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

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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 subsector. 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 missions 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.

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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 accomodated within AID's own development strategy. These include such things as economic equity, and 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 personalities, 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[4]. 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 more 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 lenders, 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 water 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's 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 institutions, 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 statements 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 effecitvely; and the strong focus on institutional and human development[6]. These major policy emphases should under-gird 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, given its relatively limited capital resources and its focus on improving production rapidly, AID should emphasize investments which involve r habilitation 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 sources.

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

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*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.

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 being7.

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

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, and 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 used productively, 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 also 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 quality, 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 asbuilding 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 irrigation management the focus of irrigation development.

3. Use a diagnostic analysis process for developing new projects. Identify the prerequisites for implementation and operation of the projects 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) institution strengthening
   c) local participation and organization
   d) extension services for farmers
   e) private incentives for improved production possibilities
   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 subcomponents 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 exercise 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 hydrogeological 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 annual averages are not adequate. Bi-weekly operation 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 multidisciplinary experience such as that outlined in (3) below if they are to be effective.

(2) Make irrigation management the focus of irrigation development

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 otained 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 terms "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 establishing 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

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

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.

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 or 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 multidisciplinary 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 fora visable 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 on-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, interdisciplinary 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 interdisciplinary 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]

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) <u>Stress building institutional capacity in host countries</u>

Evidence indicates that the major needs under institutional development are:

a) <u>Training professionals</u>: 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 <u>for new projects alone</u>, about 6,000 professional staff, 27,000 technicians and 22,000 extension personnel will need to be trained in 8 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.

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

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

Analysis and problem solving techniques. Managers of projects and irrigation systems need special training in systems operations 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 Reclaimation), 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 committment 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 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) <u>Extension vehicles to transfer the technology to farmers</u>: 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) <u>Private incentives</u>: 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) <u>Policy analysis</u>: Institutional development, which results in innovative policies creating improved production possibilities for farmers and incentives to those who work with farmers, are needed for systems' improvement. In the area of irrigation development, institutional changes are taking place primarily because governments 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 international 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, 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 thispaper 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 to validate this sub-sector as an enduring 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 nneded 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 Bureaus 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 reivewed by a wide variety of professionals in the field in the process of their preparation. Thus, while they do not represent a complete consensus, 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.

[1]AID, Annual Budget Submissions, 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 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 1981,. 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 I), 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 International Symposium, 16-21 February 1976, Alexandria Egypt, 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 estimate 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	19.3	13.1
(Salaries, consultants, planning, implementation, etc.)		
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 Component	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.

Table 6

RELATIVE COSTS FOR HARDWARE AND SOFTWARE COMPONENTS OF 40 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 mil	% (100)	Total Cost Asian AID $302 mil.	% (100)
A. Hardware	$ Mil		$ Mil		$ Mil					
1. Dams	131	(5.9)	131	(7.3)	0	(0)	115	(7.0)	0	(0.0)
2. Canals	754	(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)
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)

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.