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Working Paper

OTHER CHANNELS

Improving Public Policies and Programs for Small-Scale Irrigation Development in Asia

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PREFACE

This working paper has been prepared as part of Cornell University's participation in the Water Management Synthesis II Project (WMS-II). WMS-II is a USAID-supported effort funded under contract with the Consortium for International Development. The activities of the WMS-II Project were implemented by three universities: Colorado State University, Utah State University, and Cornell University. We express our appreciation to colleagues at all of these institutions who provided encouragement and intellectual support to our effort to understand how better policies and programs for developing small-scale irrigation facilities could be arranged.

After the first draft of this working paper was completed in December 1987, we met with a small group of colleagues to review and critique the materials. The International Irrigation Management Institute (IIMI) kindly hosted that workshop, and we wish to express our appreciation to the Director-General, Dr. Roberto Lenton, and his staff for the efficient arrangements and warm hospitality that they extended.

During that workshop a number of colleagues met over three days to provide us with detailed comments on our draft manuscript. Here we want to acknowledge their very important contributions while not implicating them in any of the imperfections that remain in the working paper. IIMI staff members who participated were: Ed Martin, David Groenfeldt, Ed Vander Velde, and Shyamala Abeyratne. In addition, the following colleagues were involved: Mr. J. Medagama, Deputy Commissioner of Agrarian Services in the Government of Sri Lanka; Mr. A. Weerasooriya of the USAID/Colombo Mission; Professor Kerr. Stutler of Utah State University; Professor M.A.S. Mandal of the Bangladesh Agricultural University; and Mr. Bryan Bruns, Ph.D. Candidate at Cornell University, currently completing field research in Thailand. Through a regrettable mix-up in communications, Mr. Jon Bressler of the USAID/Nepal Mission was not able to join us---though we had planned for him to do so.

Finally, we want to extend our appreciation to Barbara Lynch of the Cornell Irrigation Studies Group who provided important editorial assistance and Betty Van Amburg for her reliable assistance in preparing the manuscript for printing.

At this time, the manuscript remains a working paper---we believe the essential ideas have been presented but there is additional work that can be done to enliven the presentation. It is our intention to discuss the manuscript in its present form with potential publishers and to then develop the final form in collaboration with the publisher.

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Chapter One

OTHER CHANNELS

This book is about ways to improve government policies and programs for developing irrigation facilities that serve scattered, small commands---those other channels that lie outside the large systems. Since states are increasingly involved in such activities, though not always with success, there is need for a book that assembles our current best thinking in these matters.

There already are a number of publications that deal with small-scale irrigation. Most, however, are focused on informing the reader about various technological solutions to small-scale irrigation needs and providing useful information for one who is about to design and construct a facility in some location. Many are manuals prepared for staff engaged in village-level design and construction activities.

This book approaches the matter of small-scale irrigation from another perspective. It asks the question---what is needed to improve the public policies and programs that are created for the development of small-scale irrigation. We use development to include both the creation of new irrigation facilities and the rehabilitation or improvement of existing ones and throughout this book we preserve this dual meaning. Consequently, it focuses on matters that arise before the technician arrives at a village as well as those that are relevant after the engineering work is completed. In short, it deals with issues important in

establishing policy frameworks, overall program approaches, and essential principles of responsibility and action.

Key Definitions

For our discussion three definitions are important and we offer them here.

First, our concern is with small commands that serve multiple users. Consequently, we do not use the term small-scale irrigation for irrigation facilities that serve a single individual or a single enterprise rather than a group of individuals. The single-user systems might be referred to as micro-systems (such as many small individually owned and operated pump systems), or as corporate systems (as when a corporation has installed a sprinkler system for its coffee plantation). Both of these latter categories of irrigation may be important in a given setting but the focus of our discussion is small-scale systems being used jointly by a number of cultivators..

A very common method used to delineate small-scale systems is to consider size of command area--- as when "minor" irrigation is defined as all systems with less than XXX hectares in India. Another common approach used in government statistics is to define small on the basis of some level of project cost. Such parameters are often used by state agencies to identify the small-scale element in the irrigation sector for which they are directly responsible. In many countries, there is another important element of small-scale irrigation---the so-called farmer-managed irrigation systems, sometimes also referred to as traditional, indigenous, village or local irrigation. While their command areas typically are small,

the other distinguishing features they have are that they are relatively independent, though seldom completely so, of state support and are managed by a local entity that can take any of several forms.

Our definition of small-scale irrigation includes two categories: 1) systems of small command in which the state irrigation agency is directly involved (the precise definition of size will vary from country to country) and 2) local irrigation works that are managed by a local entity (and which are sometimes relatively "invisible" to the formal irrigation sector).Increasingly in the real world of irrigation these two categories are becoming overlapping as the state provides various forms of assistance for the local irrigation works and local groups become more empowered to operate small facilities in which the state has been the key actor. Nonetheless, we believe that keeping in mind the two types can be useful.

The term policies is a common one in the development literature. Here we use it to refer to the broad strategy or principles that undergird the government's actions with regard to small-scale irrigation development. These policies identify the general goals being sought, define the overall approach and provide the context for more specific decisions and actions.

Finally, we use the term programs to refer to the specific planned activities that are designed to implement the policies defined above. Designing programs involves making decisions about budgets, staffing, targets and outcomes, levels of effort and so on. It means putting in place a rational series of actions that will achieve outcomes consistent

with the broad goals and principles identified in various policy statements.

To repeat, this book is concerned with raising issues and encouraging discussion of the policies and programs needed to support the development of scattered, small irrigation commands; both building new and improving existing facilities, either those in which the state is directly involved or those in the local sector. It also is useful to underscore the fact that policies and programs are required for small-scale irrigation development that typically occurs in one of two contexts: 1) the design and installation of small works in settings where no irrigated agriculture previously existed or 2) the improvement (and sometimes expansion) of existing small irrigation works, including the refurbishing of facilities that may have been in disrepair for an extended period of time..

Our Audience

It follows that the audience we have in mind differs from that intended by the authors of previous manuals for small-scale irrigation. In general, we are not trying to reach either field staff or farmers. Rather, we have in mind another set of important actors---elected and appointed policy-makers in various departments and ministries who effect small-scale irrigation development, staff in leadership roles in implementing agencies such as the irrigation department or nongovernment organizations working with small-scale irrigation, program staff in international development agencies who encourage and manage external support for small irrigation works and, finally, expert

consultants who often are called upon to propose, shape and recommend approaches to small-scale irrigation development.

A principal purpose of the book is to provide a framework for discussion and a body of generalizations that are derived from a variety of experiences in different national settings. It is not intended to have specific answers for the diverse contexts in which small-scale irrigation policies and programs will be developed and implemented. But it should help those policy-makers and program designers and implementors consider the important issues about which choices must be made and decisions must be taken.

Present Policies and Programs

As noted in our opening paragraph, national governments and international donors have been giving increased attention to small irrigation works. There are a number of reasons for this attention---for example, there are fewer sites for the construction of large commands, and many decision-makers perceive that small works are less costly, more quickly operational, and less likely to cause major environmental degradation. They are also popular as a means for spreading government assistance across numerous political jurisdictions. While in some places the development of new small-scale irrigation works has proven to be an effective means to expand or improve irrigated area, increase food production and raise producer incomes, certain difficulties also repeatedly occur. Government programs for new systems have frequently encountered problems with the engineering design of these small systems. Often, per hectare construction and O+M costs have been high. In

addition, once built, O+M performance has been poor, sometimes because economic incentives have been negative, as with the cost of fuel for operating pump sets. But also because of the difficulties agencies have had in providing other incentives to local groups to take on these responsibilities or to directly finance or implement O+M activities.

