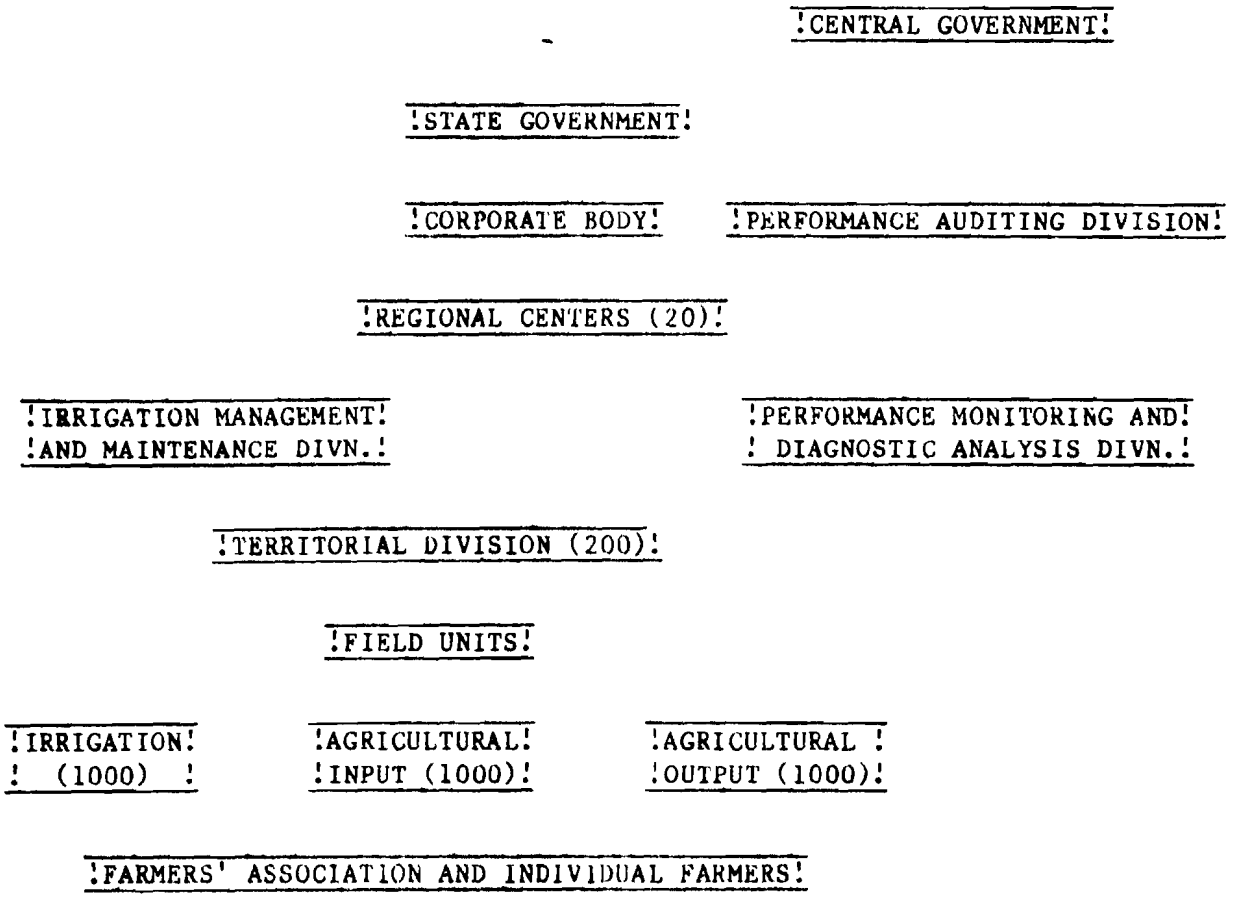


Fig. 1: AGRICULTURAL MANAGEMENT CORPORATION ORGANIZATIONAL STRUCTURE

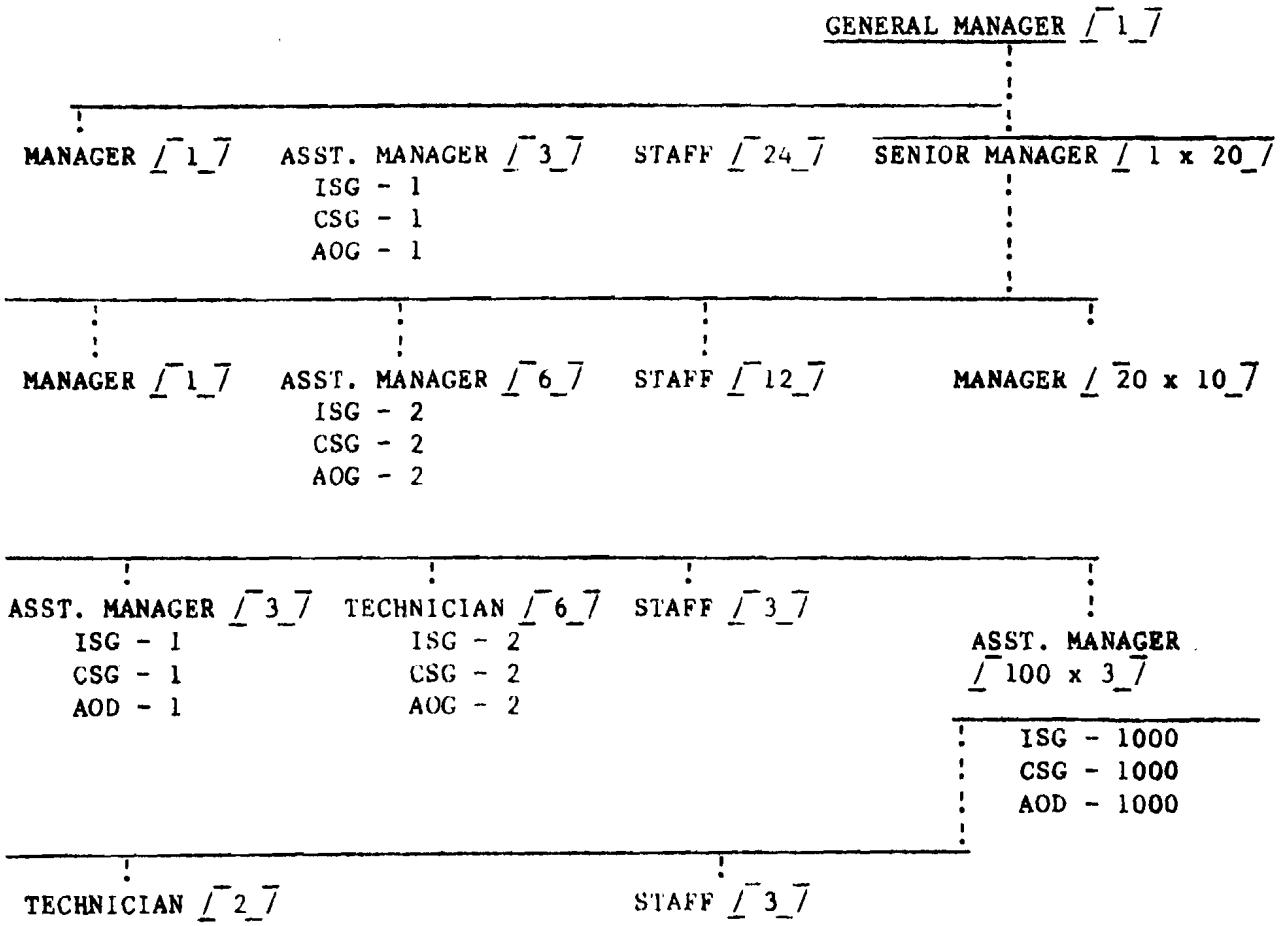


Fig. 2: MANPOWER REQUIREMENTS

Annex XIII

A SURVEY OF PROFESSIONAL DEVELOPMENT TRAINING NEED FOR IRRIGATION MANAGEMENT IN INDIA

Melvin D. Skold and B. Sen*

Improving farm water management has recently emerged as an important part of increasing food production and farmer incomes in irrigated areas throughout the world. An evaluation of a series of seminars on irrigation practices in the Near East and Southeast Asia found the problems of on-farm water management as not being adequately attended to by civil irrigation engineers responsible for overall project design and operation[1/].

The Government of India (GOI) has been quick to respond to these identified deficiencies. Water management training centers have been established with the intended purpose of training individuals to better manage the nation's vast irrigation system.

Responding to the needs identified within the GOI, a Project Identification Document (PID) was prepared by USAID under the title "Water Management and Training". Subsequently, a Pre-design Team took the recommendations of the PID a step further and developed a data base and more closely identified the targeted audiences for farm water management training.

Concurrent with the Pre-design Team's activity in January 1982, the Prime Minister of India gave emphasis to a 20-point program for implementing the current five-year plan which listed increasing the efficiency of irrigation and farm technology as the number one priority. It was indeed fortunate that the pre-design team planned for eliciting opinions from Ministries of Irrigation and Agriculture officials of their training needs and that of their staff. A questionnaire was designed and made available to selected personnel in these agencies in Maharashtra, Gujarat and Rajasthan States. Questionnaires were received from 26 officials. An additional 23 responses were received from participants in a Diagnostic Analysis Training Workshop put on by the Water Management Synthesis Project.

1/Peterson, Dean F., "NESA Irrigation Practices Seminars, 1956-1970 =
An Evaluation. AID Washington Contract, AID/Asia 597.1973.

*Skold is a member at the project design team and Sen is a member of the USAID/India staff.

This report summarizes the responses obtained from the survey. The survey asked information about the professional characteristics of the respondents. After these are described, their attitudes about a proposed National Training Center are presented and finally, their responses about training needs within States are presented. The survey results are largely self-explanatory and are presented with a minimum of interpretation.

A large number of survey forms were distributed which were not returned. As additional responses are received, this report can be revised to include them.

Characteristics of Respondents

The respondents tended to be senior personnel; 37 of 49 had more than 10 years experience and 28 of 49 had more than 20 years experience (Table 1). Most respondents were engineering graduates; over one-fourth (14/49) had post-graduate degrees (Table 2). The Training Workshop participants were structured to include a higher proportion of non-engineering graduates. Twenty eight of the respondents are employed by the Ministry of Irrigation and the other 20 are employed by the Ministry of Agriculture. (Table 1).

National Training Needs

There is a proposal to establish a National Center for Water Resources Development and Management. When asked who should be trained in such a national center, it becomes immediately apparent that the respondents view water management as a complex problem involving several disciplines. Most identified the need to train key professionals from all Departments and disciplines involved in irrigation developments (Table 3). One State, Rajasthan, would tend toward focusing training only on senior professionals and new entrants to the Irrigation Department. The multi-disciplinary nature of water management is further recognized by the administrative location of a National Center. Most respondents thought that a Center should be under a Joint Committee of the Ministries of Agriculture and Irrigation (Table 4). The Rajasthan respondents again differ somewhat from others; a higher proportion of the Rajasthani respondents see training as being designed for the Irrigation Department by the Irrigation Department.

The respondents also indicated rather strong agreement on the length of training courses (Table 5). The majority would like to see short-term courses (one week to two months). Clearly, the training needs identified are diverse. Some training of one to two week duration is desired and needs are also identified for other, more in-depth (4-6 week) short courses. And, diversity of need is also identified about the subject of training courses. Training programs to be developed must be designed to accommodate the different requirements of duration and subject matter.

Strong support exists for both technical and management oriented studies. The largest number would prefer a combination of training methods and many indicate that field oriented training methods would serve best (Table 6). Preferred methods of training were rank-ordered. Table 7 presents the highest rank responses. A significant number would like to see lectures by specialists as an ingredient in the training programs. Short courses with a combination of lectures and actual field experience would appear to well serve the identified needs. There is almost complete agreement that the training offered by a National Center should be inter-disciplinary.

There was considerable disparity among the respondents' views about the kinds of overseas studies needed as a part of the training program. The largest number would prefer intensive "hands-on" practical inter-disciplinary training lasting four to six weeks (Table 8). Others would prefer observation tours and still others would like short-term (4-6 weeks) training in highly technical specialized subject matter areas. A significant number would also like one year, non-degree academic training with a focus on water management. It should be noted that these overseas training options are not mutually exclusive and that programs are presently available to provide each of these kinds of training. Further, all of those expressing a need for one-year non-degree academic training come from more experienced personnel (seven with more than 20 years of experience and one with more than 10 years of experience). Personal and professional uncertainties may make younger professionals reluctant to consider this type of training. Somewhat surprising is the lack of desire for graduate degree training in either inter-disciplinary water management or in a technical discipline which relates to water use and management.

Given National Training Center, the opinions on staffing varied. However (Table 9), most thought that the staff could be drawn from senior professional staff of the Irrigation and Agriculture Ministries or from the highest qualified staff from any place in India. Of course, these may not be independent sets. Others listed as their first choice for drawing Center staff from Research Institutes. Only one respondent thought the universities are the place to obtain staff for a National Center.

A vast majority of the respondents indicated that the National Center staff should receive special training in Comprehensive Diagnostic Analysis of Irrigation Systems (Table 10). One-fourth felt that trainers would need an update in their respective subject matter areas and many also felt that trainers should receive special training in teaching philosophies and methods. The importance with which the respondents view water management training is indicated by the fact that all believed that some additional training of trainers is necessary.

Most respondents say that a National Center should direct its training toward senior staff in the States; most thought both senior irrigation and senior agriculture staff should be trained (Table 11). Others see the role of the National Center as training trainers for State training institutes. None of the respondents say that National Center training should be directed toward the Central Water Commission. A National Training Center focusing on training of trainers for States and to train senior State staff in Agriculture and Irrigation would meet most identified needs.

It was earlier observed that the category of participants included in the Tables above had a higher proportion of non-engineers than the respondents from the States. The participants also differed from the others in that they had completed, or were in process of completing a short course in Comprehensive Diagnostic Analysis of Irrigation Systems. It is useful to observe the differences in response between the participants and those queried in the States. Given their inter-disciplinary training experience (recognizing that a larger number of disciplines are also represented), the Participants favor training key professionals from all Departments and disciplines more than those from the States. It should be noted, however, that the State respondents favored training of key personnel in all disciplines more than any other category.

Choice of the administrative location of the National Center did not differ markedly between the participants and the States. Both groups favored the location of such a Center under a Joint Committee of Irrigation and Agriculture. Similarly, the participants did not bias the type of training response toward short courses such as they had experienced. In fact, the participants endorsed short courses of one to two weeks more strongly than the group as a whole. By and large, the participants and non-participants indicated about the same preferences for type of training.

Participants and non-participants alike favor a combination of training methods. The participants did bias the results toward field-oriented training, likely of the type which they had experienced. The State respondents voted for inter-disciplinary training as strongly as did the participants, however.

Having completed an inter-disciplinary water management training course in India, the participants voted in favor of overseas observation tours more strongly than the other group. The state respondents would prefer to take an inter-disciplinary water management short course training program at an overseas location. The participants favored short-term discipline oriented training slightly more frequently than the non-participant group. Perhaps this is because of a greater realization that to function well in an inter-disciplinary setting, one must first be well grounded in discipline subject matter.

The participants do not differ from the non-participants in their opinions on the selection and training of trainers. Participants view the National Center as having a stronger role in the training of trainers than the respondents from the States. A slightly broader role for the National Center is seen by the participants.

Twenty five of the Indian participants in two recent Diagnostic Analysis Professional Development short courses were asked for their opinions about the relevancy of such a course for others involved in the irrigation system in India. An examination of Table 12 will indicate that these individuals believe that the professional development program they had just completed should be experienced by a broad number of professionals involved with irrigation and agriculture.

State Training Needs

Those queried were also asked a number of qualitative questions about training needs within States. Several of the questions were such that tabular summaries of the responses could be made. In Table 13, the kinds of training most needed by Command Area Development personnel are identified. Most see the need for discipline-oriented field training in Team Diagnostic Analysis. Strong support was also given to technical training of an inter-disciplinary nature. The views of the participants and non-participants did not markedly differ.

Applied research needs were also identified. Table 14 includes the preferences by number of highest rank and by the rank score. The largest number of participants and non-participants alike was for irrigation system evaluation such as diagnostic analysis by a team. The subject area of crop water consumptive use requirements was also identified by a number of respondents. Several other subject matter areas received support as well.

The composite rank scores (calculated by totaling the response rankings and dividing by the number of respondents which ranked the item) are shown in the right hand column of Table 13. Clearly, special studies are needed in irrigation system evaluation and crop water requirements. Each of the special study subject matter options received important support. For example, soil fertility studies received no first-rank support but are reflected as much needed in the composite ranking. No subject matter category can be ruled out on the basis of these composite rankings as no one subject matter category received a consistently high rank among the respondents.

A vast majority of the respondents also favored the location of a small, inter-disciplinary expatriate team in the States (Table 15). Forty two of the 48 respondents would like to see such a team.

The participants were not asked of their opinions on the location of the training centers in States. The other respondents favored the location of a training center at the project area. Some qualified their votes for a city location by stating that a city near the project area would be the best location.

CONCLUSIONS

This report summarized a preliminary assessment of professional development training and special study needs for improved water management in India. Other data collection on the numbers of professionals which may require training for management and special studies was initiated by the pre-design team but these data are too incomplete for summarization at this time. The design team will collect additional professional development special study training needs. While these analyses can only be regarded as preliminary, it should be noted that the needs for professional development identified here are entirely consistent with an earlier report by Lenton[2/].

Additional evaluation of professional development requirements should be done in India and elsewhere in a more comprehensive framework. Such an assessment would help to identify (1) the types of professional development needed by age and professional responsibility, (2) the durations of professional development programs which are feasible, (3) the potential numbers of professional development trainees, (4) the targeted audience for each kind of activity and (5) the best location for each type of activity. The comprehensive survey should consider the needs for on-the-job professional development of currently employed professionals. Further, changes in college and university courses and curriculum must be addressed which will better equip graduates for meeting India's irrigation development planning and irrigation system management improvements in the future.

Some of these specific professional development needs have already been identified[3/]. In the Maharashtra Irrigation Technology and Management report, required special studies are identified as well as the types of training needed in India and in the U.S. The numbers of individuals targeted for each type of professional development are estimated and special study required for the execution of the project are set forth by discipline area.

[2/]Lenton, Roberto, "Doubling Rice Production in Asia Through Investments in Irrigation: Some Perspectives on Training and Research Needs", Ford Foundation, Delhi. Presented at a meeting of the Trilateral Commission Experts' Meeting. Tokyo. November, 1978.

[3/]USAID/India, "Project Paper: India, Maharashtra Irrigation Technology and Management", Vol.II. Project Analysis. USAID/ New Delhi, March, 1982.

SUMMARY

Although the respondents were diverse in terms of their institutional affiliations, professional backgrounds, experience and professional responsibilities, several near-concensus opinions emerge.

1. The participants agree with the already stated goals of the GOI that additional training is needed to accomplish the number one priority of improving irrigation efficiency.

2. Any National Training Center established should be under the joint direction of a committee representing the Ministries of Agriculture and Irrigation.

3. Training options should be provided that are both disciplinary and inter-disciplinary in content.

4. Short-term training programs of both specialized disciplinary subject matter and inter-disciplinary diagnostic analyses of irrigation systems are needed.

5. Training is needed for both national level personnel and to address specific problems within States.

TABLE 1

LENGTH OF SERVICE OF RESPONDENTS, STATEWISE

	Up to 5 years	5-10 years	10-20 years	20 years & above	No response	Total No. of Respondents
Maharashtra				3		3
Gujarat	1	2	1	3		7
Rajasthan			2	13	1	16
Participants in Training Course	2	1	10	9	1	23
TOTAL	3	3	13	28	2	49

TABLE 2

BASIC EDUCATIONAL BACKGROUND OF RESPONDENTS

	Graduate	Postgraduate	Total	Engineering	Others	Total
Maharashtra	3		3	3		3
Gujarat	6	1	7	6	1	7
Rajasthan	11*	5	16	15	1	16
Participants	15	8	23	9	14	23
Total	35	14	49	33	16	49

*includes one non-reported case.

TABLE 3

CATEGORIES OF INDIVIDUALS TARGETED FOR PROFESSIONAL DEVELOPMENT AT A NATIONAL CENTER

	Senior Officials in Irrig. Dept.	Senior Profess./ New En-trants to Irrig. Dept.	Senior Officials in Irrig. & Agric. Min.	Key Prof. from all Depts./ Disc. in-volved in Irrig.	Others	No Resp.	National Center should not be trng. Center	Total
Maharashtra				2			1	3
Gujarat		1	1	4	1			7
Rajasthan	3	7	1	4	1			16
Participants		1	2	17	3			23
Total	3	9	4	27	5		1	49

TABLE 4

APPROPRIATE ADMINISTRATIVE HOME OF A PROPOSED NATIONAL CENTER

	Maharashtra	Gujarat	Rajasthan	Participants	Total
Central Water Commission	1		6	4	11
Other unit in Min. of Irrig.			3	1	4
Min. of Irrig.		1	1	2	4
Jt. Committee of Ministry of Irr. and Agric.	1	5	6	14	26
Other	1	1		2	4

TABLE 5

LENGTH OF PROFESSIONAL DEVELOPMENT PROGRAMS WHICH SHOULD BE PROVIDED BY THE NATIONAL CENTER

	6-12 mos.	1 week -2 mos.	Short courses	Others	No Trng.	Short- & long term	Total	No Response
Maharashtra	1		1		1		3	
Gujarat		4	1	1		1	7	
Rajasthan	4	4	5	2			15	1
Participants	1	10	6	5			22	1
Total	6	18	13	8	1	1	47	2

TABLE 6

METHODS OF TRAINING PREFERRED BY NUMBER OF RESPONDENTS GIVING THE HIGHEST RANK*

	Maharashtra	Gujarat	Rajasthan	Participants	Total
Lectures	1	1	5	3	10
Discussion			1		1
Case Studies		1	1	2	4
Audio Visuals				1	1
Demonstrations					
Field Oriented		2	1	8	11
Lab					
Others					
Combinations	1	3	7	8	19
None	1			1	2

* One unranked

TABLE 7

TYPES OF TRAINING WHICH SHOULD BE AVAILABLE THROUGH PROFESSIONAL DEVELOPMENT PROGRAMS

	Subject Discipline Subject Matter	Inter disciplinary	None	Both
Maharashtra		2	1	
Gujarat		7		
Rajasthan		15		
Participants	1	20	1	1
Total	1	44	2	1

TABLE 8

TYPES OF OVERSEAS STUDIES NEEDED BY ORDER OF HIGHEST RANK

	Maharashtra	Gujarat	Rajasthan	Participants	Total
Observation tours			3	8	11
Hands-on Inter-disc. Water Mgt.	1	5	5	6	17
Technical, Special Subject Matter Area			4	6	10
One-year non-degree Water Management	1	1	4	2	8
M.S. or PhD in Interdiscipline Water Management					
M.S. or Ph.D. in Special Subject Area					
Technical Speciality in Irrigation	1	1		1	3
Other					
Total	3	7	16	23	49

TABLE 9

INSTITUTIONS BEST FOR SELECTION OF CORE PROFESSIONAL DEVELOPMENT STAFF BY ORDER OF HIGHEST RANK

	Maharashtra	Gujarat	Rajasthan	Participants	Total
Senior Professionals from Irri. & Agriculture		4	4	7	15
Highest Quality Staff from any place in India		3	9	4	16
High Quality Staff in Research Institutes	1			4	5
High Quality Univ. Faculty			1		1
All of the above	1			6	7
None of the above	1		2	2	5
Totals	3	7	16	23	49

TABLE 10

SPECIALIZED INSTRUCTION FOR THE TRAINING OF TRAINERS

	Teachning Philosophies and Methods	Comprehensive Diagnostic Analysis of Irrigation Systems	No Additional Training	Update of Discipline Training	Tota
Maharashtra	1	1			2
Gujarat		5		2	7
Rajasthan	4	9		2	15
Participants	3	13		7	23
Total	8	28		11	47

TABLE 11

MAJOR ROLE OF NATIONAL CENTER

	Train CWC staff	Train Irrig. Staff in States	Train Senior Irrig. & Ag. Staff in State Irrig. Project	Train Trainers for State Training Insti-tutes	All	None	No response
Maharashtra		1	1			1	
Gujarat		1	3	1	1	1	
Rajasthan		3	8	4			1
Participants			8	8	7		
Total		5	20	13	8	2	1

TABLE 12

PARTICIPANTS VIEWS OF THE RELEVANCE OF DIAGNOSTIC ANALYSIS TRAINING FOR WATER MANAGEMENT PERSONNEL IN VARIOUS BRANCHES OF GOVERNMENT

Type of Personnel	Recommendation for Diagnostic Analysis a/			
	Yes	Perhaps	No	No response
	(Percentages)			
CAD held staff	89	4	2	4
All Irrigation Dept. Personnel	69	16	11	4
All New Engineering Graduates Entering Irrigation Department	64	22	11	2
Extension Staff on CAD Programs	82	13	2	2
Economists on CAD Programs	75	20	2	2

a/ Row totals may not add to 100 due to rounding.

TABLE 13

PROFESSIONAL DEVELOPMENT NEEDED IN COMMAND AREA DEVELOPMENT

	Training Discipline Training	Technical Inter-disciplinary Training	Discipline-Team Diag-nostic Analysis
Maharashtra			3
Gujarat		1	6
Rajasthan		2	10
Participants	1	6	16

TABLE 14

SPECIAL STUDIES NEEDED IN WATER MANAGEMENT
BY ORDER OF HIGHEST RANK

	Maha-rashtra	Gujarat	Rajas-than	Parti-cipant	Total	Composite Rank Score
System evaluation	2		8	17	28	2.7
Ground water hydrology				1	1	6.7
Crop water requirements	1		1	2		2.8
Soil fertility studies						5.0
Water logging and salinity		1				5.8
Institutional constraints						8.1
Conjunctive use of ground and surface water		1				6.1
Soil-water-plant relation-ships		2		1	3	5.0
Farm manage-ment economics		2		1	3	5.8
Extension studies				1	1	6.2
Ways to involve farmers		2			2	4.2
All of the above		1				-

TABLE 15

EXPATRIATE TECHNICAL ASSISTANCE
INTER-DISCIPLINARY TEAM

	FOR	AGAINST	UNDECIDED	UNCLEAR
Maharashtra	3			
Gujarat	6	1		
Rajasthan	13	2	1	
Participants	20	1	1	1
Total	42	4	2	1

TABLE 16

BEST LOCATION OF STATE
PROFESSIONAL DEVELOPMENT CENTERS

	Project Area	City	University	Others
Maharashtra	3			
Gujarat	3	3	1	
Rajasthan	11	3		1
Participants				
TOTAL	17	6	1	1

Annex XIV

PHYSICAL AND OPERATIONAL INADEQUACIES IN CANAL SYSTEMS CITED BY INDIAN IRRIGATION OFFICIALS

Tables 1 and 2 provide a comprehensive listing of the deficiencies of irrigation systems. Indian professionals in Irrigation and Agriculture are aware of the problems identified by various panels and studies. The Irrigation Water Management and Training Project is designed to train professionals how to intervene in the system to remove these deficiencies. Unlike some efforts, a diagnostic analysis team approach will be used to identify causes of the inadequacies and systematic efforts will be made to intervene to solve priority problems. Action field studies, training, demonstrations and technology transfer are linked in this project organically to bring about positive changes at the farm through improved water supply and use.

TABLE 1

Physical and Operational Inadequacies in Canal Systems (as cited by Indian Officials) (1)

MAIN SYSTEM INADEQUACIES

Faculty Original Design

- The present level of competence in planning and preparing projects is too low.

- The system most often lacks sufficient control structures or control structures are not properly designed.

- Canals are often of inadequate capacity in relation to peak demand.

  Discharge capacity of project outlets (chaks) often too low in relation to the irrigation stream that can be handled by farmers.

Faculty Operation and Maintenance

- Canal capacity less than original design capacity owing to poor maintenance.

(1) CGIR Study Team. Report in Irrigation Management.

TABLE 1 (Cont'd)

- System operation often based on water availability rather than water demand.

- Head-end farmers get oversupply of water in initial years and resist later reduction of supply.

Faculty Modernization Procedures

Measuring devices often lacking.

Phasing often unsuitable, e.g. overlooking that first effort should be to restore system back to original design capacity.

Techniques for introduction of warabandi (rotational water supply) often not properly thought or implemented.

- Irrigation Department staff lack an adequate manual to guide them in diagnosis as a step in planning system modernisation.

ON-FARM SYSTEM INADEQUACIES

Faculty Institutional Arrangements

- Lack of coordination among key agencies especially the Irrigation Dept., the Command Area Development Authority (CADA) and the Agriculture Dept.

- Failure to appoint a head to direct (rather than merely coordinate).

- Lack of follow-through on Central Government recommendation to create separate Operation and Maintenance wing in the State Irrigation Depts.

- CADAs have inadequate administrative powers.

Faculty Personnel Policies

- Executive Officers rotate too frequently.

- CADA administrators often too junior or fail to have leadership qualities.

The CADAs do not provide adequate career opportunities.

Faculty Manpower Planning

- Lack of facilities for in-service training in water management.

TABLE 1 (Cont'd)

- Lack of adequate curricula on water management in agricultural and engineering universities.

Faulty Management Practices

- Executive Officers overloaded with administrative tasks.

- Inadequate exchange within the country of lessons from experience re operation of water users' co-operatives.

- Lack of clear targets for guidance of managers.

FAULTY ON-FARM PRACTICES

Plot-to-plot irrigation as widely practiced is inefficient.

Known technologies of efficient water use are not being applied.

The States are slow in responding to Central Government's request to extend field channels at State expense to 5 to 8 ha. blocks (rather than about 40 ha. as at present).

FAULTY DRAINAGE AND ROAD SYSTEMS

Drainage system often omitted or inadequately designed.

Farm-to-market roads often lacking.

Conjunctive use not sufficiently considered as means of reducing water logging and salinity while supplying supplementary irrigation water.

Research is lacking (and therefore farmers are not receiving advice) on appropriate farming systems including choice of cropping pattern either under existing conditions (with deficiencies in the water system) or under improved conditions.

TABLE 2

The Main Defects Found in the Quick Survey of a Canal System in July 1979 (1) included:

REASONS		
(A)	Insufficient supplies	High seepage in canals. Conversion to wet in early reaches. Silting. Minor incapable of drawing design discharge. Never received water in ten years. Design discharge not released because of weak bunds.
(B)	Defects in outlets (pipes)	Not fixed. Fixed in wrong place. Fixed but defunct. Water flowing one foot below vent. Unauthorized pipes. Broken pipes. Open cuts widened by upper farmers.
(C)	Insufficient control	Minors having both wet (paddy) and intermittent pipes. No control structures for nearly all minors and many majors. Raising crest of drop necessary. Cistern and regulating arrangements not provided at offtake points. Minor breached due to insufficiency of syphon vent way. Irregular and untimely supplies. Wrong creation of minor offtakes. Insufficient capacity of minor.

(1) Source: Hashim Ali, S. Practical experience of irrigation reform, Andhra Pradesh, India, Water Supply and Management, 5th January, 1981.

TABLE 2 (Cont'd)

		REASONS
(D)	Field channels	Not excavated. Insufficient extent not reaching each survey number. Open cuts without structures or drops. No culvert over field channel crossing cart tracks. Constructed but obliterated or damaged. Narrow channel incapable of taking full discharge. Rapid flow causing erosion. Ramps at crossings not provided. Improper alignment. Insufficient drops and distribution boxes.
(E)	Lands not getting water	Uncommandable area localised. Damaged drops/cross structures. Full supply level cannot be maintained. Weeds in canals. Desilting not done. Minor widened by farmers for using as cart track. Not a single acre getting water under one minor. Inadequate supplies in over 50 percent minors. Badly leaking system. Major not excavated up to required bed level, hence design discharge cannot flow. Breaches not repaired. Minors without drops and structures. Minors, pipes silted. Shifting of minor head sluice necessary.
(F)	Waterlogging	Due to heavy seepage from minor. Due to conversion of lands into wet in upper reaches.

Annex XV

MAJOR AND MINOR IRRIGATION OFFICIALS' PERCEPTIONS OF OPERATION OF THE IRRIGATION SYSTEM IN THE MAHI KADANA PROJECTS OF GUJARAT STATE, INDIA

A Diagnostic Analysis Professional Development Workshop was held at Anand, Gujarat, February 16 to March 19, 1981, conducted by the Water Management Synthesis Project. This training program was conducted in cooperation with the AID Mission, India, and the Commissioner of the Mahi Kadana Command Area Development Project. Participants included five engineers, three agronomists, three extension personnel, and four economists who composed three interdisciplinary teams for Diagnostic Analysis (DA) field activities.

As part of the analysis of the irrigation system below the government outlet DA field investigation exercises included structural interviews with five minor irrigation officials and six major officials. The purpose was to document their perceptions of system operation and to ascertain their views of how the management of the system could be improved.

Methods

After a review of available literature, overview lectures by officials working in the area, and informal interviews with farmers and officials in a five day reconnaissance exercise, two structured interview schedules were designed for major and minor officials. The reconnaissance findings provided input for the development of the specific interview questions and the pretesting of schedules which focused on key operational issues. The six major officials were provided with the questionnaires in English from a week to ten days prior to the personal interviews. Minor officials were interviewed in Hindi by two of the workshop staff and information was cross-checked and compared to other data available through field observations and

* This information on the operation of the minor and major system is supplemented by data collected by interdisciplinary teams on the operation of the farm system. These data are reported separately in a special technical report by the WMSP which conducted the training.

interviews with 33 randomly selected farmers of an unimproved system and also compared with information from other officials and outside sources of information for accuracy. Since the number of respondents is small, only a descriptive analysis is provided. This report examines the information from the minor officials, followed by an analysis of the information obtained from major officials. A discussion of these findings is provided along with a comparison of information from officials on four watercourse command areas, 20 percent of the Chowkidars, 50 percent of the Karkoons, and the only Section Officer interviewed.*

A. Minor Irrigation Officals and Operation of the Irrigation System

Profile of the Minor Officials

The minor officials included two Chowkidars, two Karkoons, and one Section Officer. The duties of the Chowkidars included reviewing farmers' daily demands for water and reporting to the Karkoons, opening and closing four to five outlets from the distributory; and helping with farmers' water demand applications which are processed on a seasonal basis. The Karkoons supervise the Chowkidars; raise and lower the check structures; grant irrigation passes; detect damages to structures and unauthorized irrigations; recommend to the section officer fines and other sanctions for farmer infractions of rules; preparation of water demand accounts each 15 days; and checking of structures and distributory banks.

Duties of Section Officer

The duties of the Section Officer include: collecting demand notices and providing Deputy Engineers the water demand accounts; monitoring of canals and distribution of water; inspection of major structures; supervision of Karkoons; and evaluation of the work performance of other minor officers.

Due to a lack of adequate full-time Chowkidars, only five of ten on one distributory investigated were permanent staff. Of the two interviewed, one was a farmer hired on a monthly basis during the non-monsoon period and the other was hired on a work charge or year-to-year basis without government pension or other compensation.

* The minor officials located on three improved systems were not interviewed because time did not permit during the intensive training program.

Years of Service, Family Size and Education

The two Chowkidars had 12 and 13 years of service or an average of 12.5 years. The two Karkoons had four and five years of service or an average of 4.5 years while the Section Officer had 25 years of service coming up through the ranks.

The average family size of the five minor officials was five persons and the average formal education was over 10 classes. The two Chowkidars averaged 7th level education, the Karkoons 12th level and the Section Officer had 13 levels of formal education.

In-Service/On-the-Job Training and Promotions

Only the Section Officer had received training which included four months of theory and nine months of practical training on the job.

The only promotions from a lower position were those of one Karkoon from the position of Chowkidar and the Section Officer from a technical assistance position. The latter was promoted in 1965 and the former (Karkoon) was promoted in 1975.

Special Facilities, Incentives, and Salary

No facilities other than monthly pay is provided to the temporary Chowkidars. The Karkoons have a house, medical costs, and a travel allowance. The salary levels per month reported by each minor official are provided below.

Table 1

Position	Starting Salary/Mo.	Present Salary/Mo.
A. Work Charge Chowkidar	1973 - 90 Rs	1981 - 402 Rs
B. Monthly Chowkidar	1968 - 90 Rs	1981 - 195 Rs
C. Karkoon I	1967 - 147 Rs	1981 - 607 Rs
D. Karkoon II	1976 - 573 Rs	1981 - 650 Rs
E. Section Officer	1956 - 225 Rs	1981 - 976 Rs

In terms of inflation over a 10 to 15 year period and the job responsibilities, these salary levels appear to be low; however, in comparison to salary levels for agricultural B.Sc. trained extension workers (about Rs 500-650), these levels of salary appear adequate.

The highest salary levels possible under current scales for work charge Chowkidars is Rs 450/month. The highest level available for Karkoons is Rs 705/month and for the Section Officer, Rs 976/month.

Table 2 provides the views of minor officials pertaining to the major problems perceived in the normal performance of their duties.

Table 2: Major Problems Perceived in the Performance of Official Duties

Type of Problem	Minor Officials (A thru E) (See Table 1 positions)					Number of Times Reported
	A	B	C	D	E	
A. Departmental Problems						
1. Salary not adequate	1	1	1	1	1	5
2. Work load heavy	1	1	1	1	1	5
3. Better facilities	1	-	1	1	-	3
4. Training needed	-	-	1	1	1	3
5. Better phone system	-	-	-	1	1	2
B. Local Problems (Large Landlords and Farmers)						
1. Pressure and threats on Chowkidars	1	1	1	1	1	5
2. Beating of Chowkidars	-	-	1	1	1	3
3. Taking water illegally by farmers	1	1	1	1	1	5
4. Large landlord threats	-	-	1	1	1	3
5. Destruction of structures	-	-	1	1	1	3
6. Sealing metal gates by outsiders	-	-	1	1	1	3
7. Who gets water first among farmers	1	1	1	1	1	5
8. Opening gates at night by farmers	-	-	1	1	1	3
9. Farmers who won't file water applications	-	-	-	1	1	2

The two Chowkidars responded in such a way as not to cast negative reflections on their performance of duties. All minor officials, however, agreed that the following problems exist: Farmers' use of pressure to get more water allocated illegally, stealing of water, and the question of which farmer takes water first when two or more demand it simultaneously. These perceived problems are also reported by farmers in their interviews and are confirmed from interviews with major officials who list them as constraints. Two of the five minor officials responded that large landlord politicians often threaten to report them to higher officials or to use their connections with other politicians to get extra water legally.

Information Flows and Decision Making Process from the Farm Level to the Release of Water from the Reservoir.

In theory, the farmers with irrigation passes report the water demands to the gatekeeper Chowkidar who is to be at a stipulated place on the distributory on a daily basis. This information is then relayed to the gatekeeper/Karkoon at the distributory gate on scraps of paper, or verbally. The Karkoon rides a cycle 10,000 feet to a Canal Department phone and reports to the Canal Office where daily estimates are made and communicated by phone each day at 6 p.m. to 8 p.m. to the gatekeeper on the main canal system. The Section Officer receives the daily demands from the Karkoon, prepares a demand schedule, and reports the demands for the next day to the Deputy Engineer.

The methods of communication are verbal with scraps of paper provided to the distributory gatekeeper. The gatekeeper/Karkoon enters the demands in a register and he or the Section Officer reports to the Deputy Engineer or the Executive Engineer by phone.

In practice, farmers often go directly to the distributory gatekeeper or the Section Officer and some influential farmers even report to the canal office. Canal Department phones are usually out of order for periods during the monsoon rains at which time the public phone system is used. When both fail, someone must walk or find a ride to the next reporting center. The Section Officer stressed the need for a walkie-talkie system to improve communications for better operation of the system.

In terms of specific ways certain types of information are communicated from the Department to farmers, the following methods were reported by the five minor officials. (See Table 3)

Table 3. Types of Information Provided by Number of Times Mentioned for Each Subject

Subject	Verbal by Chowkidars when get Application for Water	Written Notice on Bull. Board at Village Office	Media	Word of Mouth by Farmers	No Fixed Procedure
Closure of system for cleaning, maintenance, etc.	2	4	-	1	-
Rationing of supplies	-	1	-	1	4
Advance notice of expected seasonal supplies	-	2	1	-	4
Policy or rule changes by Dept.	1	2	2	1	2
Rotation schedule	2	2	1	-	3
When farmers need water above scheduled demand	2	-	-	-	6

Both major officials and farmers indicated that the current system of communication to the farmers is greatly inadequate. Word of mouth is often used and the few notices in the press are seldom read. Panchayat leaders and farmers report that the notices which, in theory, are to be placed on the village Panchayat bulletin board often are not there. It is obvious that there is considerable disagreement between minor officials about the information methods or channels used to provide information to farmer users.