In farmer-managed systems there often are technical problems with acquiring or conveying the water supply. Or, in continuing to mobilize resources in view of government subsidies to other sectors. Moreover, if unusual catastrophes destroy developed facilities and require uncommon amounts of labor and materials for repair these local systems sometimes get into difficulty. But, among the most troublesome problems faced by farmer-managed systems is effective interaction with government agencies---obtaining the needed assistance without disrupting existing institutional arrangements, being overwhelmed with inappropriate technical changes or losing rights to and control of the local facilities.

In fact, we propose that one of the most critical issues in formulating policies and programs for small-scale irrigation development concerns **achieving the optimal mix of government and local responsibilities for creating and sustaining small-scale irrigation facilities.** This optimal mix is needed both in new commands, as well as for the improvement of existing ones.

It is not always possible to know what the optimal mix should be at the time that policies are being set or programs planned---indeed the optimal mix might vary from location to location, as well as over time, within a single program. However, there is evidence to suggest the perspective that we adopt in this discussion---less central agency

involvement is generally better than more. That is, we propose that policies and programs be developed to support a mix that, as frequently as possible, gives lead responsibility to the local group and obligations for backstopping and support to the government agency.

A failure to have a clear policy regarding the desired balance of responsibilities between the local group and the irrigation agency, and inconsistency between this policy and the planned programs seems to be central to many implementation difficulties. Without an explicit policy, irrigation agencies seem at times to be at a loss as to what to do to improve existing small commands or what the post-construction scenario should be in new commands. Unclear policies can lead to the absurd---as when an irrigation agency becomes involved in a farmer-managed system by paying farmers to maintain the main canal which they previously did with their own resources. Or to the extravagant as when simple brush dams are replaced with massive concrete weirs that function but a short time. In either case, such actions can result in a considerable waste of scarce public resources and unnecessarily displace local capacity and resources. This theme of getting the correct blend of government and local involvement is continued throughout our discussion and highlighted in Chapter Three.

There is another mix that we are concerned with in these discussions---that involving the so-called "hardware" and "software" of irrigation development---the irrigation technology and the irrigation organization. Our approach, which we call the sociotechnical perspective, proposes that both of these elements are essential to the successful development of small (as well as large) irrigation commands---neither is

sufficient alone. Furthermore, the two elements are interactive---choices about facilities and technical rules of action, for example, can have important consequences for local rules, organizations and behaviors. The reverse is equally accurate. Our ideas about the sociotechnical perspective are spelled out in Chapter Two.

Governments are increasingly recognizing that it is undesirable, even infeasible, for the irrigation agency to continue accumulating responsibility for additional thousands of hectares of irrigated area located in tiny patches here and there. They are also more aware of the incompleteness of strategies that only deal with the physical infrastructure of irrigation. But quitting the habits of taking over small commands in the local sector, or designing and constructing new works intended to be government operated, or giving unequal attention to organization and technology all require new principles of operation and new ways of operating. In short, these new approaches can only emerge from different, and we believe better, policies and programs.

To summarize, the spread of new small irrigation commands is bringing irrigation to previously unserved cultivators. And, assistance to farmer-managed systems frequently has helped these systems to persist and improve. But these positive outcomes have been spotty. All too frequently, the results of government action have been small-scale irrigation systems that are poorly designed, costly to construct and operate, and overly dependent on government support. In these systems agencies are forced to commit substantial amounts of money and manpower to keep them operational---two agency resources that are in short

supply. We discuss the topics of design and costs in Chapters Four and Five, respectively.

But these problems are not intrinsic to small-scale irrigation development. Rather, they are symptoms of the shortcomings of our current strategies and manner of implementation. Both of these can be changed. This book hopes to stimulate the reviews needed as a prelude to these policy and program changes. And, ultimately, to improve the other channels of irrigation.

Small-Scale Irrigation and the Water Management Synthesis Project

During the course of the Water Management Synthesis II (WMS-II) Project, faculty from the three university groups engaged in a number of activities related to small-scale irrigation---project design teams, diagnostic analysis activities, special studies and so on. Thus, the discussions in this book are much informed by this set of in-depth experiences. Without those experiences this effort would not have been possible---indeed, probably would not have been conceived. However, this is not to say that the ideas put forward here represent the WMS-II viewpoint on small-scale irrigation. There is no single project view on this topic and this book is not intended to be such---though we believe that the general contours of discussions would be acceptable to the majority of our WMS-II colleagues. What can be agreed upon is that WMS-II Project activities played an important part in focusing concern on small irrigation commands worldwide and served as a vehicle for consolidating experiences with this branch of irrigation development. This book is intended to be one component in that consolidation.

Chapter Two

THE SOCIOTECHNICAL PERSPECTIVE

In this chapter and the next we are concerned with two important mixes with which public policies and programs for small-scale irrigation development must deal: the mix of technical and organizational elements (discussed in Chapter Two), and the mix of agency and user group rights and responsibilities (discussed in Chapter Three).

Defining Sociotechnical

The compound word, sociotechnical, is used to create an holistic image of an irrigation system---to portray a human enterprise that includes a complex of built facilities overlaid on a set of land and water resources and being operated by cultivators and agency staff according to various technical and socially constructed rules for some agricultural production purposes. The sociotechnical view of irrigation asserts that understanding irrigation systems requires attention to both the technical and social components of irrigation as well as the natural and socioeconomic context in which these systems are operated. Like the proverbial partial views of the elephant, incomplete images of an irrigation system are defective and can constrain the development of sound policies and programs for small-scale irrigation development.

An holistic view of an irrigation system includes six essential components: three of these are technical in character---the built-facilities, the natural resources, and the crops being grown. The other

three are social in character---the system rules, the organizational arrangements and the individual behaviors of users and managers. The first three components are easier to envision (though not necessarily simple to understand): the **built-facilities**---the canals, the tank bund or the tubewell pump; the **natural resources**---the water resource to be tapped, stream, spring or underground aquifer, the soils to be used---their water retaining characteristics, slope and so on; and the **crops** being grown---with special concern for the timing and quantity of their water requirements. The second set of components are usually less visible. First, the various **rules** in that system for using and maintaining those facilities. Some of these rules are technical in the sense that they are based on a understanding of various physical and natural relationships---such as how frequently a particular crop may require water. Other rules are social in nature and based on "social facts" such as existing water rights among the cultivators.

The second social component are the **organizations** that give substance to these rules---the groups, formal or informal, that socialize their members regarding the rules, enforce their practice and watch over their change and continuity. Within the command of even a small irrigation system, often there are a number of different organizations operating. But two are particularly relevant for irrigation operations---the irrigation agency, a formal organization, and the local organization which may be formal or informal. User organizations may take the form of village government, a legal group such as a cooperative, or an informal group such as the descendants of the original builders of a small

command. The importance of these two elements of the organization component is further discussed in Chapter Three.

The last element that completes our holistic mosaic is the individual behavior of the irrigation users and managers. This behavior is influenced by the rules of the system and by the ability of the irrigation agency or the water users' association to reward some behavior and not others. But, it is neither completely predictable nor is it uniform. It is not uniform because people control different resources and hold different interests. It is not fully predictable because through their actions people are repeatedly able to offer somewhat novel interpretations of any particular rule or to test the limits of various proscriptions.