The minor officials were asked to state the frequency of selected types of unauthorized practices by the farmers. Table 4 provides this information.

Table 4. Reports of Five Minor Officials About the Major Types of Unauthorized Ways Farmers Attempt to Take Water.

Method	Frequency		
	Much	Sometimes	None
1. Farmers open gates			
- Night		5	
- Day		5	
2. Farmers steal water from minors or canals		3	2
3. Farmers take water beyond turn time		5	
4. Farmers trade canal water for TW water and vice-versa		1	4
5. Farmers operate cross regulators or block distributory to check-up water		4	
6. Water allowed to flow from unclosed outlets when no one using water		4	1

It was obvious, by observations and from interviews with farmers, that the problems of farmers opening the outlet gates to acquire unauthorized water is a current problem. It was estimated by minor officials that about ten percent of the time this takes place, but observations indicate that this is a conservative estimate. They also reported that farmers using pumps or siphons also steal water from the minors about ten percent of the time. Minor officials reported that ten percent or more of the farmers take water beyond their allotted turn time and that at least 20 percent pay lower crop irrigation fees but use water for higher level crops. The investigators observed two places on one distributory where farmers were checking up water by throwing in wood and banana stalks to check up water levels for greater discharge at outlet gates.

Minor officials were also asked what the usual action taken is regarding several problem situations. These reports are summarized in Table 5.

Table 5. Water Problem Analysis and Usual Action Taken

Type Situation	Usual Action and Times Reported	
1. When several farmers demand water at the same time	Tell supervisor	(1)
	Close gates until they cooperate	(1)
	Section Officer intervenes	(1)
	Try to explain and get cooperation	(4)
2. When powerful farmers demand special privileges	Supply water	(3)
	Make them understand	(1)
	Call in higher official	(1)
3. When farmers open gates at outlet	Nothing/overlook	(3)
	Issue Panchnama for fine it can	(2)
4. When farmers don't close gate at outlet at proper time	Detect and close	(3)
5. When farmers damage outlets or structure	Karkoon gives Panchnama	(1)
	Inform higher official/ police	
	Nothing	(1)
6. When minor level of water drops	Raise level	(2)
	Karkoon regulates	(1)
	Informs supervisor	(1)
7. When farmers raise minor water level	Overlooks	(2)
	Report to officer or police	(3)
8. When farmers take unauthorized water	Nothing	(1)
	Karkoon gives Panchnama	(3)
	Warning	(1)

This information suggests that the system of operation and maintenance is quite loose. The Panchnama is a fine but to implement it, two witnesses must be found which is often difficult. In terms of damages to gates and structure, it was reported that in the last three years the iron gates at the branch canal were stolen five times. In 1980 one minor check structure was taken but over the last 12 years, 18 or more were stolen and sold as scrap metal. All the brass nuts on earlier outlet gates were stolen due to the high price of brass. It was also observed that some illegal pipes had been placed in the minor banks and two minor officials confirmed that two or more such cases occur each year.

Other damages to the system result from cattle, carts and tractors creating damage to minor canal banks and roads, especially during the monsoon season when roads and canal banks are in a moist, fragile condition.

Farmers Cleaning and Maintenance of the On-Farm Main Watercourses

The reported reasons given as to why farmers don't regularly clean and maintain the common or main watercourses included the following: Field channels were originally built by government and the farmers feel that regular cleaning and maintenance is not their responsibility; no pressure on farmers by Department for cleaning; some farmers keep others from cleaning; lack of cooperation, laziness, or lack of knowledge by farmers, as well as the fact that no formal farmer organization exists for this task.

The minor officials reported that no official efforts have been made to organize farmers.

The minor officials were also asked to provide their own reasons as to why farmers prefer private tubewell water to canal water when tubewell water, compared to canal water, is seven to nine times more costly. Their reports included: More water control from private tubewells; lack of field watercourse channels on much of the command area; some areas on the command are too high in relationship to level of field channels; and the fact that private well owners extend credit to farmers who purchase water. While these reasons may be valid, the major factor is probably the lack of water control in the canal gravity system and the inability of the system to serve considerable areas of the command area as the system is now operated.

When asked what should be done to improve water control at the farm level to meet the needs of farmers, the following suggestions were made by the minor officials: "Government should improve and

maintain all farm-level main watercourses"; "land leveling is needed to level fields not presently served by the canal system"; "the Department should build better watercourses"; and "farmers should be formally organized for regular cleaning and maintenance of the farm system."

B. The Major Officials and Operation of the Irrigation System

The six major irrigation officials were asked some of the same questions as those addressed to minor officials in structured interviews. They included two Deputy Engineers, two Executive Engineers, the Superintending Engineer, and the Chief Engineer. Structural interviews were supplemented by open-ended questions.

A brief profile is provided of these officials, followed by their views of system operations. The profile of the major officials includes their major duties, areas of responsibility in terms of acres of irrigation area supervised, their average formal education, special job training, and the selection process used for these important higher positions in the irrigation organization.

The Deputy Engineers

The major duties of the Deputy Engineers include the operation and maintenance of canals, guidance to minor officials, on-the-job training of staff and supervision of the Section Officers. The Deputy Engineer is also responsible for publicity and information to staff and farmers, decisions on fines and sanctions for illegal behavior of farmers, timely applications from farmers for water, and day-to-day accounts of the water regime and demands for the subdivision under his control. Deputy Engineers have an area of about 43,000 acres in a subdivision with five Section Officers, each of whom are in charge of about 10,000 acres of irrigated land. One Deputy Engineer reported that he was in charge of 39,000 acres of irrigated land with a staff of four Section Officers, 39 Karkoons, and 156 Chowkidars who handle about 860 outlets on a warabundi or improved system. The other Deputy Engineer interviewed is in charge of an unimproved system.

Both Deputy Engineers* have diplomas in Civil Engineering which require a total of about 16 years of formal education. Neither of the two reported have received special job training since 1978. Both

* One Deputy Engineer is in charge of a subdivision which has unimproved farm systems and the other is in charge of a subdivision with some improved systems.

reported that they were selected for their present positions on the basis of seniority and merit. Both Deputy Engineers had successfully passed a special departmental examination after formal schooling to qualify as professional engineers. They reported that the exam included questions about operation and maintenance, organization and administration of the Irrigation Department, accounts, measurements, and the Bombay Canal and Drainage Law.

The Executive Engineers

The reported major duties of the two Executive Engineers include the supervision of about 15 Deputy Engineers and the responsibility for the operation and maintenance of a system of about 150,000 irrigated acres.

Both Executive Engineers are B.Sc. graduates in Civil Engineering and both report that special job training, through workshops and seminars are provided from time to time. One of the Executive Engineers reported that he had taken a six week course at the Water Technology Center in New Delhi but mentioned that the method of training was solely by the lecture method. Both senior officials attend regular monthly meetings with the Superintending Engineers to keep abreast of new developments and make decisions on problems and policies.

The Superintending Engineer

The major duties of the Superintending Engineer involve the total planning of the budget, administration of the irrigation system, and the selection of officers. The Superintending Engineer reported that of the total operation and maintenance budget, about 70 percent is allocated for salaries alone, leaving little for the costs of operation and maintenance. The Superintending Engineer has a B.Sc. in Civil Engineering and has supplemented his education by attending several professional development training programs. He has also participated in many tours inside India and two special tours to study irrigation systems in the USA and Spain. He holds regular monthly planning meetings with his Executive Engineers to discuss problems and policies. The terms of selection for this important position are usually based on one's past job performance record in the department, merit, and seniority. The Superintending Engineer stated that he usually prefers to select officials for new positions from those who come up through the ranks rather than outsiders because he knows his own people.

The Chief Engineer

The Chief Engineer provided time for an interview but was unable to return a completed questionnaire. As the top most senior official in the Irrigation organization, he is in charge of the administration of the State Department. He works closely with planners and policy makers and is in charge of the total irrigation program in the State of Gujarat, India. As the highest irrigation official, he is involved with the Central Water Commission in planning and policy matters. He also reports that he spends considerable time in conceptualizing and developing projects with his staff. He travels much within India and has traveled overseas. The Chief Engineer, like the other high officials, is selected on the basis of merit, seniority, and his ability to communicate, plan and implement policy.

Facilities Provided for Major Officials

The major Irrigation officials were asked to specify facilities provided them. The special facilities reported are shown below:

Position	Deputy (2)	Exec. (2)	Supt. (1)	Chief (1)
1. Housing or house rent	x	x	x	x
2. Vehicle	x	x	x	x
3. Special training, short courses, workshops	-	-	x	x
4. Study tours				
- Local	-	Occasional	x	x
- Abroad	-	-	x	x
5. Higher education for professional development	In theory at Water Technology Center, Delhi			
6. Allowances				
- Medical	x	x	x	x
- Educational	-	-	Short course	x

As a general policy, facilities such as housing, transportation, and medical are provided by the Irrigation Department. Incentives for training, except for the high officials, exist more in theory than practice. Both the Deputy Engineers and the Executive Engineers, after observing part of the Diagnostic Analysis Hands-on Training

Program experienced the desire to participate in such training. They, along with the Deputy Engineers, expressed the value of tours to other projects in India to learn about different approaches to system operation and management and other developments in system improvements.

Views of Major Officials on How to Provide More Status and Prestige for Staff Involved in Operation and Maintenance as Compared to Staff Involved in Design and Construction of Irrigation Systems.

This is a critical issue under current policy debate in India. It is now being realized that with an expenditure of about $3 billion per year for irrigation projects and improvement schemes, operation and maintenance (O&M) must be highlighted more than in the past. Traditionally in India, as elsewhere, design and construction has been far more prosperous and prestigious for engineers than operation and maintenance.

The ways the six major officials believe this institutional change can be achieved include the following:

- Establish a separate career structure of O&M.
- Provide more incentives in terms of salary and other benefits for O&M.
- Provide special O&M training with a focus on water management.
- Increase O&M budgets in projects.
- Provide improved facilities for minor officials and increase quantity and quality of these key people.
- Provide more recognition by government for O&M.
- Provide Executive Engineers with magistral powers such as forestry and railway officials have (Guards and Inspectors).

This is a real issue with those officials who are concerned with the growing responsibilities in O&M and the present lack of policy and budgetary focus provided for operation and maintenance activities. These major officials agree with central government thinking about the establishment of a career cadre for O&M separate from a cadre for design and construction. They also express the need to require selected Irrigation Department employees and new employees to acquire special training in water management. A member of the National Planning Commission in Delhi also stated that all engineers need special training in water management. His expressed concern is that with the large GOI expenditures in irrigation improvement, unless better quality work is achieved, there may be political opposition created to the Command Area Development Program concept which might impede its progress.

Political Problems and Externalities of Irrigation Projects

Since water is not merely a technical problem but one which has social, economic and political aspects and definite impacts, it was thought important to learn from the six major officials their views on some of these impacts or externalities. Table 6 provides a summary of their views about these impacts.

Table 6. Major Officials' Views about Various Types of Impacts of Irrigation Projects

Type Problem	Synthesis of Views Reported
1. Interstate problems:	- Submergence of land in States of Rajasthan and Maharashtra due to reservoirs
	- Sharing of water between States from same watershed
2. State problems:	- Political influence in location and operation of projects
	- Submergence of Okahi lands within Gujarat State.
	- Civil court cases versus the Irrigation Department
	- Different water requirements and politics of distribution between areas in the State
3. Externalities of projects:	
a. Submergence of land by reservoir	- (See above between and within States)
b. Emergency flooding	- Two escapes built into Mahi-Kadana System used in 1973 but often have to flood crop lands
c. Water logging/salinity	- Due to heavy clay pockets in some areas, lack of lined canals, and the lack of a conjunctive use program

d. Health hazards	- Rises in incidence of malaria (need studies of waterborne diseases, etc.)
e. Other hazards/impacts	- Need studies about environmental impacts; how to irrigate lands above canal command; and the degree of damage to transportation system; need to make water more equitable in supplies between head and tail-enders.

These reported impacts are of concern to the major irrigation officials interviewed. They are aware of the negative impacts but desire more data and understanding of how they might be mitigated in actual project areas.

Professional Development Needs for Irrigation and Other Officials Involved in Irrigation

These officials perceive a definite need for intensive training for technicians and extension workers who work at the farm level with farmers. For civil engineers they suggest special training in precision land leveling and improvement of the canals and distributories. For agricultural engineers they recommend special training in precision land leveling, watercourse rehabilitation, improved irrigation practices and water requirements of crops. For agronomists they recommend training in aspects of precision land leveling, improved cropping practice and economics of various crops. For extension personnel the training needed includes improved crop management practices, utilization of inputs, plus methods of how to organize and train farmers effectively. Finally, they perceive the need for farmers trained in improved cropping and irrigation practices as well as how to maintain improved systems. All the major officials interviewed felt that the required training should be done in short hands-on intensive courses which teach how to do rather than simple lectures.

As to specific training for minor officials, the following types were recommended.

Position

1. Canal Chowkidar	- Specific training related to job function and water accounting, settlement of conflicts/warabundi system.
2. Canal inspectors/ Karkoons	- Canal maintenance, methods for water allocation, communications with farmers and supervision of gatekeepers (Chowkidars).
3. Section officers	- Distribution of water, supervision of staff, water management demonstration and extension methods.

This suggests that there is not only a felt need for training but some understanding of the types of training required. The major officials ranked the need for training in terms of training first the Deputy Engineers, secondly the Section Officers, thirdly the Karkoons and fourthly the Chowkidars.

The major officials also suggested ways to strengthen the present legal authorities of irrigation staff. They were asked to suggest specific new or improved legal authorities needed to ensure more discipline in the operation and maintenance of the irrigation system from the farm level to the main canal level. As indicated earlier, both minor and major officials reported that inadequate discipline currently exists in the present operation of the system.

In reference to the farm level, those officials interviewed felt that farmers should be organized at the watercourse level and be given specific responsibilities for regular cleaning and maintenance activities. Mobile magistrates were suggested as a means of circumvention of the present method of having to find two witnesses to any infraction of the rules prior to the issuance of a Panchnama or levying a fine. Such mobile magistrates, in their views, could also work along the main canal and handle cases which often currently require up to four years to resolve through the civil court system.

Most officials agreed that the old Bombay Irrigation Act needs much revision in light of current irrigation needs to support improved agriculture. In terms of conflicts which need to be resolved, the following types were reported which occur in the operation and maintenance of the Mahi-Kadana system:

Area of System	Major Types of Conflicts
1. Farm System Level	- conflict over who maintains water-courses; between farmers over cleaning

		and between farmers over whose turn is first when two or more demand water.
2. Outlet Level	-	Chowkidars job and farmers wishes, conflicts over damage to outlets and who is guilty.
3. Minor System Level	-	Obstructions by farmers, damage to system, stealing of water, local pressures on minor staff.
4. Main System Level	-	Release of water downstream, lack of budget for O&M; encroachments by tubewells as they place pipes under canals and conflicts within department over level of staff needed.

De Jure and De Facto Operation of the System at the Outlet and Farm Levels.

The major officials interviewed were asked to compare the operational rules with actual practices observed in the field about how the system presently works at the farm level. The following information was provided as shown in Table 7.

Table 7. De Jure Rules and Regulations of System Operation Versus the De Facto Operational Situation

De Jure Rules and Regulations	Practice
1. Water applications require 15 days to process for farmers.	Four officials reported that it takes more like 20-25 days.
2. Outlets are to be operated only by authorized personnel	Two officials reported that farmers opened and closed the outlets about 75 percent of the time.
3. Official regulated outlet discharge	One reported there is little or no variation while two officials reported variations from 1.0 to 2.5 CFS at times.
4. Regulated and fixed turns on Warabundi system	On the Warabundi W.C.'s it is thought to be working.

– cannot be changed unilaterally by farmers.	
a) Trading of turns not permissible.	This takes place and is allowed
b) Trading canal water for TW water and vice versa not allowed.	Does take place but not much due to the higher price of TW water.
5. Illegal to use water from one outlet for area on another outlet command.	Takes place because of the unlevel topography and lack of good watercourses in some areas.
6. Illegal to make unauthorized cuts in distributory or main watercourses.	Does take place at times.
7. Illegal to steal water from unauthorized turn.	Sometimes takes place.
8. Unauthorized remission of water rates not permissible	Probably happens. Should not.
9. Farmers must do regular maintenance of main water courses and protect structures.	Usually do not.
10. Illegal to give gifts to minor irrigation authorities.	Bonus is given to Chowkidars.
11. Irrigation authorities will provide farmers ample advance notice of all canal closures.	Need to improve on this.
12. Irrigation authorities will provide information to farmers about rotation of minors.	Use the Panchayat Board.

Essential Technologies and Management Procedures to Improve O&M of the Major, Minor, Outlet and Farm Level Systems.

The six major officials were asked to rank selected technologies and management procedures which they perceived as essential to improve the O&M of the major system to the farm system. The following Table 8 provides these ranking with (1) as high and the largest number as lowest

in perceived priority. The acronym for Deputy Engineer is D.E.; for Executive Engineer is E.E., for Superrintending Engineer is S.E., and for Chief Engineer is C.E. as shown below:

Table 8 Ranking Provided of Priorities in Improving Operation of the Irrigation System at the Farm Level.

		Rank given by					
		DE	DE	EE	EE	SE	Totals
A.	Major System Level						
1.	Improved Information System	5	2	2	4	2	15
2.	Improved Monitoring	3	1	4	2	4	14
3.	Improved Maintenance	1	3	3	3	1	11
4.	Implemenation of Codes	2	5	5	5	5	22
5.	More Trained Staff	4	4	1	1	3	14
B.	Minor System Level						
1.	Improved Information System	5	4	5	6	2	22
2.	Improved Maintenance	7	1	3	3	1	16
3.	Improved Lining	3	2	7	7	4	23
4.	Improved Monitoring	2	3	4	2	7	18
5.	More Trained Staff	6	5	2	1	3	17
6.	Better Structures	1	7	6	4	5	19
7.	Improved Rotation System	4	6	1	5	6	22
8.	Additional Regulation	-	-	8	8	-	NA
C.	Outlet Level						
1.	Improved Rotation System	7	4	2	3	2	18
2.	Improved Information System	1	7	5	5	5	23
3.	Improved Gates	5	2	3	7	6	23
4.	Improved Monitoring	3	3	7	4	3	20

	DE	DE	EE	EE	SE	Totals
5. More Trained Staff	2	1	4	1	1	9
6. Improved Pass System	4	5	6	6	7	28
7. Warabundi	6	6	1	2	4	19
D. Farm Level						
1. Lined Channels	4	5	1	1	6	17
2. Improved Channels	1	4	2	4	2	13
3. Land Leveling	2	1	5	2	1	11
4. Warabundi	5	2	3	3	4	17
5. Maintenance	3	3	4	6	3	19
6. Local Farmers Organizations	6	6	6	5	5	28

Since the number of respondents is so small, this ranking tells us little except that there is some general agreement on a few technologies but much disagreement on others among most of the major officials. In terms of the major system, however, most concerns appear to be on the need for improved information systems, improved monitoring and maintenance and training. In terms of the minor system, the general concensus is the need for improved maintenance, trained staff and monitoring. At the outlet level, however, top priority technologies relate to training. At the farm level, the two top perceived priorities by these major officials include land leveling the lining of channels.

Procedures for Achieving Improved Farmer Cooperation in Regular Cleaning and Maintenance of Main Watercourses

The five major officials interviewed were also asked to rank six ways or means for the achievement of greater farmer cooperation in watercourse cleaning and maintenance. The rankings are provided in Table 9.

Table 9. Ways to Achieve Greater Involvement in Regular Cleaning and Maintenance of Main Watercourses.