The sociotechnical view of irrigation starts with this mishmash of components---facilities, natural resources, crops, rules, organization and behavior---using it as the basis for contextual understanding of established irrigation systems, as well as for planning new commands or modifying existing ones. Successful irrigation development requires attention to all of these components and the interactions among them---none can do the job alone. Each element establishes both possibilities and limits for the others---water distribution rules need to be buttressed by technical structures but the latter will have little effect if they are not complemented by a water user organization that bounds the behavior of the users.

Most irrigation agencies have an uneven understanding of these various components---they are relatively confident about some of the technical components such as the built-facilities and the technical rules. This is not to say that there are not important technical issues to be

considered as we discuss in Chapter Four. However, less familiar to them are the important social elements---socially based rules, the organizations and individual behaviors of those in the system. As a short-hand, we will sometimes refer to these social elements as the social organization of the system.

Two important points about the connections among these technical and social components should be kept in mind:

First, they are **INTERACTIVE**---they have implications for one another. Changing one may require change in another---or may cause a misfit among them. For example, replacing traditional proportional flow weirs with rising stem gates will require new rules, organizational arrangements and behavior to effectively operate the gates---new rules of water distribution will have to be devised to organize the timing of gate openings and the size of the opening to be set, and someone may need to be enlisted to adjust the gates in accordance with these rules

Not all variations of built-facilities will be equally compatible with all variations in the other components. The opposite also is true. In planning and implementing irrigation development none of the elements can be said to take precedence over the other. Sometimes social organization will need to be modified to deal with new technology while at other times technological alternatives can be selected to be compatible with existing technical or social rules.

Second, the components have **LIMITED SUBSTITUTABILITY.** Simple technical devices may perform effectively if managed with sophisticated rules and organization---one thinks of the many simple proportional flow weirs in farmer-managed systems that operate effectively because of the

well-established water rights that surround them. But also there can be important technical solutions, or shortcuts, to otherwise complicated social organizational problems---consider, for example, the innovative circular distribution systems being used with tubewells in parts of India. But there is a limit to this substitutability, no one element can completely replace another.

A sociotechnical approach to policy development and to project planning and implementation is one in which no single element dominates. For example, in project planning, reconnaissance studies of irrigation situations should give attention not only to the built-facilities that exist but also to the various rules, organizations and behaviors that are in place to use these works. This would include attention to the existence and functions of the local field staff supported by the users and the water distribution practices that they may be using for rotating supplies. The sociotechnical perspective is important at this point because usually when an outsider encounters an established small-scale irrigation system, one component, the built-facilities, is highly visible, while the others are invisible, if not hidden. Consequently, much of the outsider's "feel" of an irrigation system is based on these visual images of facilities abstracted from the social context in which they are utilized. For example, many farmer-managed systems in Asia have built-facilities that can be characterized as rudimentary---simple stone and bamboo structures acting as a diversion or rough proportioning weirs used as turnouts. However, judgments regarding their suitability should be made only after one is able to understand their actual performance in that location---something which cannot be done without combining an analysis

of the physical structure with an analysis of the rules, organization and behaviors in place for operating and maintaining them.

To illustrate the complexity that can occur in "simple" farmer-managed systems, consider the case of people's irrigation systems in northern Thailand. Here agriculture is quite intensive and many systems irrigate some portion of their command in the dry season. In one such system researchers "discovered" that the distribution of water during the dry season is achieved through a combination of technical and nontechnical means. In this system water is delivered from the distribution canals to the individual fields through bamboo tubes. These bamboo turnouts are installed each season by the user group's "management staff"---locally selected and supported field staff who manage the system. Turnouts are installed according to existing rules and requires placing the correct size bamboo tube at the proper elevation for the command to be served. In the dry season, since less water is available to the system, the management staff adjusts these turnouts by inserting in each tube an inner sleeve of bamboo which reduces the size. Clearly, thorough reconnaissance of this system prior to any external assistance would require attention to this sociotechnical complex of the irrigation facilities, local staff, and irrigation rules and practices.

Design decisions and implementation actions also should proceed based on continuing attention to the interplay between the sociotechnical components. Choices concerning the built facilities and the technical rules should be informed by an understanding of the social rules, organizations and behaviors necessary to utilize and sustain them. This does not mean that one can only choose facilities or technical rules that

fit with the nontechnical components---since not all existing social rules, organizations or behaviors are effective and desirable. However, if the new facilities or technical rules will result in a lack of fit with the nontechnical components then one should take important follow-on actions. One possibility is to review the first technological choice and ask if there is a technological alternative that better coincides with the existing situation. If not, then one needs to plan as an explicit part of the program actions (such as training or organizational development assistance) to establish the needed capacities. A good example of this situation is when a new sluice device is installed in a village tank system that may create opportunity for new operational procedures if the organizational capacity to manage the technical rules and required behaviors for such are also established.

Or, the needed organizational arrangement may involve agency actions. For example, impermanent diversion weirs are often complemented by effective local rules and organizations for mobilizing labor and materials for routine and emergency repair and reconstruction. "Permanent" weirs built by the irrigation agency will need to be complemented by irrigation policies and programs for their routine maintenance or rapid repair following natural catastrophes. Viewed from a sociotechnical perspective it is clear that permanent weirs will have no superiority over temporary ones unless policies and programs can be put in place to support the "permanent" weir in ways that are as effective as the arrangements for supporting the "impermanent" one.

In brief, one important feature of good irrigation systems---those that support appropriate and changing agricultural production and that

persist over time---and good irrigation development policies and programs is that they establish a satisfactory mix of technology and social organization---what some have called "hardware" and "software."

Sociotechnical Policies and Programs

The sociotechnical perspective suggests two important questions concerning policies and programs for developing small irrigation works and the agencies that implement these:

1. Do the policies and programs intended to support small-scale irrigation incorporate a sociotechnical perspective? Are they pro-sociotechnical?

Many existing policies and programs are pro-technology. They propose dealing with small-scale irrigation development almost entirely through changing the built facilities and associated technical rules for operation---replacing impermanent with permanent structures or substituting simple control facilities with elaborate ones. Often the social organization for the utilization of this new apparatus is not considered---the social rules, organizations and individual behaviors. Or if there is consideration the solution is to assign the responsibility to agency field staff. The solution to overly pro-technology approaches is not anti-technology policies and programs but rather policies and programs that combine attention to technology and social organization.

How can policies and programs be pro-sociotechnical? They must give explicit attention to both technical and social organizational matters and to the connections between the two. For example, setting forth the

principle that there must be a fit, actual or planned, between the irrigation facilities and the technical rules recommended or supported by the state and the technical skills of the irrigation agency and the organizational capacity of the local user groups.

Programs are pro-sociotechnical when they include attention to both technical and social organizational matters in all phases of program planning, implementation and operation. For example, they use social organizational criteria as a significant, but not dominant, element in technological choice. They identify and, when required, implement actions to foster the development of social rules, organizations and behaviors appropriate to utilize new and established irrigation facilities.

2. Are the agencies charged with implementing these policies and programs capable of sociotechnical activities? Can they operate in an sociotechnical manner?

Agencies have sociotechnical capacity when staff within the agency, or closely affiliated with the agency, can deal with both technical and social organizational matters in an integrated fashion, and when clear and effective procedures guide the work of these staff members. That is, sociotechnical-capacity requires the absence of agency procedures that block, or complicate, the implementation of sociotechnical approaches.

One contemporary approach used in several countries to increase the sociotechnical-capability of agencies is the use of community organizers (discussed in more detail in Chapter Three). The basic idea is a simple one. Organizers (usually young graduates with training in various fields including agriculture and the social sciences) are recruited

to work in rural areas where irrigation development is underway, or planned. They live in these rural areas and work closely with the irrigators. By increasing communication between the users and the agency they increase the likelihood that the implications of proposed changes in the facilities or technical rules for local organizations, their social rules and the behavior of their members will be considered.