Procedure	DE	DE	EE	EE	SE
1. Improved control of water for farmer such as delivery on demand.	3	3	2	5	2

	DE	DE	EE	EE	SE
2. Improved and enforced laws to gain compliance.	2	2	1	2	6
3. Formation of legal water user associations.	1	1	4	1	1
4. Closure of outlets when watercourses are adequately cleaned.	4	4	3	4	3
5. Reduced water rate incentive to farmers who regularly clean and increased rates for not cleaning.	5	5	5	6	4
6. Charge supplementary water rates and return this to a formal WUA to utilize for cleaning and maintenance.	6	6	6	3	5

It is obvious that in terms of the best perceived method to gain more farmer cooperation, the formation of legal WUAs is viewed as important, followed by improving and enforcing laws to gain compliance. The third ranked method was improving water controls at the farm level. Likely no one method alone is adequate but a combination of incentives, such as better water control, with a strong legal WUA and laws which can be enforced could be packaged as a means to gain more farmer involvement in both improvement programs and in regular maintenance of the farm system. Such a combination of procedures is currently needed to help bring more discipline to a very loosely operated system.

Irrigation Authorities' and Farmers' Suggested Solutions to Selected Watercourse Problems*

As a part of the diagnostic analysis of the Mahi-Kadana unimproved watercourses at outlets 2/1; 10 A/L; 11/L and 12/L of the Shiol distributory, both the officials and the 33 farmers suggested solutions to specific problems raised by interviewees. For both groups, neither all the farmers nor all the officials provided solutions to all the perceived problems because, evidently, some did not perceive all the matters raised, to be major problems. Where possible, solutions suggested are ranked from most to least in importance. Where possible,

* Extensive farmer data is reported in a separate paper.

solutions suggested are ranked from most to least in importance, (The numbers in parantheses refer to the number of farmers and officials reporting each suggested solution.

Table 10

Perceived Problem	Suggested Solution	
	Authorities	Farmers
1. Spills or overtopping of watercourse channels	Improved design (4) Govt. repairs (2)	Govt. repairs (1)
2. Leaks in channel banks	Lined Channels (2) Farmers repair (1)	Govt. repairs (10) Lining (5) Farmers repair (2) Pipe turnouts (1)
3. Seepage at the bottom of Channels	(no problem)	Lining (1) Bottom design and cleaning.
4. Dead storage in Channels	Beter Design (1) Better maintenance (1)	Better design (4) Better maintenance (1)
5. Vegetative Growth along channels	Farmers Clean (7) (Govt. clean (2)	Farmers Clean (1)
6. Non-alligned channels	Better design (3)	Better design (9)
7. Breaks at junctions	Pucca Nuccas (7)	Pucca Nuccas (3)
8. Silt in channels	Cleaning farmers (9)	(No response)
9. Unlevel fields	Land Leveling (7)	Govt. LL (7) Private LL (4)
10. Lack of farmer organization and cooperation	Legal WUAs (7) Warabundi (7) More Legal (6) Authority of Department	WUAs* (5) Warabundi (4) Enforce (4) Rules Panchayat (4) Involvement

* Key informants in three Panchayats suggested that irrigation officials should meet with Panchayat and discuss their problems. They should involve farmers in decisions about outlets and create a mechanism for federating Water Users' Associations at the Panchayat or some other level. Consideration should be given to providing part of the water revenue to legal WUAs for regular maintenance costs and farm level structures.

11. Irregular distribution of water by canal Chowkidar	Establish Warabundi (7) Add more staff (7)	Warabundi
12. Farmers taking water out of turn or taking more than their own turn	Warabundi (9) More staff and staff training	Warabundi Enforce Rules

Though the number of authorities and farmers who provided specific suggestions for solutions to problems is not large, several useful conclusions can be drawn. First, both farmers and officials often agree on the way to solve specific problems. Secondly, due to lack of farmer involvement when the first channels were designed and built, they think that it is the government's job to repair, improve and maintain the watercourses. Thirdly, farmers often spoke of never being able to talk with irrigation officials or never being heard when new outlets are designed and located. Fourthly, this suggests a serious problem of communication between irrigation authorities and farmers. Both parties appear to agree both on the nature of many problems and their solutions, but they presently do not communicate with each other adequately. To date, on the unimproved system studied, no mechanism has been established to either improve communications with farmers or to involve farmers in improvement programs. It is worthy of note that five of the farmers interviewed reported that they would even pay for watercourse improvement activities such as structures and lining if they could be adequately involved in the planning and implementation.

In conclusion, the information provided by minor officials, major officials and farmers suggest that there is a definite perceived need for change and improvement. Greater focus than was possible to provide in a short, intensive training situation is needed on ascertaining appropriate information from both irrigation authorities and farmers as to how the system can be improved. Neither party, without the other will likely be able to accomplish this task.

Annex XVI

PARTICIPANTS' EVALUATION OF DIAGNOSTIC ANALYSIS TRAINING WORKSHOP AT ANAND, GUJARAT, INDIA

February 16 to March 19, 1981.

I. Introduction and Purposes

The WMSP Diagnostic Analysis Training Model is being conducted in two countries to test its relevance and to refine its training content and procedures. Self-evaluation of the trainees was provided twice to ascertain their views of this model and as a means for improvement of training approaches. This type of evaluation takes place the second week of training and the findings are compared with a final self-evaluation at the conclusion of the courses. Other forms of evaluation used include: evaluation by trainees upon entry into the course by discipline trainers; daily evaluative observations of training team being discussed in regular staff meetings; evaluations by outsiders who observe the training for two to three days; a structured final evaluation by participants themselves; and a final two days training team review session. Combined, all of these evaluations provide useful information for refinement of the training model. The structured self-evaluation results show that focus is given to acquisition of specific skills, knowledge, and attitudes considered essential for professional development in water management improvement. The course is of a hands-on nature and is conducted in special discipline sessions, team sessions, and specific field exercises conducted by interdisciplinary teams. A living laboratory of actual watercourse commands is used for all field exercises in order to make the training relevant. The estimated time in the field ranges from 60 to 70 percent of the total training time.

The training materials used include: two training manuals, one which covers the key concepts and describes the subsystems of a farm level command area and another manual which contains the how-to-do diagnostic analysis field methodologies; lectures by each discipline leader in the form of handouts; and audio visual materials.

The primary methods used in the training include: intensive field exercises team and group discussions, panel discussions, demonstrations, and lectures with least attention given to the lecture method.

Each trainee was asked to respond to an open-ended question about the importance of the diagnostic training course for their current job assignments. The participants included senior executive irrigation engineers, agronomists, extension staff, junior engineers and economists. Their responses are summarized below:

1. "Learning diagnostic analysis skills to identify and solve water management problems to improve system performance" (three participants).

2. "Learning specific skills of flow measurements, measurements of irrigation efficiency, data collection, irrigation practices for helping farmers improve their crop production" (six participants).

3. "Understanding more about complete farming systems, crop practices, and basic agriculture in order to improve technologies for crop production" (three participants).

4. "Helps me improve my work in the command area development program and the management of staff" (three participants).

5. "Provides me an opportunity to improve my professional capabilities in irrigation improvement" (one participant).

II. Participants' Final Evaluation of Key Aspects Related to the Diagnostic Training Workshop

The final overall evaluation was conducted on the last day of the training program. This included items under the following major areas:

Physical Facilities
Training Equipment/Supplies
Training Teaching Methods
Quality of Discipline Training
Quality of Trainers
Attitudes of Trainers
Relevance of Training to Present Work
Relevance of this Training for Others
Need for Future Similar Training Progress
What This Training Meant to you Personally

The details are useful for improving the training program which will later be refined and packaged for use elsewhere. The participants were made aware that they had a special role in helping training staff improve the training format, content, methods, and materials for other professionals in water management improvement. Again their evaluations were frank, candid, and honest which made the training staff agree that the participants were professionals concerned with professional development for themselves and others.

The items that received the highest marks as very good included the following:

Transportation Facilities
Training Manuals
Discussion Methods
Objectives of Trainers and Trainees
Reconnaissance Field Exercises
Team Building Exercises
Attitudes of Trainers toward Trainees
Attitudes of Trainees toward Others
Participation of Trainees (each discipline in discussion sessions)
Listening of Trainer to Trainees
Flexibility of Trainers
Understanding of Trainees' Needs
Interest in Subject Matter
Relevance of Training to Command Area Development Program

These are the items which 50 percent or more of the participants judged as very good. Activities reported as good and those which need more improvement include the following: lab facilities, scheduling of events, and developing reports. These and other items which need improvement agree with the views of the four trainers who held their own two day evaluation after the course was completed. The participants not only gained much but also provided good quality field data on 53 farms which are being used by the Mahi Kadana Command Area Development Authority for irrigation improvement programs. The data generated during the field exercises are being analyzed and synthesized and will appear in a special technique report produced by the Water Management Synthesis Project. The trainees and the trainers played a major role in these reports which will be utilized in the Mahi Kadana CADA and elsewhere.

The participants were asked to provide their views of the need for this type of training for others.

Table 1 provides an overview of the participants' responses to an evaluation question: "Would you recommend such training for others?" The majority of participants feel that similar training is needed for all CADA staff; especially extension, agronomy, engineering, and economies personnel. Most of the participants also report that similar training is needed for officers in similar positions as their own and for all new irrigation engineering graduates. Fifty-six percent of the respondents also feel that all Irrigation Departments need this training. While 94 percent feel that all CADA staff should be trained, thirteen of the sixteen participants state in an open-ended question: "Do you perceive the need for similar training for the staff under your supervision?"

Table 1

Participants' Views About Relevance of Diagnostic Analysis Training for Various Personnel and Programs

	Personnel	Responding (No.)	Yes	Perhaps	No	Don't Know
			(Percent)			
1.	Other officers with positions similar to yours	15	60	13	27	-
2.	CADA field staff	16	94	-	-	6
3.	All Irrigation Department Engineers	16	56	19	19	6
4.	All new Irrigation engineering graduates	15	73	20	-	7
5.	CADA extension staff	16	87	13	-	-
6.	CADA agronomists	15	87	7	6	-
7.	CADA economics	16	75	19	6	-

The participants feel that the training is needed but that there is also a critical need to train or convince the top officials as well because they control the budgets, make the plans and finally will have to respond to training needs and assure that new skills gained will be properly used in action programs. It is true that before such training will result in substantial program results, it is important to focus short and well focused training seminars on the high level policy makers and administrators. Also, it was suggested that top officials should receive a "stream" of good literature which can help change some of their attitudes and behaviors toward new approaches of improving water management through more well-trained professional staff. Unless this important audience of officials is effectively reached, those trained may not be able to implement their new skills and knowledge.

The participants were also asked to respond to an open-ended question in the final overall evaluation, which was: "What has this training program meant to you?" Table 2 provides a summary of these responses. Note that several of the participants also listed several other benefits.

Table 2

	Responses	No. of Response	Percent of total Responses
1.	Good training program	9	23
2.	Learned interdisciplinary team work	8	20
3.	Understanding of real farmer problems	4	10
4.	Learned what water management is	5	13
5.	Learned from working with other discipline members of team and staff	4	10
6.	Understanding of farm irrigation behavior	2	5
7.	Learned about importance of water control	2	5

8.	Learned diagnostic analysis process and procedures	3	8
9.	Field study was a new experience	1	3
10.	Learned to evaluate a real system	1	3
		40	100

Table 2 also indicates the participants' views about what the training program meant to them. In terms of ranking, it appears that learning interdisciplinary team and team management approaches, understanding of real farm level problems, gaining a knowledge of the meaning of water management, learning with and from other disciplines, and learning diagnostic analysis processes and procedures were most important.

Annex XVII

PARTICIPANTS' EVALUATION OF CHITTORGARH RAJASTHAN (INDIA) IRRIGATION SYSTEMS DIAGNOSTIC ANALYSIS WORKSHOP

January 18 - February 20, 1982.

The diagnostic analysis approach places central importance on the evaluation of irrigation systems. Likewise, the Professional Development Workshop is evaluated systematically by the participants for refinement.

A. Types of Evaluation

Several formal and informal evaluations were conducted during and after the workshop. First, the participants were asked to evaluate themselves in regard to basic skills, procedures, and attitudes during the third week of the course. This feedback was utilized by the trainers and assistant trainers for providing special attention to the individual needs of participants. Second, at the end of the workshop this self-evaluation was repeated. Although the time lapse between the "before and after" self-evaluations was inadequate, it is evident from Table 1 that participants perceived some progress. Third, another formal evaluation was conducted at the end of the workshop followed by a period for open ended remarks. The results of this evaluative feedback are reported and discussed in this brief report. A fourth method of evaluation was used to ascertain to what degree participants felt that their expectations of the workshop were actually fulfilled. It must be stated that some participants were not briefed adequately before the course as to its nature and content. Other participants were well prepared and in the early sessions were able to articulate expectations. Table 2 provides the results of this method of evaluation. Finally, a fifth type of evaluation was informal. This included daily observations of trainers and assistant trainers, daily meetings of the training staff, the observations of visitors from central and state governments, AID, and other organizations. Finally, after the workshop was completed, the core staff from Rajasthan and Colorado State University spent several days in critique and refinement of the format, content, and methodologies of the training course.

As a result of these systematic efforts, the intention of the Diagnostic Analysis Workshop in respect of content and approach has been greatly improved. Each participant in fact contributes to this process as does each trainer.

B. Participants Self-Evaluation of Progress Achieved

Both the small number of participants and the short time span between the two self-evaluations make it difficult to interpret the findings in Table 1. Although change is indicated, the major value of these exercises is what it means to the participants.

The participants are made aware of the types of measures against which they can evaluate themselves. They know there is no pass or fail, which is important for adult learning but they like to have some means of judging their individual progress. Adult learners need to know what is expected and how well they have performed for effective learning. To assure the participants that no personal evaluation forms will be used against them by supervisors or others, the forms are returned shortly after study by the trainers and the completion of the summary tabulation.

C. Final Overall Evaluation of the Quality of the Professional Development Workshop

Table 3 provides the reporting findings about the following aspects of the Diagnostic Analysis Workshop: physical facilities; training equipment/materials; training/teaching methods; quality of discipline training; attitudes (and behavior) of trainers; and relevance of the training for various disciplines/professional groups and levels of staff involved in irrigation improvement.

The final overall evaluation was completed by the participants, the assistant trainers*, and the trainers -- a total of 29 persons.

Each evaluation category is discussed briefly along with the findings. Table 3 provides more detailed information.

1. Physical Facilities for the Training Program

Over 65 percent of the 29 reporting rated the classrooms, the housing, and the transportation facilities as "very good". From 20 to 28 percent ranked these as "somewhat good". The food facilities were ranked lowest because only 17 percent reported it "very good" but 35 percent reported "needs improvement". Also the lab facilities were judged to be "very good" by only 24 percent and somewhat good by 55 percent. Fourteen percent suggested "needs improvement". These reports indicate that more attention should be given to the food arrangements and to lab equipment. The latter

*The assistant trainers had participated in an earlier Diagnostic Analysis Workshop and were asked to take part in this workshop as a means of preparing most of them as future trainers.

is often somewhat difficult to arrange in the field. Food is important because when the adult participants are not satisfied, low morale soon results.

In terms of the responses provided the rankings+ of the physical facilities evaluated are from I to V with I as highest:

RANK	ITEM	PERCENTAGES RESPONDING "VERY GOOD AND GOOD"
I	Transportation	94
II	Housing	90
III	Classrooms	87
IV	Lab Equipment	79
V	Food Arrangements	62

2. Training Equipment and Supplies

As seen from Table 3 Item B, the majority of the respondents thought that the classroom teaching equipment was "very good" (83 percent). About 70 percent thought that Volumes I and II of the Training Manuals used were "very good" as well as the video tapes. Fifty-nine percent reported that the field equipment (flumes, instruments, etc.) were "very good" and 31 percent thought they were "somewhat good".

The items which received low marks were the typing/duplication arrangements and the handouts provided. Note that 42 and 24 percent, respectively, report that these activities "need to be improved". They are related in that due to delays in typing and mimeograph duplication, many handouts were delayed or not made available when needed. Both of these problems need to be examined. There is a limit as to how much relevant materials can be prepared in advance. The nature of the training is such that the questionnaires and other data collection instruments are designed during the course in relationship to the situation. Likewise, some special handouts and reports cannot be prepared in advance. In most places where the training is held in temporary facilities it is difficult to locate good typists and duplicating facilities.

+The responses in categories "very good" and "somewhat good" are summed to obtain the score for ranking shown above.

The ranking of the items under "Training Equipment and Supplies" from highest to lowest in the evaluations are shown below. Note that the responses under "very good" and "somewhat good" are summed for ranking.

RANK	ITEM	PERCENTAGES RESPONDING "VERY GOOD AND GOOD"
I	Reconnaissance Field Exercises	87
I	Objective of Trainers	87
II	Detailed Team Field Exercises	84
III	Discussions	80
III	Objective Setting by Trainees	80
IV	Participation by Trainees in Discussions	76
V	Team Planning	73
VI	Lectures	69
VI	Schedule of Events	69
VII	Team Reports	66

3. Quality of the Discipline Training

Time is utilized in the workshop to review special discipline skills needed to perform diagnostic analysis. Each trainer spends time with his or her discipline groups. As shown in Table 3 under D, the discipline training was judged as "good to very good" by the large majority of the respondents. There is room for improvement in providing this training quickly and in sufficient depth. It cannot be assumed for example, that all the professionals are up-to-date in the performance of the skills required. Sometimes there are new skills which require time to demonstrate and learn.

The ranking of the quality of types of discipline training is provided below.

RANK	ITEM	PERCENTAGES RESPONDING "VERY GOOD AND SOMEWHAT GOOD"
I	Agronomy (soil-plant) Water Relationships	90
II	On-Farm Engineering	76
III	Economics of Farm Operation	73
III	Extension and Farm Irrigation Behavior	73
IV	Irrigation Engineering Main and Main Systems	72

As seen in the rankings, except for very high marks for agronomic training, there is almost no difference between the other disciplines. It should be noted that every respondent evaluated each type of training which suggests some basis and likely lack of sufficient information. There was, however, much discussion and interaction between disciplines as to the value or quality of this and that activity or lesson.

4. Quality of the Interdisciplinary Training

A number of learning activities and situations focused on team activities. A major objective of the course is to provide "hands-on" field experience in interdisciplinary field work. The two activities which were judged most in need of improvement were developing team reports and developing team workplans. Forty-two and 35 percent, respectively, responded that these need more attention. In fact, these two activities are also the most difficult to teach and much time is needed before individual team members learn how to perform effectively as a team. This, of course, is one of the big challenges of team research and team approaches to other aspects of development. The rankings of the various training activities are:

RANK	ACTIVITY	PERCENTAGE REPORTING "VERY GOOD TO SOMEWHAT GOOD"
I	Learning Field Method	90
I	Reconnaissance Field Studies	90
II	Team Building Exercises	87
III	Films Shown in the Evenings	84
IV	Lectures on Team Building	80
V	Focus on Understanding Other Disciplines	77
VI	Detailed Field Studies	76
VII	Developing Work Activities	66
VIII	Developing Reports	52

5. Evaluations of the Attitudes and Behaviors of the Trainers and Assistant Trainers

The attitudes and behaviors of the trainers reflect their abilities and understanding of the training-learning process. The attitudes and actions of trainers which quickly become obvious to adult trainees can literally "make or break" a training program. A trainer can always improve in this area as in the skill and knowledge areas.

The majority of those involved in the evaluation reported "very good" to "somewhat good" for all 10 items. That is from 72 to 88 percent of the reports for all items are "very good" or "somewhat good". The areas which still need attention are "more participation of trainees allowed in discussions (24%), more listening to views of the trainees (17%), more flexibility (17%), and more understanding of on-farm water management (24%)."

The overall ranking of the attitudes and behaviors of the trainers and assistant trainers are:

RANK	ITEM	PERCENTAGE REPORTING "VERY GOOD AND SOMEWHAT GOOD"
I	Positive Attitude Towards Trainees	88
II	Compromise in Changing Training Format and Activities	87
II	Understanding of Trainees' Needs	87
III	Flexibility	86
III	Interest in Subject Matter	86
IV	Ability to Communicate	83
V	Positive Attitudes Toward Other Disciplines	80
V	Listening to Views of Trainees	80
VI	Understanding of On-Farm Water Management	74
VII	Encourage Participation of Trainees in Discussion	72

It is obvious that some of these can be improved quickly such as more listening and encouragement of discussion. The need for more understanding of water management is interesting. It may reflect the needs of the assistant trainers who participate in the course to acquire more experience.

6. Perceived Relevance of Training

As seen in Table 3, twelve items were utilized to ascertain views about the relevance of the training.

The least relevant area was "to future training programs you may develop or take part in as a trainer". Twenty-one percent felt that the course needs improvement.

The rankings given to the 12 items are provided below:

RANK	ITEM	PERCENTAGE REPORTING "VERY GOOD AND SOMEWHAT GOOD"
I	To understanding how the farm system works	97
II	To understanding farmer's attitudes	94
III	To identify priority problems on-farm	93
III	To evaluate value of system improvements	93
IV	To interests and felt needs	90
V	To present job	84
VI	To CADA programs	83
VI	To understanding field research needs	83
VI	To understanding field research problems	83
VII	To understanding farmer's problems	82
VIII	To own professional development	79
IX	To future training programs you may develop or take part in as a trainer	69

It is significant that this type of training is viewed by most as relevant to their present jobs, to command area development programs CAD and to the felt needs and interests of those who participate.

In terms of relevance of this particular mode of training more specific questions were asked. The purpose was to acquire some information about the target professional groups which require diagnostic types of training.

Tables 3 and 4 show that most respondents felt that there is a need for this type of training for CAD staff which include extension, agronomy, economic and engineering personnel. Seventy-six percent felt that all irrigation department personnel needed this training. Only sixty percent felt that all new engineering graduates entering irrigation departments needed this training.

Table 4 provides views about how relevant a shortened diagnostic analysis type course would be for higher level agricultural and irrigation officials and policy makers. Note that again the majority report that there is a need for this type of training to help them become acquainted with the new approaches to diagnosing and improving systems. Participants expressed this need because in their words "unless the top brass understand this approach and realize its uses, they will not provide ways and means for us to introduce it in our field programs".

A definite need exists to train or provide orientation to key policy makers and high level officials. It is not enough only to focus on operational staff. Perhaps the biggest challenge in training is to find ways and means to assure that those trained are provided the incentives to perform the new skills in operational situations.

D. Evaluation of the Degree to which Participants' Expectations of Workshop were met

At the beginning of the workshop the participants and the assistant trainers were asked to articulate their expectations of the workshop. These were written on a large wall chart and remained before the participants throughout the training.

To the degree possible the trainers attempted to meet these needs. Some were, as expected, unrealistic because it was found that some participants had not received adequate preparation and information about the course. As a policy it is important that those taking part receive the training manual and descriptions of the course in an appropriate time before they arrive for the workshop.

Table 5 provides the findings of 22 respondents which include trainers and the assistant trainers.

As expected, not all the expectations were met nor is it realistic to expect that they can always be met. The approach, however, is to have a training mode which has flexibility. No one wants a "canned program" and the mode under experiment and improvement is flexible. For example, the situation or irrigation system being used as the living lab dictates much of the data to be collected. The survey questionnaires and many methodologies are developed in the training program after the initial reconnaissance is done in order to have more ground truth.

As suggested by several of the participants, there is a need to provide better information and orientation to the participants prior to the course. When the participants receive the two volume training manuals, for example, they then have more realistic expectations.

In terms of Table 5, the participants and assistant trainers felt that the following expectations were not adequately met. Note that the expectations are listed below with the percentage stating that it was met only to a "small (little) degree" or "not at all".

	I T E M	PERCENT
1)	Knowledge of what farmers expect from government	46
2)	Water management practices in USA and other countries	46
3)	Opportunities for other training courses here and overseas	37
4)	Information about water requirements of particular crops	32
5)	Information on salinity and alkalinity problems	41

The above suggest some expectations were not fully met.

Finally, under D on Table 5, almost all those responding reported that the workshop had been useful both personally and professionally.

In terms of other types of special training programs, the following percentages of those reporting desired the programs listed below:

RANK	TYPE PROGRAM	PERCENTAGE WANTING PROGRAM
I	Monitoring and Evaluation Methods for Irrigation Systems	91
II	Implementing Development Projects	86
II	Water Use Practices	86
III	Principles and Methods of Farmer Involvement in Improvement Projects	82
IV	Design and Construction of On-Farm Structures	55

Open Ended Comments by Participants

As part of the final evaluation, each participant was given time to comment on any aspect of the training program. The following comments were made:

1. (Agronomist) "Staff from the Gambhiri project which we used for D.A. should have been involved. Then they could have utilized the data and methods to improve what is a "sick" system".

2. (Engineers) "In the future it would be good to have all lectures and how to do field methods on video tapes for use".

3. (Agronomist) "The interdisciplinary research approach is new. We should have gone to the field for D.A. activities earlier in the course. With more use of video the how-to-do methods can be taught quicker to provide an update for some methods".

4. (Extension) "This is a new type of training and our first introduction. It requires new attitudes. There is a need for more advance information and orientation before the participants come to the training. Some of the interviews with farmers by extension personnel were too long. The farmers therefore cannot give correct information!"

5. (Economist) "Need to reduce the survey data collected by economists and extension personnel. Need more time for critical analysis of data, interpretation, and preparing reports by the teams. Also suggest more use of video in teaching some methods for data collection, analysis and report writing".

6. (Extension) "The experience of irrigation and agricultural personnel is new and it takes time to learn how to work effectively across disciplines and organizations. We are making a good beginning".

7. (Engineer) "This is the second time some of us took this course and this time in the role of assistant trainers we have learned much more. We are learning how the interdisciplinary approaches work. The team approach to data collection and analysis is useful. We are trying to create a marriage between agricultural department and irrigation department staff. This is like creating a sharp two-sided sword to make irrigation systems better".

8. (Engineer) "I expect now to get more efficiency from my staff. I also plan to use other disciplines and to coordinate their field activities. It will take time to get cooperation".

   "In the command area development program we need the team approach to identify and solve problems. Also need teams for internal monitoring of systems and projects as well as for evaluation. If we use the team approach we will need government approval and more staff".

9. (Agronomist) "We should have had some of the farmers from the watercourses invited to a special tea or meal as we did government officials. We would be able to show them our appreciation and report to them the findings. We need to work more at integrating the team members".

10. (Agronomist) "There is a need to select the teams from the field programs where they will return for follow-up work. Many people involved in this demonstration workshop will not go back and use the training. We need to work hard to get the necessary commitment from government to allow us to use our new skills in a project".

11. (Engineer) "Agreed, we must find ways to train the senior officers. Could this be done in short 2-3 day workshops? This is why we need to have local leaders and government leaders come observe the training, we need to get them to make appropriate decisions".

12. (Agronomist) "We need to use video more in the training. For example, how-to-do methods and how-to-do data management, analysis, synthesis and reports should be on video".

13. (Agronomist) "This is the best training program I have ever attended. The program itself is a good example of management".

14. (Extension) "This was my second opportunity and I have learned much which will benefit me as a trainer".

These comments by participants conclude the various approaches used for evaluation by the participants themselves. These findings were studied by the host country trainers and coordinators with the expatriate training team. This group spent a full day discussing the strengths and weaknesses of the training program. Lessons learned were used to improve the diagnostic analysis course. For example, before the next training program scheduled for Sri Lanka, training manuals, video tapes, and other materials will be revised. Other changes include the use of more pre-training orientation and some new ideas about how to begin to reach high level officials with the importance of training those individuals who will return to perform these new skills.

Many groups of participants have contributed to helping trainers to define and refine this diagnostic analysis mode of training since 1979.

Table 1. Participants' Self-Evaluation at Midpoint in Professional Development Workshop and at Completion.

EVALUATION POINTS	SCALE OF ACCOMPLISHMENT* (Percentage Reporting)				
	VERY	GOOD	FAIR	POOR	NO RESPONSE
A. Job Performance Engineers (n=8)					
1. Installation of Flumes	62.5 / 50.0	37.5 / 37.5	-	0.0 / 12.5	-
2. Reading Flumes	62.5 / 82.5	25.0 / 0.0	12.5 / 12.5	- / -	-
3. Checking Flumes	62.5 / 37.5	37.5 / 50.0	0.0 / 12.5	-	-
4. Evaluation of Ditch Losses	37.5 / 12.3	25.0 / 37.5	0.0 / 12.5	-	37.5 / 37.5
a. Correct Location	50.0 / 37.5	25.0 / 50.0	12.5 / 0.0		12.5 / 12.5.
b. Correct Length of Time	37.5 / 25.0	37.5 / 62.5	12.5 / 0.0		12.5 / 12.5
5. Estimates of Irrigation Efficiency					
a. Field Area	37.5 / 25.0	37.5 / 50.0	12.5 / 12.5		12.5 / 12.5
b. Average Flow Rate	12.5 / 12.5	62.5 / 50.0	12.5 / 12.5		12.5 / 12.5
c. Average Estimated Deficiencies	0.0 / 12.5	62.5 / 37.5	25.0 / 25.0		12.5 / 12.5
d. Channel Elevation Control	25.0 / 25.0	62.5 / 37.5	12.5 / 25.0		
e. Field Levelness	75.0 / 12.0	25.0 / 50.0	0.0 / 25.0		

*Very good means very adequate; good means somewhat adequate, poor means "need much more experience"; and poor means "still very weak. The percentages are shown as final/before to indicate the change in perceived progress.

Table 1 (Continued)

EVALUATION POINTS	SCALE OF ACCOMPLISHMENT (Percentage Reporting) VERY GOOD	GOOD	FAIR	POOR	NO RESPONSE
B. Job Performance Agronomists (n=3)					
1. Reading Flumes	33.3	63.7	0.0		
	67.7	0.0	33.3		
2. Estimation of Crop Stands	100.0	0.0			
	50.0	50.0			
3. Potential Yield	100.0	0.0			
	33.3	67.7			
4. Soil Moisture Deficit	100.0	0.0			
	0.0	100.0			
5. Plant Nutrient Status	100.0	0.0			
	33.3	67.7			
6. Soil Salinity	100.0	0.0			
	33.3	67.7			
7. Soil Texture Analysis	100.0	0.0			
	33.3	67.7			
C. Job Performance Engineers & Agronomists (n=11)					
1. Detailed Irrigation Evaluations					
a. Profile	36.7	54.5	0.0		9.1
	36.7	36.7	18.2		9.1
2. Advance and Recession	27.3	54.5	9.1		9.1
	18.2	36.4	18.2		29.3
3. Infiltration	9.1	63.6	18.2		29.3
	9.1	81.7	0.0		9.1
4. Understanding Results	9.1	63.6	9.1		18.2
	0.0	45.5	18.2		36.4
D. Job Performance Extension Personnel (n=3)					
1. Observations and Documentation of Farmer Behavior	0	100	0	0	0
	0	67	33	0	0

Table 1. (Continued)

EVALUATIOIN POINTS	SCALE OF ACCOMPLISHMENT (Percentage Reporting) VERY GOOD	GOOD	FAIR	POOR	NO RESPONSE
E. Job Performance Economists & Extension Personnel (n=5)					
1. Design of Data Schedules	80/20	20/60	0/20	0/0	0/0
2. Care in Interviewing	80/60	20/40	0/0	0/0	0/0
F. Job Performance All Trainees (n=16)					
1. Accuracy of Data	50/19	50/44	0/12	0/0	0/25
2. Approach to Farmers	37/25	56/50	0/6	0/0	6/19
3. Data Collection	44/19	44/50	0/6	0/0	12/25
4. Problem Solving in Field	37/31	50/31	0/12	0/0	13/25
5. Care in Data Recording and Promptness	56/19	31/12	0/0	0/0	13/70
6. Writing Data Legibly	69/37	31/44	0/6	0/0	0/12
7. Organizes Work Daily	56/37	31/37	0/0	0/0	13/25
8. Data Reduction	37/37	56/37	0/0	0/0	6/25
9. Data Management	37/25	50/37	6/12	0/0	6/0
10. Report Preparation	12/25	69/44	0/12	0/0	19/19
11. Quality of Report Presentation	6/19	75/31	6/25	0/0	12/25

Table 1. (Continued)

EVALUATION POINTS	SCALE OF ACCOMPLISHMENT (Percentage Reporting)				
	VERY GOOD	GOOD	FAIR	POOR	NO RESPONSE
11. Quality of Report Presentation	6/19	75/31	6/25	0/0	12/25
12. Interviewing Techniques	19/19	25/31	13/25	0/0	44/25
13. Farmer Credibility	19/6	31/37	6/25	0/0	44/31
14. Working Overtime to Finish a Job	38/19	19/19	25/0	0/6	19/56
15. Makes Special Notes in Field Books about Questions(Issues)	19/13	31/37	6/13	0/6	44/31
16. Observations of Farmer Behavior	13/6	31/50	13/6	0/6	44/31
17. Speed in Work	38/25	19/44	0/0	0/0	44/31
18. Arrives at Location on Time to Set Up Instruments	44/31	13/25	0/13	0/0	44/31
F. Relationships with Team Members					
1. Showing Work/Helpfulness	62/37	31/31	0/13	0/0	6/19
2. Cooperation with Others	75/56	19/25	0/6	0/0	6
3. Participation in Decision Making	50/37	44/37	0/6	0/0	6/19
4. Showing of Leadership	56/44	31/31	6/0	0/0	6/25
5. Follows Leader's Instructions	62/62	19/19	0/0	0/0	19/19
6. Solving Team Problems	50/50	44/31	0/0	0/0	6/19

Table 1. (Continued)

EVALUATION POINTS	SCALE OF ACCOMPLISHMENT* (Percentage Reporting)				
	VERY GOOD	GOOD	FAIR	POOR	NO RESPONSE
7. Management of Team Activities when in Team Leader Role	50/56	31/13	6/6	0/0	13/25
G. General Attitudes					
1. Extra Work, Long Hours, etc.	50/37	44/44	0/0	0/0	6/19
2. Pride in Work	69/50	25/25	0/6	0/0	6/19
3. Modesty about Self and One's Discipline	69/31	25/44	0/6	0/0	6/14
4. Frankness and Honesty in Relationships	75/56	25/25	0/0	0/0	0/19
5. Positive Attitudes about Farmers	56/37	37/44	0/0	0/0	6/19
6. Positive Attitudes about Field Hardships	37/31	63/44	0/0	0/0	0/25
7. Openness in Communication	37/37	73/31	0/6	0/0	0/25
8. Cooperativeness	69/63	31/13	0/6	0/0	0/19
	NONE	SOME	MUCH	VERY	NO RESPONSE
9. Showing of Difference to Trainers	69/37	31/44	0/0	0/0	0/19

*Very good means "very adequate"; good means "somewhat adequate", poor means "need much more experience"; and poor means "still very weak".

The percentages are shown as final/before to indicate the change in perceived progress.

Table 2: Participants' Views of Relevance of Diagnostic Analysis Training for Various Water Management Personnel (Workshop at Chittorgarh, Rajasthan, January 19 - February 20, 1982)

"Would you Recommend Diagnostic Analysis Types of Professional Development for .....?"

(Number of Participants Reporting is 29)

Type Personnel	Yes	Perhaps	No	Don't Know	No Response
			Percentages		
1. CAD Field Staff	86	7	0	3.5	3.5
2. All Irrigation Dept.Personnel	76	14	7	0	3.5
3. All New Eng. Graduates Entering Irrig.Depts.	60	24	16	0	0
4. Extension Staff involved in CAD Programs	79	14	3.5	3.5	0
5. Agronomists involved in CAD Programs	90	7	0	3.5	0
6. Economists involved in CAD Programs	76	21	0	3.5	0
7. Officers with similar Positions to yours	83	3.5	7	3.5	3.5

Table 3: Final Overall Evaluation of the Diagnostic Analysis Workshop by Participants, Assistant Trainers, and Trainers (N=29).
(January 18 - February 20, 1982, Chittorgarh, Rajasthan, India)

	Percentage Reporting				
	Very Good	Somewhat Good	Needs Improvement	Not Acceptable	No Response
A. Physical Facilities for Training Program					
1. Classrooms	69	21	14	0	0
2. Housing	69	21	10	0	0
3. Food arrangement	17	45	35	3	0
4. Transportation	66	28	7	0	0
5. Lab equipment	24	55	14	0	0
B. Training Equipment/Supplies					
1. Classroom teaching equipment (blackboards) projectors	83	14	3	5	0
2. Field equipment (flumes, instruments, etc.)	59	31	10	0	0
3. Typing/duplication	7	45	42	0	7
4. Manuals provided					
a. Volume I	72	14	14	0	0
b. Volume II	69	17	14	0	0
5. Handouts provided	21	52	24	0	3
6. Video tapes	66	31	3	0	0
C. Training/Teaching Methods					
1. Lectures	48	21	31	0	0
2. Discussions	38	42	21	0	0
3. Team reports	21	45	35	0	0
4. Team planning	21	52	24	3	0
5. Schedule of events	21	48	28	0	3
6. Objectives of trainers	45	42	14	0	0

Table 3 (Cont)

	Percentage Reporting				
	Very Good	Somewhat Good	Needs Improvement	Not Acceptable	No Response
7. Objectives of trainees	35	45	17	0	3
8. Participation by trainees in discussion	38	38	24	0	0
9. Reconnaissance field exercise	45	42	14	0	0
10. Detailed team field exercises	42	42	14	0	3
D. Quality of Discipline Training					
1. On-farm engg.	48	28	21	0	3
2. Irrigation engineering	48	24	24	0	3
3. Agronomy soil-plant-water	48	42	10	0	3
4. Economics of farm operation	31	42	24	0	3
5. Extension and farmer irrigation behavior	35	38	24	0	3
E. Quality of Training					
1. Learning field methods	48	42	10	0	0
2. Focus on understanding of other disciplines	42	35	24	0	0
3. Team building	52	35	14	0	0
4. Lectures	42	38	21	0	0
5. Reconnaissance field exer.	35	55	10	0	0
6. Detailed field studies	38	38	24	0	0
7. Developing work activities	28	38	35	0	0
8. Developing reports	17	35	42	0	2
9. Evening films	42	42	17	0	0

Table 3 (Cont)

	Percentage Reporting				
	Very Good	Somewhat Good	Needs Improvement	Not Acceptable	No Response
F. Attitudes of Trainers					
1. Towards trainees	66	21	10	0	1
2. Towards other disciplines	52	28	14	0	1
3. Participation of trainees in discussion	24	48	24	0	1
4. Listening to views of trainees	42	38	17	0	1
5. Compromises in changing training format and activities	42	45	10	0	1
6. Understanding of trainees needs	42	45	14	0	1
7. Understanding of on-farm water management	42	31	24	0	1
8. Ability to communicate	38	45	14	0	1
9. Flexibility	28	52	17	0	1
10. Interest in subject matter	48	38	10	0	1
G. Relevance of Training					
1. To present job	42	42	10	3	0
2. To professional development	31	48	17	3	0
3. To CADA programs	42	31	10	0	7
4. To interests and felt needs	52	38	7	0	3
5. To evaluating value of system improvements	45	48	7	0	0
6. To understanding how the farm system works	42	55	3	0	0
7. To identify priority problems of on-farm system	72	21	7	0	0

Table 3 (Cont)

	Percentage Reporting				
	Very Good	Somewhat Good	Needs Improvement	Not Acceptable	No Response
8. To understanding farmer's attitudes	42	52	7	0	0
9. To understanding farmer's problems	72	10	14	0	3
10. To understanding field research methods	21	62	17	0	0
11. To understanding field research problems	38	45	24	0	0
12. To future training programs you may develop or take part in as a trainer	45	24	21	3	7

Table 3 (Cont)

	Percentage Reporting				
	Yes	Perhaps	No	Don't Know	No Response
H. Would you Recommend Such Training for:					
1. Other officers with a similar position as yours?	83	3	7	3	3
2. CADA field staff?	86	7	0	3	3
3. All Irrigation Department engineers?	76	14	7	0	3
4. All new irrigation engineering graduates?	59	24	17	0	0
5. Extension staff involved in CADAs?	79	14	3	3	0
6. Agronomists working in CADAs?	90	7	0	3	0
7. Economists working in CADAs?	76	21	0	3	0
I. Would you Recommend a Short 1-4 Day Workshop for Top Level Officers?					
1. Policy makers (national level)	83	14	0	0	3
2. CWC members	79	17	0	0	7
3. CADA commissioners	93	7	0	0	0
4. Secretaries, Chief Engineers and Supt. Engineers	76	17	3	0	0
5. Directors of Agriculture	93	7	0	0	0

Table 4: Participants' Views of the Importance of Short 1-4 Day Workshops for Top Level Officials on Systematic Interdisciplinary Approaches to Diagnose and Improve Farm Irrigation Systems.