Sometimes the new agency procedures in support of the sociotechnical perspective can be quite simple. For example, in the Philippines the National Irrigation Administration added a procedure to the design process for small irrigation systems called the "walk-through." When the first layout and design of structures has been developed by the design team they then take that plan to the command area and with a group of user representatives actually walk along the canals noting where changes and improvements are to be and requesting farmer reactions. With this procedure there is the assurance that the local users have an opportunity to comment on the proposed design and layout of the engineers in terms of existing local conditions---both physical and social. This is a sociotechnical procedure in practice!

Using the Sociotechnical Perspective

What we have suggested above is that policies and programs for small-scale irrigation development should begin with a sociotechnical approach---the simple, yet powerful, perspective that irrigation development involves both technology and social organization in correspondence---each fitting and reinforcing the other.

We believe the point at which to begin is with a policy that clearly emphasizes high user involvement in the everyday activities of small-scale irrigation commands complemented by essential agency assistance. That is, local groups should have the lead rights and responsibilities for the small systems but they should be supported and under-girded by selected agency actions such as technical advice, inter-system regulation, aid for initial development or assistance with catastrophic damage. As will be elaborated in Chapter Three, this mix of local and agency responsibilities can have numerous advantages including the incentives for local resource mobilization and the ability of the agency to focus on tasks which it is best prepared to implement.

To make this first policy operational it must be joined with the twin principle that the irrigation facilities and technical rules to be used for small-scale irrigation development should, as far as possible, fit with the overall pattern of lead responsibility for the local group and agency support as needed. In short, technical facilities and rules that can be managed by the local group are to be preferred over those which require responsibility and control by the agency.

In many cases this can be achieved by designing and constructing (new or improved) works that use principles and techniques that are familiar to local people and within their capacity to operate and maintain. Often these works can be built of materials available to local people either in their own environment or affordable through market purchases. Let's call these **locally-manageable technologies** in the sense that their routine operation and maintenance can be done by the users themselves--but not in the sense that they are old or unimproved facilities since

such locally-manageable technologies might reflect the best of new engineering principles.

Of course, this will not always be possible. Sometimes it may be necessary for the new facilities to be comprised of elements that are provided, operated and maintained by the agency---as when permanent storage facilities are required or modern pump sets are needed to lift water. Let's call these technologies which require agency involvement for their routine operation and maintenance **agency-essential technologies.** A third situation is a **transitional** one in which a new technology is introduced, for example a pump, and initially operated by the agency. However, over time as the users gain the needed skills, organizational procedures and financial resources they may assume O+M responsibilities. Thus, an agency-essential technology is transformed into a locally-manageable one. Now the point is not that locally-manageable technologies are always good and agency-essential technologies always bad. Rather, the relevant point is that, in general, locally-manageable technologies will be more consistent with the policy of confining the agency's role to that of basic support. But, locally-manageable technologies won't always be technically appropriate to solve the particular problem being encountered. To help identify the situations in which agency-essential technologies are appropriate we suggest the following three criteria (see Diagram 1). Agency-essential technologies will be appropriate first if they are clearly superior to the local technology and techniques with regard to some important need---for example, if they more effectively conserve water in a water scarce situation.

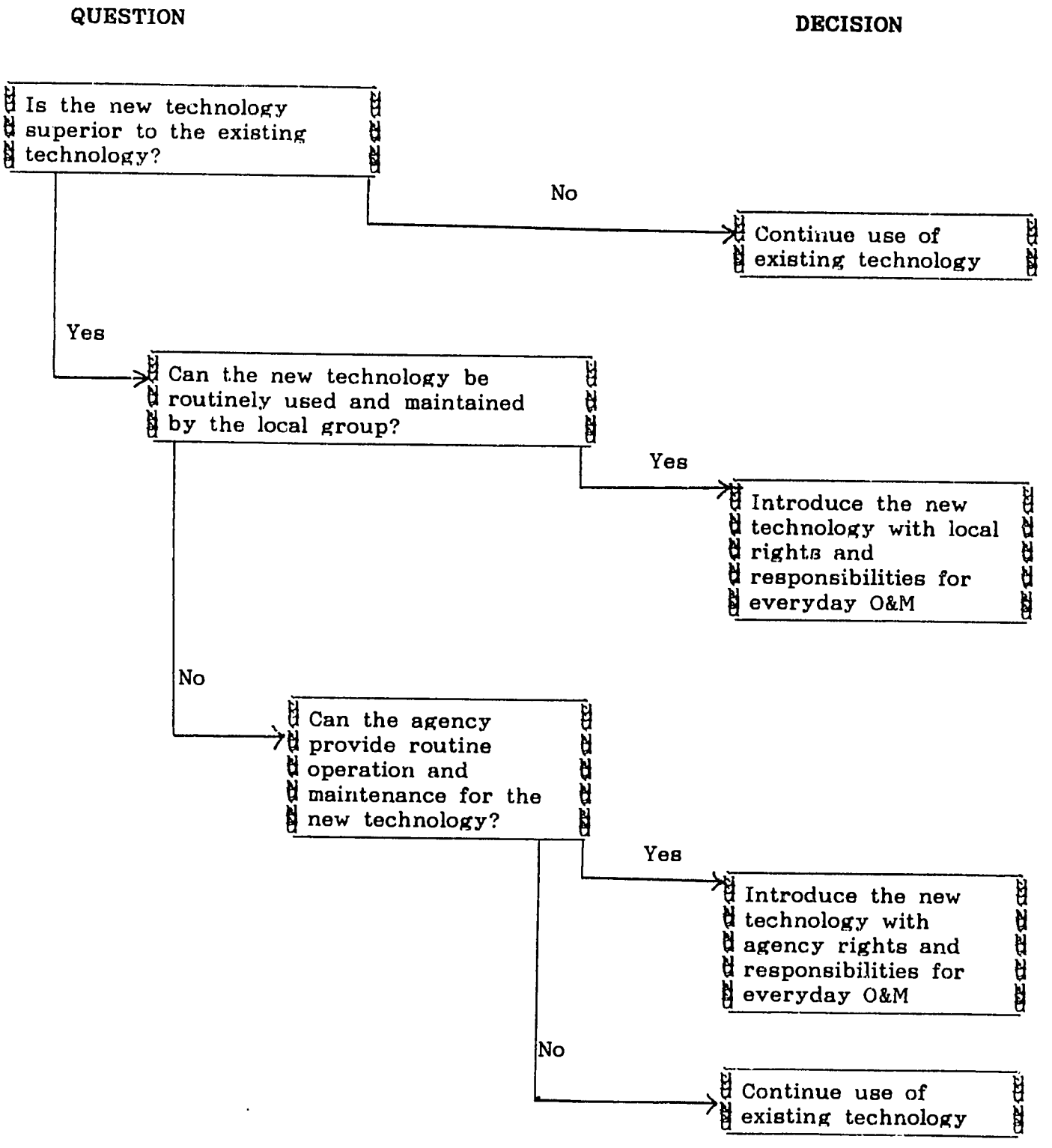

Diagram 1. Decision Criteria for Replacing Existing Irrigation Facilities with New.

But not all superior technologies have to be under agency control, so the second criteria for agency-essential technology is that for reasons of cost, technical skills or whatever, they cannot be routinely operated and maintained by the local group.

Yet even this is not sufficient reason for installing agency-essential technology. The third point is that agency-essential technology should be introduced only if the agency has the technical staff, the necessary budget and the organizational procedures that give it the capacity to routinely operate and maintain the new facilities. Our point is that if any of these features are absent---the agency-essential technology is not superior, or could just as well be looked after by the local group, or is unlikely to be satisfactorily operated and maintained by the agency---the original technology should be the preferred choice.

If any one of these conditions fails to apply it is unlikely that the agency-essential technology will be a better solution in the long term. For example, replacing a farmer group's temporary weir with a permanent structure to be operated and maintained by the government may be a good solution if 1) the agency really can design a technologically sound and cost-effective structure for the diversion site that has no environmentally negative consequences and diverts water (or does something else) more effectively than the farmers' structure, 2) the structure cannot be operated and maintained by the local users because it is complex to operate and requires maintenance skills beyond those of local artisans, and 3) the agency does have the capacity (skilled manpower, budget, responsive procedures) to operate the facility in correspondence with local needs and maintain and repair it when

required. Otherwise, those farmers may be in a better position with their impermanent weir which requires several repairs during the course of the cropping season. Note that a good "middle" position might be for the agency to construct a "permanent" weir that can be routinely operated and maintained by the local group---i.e., an improved technical item that is locally-manageable.

If these three points were scrutinized each time an agency planned changes in facilities or technical rules in an existing or new system it seems likely there would be less agency-essential technology and more locally-manageable technology in small-scale systems---certainly fewer cases of agencies expending resources to perform tasks that farmers could do for themselves and less facilities that had fallen into disrepair because of inattention by the irrigation agency. Scrutiny of proposals to install agency-essential technology would sometimes lead to rejecting the proposal because it simply would not be an improvement over the existing facility---a situation that seems to apply with many of the permanent and gated turnout structures that are installed. In other cases, the proposed technology actually would be an improvement and ought to be installed but there is no need to have it be operated and maintained by the agency---local people could do it.

But, perhaps the most important reason for not installing much of this agency-essential technology turns on the third point. Once installed the agency lacks the capacity to be responsible for its operation and maintenance---staff are too few or poorly trained, budgets are meager and agency procedures are cumbersome, at best. Facilities or technical rules that are beyond the capacity of the local group and made the

responsibility of an agency that is unable to fulfill that charge will simply be ignored---placed in a social vacuum and tended by neither the local group nor the irrigation agency---or lead to frustration of the farmers with the agency and the agency with them. Under those conditions they hold little promise of improving irrigation capacity.

In sum, our proposal is that small-scale irrigation development policies be built on the sociotechnical perspective. Two basic principles derive from this. First, that as much as possible local groups have the primary responsibility for routine operation and maintenance of small irrigation works and that they be backstopped by the irrigation agency with basic support. And, second, that in conformity with this first principle, preference be given to what we have called locally-manageable technologies over agency-essential technologies---that is, facilities and technical rules that can be locally managed should be chosen, whenever possible, over those that require agency responsibilities.

Working in Existing and New Commands

In simple terms, governments usually have to fashion small-scale irrigation development policies and programs for one, or both, of the following situations: 1) where irrigation facilities are being introduced to previously unirrigated lands and 2) where improved irrigation facilities are planned for an already irrigated command. Both situations are common in small-scale irrigation programs. For example, the Village Irrigation Rehabilitation Program (VIRP) in Sri Lanka deals with the latter case whereas much of the work with small systems in Bangladesh has confronted the former situation. The Hill Areas Land and Water

Development Project in Himachal Pradesh (India) deals with both. In the following discussion we will examine how the sociotechnical approach can be used in each of these situations.

Using the Sociotechnical Approach with Existing Systems

In existing commands both technology and social organization for irrigation are already in place. Either, or both, may be working well, not working at all, or simply operating at some suboptimal level. The sociotechnical perspective advocates that planning begin with a thorough understanding of what is in place and what is already going on---a reconnaissance of both the existing irrigation facilities, natural resources and agricultural activities as well as the rules, organizations and behaviors being used to perform critical irrigation tasks.

Creating effective local irrigation groups has been one of the most elusive achievements of irrigation agencies. Where they exist they should be viewed as "endangered species" and the highest priority given to strengthening and supporting them. Of course, in some cases, previously active groups may have now become ineffectual or even defunct for some reasons. If that is the situation there is need to carefully consider the options for reinvigorating these old groups. In many cases this will be more effective than attempting to form some new state-sponsored association, or simply presupposing that the agency will have to assume responsibility for what the local groups previously did (more on this in Chapter Three).

In either case, supporting a strong group or reinvigorating a fragile one, the selection of technical improvements, both the process of

selection and the form of technology chosen, can have a large impact on the social organizational component. Involving the irrigation group in the process of selecting from among alternative technical options can itself be a means of strengthening the local irrigation group (as well as assisting the irrigation agency make a better informed choice).

The nature of the facilities and technical rules selected---the locally-manageable technology versus agency-essential technology choice discussed above---will also be important in contributing to local organization persistence and effectiveness. The first principle will be to select locally-manageable technologies whenever technically possible since these should support the existing local organization with, or without modest alterations, and minimize the demands for agency servicing.

But, of course, not all locally-manageable technologies will be equally compatible with the rules, organizations and behaviors the users may have in an existing command. Incompatibility may arise in three situations in particular. One situation is that in which the new technology requires social organization more complex that which exists. This often happens if several small units are aggregated into a single integrated command and previously small, independent groups are expected to form into a larger federation. There can also be a significant lack of fit between the new technology and the existing social organization if a significant alteration is being made in water rights, unless somehow all parties are made better off by the new rights. This often happens when an existing command is expanded as part of the government's development project---for example, if the coverage of a village tank is being extended to new users.

A third situation in which complications can arise is when there is a lack of fit between the introduced technology and the "logic" of the established system. By the "logic" of the system we mean the nexus of local purposes and objectives for irrigation and the operational practices and procedures in place to support those objectives. For example, in parts of southern Sri Lanka, cultivators are actively involved in both irrigated and unirrigated production. The irrigated areas provide the basic food grains for family subsistence while the upland, unirrigated areas are used for the production of cash crops. Both types of agriculture are essential to their livelihood. In this context, the logic of the irrigation system is to provide an assured food crop supply. The system is not for intensive use for market production. The facilities that are in place and the associated social arrangements and irrigation practices all appear to be geared to this objective. State intervention that implicitly builds on a "logic" of intensive irrigated farming may introduce new facilities intended to support more intensive and careful water use, such as better water control gates, but find little demand for these facilities because of their incompatibility with the system's "logic".

Policies and programs for these existing commands can begin either with a focus on facilities and technical rules or a focus on social organization. In either case it should quickly move to concern with the linkages between the two. If one begins with needed technical changes then the sociotechnical approach first attempts to choose locally-manageable technology that will support, and be supported by, the existing social organization. Or, if that is not possible nor desirable, fashioning new local rules, organizations and behavior that will support

the selected technology. The social organizational supports might be provided through arrangements already in place, through the modification of these existing arrangements, or in some cases, through the creation of entirely novel arrangements. Selecting technology that can be supported by the existing local social organization has the advantage that success is not simultaneously dependent on social modifications as well as technological change. However, there will be some instances in which this will not be possible and both will have to be tackled at the same time. Also, of course, there will be many instances in which improvements in the existing command will be possible only with agency-essential technology of some type. In this case, as we mentioned above, a critical matter is to insure that the agency actually has the capacity to provide the services of routine operation and maintenance as well as catastrophic repairs.