"Would You Recommend Short 1-4 Day Workshops for Top Level Officials to Understand the Systematic Approach to Understanding How to Diagnose and Improve Farm Irrigation Systems?"

Type of Personnel	Yes	Perhaps	No	Don't Know	No Response
1. Policy makers at national level	83	14	0	0	3.5
2. CWC members	76	17	0	0	7
3. CAD commissioners	93	7	0	0	0
4. Secretaries, Chief Engineers, Supt. Engineers - Irrigation	76	17	3.5	0	3.5
5. Directors of Agriculture	93	7	0	0	0

Table 5: Participants' and Assistant Trainers' Initial Expectation About the Workshop and Their Views of the Degree to Which They Were Met.

	(Percentages) Degree Expectation Met				
	Completely	Partially	Little	Not At All	No Response
A. Expectations Related to Farmers					
1. Knowledge for farmers expectations from government	14	41	32	14	0
2. How to increase farmer involvement	14	55	27	5	0
3. How to communicate with farmer	14	55	14	5	14
4. How to identify farmer problems without confusing theory	36	54	5	0	5
5. Understanding more about why farmers do what they do	18	59	14	5	5
B. Knowledge About					
1. Water management practices in USA and other countries	5	50	41	5	0
2. Further opportunities for workshop and training overseas	23	36	23	14	5
3. Farm irrigation system	27	59	9	0	5
4. How diagnostic analysis process can improve irrigation systems	59	36	0	5	0
5. The warabandi rotation system	45	27	18	9	0
6. Problems of farm irrigation systems	50	45	0	5	0
7. Causes of poor irrigation and crop production	64	27	0	0	9

Table 5 (Cont.)

	(Percentages) Degree Expectation Met				
	Completely	Partially	Little	Not At All	No Response
8. Packages of irrigation practices for field adoption	32	41	27	0	0
9. Ways to improve crop production	27	59	18	0	0
10. Water requirements of particular crops	18	50	32	0	0
11. Salinity and alkalinity problems	14	45	27	14	0
12. Why USAID and CSU conducts workshops like this	45	36	18	0	0
13. How Gambhiri irrigation project and similar projects can be made to operate better	41	55	5	0	0
14. Key constraints of the Gambhiri project	59	36	0	0	5
15. How I can continue to increase my knowledge about water management	45	50	0	1	0
C. Skills Related to					
1. How to do diagnostic analysis	50	45	5	0	0
2. How to communicate findings of D.A. to farmers	32	68	0	0	0
3. How to work on interdisciplinary teams	64	36	0	0	0
4. How to improve my own professional and discipline skills	50	45	5	0	0
5. How to analyze data better	41	50	9	0	0
6. How to synthesize data and prepare reports	36	54	9	0	0

BEST AVAILABLE COPY

Table 5 (Cont.)

	(Percentages) Degree Expectation Met				
	Completely	Partially	Little	Not At All	No Response
7. How to increase my own professional expertise	14	77	9	0	0
8. How to help others adopt and use D.A. methods to improve system	18	73	9	0	0

	Yes	No	Undecided
D. Specific Questions			
1. Has this workshop overall been useful to you			
a. Personally	100	0	0
b. Professionally	95	5	0
2. Would you like to participate in further such workshops if they are available and focus on:			
a. Water use practices	86	9	5
b. Implementing of development projects	86	9	1
c. Design and construction of on-farm structures	55	32	9
d. Monitoring and evaluation methods for irrigation systems	91	9	0
e. Principles and methods of farmer involvement in improvement project	82	14	5

Annex XVIII

JUSTIFICATION FOR TAMIL NADU CONSORTIUM FOR IRRIGATION MANAGEMENT TRAINING AND ACTION RESEARCH

The inclusion of Tamil Nadu in this project is based on a particular rationale. First, in Tamil Nadu the per capita water resource is only 0.17 hectare meters as compared to the all India average of 0.40 hectare meters. There is the realization that these scarce water resources must be managed more effectively. Second, utilization of more than 92 percent of all the available surface water resource and about 70 percent of groundwater resources in the State has been developed. This is why older canal systems such as the Periyar systems in Tamil Nadu and many tanks which cover a third of the current net irrigated area are now being modernized. Given the fact that improved irrigation management rather than construction of new systems is the number one priority, there is much opportunity to introduce improved IM programs. The position of Tamil Nadu in terms of development of potential is a forerunner of where other States will be in a few years. As attention is now focused on IM, there is a good opportunity to innovate and develop new approaches which can have transfer value to other States.

Third, the officials of the Irrigation Department have requested that a consortium be developed using the resources and services of Anna University and the Indian Institute of Management Bangalore to create a training and action research program. This consortium under the leadership of the PWD (Irrigation) Department is a unique innovation which brings to bear the resources and strengths of several organizations to develop and maintain an interdisciplinary IMT program. This aproach will be carefully studied in order to discover lessons which may be valuable for other States in the future. Though the Tamil Nadu Agricultural University will not officially be a member of this consortium, initially with funds from SIDA for a post-graduate option in IWM they will be able to provide trained agricultural expertise. It is hoped that in the future this organization will also become a part of the Tamil Nadu consortium for IMT.

The criteria the consortium has adopted to guide the IMT program are:

1. "Improved water control and reliability of supplies to the farm level.

2. "Improved equity of water distribution among all classes of farmers at different locations on command sytems.

3. "Improved productivity of water in terms of units of land and water.

4. "Improved conservation and maintenance of soil and water resources over time.

5. "Increased participation of farmers in planning, operation and maintenance of farm irrigation systems, utilizing their local knowledge and labor inputs.

6. "Improved cost effectiveness of investments in system improvements." (Tamil Nadu Proposal, Jan. 1983, pp.8-9)

They have agreed that a system team approach linking water source, supply, application, use and removal will be used to achieve their objectives. A solid focus on the needs of farmers will be used to gain their participation in design, implementation, operation and maintenance of the system below the outlet. Also demonstration areas will be developed to spread new technologies. There is agreement that irrigation and agricultural departments will work closely in evolving roles and responsibilities to achieve better coordination and integration of timely inputs and services to end users. Training programs of several types for officials, operational staff, seminars, symposia and field days will be used to develop IMT understanding and skills for professionals and farmers.

(Tamil Nadu Proposal, Jan. 1983, pp.10-11)

Annex XIX

LINKAGES BETWEEN THE PROPOSED INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE AND THE PROPOSED IRRIGATION WATER MANAGEMENT TRAINING AND SPECIAL STUDIES PROJECT OF U.S.A.I.D.

The concept of the International Irrigation Management Institute (IIMI) had been under discussion during the last few years. At the last meeting held in Washington on November 4 and 5, 1982, some agreement in regard to the funding of the Institute as well as implementing agency was arrived at. Currently it appears that the IIMI will most likely be headquartered in Sri Lanka with branch offices in other countries, including India.

USAID has already proposed an Irrigation Management and Training Project in India with the sole aim of strengthening institutions and developing human capital for India's capability to design, implement, and operate more effective irrigation systems. It is therefore necessary to examine both the projects to determine whether there is any overlap in their scope and functions and if not, how they complement each other in their working.

The International Irrigation Management Institute, as proposed, will have a small resident staff of experts who will primarily focus on developing research methodologies in solving major problems in irrigation systems, on evolving unproved technology in the field of irrigation and agriculture, on introduction of new methodologies in training and who will help in the technology transfer by creating an international network. To propagate their research findings, etc., regular seminars and short workshops would be held to which professionals from various countries would be invited. Most of the staff of the International Center will be working outside the country and the resident staff will have networking and technology transfer responsibilities as well as involvement in limited field studies to perfect field methodologies and procedures.

The Irrigation Management and Training (IMT) Project will primarily focus on training operating personnel in agricultural and irrigation departments in India for improved job performance. The project will also conduct system studies on live systems in several States utilizing diagnostic analysis and other team methodologies.

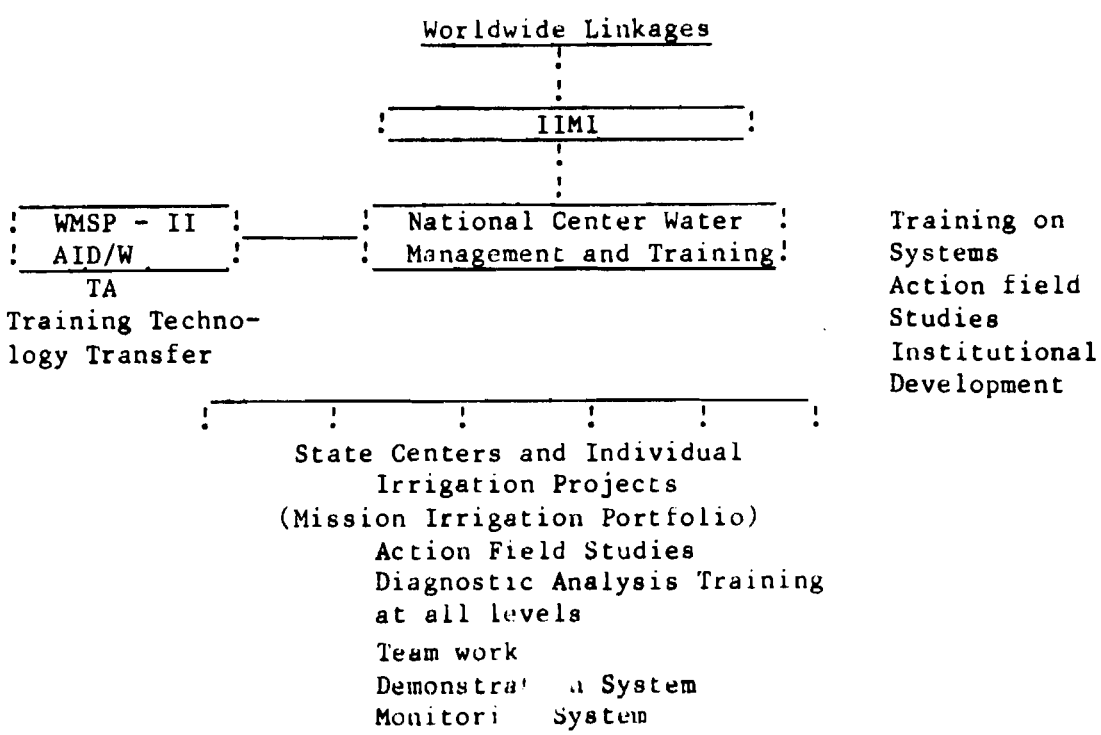
USAID is at present assisting te GOI in irrigation projects in Gujarat, Rajasthan, Maharashtra, and is likely to help in Madhya Pradesh, Himachal Pradesh, etc. The design, implementation and operation of the projects in these States require new approaches and technologies which fit the particular physical and cultural conditions of each State. Traditional design models cannot be used without finding out the appropriate field technologies. The solutions to each problem will have to be location and cultural specific. With each solution applied, one must ask is it technically correct for this situation, economically viable for this system, socially acceptable to

the clients, politically feasible in relationship to land-water rights, water rates, irrigation codes, etc. and administratively implementable. This calls for evolving custom-fit solutions towards which training in irrigation management under the IMT Project in being oriented.

Each of the State irrigation projects in which USAID is participating with GOI will be linked to the Mission's Water Management Training and Special Action Studies Project. The individual sub-projects within the States can be used as the sites to carry out the special studies and training. Many of the Indian professionals who have been trained earlier under this project will be used in the State sub-projects and the findings of the special studies will feed back into sub-project design and implementation.

To summarize, the individual State sub-projects will serve as the training and proving grounds for the IMT Project. They will receive inputs from and provide lessons learned to the IMT Project which will in turn provide feedback to the International Center. The International Center would provide international information dissemination and provide inpouts to the IMT and other projects throughout India. The USAID Mission program in irrigated agricultural development which is integrated with the IMT Project will greatly benefit from and also contribute to the International Center.

The figure below indicates some of the possible linkages. The figure also shows the relationship between the USAID Mission's program and the central funded Water Management Synthsis II Project. These projects will provide inputs to the irrigation development in India in the form of technical assistance and support to the training, special studies, and technology transfer activities.



Annex XX

ACTION RESEARCH STUDIES

1. Introduction

The concept of field action research in Irrigation Water Management arises because most of the unsolved problems in irrigation are "systematic" ones, i.e., they are related to the interaction of the various components themselves. Component research on controlled experimental plots has been and will continue to be the backbone of applied agricultural research and is not to be undervalued; however, because of the interactive influences of various aspects and features of systems, research on systems components in isolation has often led to wrong conclusions. Systems research begins with identifying systems goals and objectives. The objective of an irrigation system is increased agricultural productivity. Thus the system concept must include the farm and farmers and their practices and needs as well as the hydraulic works. The term "field action research" encompasses the implementation of corrective actions as well as their identification. Action research on IWM must be interdisciplinary because engineering, agronomic, economic and human behavior are all involved.

Equally important to production of new knowledge is the opportunity for development of new professional skills through training. This happens through the interdisciplinary diagnostic experience provided to mid-level personnel assigned to action research study teams and to batches of junior level in-service trainees detailed for training to action research study sites. Action research (diagnostic analysis) training on live systems is the most important component of responsive professional training in Irrigation Water Management.

Action studies can involve a small or an entire large system or part of a large system such as a minor, a distributory or a branch canal. Major activities are:

a. Diagnostic analysis, prioritization of key constraints and the choice of interventions;
b. Benchmark surveys;
c. Implementation of priority intervention;
d. Monitoring and evaluation of interventions;
e. Identifying lessons learned;
f. Extending the learning to others as well as other systems, (technology transfer);
g. Utilizing the findings of the studies for improvement of existing systems.

2. Problems of Irrigation Systems

The principal problems of irrigation systems have been summarized as:

a. Main systems in many cases are not capable of carrying the requisite quantity of water;
b. The system of water delivery from main systems to farms is neither adequate nor timely;
c. Water deliveries are inequitable since tail-enders and often the smaller farmers do not receive their share of water;
d. On-farm land preparation is faulty causing wastage of water and inhibited plant growth;
e. Farmers are not properly informed on techniques of agricultural production using irrigation and production inputs, markets and incentives are deficient or missing;
f. In some systems, rising water tables are causing water logging and salinity.

The current deficiencies of irrigation systems identified by a panel of Indian irrigation experts are grouped under System Design, Farming Systems, System Operation and Institutional Arrangement.1/

a. System Design

Physical deficiencies of the main system include:

- improper design of canal system;
- insufficient control structures and measuring devices;
- absence of canal lining and automation (to the extent practicable and if properly phased);
- poor communications (roads and telecommunications);
- inadequate or poorly maintained drains.

The on-farm system needs:

- measuring devices and better outlet structures from the main system;
- better field channels downstream of the outlet structures;
- better division boxes serving individual farmers or small groups of farmers;
- better land preparation (land shaping and land levelling).

In many (but not all) cases, physical improvements in the main system must either precede or at least be concurrent with improvements in on-farm water delivery systems so that the latter can function effectively.

b. Farming Systems

Irrigation water is only one production input. Other factors - labor, farm roads, fertilizer, pesticides, credit, marketing, prices - influence farmers' practices and the productivity of irrigated agriculture. With inadequate, unreliable and untimely water supplies and with water logging or saline conditions, farmers have very little incentive for on-farm developing water user organizations or for the adoption of high-yielding crops and varieties and the use of fertilizer and improved irrigation practices.

c. System Operation

Operational deficienceis on main systems include:

- inability to carry the required discharge either due to inadequate design or faulty maintenance;
- water wastage due to seepage and poor maintenance of canal banks;
- slow or non-existent responses to rainfall;
- distribution according to rule of thumb without any attention to crop-water requirements;
- inadequate phasing and zoning of cropping patterns and sowing time;
- lack of monitoring facilities and procedures to enable managers to know how their systems are performing;
- poor maintenance;
- unwillingness or inability to deliver water to outlets in predetermined quantities and at predetermined times;
- lack of two-way communication with farmers;
- lack of coordination with the agricultural department.

Operational deficiencies at the on-farm level include:

- poor or no control over flows in the field channels;
- poorly organized distribution systems;
- lack of maintenance of field channels and drains;
- lack of synchronization and phasing of crops to suit water availability;
- wastage of water due to lack of night irrigation and other factors.

d. Institutional Arrangements

There is no adequate coordination and understanding between the Departments of Irrigation, (usually controlling the distribution of water on main systems) and the Department of Agriculture (who are engaged at the on-farm level). Irrigation engineers do not have much experience in operation of the systems below the outlet and in agronomic practices. At the on-farm level, farmers' organizations

often do not exist or are weak. Communications are poor between farmers' groups and the irrigation management staff who control water distribution on the main system. A cadre of water distribution specialists to distribute the water from the outlet to the farmers is non-existent.

Removal of the deficiencies indicated above involves a multiplicity of current efforts. A number of steps have been and are being taken by the Ministries of Irrigation and Agriculture at the Center and the corresponding departments in the state. These efforts, although in the right direction, are inadequate and need much strengthening and speeding up. Also these efforts are not sufficiently coordinated at a national level for many large systems. As to farming systems and agricultural inputs and practices, substantial advance has been made by the Ministry of Agriculture and the ICAR. A major on-going effort has been the establishment in 1974 of CADAs. Although they have done useful work in the irrigation systems where they have been functioning, the CADAs have had only limited success, partly because of institutional weaknesses and because adequate attention has not been given to development of appropriate farming systems. Likewise not much has been done so far for effective participation by the farmers in the management of larger systems.

3. Description of Action Research Process

While the contributions of conventional disciplinary agricultural research in irrigation are tremendous, they are only part of the story in the field of irrigation water management which is by nature multi-disciplinary. What is needed is research which includes the whole system: its physical, agricultural, institutional and operational dimension together with the systems environment and linkages among these. This approach will illuminate significant gaps in knowledge and understanding which can lead to improvements in management performance. Narrow disciplinary perspectives and the omission of the concerns of any major discipline or group of disciplines (especially engineering, hydrology, soil science, agricultural economics, sociology and management) can generate misleading diagnosis and ineffective prescriptions. Analysis and activities to improve irrigation management must thereafter be rooted in the realities of real systems.

The objectives of action research studies are increased productivity and more efficient use of irrigation water. Studies purposes include:

a. Devising new procedures and institutional arrangements which are tested and modified (under closely monitored but replicable conditions) with a view to identifying those most likely to succeed in similar environments.

b. Providing visible and convincing demonstrations for farmers, politicians and administrators of the precise benefits and the administrative and financial costs of interventions.

c. Providing field-oriented training to officials and staff charged with responsibility for extending lessons from the experimental area elsewhere and

d. Advancing general understanding about certain key issues in irrigation management by testing important questions about which present knowledge is limited i.e., how irrigation water may be more equitably distributed? Do large farmers tend to dominate small farmers? How can tail-enders best be accommodated? At what level in the system should farmer organizations occur and what are their functions?

This comprises diagnosis of an existing irrigation system by a team of trained professionals who determine the deficiencies in the introduction of the interventions in the systems, likely interventions needed and then monitoring the results.

Ideally, action studies involve collaborative learning among farmers, researchers and project staff. They are iterative and interventions such as changes in water scheduling, other management procedures and minor infrastructural improvements and subsequently moving to major system improvements, changes in cropping patterns and agricultural production practices, farmers' incentives, farmers organizations, incentives for government staff members and organizational structures. Action research sites are live learning laboratories for understanding the problems and potentials of irrigation management and for use in management training.

The action field studies are different from demonstration farms in that they are multi-disciplinary dealing with all branches of irrigation water use, hydraulic, agronomic and behavioral in a systems context. Demonstrations on farms are carried out under controlled conditions difficult to reproduce under actual farm conditions. The farms where such demonstrations are conducted, are smaller in area, whereas action studies involve areas varying from 20 ha. to 20,000 ha. Large scale (system) farm demonstrations on actions studies can be monitored before and after interventions and comparisons made to determine the efficacy of the intervention. An important and vital point is that on demonstration farms, the principal actors are the professional researchers. The farms, the principal actors are the professional researchers. The farmers, operating staff and the administrators are usually only witnesses. In the action studies, administrative, operating staff and farmer are all involved; in fact, are actual components of the experiment. This involvement helps convince high level officials, pertaining personnel and the beneficiary farmers of the utility of better irrigation water management.