Some may wonder how common are existing irrigation commands with strong local irrigation groups and effective irrigation practices such as elaborate forms of rotational water distribution and the continuing mobilization of local resources for maintenance actions. Recent research indicates that such systems are found in many areas. For example, in a number of regions in Asia well-organized irrigation groups presently operate and maintain their own small commands---from the famous subaks of Bali to the hill systems of Nepal. If one is working in these situations the approach should be to introduce technological changes that will support, rather than disrupt, these important organizational resources. Unfortunately, too often this has not been the approach and policies and programs have proceeded as though these existing facilities and local

groups and their established irrigation practices were absent or insignificant.

Where irrigation facilities already exist and social organization for irrigation is in place, the sociotechnical perspective suggests caution and care in making changes. But, this view is not meant to immobilize planners and program implementers.

Actually, neither established technology nor social organization is ever unchanging or impossible to improve. Both in small commands that are farmer-managed as well as those that are operated by an agency the status quo is not static and social and technological change is frequent. But neither should outsiders assume automatically that they have a better organizational or technical solution. While either element can be changed and modified, it is not without cost and not without uncertainty of the results. Moreover, as we have stated before, not all forms of either technology or social organization will be suitable co-elements. The introduction of a centralizing technology such as a common storage dam for several existing local irrigation systems may fit poorly with the strong, but cellular, organizations of the previously independent irrigation units and require large changes in the rules and behavior of water distribution.

Using the Sociotechnical Approach in New Systems

The most important sociotechnical facts about these new systems are that there are no irrigation facilities in place, the users have no previous irrigation experience (at least not in the project location) and there is no existing social organization for irrigation operations.

However, this does not mean that there are not important social patterns in the command to be considered for irrigation planning purposes. The command may be divided into several village boundaries, kinship ties may bind some field groups with others, patterns of reciprocal labor exchange may connect various groups and so on. Furthermore, these cultivators because they have been working the land will have knowledge about soils, topography, drainage, rainfall and so on. They may even have individual and joint experiences with water management under rainfed conditions. All of these can be important "facts" for the system designers. Thus, even in new commands, a sociotechnical perspective is important for identifying relevant social and ecological features and incorporating them into the design process.

The sociotechnical perspective can apply in another way in these new commands: it can help focus attention on the post-construction conditions that the agency wishes to see prevail---we believe, as stated before, that this condition should be one of agency support for local management, in the long- if not short-term. Early concern with this later condition will highlight the need to review design choices in the context of their impacts on this future scenario. In other words,there is a need to examine "final" designs and ask the question (phrased in current computer terminology)---Is this a user-friendly layout and set of irrigation facilities and technical rules? Does it lend itself well to being managed by the users themselves, now or in the near future? Or, is it a technical arrangement that will require regular and continuing agency involvement?

There is one other matter about new commands that the sociotechnical approach highlights---the maturation period required for final technical adjustments to happen and for learning by both agency staff and water users to occur. It requires time using the various new facilities to discover where imperfections exist and what changes are required. Likewise, it simply takes time for people to learn to use the new facilities effectively and to create the various rules, organizations and behaviors required for irrigation system operation---to elaborate the fit.

In short, the sociotechnical approach is applicable when working with new commands---and not just after the new command has become operational. Thinking "sociotechnically" from the start can help clarify objectives and sharpen the selection of social organizational and technical means for reaching those objectives. It also alerts us to recognize the time required for system maturation.

A Brief Summary

At one level the sociotechnical perspective is elementary and obvious---an irrigation system involves facilities, natural resources, crops, rules, organizations and behavior, and all have to be considered. But its full application to small-scale irrigation policies and programs will result in profound changes in our concept of the development process, the preferred outcomes of this process and the means for implementation.

For most small-scale irrigation policies and programs technological change is the lead instrument for intervention. Some new, perhaps different, apparatus is to be built and often this new technology is to

have associated with it novel operational rules. But this technical intervention can be successful only if there is organizational support for it from both the users and the irrigation agency---including the rules, organizations and individual behaviors for its use and maintenance.

The core of the sociotechnical perspective is consideration of this technology and social organization combination. The essence of the sociotechnical approach is designing policies and programs that give attention to this combination and which contain procedures for accomplishing an effective fit between these two sets of components. Sociotechnical policies and programs apply both to the development of new irrigation systems as well as the improvement of established facilities.

Having discussed the critical technology-social organization linkage in this chapter, our attention in Chapter Three turns to a second essential tie---that between the irrigation agency and the local users' organization.

Chapter Three

COMBINING AGENCY AND USER STRENGTHS

Introduction

Nearly all irrigation development efforts require some government action and some local action, but while both are necessary neither is sufficient alone. As noted in Chapter Two, it is these two elements, the agency and the local group, that together comprise the critical irrigation organizations in most small systems. The precise combination of the two elements required and feasible will be different from place to place and from time to time. This chapter deals with the process of getting the right blend of the two.

In fact, many small commands currently are operated jointly---often with the agency being responsible for certain "main system" activities and farmers being responsible for the rest. Sometimes this is no more than a stand-off defined and imposed by the agency. It is not the result of deliberation and negotiation between the two parties or of the clear search for the complementary strengths of each. To facilitate the discussion in this chapter we assume that the government prefers a policy of focusing scarce agency resources on backstopping tasks essential to small-scale irrigation development while creating a positive environment for water users to assume a large portion of the total set of routine operational and maintenance rights and responsibilities. With this broad policy in place the ensuing exercise is to develop procedures for

identifying the best combination of agency and user involvements for the particular program situation.

The discussion begins by identifying certain key tasks to be performed in an irrigation system. From there we move to an examination of each of the two components---agency and users---identifying their strengths and limitations relative to these chores. That, then, leads logically to a consideration of approaches to small-scale irrigation development that build on complementarities and emphasize thinking about joint approaches.

Key Tasks in an Irrigation System

Previous discussions have identified the essential tasks to be performed in any ongoing irrigation system. Although many tasks must be organized to operate an irrigation system, five are of fundamental importance.

Three of these tasks are somewhat specific: 1) water acquisition---the task of obtaining water for the irrigation system through regular or extraordinary means; 2) water distribution---the task of dividing and distributing the system's supply to its users; 3) system maintenance---the task of repairing, cleaning, and otherwise reconditioning the physical apparatus of the system. The remaining tasks are more general and may, in fact, be directly related to one or more of the above tasks; 4) resource mobilization---the task of activating and accumulating labor, materials, funds and other resources needed to implement tasks such as system maintenance; and 5) conflict management---the task of containing

and adjudicating (though not necessarily resolving) disputes and disagreements arising from operations such as water allocation.

These five tasks relate largely to the internal activities to be performed in a given system---but some of them do extend to dealing with neighboring commands---upstream or downstream or within the same drawdown area where groundwater is being used. Acquiring water can create conflict with nearby systems as can water allocation procedures that create problems, for example, for users downstream.

Agency Strengths and Limits

A first point to note is that often several agencies are involved in planning and implementing small-scale irrigation programs---sometimes in the same region. Thus, in addition to the irrigation agency, agriculture and rural development might also have programs for small irrigation works. While we recognize this complexity, in the following paragraphs we are going to speak as though a single irrigation agency is involved. You may be working in a region where the other agencies are also active. If so, we leave it to you to determine to what extent the issues raised with regard to the irrigation agency also apply to the others. Our hunch is that many will apply.