It follows that careful thought will need to go into the planning and detailed design of action field studies programs if they are to carry conviction and meet their objectives satisfactorily. Principal responsibility for this task should, where possible, be given to experienced agencies who have had prior experience of carrying out such studies elsewhere. This is an unfamiliar field to most, including the professionals in India, because it involves work of a kind not carried out before by irrigation enginers and agronomists and which academic social scientists have rarely found professionally rewarding.

4. Relation to Training

Professionals involved in comprehensive water management programs are agreed that greater emphasis must be given to action-oriented diagnostic and evaluative approaches to irrigation systems problems in order to understand how systems are currently functioning and to identify priority problems which must be solved. The general view is that the current training courses in irrigation management fall far short of what is needed in style, content and scale. In-depth field exposure is quite inadequate. Most academic courses are specialized, with continuing divisions among engineering and hydrology, agriculture and the social sciences. There are a large number of specialized in-service training courses on technical aspects of agronomy and engineering but courses on comprehensive irrigation management are few. These often are deficient in in-field exposure. Even where the style and content are appropriate, the number required falls far short of needs. Since the training of water management personnel will require a "hands-on" approach, the appropriate "laboratory" is an actual irrigation system. Each component of the training should be designed around a set of field studies located on on-going irrigation projects.

5. Candidate Site Identification and Examples of Study Issues

Action research studies should be taken up in some areas where good irrigation practices and agricultural husbandry has not been adopted and where productivity is low in order to demonstrate the effects of improved management. However, DA should demonstrate that the basic systems capability for a successful experiment exists as a means of identifying alternative actions which may be taken. Control sites where new management techniques have not been implemented should be chosen on the same project. Irrigation and Agriculture Departments will have to make necessary investment in personnel for carrying out the studies, rehabilitating the infrastructure and implement appropriate changes in management required by the study plan.

Examples of issues on which action research needs to be undertaken on all or nearly all systems are: (1) Problems of water distribution and of irrigated agricultural production below the outlet; (2) Improved operation and rehabilitation of canal systems to deliver required discharges at outlets; (3) Improved allocation of available water supplies to cropping patterns taking into account soil and climatic variables; (4) Optimizing conjunctive use of surface and ground water; (5) Insuring against water logging, salinity and excess soil erosion etc. In general any single water management study should be able to deal with all of these issues and studies should be so designed. In addition action research should be carried out on such special topics as (a) supply of irrigation water on demand, (b) use of automatic control equipment to maintain water levels and flow in canals and distributaries, (c) studies in both deep and medium vartisols (black cotton soil areas), (d) improvement in methods of communication of operational information, (e) use of existing or newly acquired computer system for storage and processing of information.

As there are many variables due to different agro-ecological, social and economic environments as well as technological ones, implementation of the program of action studies will need to proceed carefully. Skilled human resources will be scarce especially at first and this is a new endeavor where much has yet to be learned about methodology. Several states and COI groups and the Ford Foundation have already given considerable study and thought to implementation of action research studies and the results of this will be drawn upon.

A few excellent studies should be completed rather than a large number of lesser quality. Implementation will be sequential starting with one study, or at most two, the first year and adding two or three for the next two or three years with one or two studies in each State. Completion time for each study should take about five years. Budget provided in the project is believed adequate for four to six studies. To enable action research studies to be replicable, two scales are visualized, though additional thought needs to be given to this: (1) the intensive sub-systems of water distribution to individual farms and agricultural production and human resources at farm level and (2) the water supply and distribution sub-system generally. The first will require more intensive investment of research effort and infrastructure modification and may be of the scale of a minor or distributary commanding several hundred or up to a thousand or more hectares. The second might be of the scale of a medium irrigation project of several thousand hectares or a main lateral in a major project commanding an area of comparable size, but at a less intensive level of investment. Optimally both components would be included in most action studies.

6. Selection of Action Research Studies

At the State level, a Technical Council (STC) consisting of representatives of State Departments of Irrigation, Agriculture and Cooperation, CADA, Irrigation Management Cell at the Center, USAID and World Bank, the Director of the Water Management Training Institute and the Director of the Land Development Corporation will finalize on the selection of sites. Recommendations should include a statement of objectives, an outline plan of work and estimated cost. In this, the STC will be assisted by a technical working group comprising the Chief Engineer, Irrigation, Chairman, Director, Department of Agriculture, CADA Commissioners, the Director of the State Training Center and representatives of the Land Development Corporation and the resident international specialist team and the International Irrigation Management Institute. Indian/international experts comprising the Action Research Technical Support Team (ARTST) will participate in selection, planning and developing action research studies. Detailed work plans developed by the working group will be reviewed and approved by the State Technical Council. Listing of selected schemes will be forwarded to the Central Technical Advisory Committee (TAC). After selections of the schemes by the TAC, the concerned States will recommend the specific schemes to be taken up in each State under the project.

7. Design and Implementation

a. Action field studies will be planned and conducted by designated representatives of the Irrigation and Agriculture Departments of the State Government with participation of the universities, institutes of management and IIMI, the international/Indian experts (ARTST) provided under the project.

b. A study director will be chosen on the basis of his expertise and may be an engineer, agronomist, or social scientist as appropriate. As far as possible, the staff shall be deputed from the irrigation/agricultural department with a view to attract more talented personnel and to improve career prospects. Once the scheme is sanctioned, the study director shall have full control of the budget and the staff.

c. Continuity of personnel working on action studies or research programs is extremely important. Key personnel should be assigned normally for five years, but in no case less than three years.

d. Two main problems arise in the design and implementation of action research studies:

1. The design should be based on a correct identification of the major current impediments to better performance of the selected system. Traditional "Pilot" experiments on new large-scale irrigation projects have often been irrelevant because they have been based on unsubstantiated assumption about the main problems;

2. In order that results be broadly replicable elsewhere with respect to infrastructure and administrative manpower and the temptation of making studies achieve "success" by the injection of unrelated administrative and other inputs which make them non-replicable must be avoided.

e. Based on the results of action research studies, planning rehabilitation of the project should be scheduled as early as practical in the States' program of construction.

f. Staff salaries and substantial infrastructure modifications as required will be provided by GOI. AID will support the cost of international specialists and needed imported equipment and certain host country costs including local consultants and salaries of members of the Action Research Technical Support Team, local travel, temporary buildings and furniture, workshops, documentation, publications and limited modification of physical infrastructure.

8. Bench Mark Surveys

For evaluation, a cross-sectional appraisal or bench mark survey to collect information about the site prior to initiating the action research study is necessary. This comprises two parts: physical and agronomic information about the irrigation system and socio-economic studies.

Physical information needed includes the state of the diversion and canal system including historical information about water deliveries and other infrastructure such as groundwater development, market roads, market facilities credit banks etc. On the agronomic side, historical cropping patterns both irrigated and rainfed are essential. Project-wise information about agricultural production, yields, etc. should be compiled. Often this must be separated from overall district or tehsil-level data which includes both irrigated command and non-irrigated command areas.

On the socio-economic side, general demographic information on population, labor force, distribution and size of holdings, etc. should be compiled. A socio-economic sample survey concerned with household production factors, farming practices, income and expenditures, use of credit, cropping patterns, family and hired labor, caste, tribal and other social data should be made. There is considerable experience, including that of USAID on other AID-supported irrigation projects, which can be drawn upon in designing a sample survey.

9. Monitoring and Evaluation

Routine monitoring and evaluation of progress as well as end results of each study will be carried out by a separate group designated by TAC/STC in consultation with international/Indian specialists working on the particular study.

Progress reports will be prepared three times a year: (1) during the cropping season to determine performance; (2) at the end of the season to determine improvements and program further action for next season; (3) before commencement of the cropping season to determine the facilities completed and decide on the program of monitoring. Evaluation must include as early as possible an assessment of technology transfer activities. (See Sec. j. below).

A special evaluation will be made by the STC with USAID representatives participating 30 months after each action study is commenced and again on completion. These evaluations will be made available in support of the overall project mid-term and EOP evaluations in Project Years three and seven.

Progress, mid-term and final analysis of results will be communicated to the State Technical Council, CWC, Technical Advisory Committee, USAID and the Directors of relevant State Training Institutes.

10. Technology Transfer

For project objectives to be achieved the results of action research studies must be widely distributed by publications, video material, demonstrations, workshops, etc. and used in the development of training materials for STIs and universities. Further, the results must be integrated into design and operating codes, standards and procedures of Irrigation and Agriculture Department and CWC.

Each study director will be responsible for producing timely publications, scheduling workshops and demonstrations and shall coordinate with the appropriate sections of the STI and IMIC to produce training materials in the form of handbooks, video materials and reports. Responsibility for assessing the results of studies and ensuring that the technologies and procedures are introduced into engineering, agricultural and management procedures in the several States shall be that of the Central and State Governments. The Central Water Management Improvement Cell will have the chief responsibility for transfer of technology among States.

11. Action Research Technical Support Team

Experience with interdisciplinary action research using existing live systems has been quite limited. Thus, a continuing high level

of technical specialist support will be required for the action research program at least for the first few years. For this purpose, a full-time, multidisciplinary technical team (Action Research Technical Support Team, ARTST) will be established. ARTST will consist of five specialists: a civil engineer with irrigation systems experience, an agricultural engineer with expertise below the outlet, a water resource economist with farm management orientation, an agronomist, and an extension specialist or behavioral scientist. It will be multinational with both Indian and U.S. resident specialists. ARTST's responsibility will be solely to facilitate the identification, design, implementation, analysis, evaluation and transfer of technology of action research studies. The team will participate in all of these activities. The team's responsibility will not be to do the research, but to work closely with those who are assigned that function in each case. A budget is provided for salaries and expenses of ARTST. The services of ARTST will be provided under a contract with a qualified contractor.

Annex XXI

WATER RESOURCES SYSTEMS PLANNING AND MANAGEMENT

I. Background and Statement of the Problem

A major emphasis for the Ministry of Irrigation (MOI) of the Government of India (GOI) is the development of its major river basins for a variety of purposes. This development will require careful planning, considerable investment and well organized management and operation. An important aspect is that not only should individual components and projects be carefully planned, but their integration into an overall system must also be considered. For example, in addition to concerns over efficient distribution of water, the project evaluation and analysis should also be concerned with efficient utilization of the water by the end users, namely local residents. In design and implementation of such large scale river basin development, it is imperative that its planners, designers, and managers are aware of multi-objectivity of the system and are knowledgeable of quantitative techniques and tools that allow them to assess various alternatives.

The key to the question of whether such development in a river basin will yield expected benefits lies in two main concerns:

a) Do the individual projects as proposed integrate well into a viable system and

b) Are the appropriate organizations strong, well trained and well structured to perform the necessary managerial and analysis tasks to bring the overall system to fruition?

In the first case, system integration, little capability within the Ministry of Irrigation or the State Governments exists for determining how large scale systems interact. In the past, due to lack of analytic capabilities, reservoirs were planned for every possible site, and irrigation for every potential area with little cross-checking as to whether one reservoir's operation would interfere with another and whether enough water is available when needed for each irrigation site. In any basin, there are inherent conflicts between irrigation and electricity production, between upstream and downstream users, between irrigation in different time periods, between all other uses and flood control, between within year and over year operational strategies, and in the scheduling of projects. Little of this used to be taken into account. Will there be enough water to release during non-irrigation periods

to produce hydroelectricity production year round? Will operations at upstream reservoirs hurt the productivity at downstream reservoirs? Will the scheduling of projects bring adequate early benefits before the project is finally completed? Will one year storage in wet years violate the tribunal decree, increase flooding risks and/or interfere with power generation? How will these conflicts be illuminated and resolved?

All these questions imply the need for a planning framework based on analytic tools and of a much different nature than those used for the detailed project design. Until recently, little of this could be answered due to lack of analytic capabilities on one hand and numerical and computational complexity on the other. Over the past ten years, however, such a framework and planning tools incorporating a systems analysis approach have been developed in the United States by universities, government agencies and consultants and is being applied to large scale river basin development throughout the world with an increasing frequency. They depend on computer based models to help in integrating the large amount of basin data, the simulation over time of possible system configuration along with screening to bring forth good alternatives and the establishment of an evaluation procedure to allow comparison of alternatives using various social and economic cost benefit analysis methods. In addition to these relatively technical steps, a parallel process of eliciting goals and objectives, educating decision makers about the implications of alternatives, building a mechanism for implementing, financing and operating the plan and providing basic elements for planning decisions must be carried out. Similarly indicated by the second question, a training program in Water Resources Planning and Management includes not only a technology transfer of computer models and training individuals to use and understand them, but the help in structuring institutions which can develop and use these tools to properly carry successful planning and implementation.

To meet this need, the following capabilities have to be developed at the national level and transferred to the states:

1) A human resource development program capable of bringing together at the national level available Indian technical resources under the auspices of MOI to provide a training cadre for all of India. This new group will be nurtured and grown through interaction with a U.S. academic institution to provide self-sustained training capabilities in Water Resource Planning and Management.

2) Institutionalization capability, which will enable the Ministry of Irrigation to assist various States in establishing appropriate organizational unit for water resource planning and management. This will include organizational structure, staffing requirement, infrastructural needs, and its hierarchical ties to the State Government. Since development of this in-house capability at the State level is highly dependent upon the State, its needs, its programs, and its priorities, it is advisable that one State be used as demonstration case.

II. Purpose and Objectives

A five year collaboration program of human resource development in Water Resource Planning and Management and the ability to institutionalize such capability at the State level is proposed. The programs will be carried out by a U.S. contractor in association with a U.S. academic institution and in collaboration with MOI and a State Government. The program will develop and carry out the necessary activities required for development of the qualified manpower in this area at the national and State level, and will demonstrate through cooperation with MOI and the State Government, the steps and activities required to institutionalize such capability in one State.

Thus the program focuses on:

a) Development of human resources for a national Water Research Planning and Management training program (WRPMTP) in collaboration with MOI and CWC of GOI, and several academic institutions. This will include:

i) Administration and organization of the training program.

ii) Identification of teaching and training staff, and improvement of their capabilities by short term training in the U.S. academic institutions.

iii) Development of curriculum design and selection of applicants.

iv) Assistance in development of hands-on training and case studies needed for the program.

v) Assistance in providing logistic support for the training program in terms of computer hardware, upgrading of physical facilities, library, etc.

b) Development of appropriate administrative and organizational arrangements, personnel requirements, and infrastructural supports (physical facilities, computers etc.) that are needed to establish such an institutional capability

within the Department of Irrigation of a State Government. Specifically, the following will be provided in cooperation with officials of the State:

1) The structure, organization and roles and responsibilitis of a unit affiliated with the State Government. This unit is expected to provide an in-house capability for overall data gathering, modelling, implementation and application of system methodologies to the case study water resource planning and management problem.

2) Selection, adaptation and application of computer based models for the case study. Primary emphasis will be placed upon suitability of models, their adaptation to local conditions, compatability with the existing data base, and proven application to similar river basin in other parts of the world.

3) Review and evaluation of computer needs of the program, purchase, shipment and installation of the necessary hardware in the established institutions. Adaptation and implementation of appropriate computer programs and models to the computer systems installed.

4) Additional hands-on training of staff in application and evaluation of computer based models and other analytic tools and techniques available for water resources planning and management.

III Project Components and Activities

To achieve the objectives of the proposed work, and to assure the viability and feasibility of the institutionalization effort proposed here, four separate phases are identified. The basic premise underlying the activities and tasks identified for each phase is the interlocking nature of the activities and their reinforcement of the overall objective of the program. The four specific objectives proposed here are vital to creation of a viable, productive and appropriate manpower in India, capable of conducting systematic water resource planning and management. The development of necessay analytic tools and models, their application to a major case study, training of appropriate manpower for practice and future training, and acquisition of necessary computer facilities for in-house use constitute the basic components of a comprehensive institutional effort.

Specific Tasks

Phase I - Mobilization and Start-up (Year one)

In this phase, the U.S. contractor will establish itself in India to lay the groundwork for both the Water Resources Planning and Management Training Program (WRPMTP) and for work in a State. The contractor will establish an office in Delhi, will coordinate with the Ministry of Irrigation, GOI on the logistics of setting up the training program, will review available computational facilities in India and the computational needs of the WRPMTP and will establish with USAID a detailed schedule and enumeration of further tasks. The U.S. contractor team will interact with USAID and GOI on the selection of training staff, the curriculum for subjects within WRPMTP, training needs for the program personnel, policies and procedures for manpower development via the program and selection criteria for trainees. The objective of the program in this phase is to have it structured and located and actively training a first set of trainees by the end of Phase 1. The U.S. contractor will in this phase begin collection of available data and meet with government officials on the scope of the development program and the institutional needs of the planning group. The contractor will also work with the identified Indian academic and GOI training personnel on specific curriculum development, will supervise advanced training and will identify methodology areas where research on India specific issues can benefit training, development and technology transfer.

Phase II - Training and Analysis (Years two and part of three)

In this phase, the training program of WRPMTP will continue to evolve, computer recommendations will be made and implemented, available computer models will be evaluated, procured and installed in India, and logistics for the program and for work on the case study continued. The U.S. contractor will focus on the logistic arrangements in India for computers, facilities, training, identification of available models for Water Resource Planning and Management at the river basin level (such as the MIT River Basin Simulation Model, optimization, screening scheduling and sequency models as outlined in Advanced Water Resource Systems Analysis, Major D.C. and Lenton R., editors, Prentice Hall Publishers, Englewood Cliffs, N.J., 1980), preparation of these modes for installation on the selected computers and data gathering for the case study. The U.S. contractor will continue its work research, development and training for the center staff. The U.S. contractor, USAID and appropriate GOI and State personnel will coordinate activities to ensure that both activities are meeting their specific goals and interacting well.

Phase III - (Part of Year three and Year four)

In this phase, the contractor will continue logistic work at WRPMTP and begin extensive involvement in a specific river basin. Interaction on the institutional structure of the planning institution, its facility needs, computer installation completion, model installation, and hands-on training using real system data will be begun. The contractor will continue its interaction with WRPMTP with emphasis on faculty training and development of new methods growing out of identified Indian needs for Water Resource Planning and Management.

Phase IV - (Year five)

A continuation of the activities of Phase III with an emphasis on continued hands-on training in one State. An evaluation process for the center and for the State institution designed to identify future needs and summarize document and evaluate work to date will be carried out.

The contractor in all four phases will participate with USAID, GOI in an advisory committee for WRPMTC and with USAID, GOI and the State Government on the work in the State Government.

IV. Project Expectations and Output

At the end of the five-year period, the following outputs are expected:

1. A Water Resources Planning and Management Training Center will be established at a location to be decided by GOI. It will have:

a) A building to house classrooms, a computer and offices for training personnel.
b) An established training curriculum including detailed case study materials, and teaching materials.
c) A trained staff capable not only of teaching existing methods but of providing the research and development needed for new methods.
d) An established institutional link with an American educational institution.
e) Established procedures for selecting trainees, evolving its program, and maintaining the center's capabilities.
f) A computer facility and software library pertinent to Water Resource Planning and Management.
g) A mechanism for continuing the existence of the center including funding and institutional structure considerations.

2) For the State Government, a planning institution within its Department of Irrigation will have:

a) Personnel trained by WRPMTP and by additional hands-on training in the State.
b) A physical facility for the planning unit including a computer and software library pertinent to Water Resources Planning and Management.
c) Tested and calibrated models pertinent to the planning and development of the case study area.
d) An institutional structure directed towards providing planning
e) A continued training and expertise link with WRPMTP.