The first thing to do is to remind ourselves of an essential feature of small irrigation works---they usually are patchy! That is, these small systems are like bits and pieces scattered over the landscape. Having spent many hours traveling in jeeps in various parts of Asia and Africa to observe small-scale systems, we know this is true (we also know that in some places small systems are clustered---closely bordering one

another---if that is your situation you have a significant advantage). Consequently, the relevant question becomes, Which of the tasks identified above, if any, can the irrigation agency hope to implement effectively in these irrigation patches? Several of the tasks cannot be performed effectively unless one is in the command area on a regular basis during its operational periods---water distribution, routine maintenance and mediating everyday conflicts. Other tasks are more episodic e.g.,improving the water supply to the system, repairing catastrophic damages or adjudicating inter-system conflicts. Agency staff could help with these when needed.

If we assume that irrigation agencies have limited staff, facilities and budgets and that their staff are trained primarily in a technical discipline, it seems appropriate to focus their responsibilities in small-scale irrigation development on those functions which fit these parameters. Being permanently responsible for the detailed and routine operation of each irrigation patch is simply infeasible---though it many be necessary on a short-term basis in some situations. On the other hand, collaborating with and backstopping these scattered units by supporting their quests to improve the water supply to their system, designing solutions to significant technical difficulties in their small commands, providing technical and financial assistance following catastrophic damages or regulating their interactions with one another, while not easy tasks for the irrigation agency, are feasible. They are possible precisely because they relate to the real or potential strengths of the agency. These include the following: (1) providing generalized technical knowledge and practical experience across systems; (2) acting

as a channel for the distribution of state financial and other resources; (3) inducing other state agencies to supply needed complementary services---everyone from the electricity board to the agricultural extension staff; and (4) enforcing rules and (sometimes) acting as a "neutral" party with regard to local conflicts.

User Strengths and Limits

The strength of the users lies with the contributions they can make to system development and operation. Four of these are most significant. First, users can contribute important local resources needed for routine operation and maintenance---materials, finances, and labor. They typically provide all these resources in their farmer-managed systems and the right policies and programs can stimulate them to do so in new small commands that are built by the government or continue to do so in farmer-managed commands that have received some government aid. A second essential resource that users can contribute is location-specific knowledge---knowledge that comes from years of experience with the physical habitat of the command. This includes detailed knowledge of soil characteristics, topography, drainage patterns, rainfall, stream flows and so on. Farmers in both new commands and old commands will have this type of information based on their farming experiences. In addition, farmers who already have irrigation facilities also will have information that is irrigation-specific---about such matters as the functioning of various elements of the irrigation facilities and the effectiveness of existing practices of water distribution.

The third resource that users can provide for irrigation development are their established organizations and institutions--- the social apparatus by which they organize actions, make decisions, and enforce compliance, when needed. The everyday operation of irrigation facilities is highly dependent upon the orderly behavior that user organizations and institutions can produce.

A fourth resource that users may have to contribute is their incentive to have the system operative effectively. In those situations where their family livelihood is largely dependent upon irrigated agriculture they will have a high incentive to see that the irrigation facilities are operated and maintained effectively---an incentive that may be lacking among outsiders assigned to operate and maintain the system but whose livelihood is not directly tied to system performance.

In contrast to these potential user contributions an important feature that can act as a limitation on these contributions must be highlighted. Users seldom are a homogeneous group---usually important differences exist among them. Even in small commands the users frequently reside in different villages and certainly cultivate in different locations within the command---the familiar head and tail problem. And in nearly all cases they have different access to the critical resource of land. Some own more land, or better quality land, than others---some own no land at all and have access to it only through tenancy or other rental arrangements. And also,there frequently is uneven access to other important production inputs such as credit, fertilizers, seed and so on. These differences can directly relate to irrigation matters. They translate into different goals for the various users of the irrigation

system---some may be concerned with basic subsistence needs while others are producing for the market. Disparate sets of problems faced by users can produce disagreements about the need for system improvements, common repair efforts or patterns of water distribution. And uneven incentives on the part of users to see particular arrangements made or procedures followed can jeopardize joint action.. In short, the users of these irrigation commands often are composed of distinct interest groups who sometimes cooperate with one another but at other times act in conflicting ways. Strong and effective local groups can devise arrangements for such competing interest groups to cooperate more frequently than they conflict---and to mediate the conflict when it arises. Differentiation among the users is a social fact that has to be taken into account in developing sound policies and programs for utilizing the strengths of the users.

Efforts to mobilize these important user resources have to be considered in the light of these differences among users. For any given activity to be undertaken in the irrigation command, the contributions that users will be able, and willing, to provide will vary since it is unlikely that everyone will be affected similarly. Understanding this variability and forecasting the responses to and effects of any change in the system, technological or organizational, are extremely difficult undertakings for any outsider. These are good reasons for limiting agency involvements in the everyday activities of these small systems and while emphasizing the role of local management.

But local management is neither good nor effective management in all cases---just as agency management of these small systems is not

always the best. Thus, we are back to the issue of blending agency and user responsibilities--- finding a mix that is complementary and builds on the strengths of each of these groups.

Deciding About the Mix

One significant issue to be resolved is the extent of agency involvement in system operations---under what conditions will the agency be involved to do what? The first step is to have a clear policy on this matter. We repeat our suggestion that the position of the government be preference for significant involvement of users in routine system operation complemented by essential backstopping by the irrigation agency. From the clear statement of such a policy should flow a program with technical facilities and operational procedures that support this principle.

Achieving this mix should be quite straightforward where effective local groups already are in place. Regrettably, there are a number of cases in which even in this "ideal" situation programs have been designed to create an agency tilt to the mix. It is not fully understood how this strange result occurs but it appears related to the absence of a clear contrary policy and to inattention to local circumstances.

Some years ago the Philippine irrigation agency, with assistance from a foreign donor, planned an elaborate irrigation development project in a region of Luzon Island which has a rich tradition of farmer-managed irrigation systems. Unfortunately, in the early planning and implementation of the project no attention was given to the existence of these centuries-old facilities and organizational patterns---the planners

acted as though the command of the new system was virgin land. Only after very strong local objections to the agency's action was serious consideration given to the functions and capacities of these farmer-managed facilities. Then, much to the credit of the irrigation agency, it made a serious attempt to restructure the project to assist these established groups and provide an important continuing role for them while focusing agency attention of inter-system water supply problems.

The correct course of action is less clear in the absence of effective local groups---as in the case where the command is completely new or when previous groups have become disorganized.
There are several points to consider. The absence of an effective local user group does not necessarily signal the need for permanent agency management. There may be need for an initial agency role in operations, for example in new commands, but an understood policy supported by clear procedures and steps should be in place to ensure that this is only a transitional stage. Next, if it is decided that the agency must take some role in strengthening the capacity of the local group then it must follow that the agency will need to recruit staff with the training and skills to work with users.

Working with farmers to establish effective local irrigation groups is a job that calls for particular skills and special training in what is sometimes called, community organizing. Both because these special skills are required and because the work to be done is intensive it is very unlikely that these organizing functions can simply be assigned to the irrigation field staff or the agricultural extension worker who have been trained for other functions and usually already are overloaded with

responsibilities. If such novel staff are added to the agency, and we recommend they should be if organizing irrigation groups is to be done effectively, then the irrigation agency will need to carefully examine their existing procedures to identify those that might actually hinder the efforts of these new staff. We discuss this further in a later section reviewing some experiences with community organizers in irrigation development. Finally, as noted in our discussion of the sociotechnical perspective, changes in the technical facilities and rules of the system should be made so as to be supportive of this transitional approach---for example, by designing and installing locally controlled technology rather than agency-controlled technology whenever feasible.