V. Project Organization and Administration

In order to fulfill the objectives of this project, professional resources and capabilities of several distinct professional groups are needed. These include:

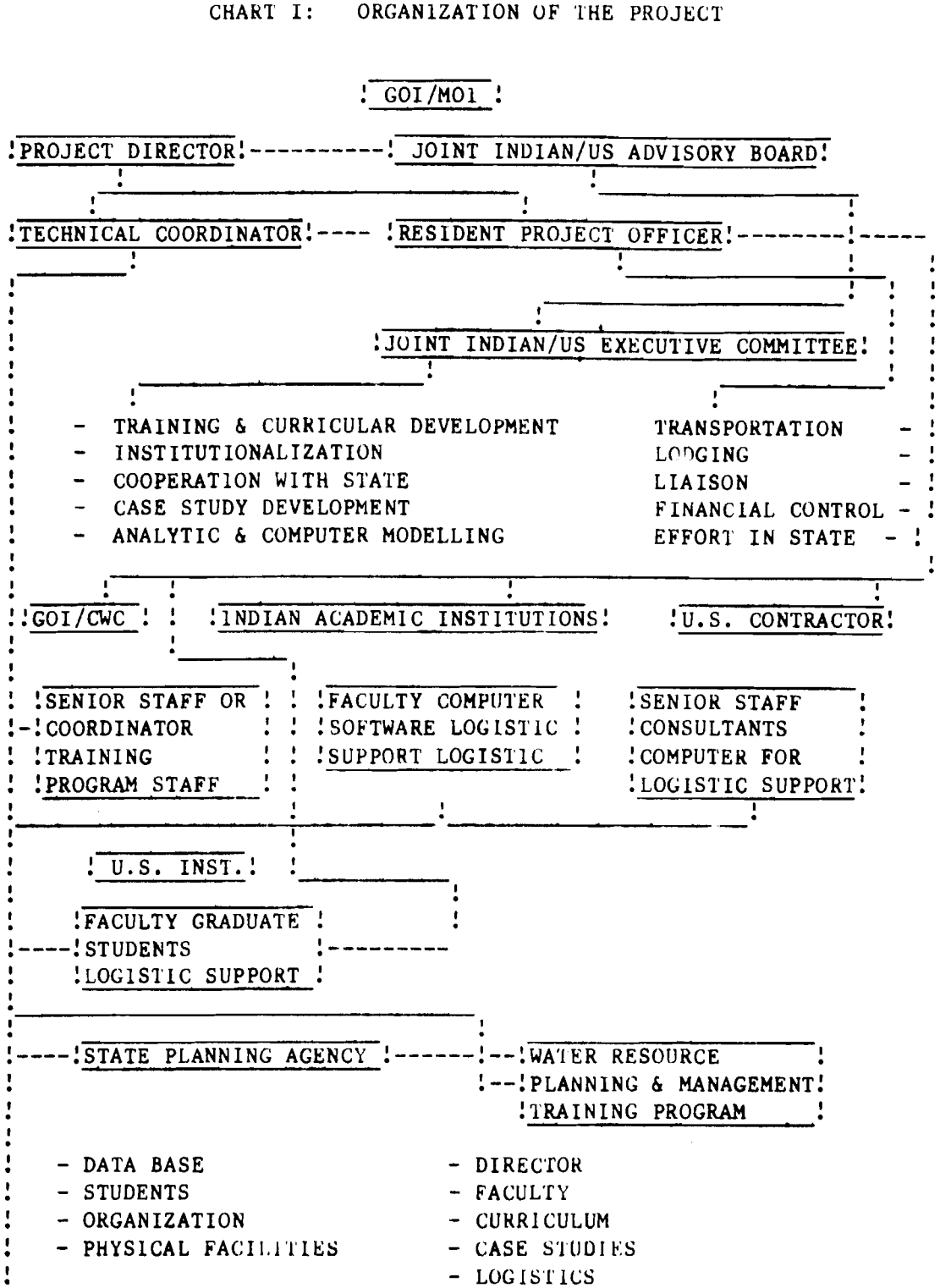
1. A U.S. based academic institution with experience and capabilities in water resources planning and management, in application of computer based models to major river basins in other parts of the world, in developing working relationships with academic institutions and government agencies overseas, and in cooperating with government agencies of foreign countries in establishment of autonomous centers and institutions for research and development and planning.

2. A limited number of Indian institutions of higher education with experience and expertise in teaching and research in the water resources field and having well trained faculty in appropriate areas relevant to this program.

3. Participation of key members of the Ministry of Irrigation of GOI and CWC in providing personnel, physical facilities and in-kind contribution towards establishment of an autonomous center for water resources planning and management.

4. A U.S. based consulting firm capable of and experienced in providing overall supervision, coordination and management control for the program. In addition, the firm has to have a long-term experience in working in foreign countries, but fully familiar with and experienced in application of the models being proposed for use in this program, and having demonstrated experience in working with academic institutions in developing and administering training programs. Chart I contains the organization framework proposed for this project.

CHART I: ORGANIZATION OF THE PROJECT



VI. In order to assure feasibility of any project, one needs to be assured of existence of need, commitment by in-country organizations, availability of resources, and similarity with other successful projects with similar objectives.

It is quite clear, based on magnitude of anticipated expenditure, scale of operation, nature of large scale river basin development in India, and lack of adequate trained manpower in Water Resources Planning and Management, that a significant and immediate need exists for human resource development in this area.

Recognition by GOI, staff of MOI and CWC, and Department of Irrigation of several States in India for such need points to the urgency of the problem. Delay in funding by major international agencies for these projects and their insistence that such capabilities be developed also indicates the timeliness of this effort.

Commitment by GOI and State agencies to formation of system analysis cells and planning agencies within their Irrigation Departments shows the strength of their willingness to development of such capabilities and to its utilization in evaluation of large scale river basin development.

To develop this human resource, the following is needed; highly qualified staff, employment opportunities, appropriate institutional arrangements, timing and financial resources.

Combination of an experienced U.S. consulting firm, U.S. academic institution and availability of highly qualified and willing to participate Indian faculty members assure that academic program will be finely tuned to the needs and adequate control will be exercised. Need by MOI and Irrigation Departments at State level, their willingness to establish planning agencies assures the participants not only of employment opportunities, but also a challenging one. To assure appropriate institutional arrangement, the project envisions working in close cooperation with one State (to be finalized by GOI) in developing the institutional organization structure, and physical infrastructure needed to support the institute. Five-year period proposed assures that adequate incubation period is provided so that a critical mass is developed and institutionalization effort would be self-sustaining. USAID provision of full support for foreign exchange and certain local currencies assures continuity of the effort.

Projects with similar scope have been successful both in India and other parts of the world. For example, GOI decision

several years ago in establishing schools of management (IIM), or their recently established National Institute of Hydrology show that once the need, commitment and resources are available, such projects do succeed.

VII Alternative Approaches

To meet the objectives of developing experienced water resource planners for India, many approaches might be taken. The one suggested here has several components:

1. Assembly, training and interaction with Indian academic institutions and the Ministry of Irrigation, Government of India, to build an ongoing training and research component capable of sustaining itself after the project period. This would be accomplished by a U.S. academic institution, interaction in India and in the U.S. for research development and training.

2. Establishment of a curriculum for training of water resource systems specialists, selection of teachers, students and implementation of subjects in Delhi for a national training center and in the State for hands-on training.

3. Establishment of a computer and advanced computer models in both locations and the use of local facilities for "hands-on" technology transfer using real data.

4. The development of modern planning skills for a State Planning Institution include institutional structure and function studies and excercises in how planning information can be incorporated into decision making.

Possible alternatives, as exemplified by approaches in the past that were less than successful, can be categorized as follows:

a) U.S. training and Indian case study - numerous projects have been attempted in the past in which local engineers are sent to the U.S. for short tours at U.S. academic institutions and/or agencies. An example is a current UNDP project "Systems Engineering for Integrated Developmnt of Water Resources in India". In this project, several engineers are being sent to the U.S. for short term training. When they return, they will work together on a study of the Mahanadi River with outside consultant help over a 48-month period. This approach provides training for only a few individuals, and does not build training capability in India. Further, there is no institution building to provide a place for trainees to return to after training nor a mechanism for maintaining a planning process.

b) Training only in India - provided by a U.S. consultant or by U.S. academic institution alone. Difficulty in providing the full range or services needed. A consultant alone cannot provide Indian academic institution building and has difficulty with training courses curriculum. The academic institution alone has problems with continuity, real case studies and the massive logistic needs of overseas projects.

c) Training only in the U.S. - This has been the most prevalent form of training provided by outside groups so far. It fails to address all important issues raised above: institution building, hands-on experience, and self-sustaining training.

VIII Monitoring and Evaluation

The project, as noted above, contains five major actors: a U.S. contractor/U.S. academic institution combination, the Government of India, the State Government, an Indian academic institution(s), and USAID. There are also several different functions for these actors: The U.S. academic participants, the U.S. consultant for logistics of the training program, computer selection and installation, model selection and installation and provision of "hands-on" and practical training. For all the above tasks, GOI, the State Government and USAID will act as advisory board members to ensure the objectives of each of these organizations are being met. In addition, the concerned State Government must provide physical facilities for the location of planning institution as well as the necessary organizational structure, proper types of employees and logistic support.

1. Things that could go wrong

a) Delay in the consultant providing competent long-term resident personnel in India for the project. Specific provisions in the contract should set time limits on personnel postings, define qualifications for long-term positions and determine approval by GOI, State Government and USAID for assignment.

b) Delay in provision of students for training by State Government and GOI. In early years, the main emphasis of the program is on training State as well as GOI personnel. Selection of such trainees should be made as quickly as possible and incentive mechanisms to ensure their long run participation in the project should be investigated and adopted.

c) Delay in provision of physical structure in the State for housing the planning institution and new computer facility. Such a delay will make it difficult for the planning

institution to function well and could delay computer installation. The delays could be caused by financial or management difficulties on the State's part.

d) Delay in import licenses for the U.S. computers to be supplied for this project. India's current computer policy which attempts to stimulate Indian computer production may cause problems as the computers needed for this project are not available from Indian manufacturers. Negotiations should begin at once to ensure timely securing of necessary permits.

e) Delays in Indian/U.S. academic institutions' interaction. USAID has already taken advanced steps to determine and evaluate capabilities, availability and willingness of selected Indian academic institutions to work with this program. Six major institutions have submitted proposals detailing the services of faculty and facilities they could provide, their availability and the cost of such arrangements. The U.S. academic institution would be chosen by AID to complement Indian skills on the basis of experience, expertise, and willingness to participate as well. An important aspect of the selection of both institutions will be an evaluation of their ability to work cooperatively.

f) Transfer of trained personnel to activities other than State Government system activites or River System Planning (GOI) or loss of trained people to other sectors. The State Government and GOI must make immediate commitments not to reassign trainees without cause and must work towards incentive mechanisms (bonuses, extra pay, other perks to ensure trainees will stay).

g) Delays in computer activities. The contractor is to specify a computer for AID purchase and installation at the selected State and Delhi, provide models for installation on the computers and train personnel in their use. Delays could be caused in securing necessary environmental and infrastructure inputs (stable and reliable power supply, air-conditioning, water, physical facilities). Clearly many things can and probably will go wrong here. Cooperation of GOI and the State as well as an efficiently run U.S. contractor operation is essential to keep such disturbances to a minimum.

2. Monitoring Activities

USAID will monitor the performance of the U.S. contractor/academic institution team against task assignments and budget constraints. The State Government and GOI along with USAID will also ensure that the team is providing outputs consistent with these orgnization's objectives for the program. The following monitoring and coordinating groups will be established:

a) A joint U.S.-GOI Advisory Board - This board will consist of three Indian representatives, one from each of the following: consulting firm, U.S. academic institution, and USAID. This board will periodically review the progress of the program and advise the contractor on adjustments needed to improve the quality of its output.

b) Joint U.S.-Indian Executive Committee - Composed of four members from: MOI/CWC, State Planning Agency, U.S. contractor and an academic institution. This body will assist the contractor in carrying out its activities, will review on a regular basis the progress of the work, will consult with participants, and will advise the contractor on modifications cneeded to improve the program.

c) A mid-term evaluation by a team of expert(s) (one to three members) appointed by AID in consultation with GOI and contractor, who would provide an independent evaluation of the progress of the project and mid-course corrections that might be required.

Attachment A

MONITORING SCHEDULE AND AID MANPOWER IMPLICATION

Phase I

a) Participation in Advisory Committees for WRPMTP and State activities	1/2 man month
b) Supervise U.S. Contractor and Academic Institution efforts	1/2 man month
c) Interactions with GOI and State Government on details relating to their participation	1 man month
d) Participation in computer selection, import consideration, facility, construction in Delhi and at the State Center	1 man month

Phase II

a) Participation in Advisory Committees for WRMTP and State planning activities	1/2 man month
b) Supervise U.S. Contractor and Academic Institution efforts	1/2 man month
c) Interactions with GOI and State on details relating to their participation	1 1/2 man month
d) Participate in purchase, importation, installation of selected computers and facility construction in the State Center	1 1/2 man month

Phase III

a) Participation in Advisory Committees for WRPMTP and State activities	1/2 man month
b) Supervise U.S. Contractor and Academic Institution efforts	1/2 man month

c) Interactions with GOI and State on details relating to their participation	1 1/2 man month
d) Participate in purchase, importation, installation of selected computers and facility construction in the State Center	1 1/2 man month

Phase IV

a) Participation in Advisory Committees for WRPMTP and State activities	1/2 man month
b) Supervise U.S. Contractor and Academic Institution efforts	1/2 man month
c) Interactions with GOI and State on details relating to their participation	1 man month

Attachment B

CONTRIBUTION OF THE GOI AND SELECTED STATE GOVERNMENT

The Government of India and the selected State will provide resources both in kind and in local currency to this project. Below is an estimate of their contribution to this effort:

	IN KIND Rs.	LOCAL CURRENCY Rs.
1. INFRASTRUCTURE		
A. Suitable office space for approximately 50 professionals and their support staff 1000m^2 @ approx. 300 Rs/m^2	3,000,000	
B. Air conditioning, remodelling of space required for computer facilities		1,000,000
2. SALARIES AND WAGES		
A. 50 Trainees/year 250/5 years 30,000 Rs Average salary/trainee/year	7,500,000	
B. Administrative, Supervisory and Logistical Support Staff	1,500,000	
C. Benefits and Overhead at approx. 50 percent	4,500,000	
3. TRAVEL		
A. Local travel to and from selected Indian Institutes for collaborating training		
50 trip/year at 1000 Rs/trip 3 year total		
Per Diem Approx. 100 Rs/Day/Person 150 Days/Person 50 Persons/Year 5 Years Duration		250,000 3,750,000

B. Local Transportation in India	500,000	
4. MISCELLANEOUS		
Telephone, Library facilities, Xeroxing etc.	1,000,000	
TOTAL:	18,000,000	5,000,000
GRAND TOTAL:	Rs. 23,000,000	

Table 1 - TOTAL BUDGET (1,000 U.S. Dollars)

1.	Manpower (Table 3)	$ 3,916
2.	Travel and TDY Living Costs (Table 5)	625
3.	Admin. in India & Capital Equipment	2,150
4.	Computer Services in U.S. at MIT	100
	at CDM	100
5.	Local Travel (U.S.)	40
	TOTAL:	$ 6,931
At 1.21 escalation for inflation		$ 8,400

* Items in local currency (expressed as $)	1,220
At 1.2 escalation	1,500

Table 2 - MANPOWER ESTIMATES (man-months)

PERSONNEL		YEAR 1	2	3	4	5	TOTAL
U.S. Consulting Firm							
Program Director	U.S.	3	3	3	3	3	15
)	U.S.	6	3	3	3	3	18
Prog. Tech. Co.)	India	6	9	9	9	9	42
Resident Admin. Officer	India	12	12	12	12	12	60
Sr. Staff	U.S.	6	6	6	6	6	30
Sr. Consultants	India	2	2	2	2	2	10
Jr. Staff	U.S.	12	18	18	12	6	66
Admin./Clerical	U.S.	12	12	12	12	12	60
Support Staff	India	60	60	60	60	60	300
U.S. Academic Institution							
Principal Inv.	U.S.	4	4	4	4	4	20
Res. Associate	U.S.	10	10	10	10	10	50
Res. Assistants	U.S.	24	24	24	24	12	108
Admin./Clerical	U.S.	6	6	6	6	6	30
Visiting Fellows	U.S.	12	18	18	18	12	78
Indian Institutions							
Program Director	India	12	12	12	12	12	60
Faculty Partic.	India	60	60	60	48	36	264
Grad. Students	India	60	60	60	60	60	300
Support Staff	India	36	36	36	36	36	180

Table 3 - MANPOWER COSTS (U.S. Dollars)

Billing Rate

PERSONNEL	LOCATION	$/Month	YEAR 1	2	3	4	5	TOTAL
U.S. Consulting Firm								
Prog. Director	U.S.	13.5	40.5	40.5	40.5	40.5	40.5	202.50
Prog. Tech. Co.	US/Ind.	10.0	120.0	120.0	120.0	120.0	120.0	600.00
Res.Adm.Officer	India	10.0	120.0	120.0	120.0	120.0	120.0	600.00
Sr. Staff	U.S.	12.0	72.0	72.0	72.0	72.0	72.0	360.00
Sr. Consultants	India	15.0	30.0	30.0	30.0	30.0	30.0	150.00
Jr. Staff	U.S.	7.2	86.4	129.6	129.6	86.4	43.2	475.20
Admin./Clerical	U.S.	4.0	48.0	48.0	48.0	48.0	48.0	240.00
Support Staff	India	.3	18.0	18.0	18.0	18.0	18.0	90.00*
Sub-Total			534.9	578.1	578.1	534.9	491.7	2,717.70
U.S. Academic Institution								
Princ. Inv.	U.S.	10.0	40.0	40.0	40.0	40.0	40.0	200.00
Res. Assoc.	U.S.	7.0	70.0	70.0	70.0	70.0	70.0	350.00
Res. Ass.	U.S.	1.5	36.0	36.0	36.0	36.0	18.0	162.00
Admin./Clerical	U.S.	3.0	18.0	18.0	18.0	18.0	18.0	90.00
Visiting Fellows	U.S.	3.0	36.0	54.0	54.0	54.0	36.0	234.00
Sub-Total								1,036.00
Indian Institutions								
Program Director	India	0.6	7.2	7.2	7.2	7.2	7.2	36.00*
Faculty Partic.	India	0.6	36.0	36.0	36.0	28.8	21.6	158.40*
Graduate Students	India	0.2	12.0	12.0	12.0	12.0	12.0	60.00*
Support Staff	India	0.2	7.2	7.2	7.2	7.2	7.2	36.00*
Sub-Total								290.40
TOTAL								3,916.10

(*) Items that can be paid in Rupees

Table 4 - TRAVEL SCHEDULE

Temp. Duty (TDY)	YEAR 1	2	3	4	5	TOTAL
1. Supervisor/Coord./ Tech.	18 @ 10	15 @ 10	15 @ 10	15 @ 10	15 @ 10	78 trips
2. Teaching/Training	6 @ 20	6 @ 20	4 @ 20	2 @ 20	2 @ 20	20 trips
3. Indians to U.S.						
a. Short-term 30 days	8 @ 15	7 @ 15	7 @ 15	4 @ 15	4 @ 15	42 trips
b. Long-term 30 days	2	2	3	2	2	15 trips
	34	31	29	23	23	140 days

Table 5 - TRAVEL AND LIVING COSTS

Travel @ 3000/ trip	102	93	87	69	69	420
Living in India $100 Per Diem 20 Transp.	36	32.4	27.6	22.8	22.8	141.6*
Living in U.S. $100 day	15	15	15	9	9	63.0
						624.6

(*) Items that can be paid in Rupees

Table 6 - ADMINISTRATIVE EXPENSES IN INDIA AND CAPITAL EQUIPMENT (IN $ 000)

A. ADMINISTRATIVE EXPENSES IN INDIA

1. Admin. Officer		
Living Costs $ 1000/month		$60
Relocation Allowance		15
2. Office Operations		
a) Telephone/Telex	$30	
b) Courier	24	
c) Printing	75	
d) Vehicle	60	
e) Consumables	50	
f) Office renovation and rent	56	
g) Renovation of residence for visitors in local campuses	100	
h) Housing renovation of students at local campuses and/or Delhi	300	
i) Local computer time + software	75	770
3. Capital Equipment		
a) Computer hardware (2 Vax II - 780 or equivalent)	1,000	
b) Library books	75	
c) Reproducing & audio visual	100	1,175
4. Miscellaneous		
a) Insurance	75	
b) Local transportation India ($1000/month	60	130
		2,150