Innovative Approaches to the Mix

In recent years several interesting, and innovative, approaches for achieving an effective mix of agency and local rights and responsibilities have been implemented in various parts of Asia. One can view them as "natural experiments" that have occurred and from which we might learn some significant lessons. Five are briefly discussed here---not as approaches to be imitated but as endeavors that are suggestive of possibilities. The cases represent fundamentally different means of dealing with the agency-users mix that we have been discussing. In the first, the augmentation strategy, the issue is dealt with by nearly completely removing the agency from the system-level scene. In the second, the community organizer approach, the agency develops new staff capacity to allow it to become intimately involved in matters of system operations for a transitional period. The intermediary approach, the

third case we discuss, illustrates the importance of program procedures and techniques that actually allow the outside group to be supportive and empower the local group to carry out its responsibilities. The fourth case reviews a more general approach to financing irrigation development that also impacts on the organizational mix we are discussing. Finally the last case we discuss is the turnover approach. This is a relatively new activity being tried in a few countries and involves the irrigation agency transferring to some form of local user group responsibility for the everyday operations of small systems which the agency previously managed---a significant redefinition of the mix of agency and user actions.

1. The Augmentation Strategy

Several years ago, a design team organized under the WMS-II project recommended to the Indonesian government and to the AID Mission an approach to assisting existing farmer-managed systems that built on the principle of separating agency and user responsibilities. The essential features of the situation were (1) a number of operating farmer-managed systems deriving water from small streams whose flows vary considerably between the wet and dry seasons, (2) effective user groups which had sustained these systems over long periods of time, and (3) a significant hydrologic constraint on dry season production---little irrigation was possible at this time because of the low stream flows available to be diverted.

The strategy suggested for assisting the small systems in this case was based on several principles. Given the effectiveness of the user

groups in maintaining and operating their small systems it was suggested that there be little agency involvement at this level. Instead of the agency giving attention to intra-system improvements (lining a few canals, replacing quite acceptable proportioning weirs with more elaborate control devices and so on), it was proposed that the agency devote its civil engineering expertise to augmenting the supply of water to these small commands. This was to be done by designing and constructing civil works on the larger, perennial rivers in the region and then conveying this new supply to natural river courses that were being diverted by the farmer-managed systems. The new supply would be added to these natural river courses and flow down to the points of diversion built and maintained by the farmers. If needed, the user groups could be given modest assistance to make any required improvements in their facilities so as to effectively utilize the augmented supply. A simple strategy---the agency doing what it was uniquely prepared to do and user groups continuing activities suited to their interests and capacities. Unfortunately, the project design was subsequently shelved.

But an analogous strategy has recently been implemented in northern Thailand. This too is a region rich with farmer-managed irrigation systems. Here the very intensive farming systems that are practiced result in a high premium for good irrigation supplies---particularly in the dry season. A recent project of the Royal Irrigation Department (RID), the Huay Mae Awn Reservoir Project, is dealing with these problems through an innovative augmentation strategy based on the approach that the users are capable of managing their systems and that there is no need for the RID to rebuild these existing facilities. Rather,

the appropriate RID role is to attempt to augment the water supply available to these systems. The result, recently completed, is a reservoir on the Mae Awn River which will store water and release it as needed back to the Mae Awn. This augmented supply will then be utilized by 29 existing farmer-managed systems to irrigate more than 800 hectares of land. The RID will manage the reservoir and the user groups will each manage their own system---procedures for coordination between agency and users are being worked out now. An important experiment to follow and one that suggests a significant means for blending agency and user rights and responsibilities.

2. The Community Organizer Approach

Unlike the augmentation approach that blends through specialization of the functions of the agency and the users, the community organizer approach mixes the two by creating, at least temporarily, an overlap between the agency and the users. The heart of the community organizer approach is concern with creating or strengthening user groups to be responsible for routine operations of the small commands. A significant innovative element of this approach has been to begin the organizing effort before, rather than after, construction has begun. This allows for joint participation in the important processes of initial planning, design layout and construction. In fact, this involvement is used as a vehicle for encouraging user groups to form and act---providing input and being involved in these key processes are valid activities for the nascent group to undertake.

In the several countries in which community organizers are being used---the Philippines, Thailand, Indonesia, Sri Lanka, Nepal, India---have several common characteristics and patterns of work. They usually are young people, men and women. They are recent graduates in diverse fields from agriculture to the social sciences. They are provided specific training with regard to both community organizing and irrigation development. Their assignments are to villages not offices---they live and work in the commands where irrigation development activities are programmed to occur. And finally, they are specialists whose efforts are focused on the organizational component of the irrigation task.

One final point is important to highlight. The community organizers are intended to be a link between the agency and the users---a liaison person facilitating the flow of information, ideas and concerns between these two groups. In performing this task, community organizers often have helped identify various agency procedures and actions that may be impeding achievement of the new mix of agency and user responsibilities--- for example, procedures that reward field staff for fully expending their budgets in a given budget year may clash with the need to slow the pace of planning and implementation in a particular site until farmers have achieved solid agreement on some important matter.Achieving a effective mix can require agency adjustments and changes as much as changes in the organization and behavior of the users.

3. The Service Agency Approach

The northeastern region of Thailand is zone with a prolonged dry period and is prone to drought even in the wet season. In this region

the Thai government has been developing small water resource facilities, weirs and small reservoirs, for some time---but with uneven success. With support from the New Zealand government, faculty at Khon Kaen University (KKU) began an experimental project to devise new approaches for developing effective small irrigation works. This approach, as we will see below, attempts to deal with the agency-community mix by having the external agency (in this case the KKU team) provide technical and other services to a community-based effort. In addition to the Thai case that we summarize here, another important example of this approach is the work of the Aga Khan Foundation in the mountainous areas of northern Pakistan.

In the KKU program the activities in any particular site begin with a request emanating from that location. Initial meetings with the villagers clarify the division of responsibility between the outsiders and the insiders. The role of the outsiders is limited to technical advice and construction materials while the insiders have responsibility to plan, organize labor, carry out the construction, and operate and maintain the completed facilities.

Having established the different responsibilities of the two groups, there are significant features of the KKU approach that are important in reinforcing this basic strategy. First, technical advice is channeled through a so-called "village technician"---a locally identified person who may have traditional construction skills and who may have received some training from the KKU staff. The village technician acts as a link between KKU engineers and the users and also supervises construction activities. Second, design assistance from the KKU group is provided in

a way that bolsters the lead role of the local group rather than creating a dominant function for the outsiders. The design information has the following characteristics: 1) designs are standard and require little alteration from site to site, 2) designs are simple, intended to be understood by villagers and relatively insensitive to inaccuracy in construction technique, and 3) the designs are communicated through models and construction manuals using sketches and photographs rather than conventional engineering drawings. Together these features allow outsiders to maintain a supportive, low-profile role and facilitate local control---the design advice that is provided by the outsiders really can be used and controlled by the villagers.

In short, what we see in the case of this intermediary approach is that the basic policy---villagers will have lead responsibility---is supported by a number of program actions and techniques, including the use of the village technician and the provision of usable designs in an understandable format. The result is a mix of "agency" and user rights and responsibilities that works in this situation.

4. The Indirect Investment Approach

During the last two decades, the dominant mode of investment in irrigation works has been direct. That is, the government operating through one or more of its technical agencies acts directly, using its own budget and staff to design, construct and operate irrigation facilities that are government-managed. This direct investment strategy reflects a combination of agency and users that gives heavy emphasis to the agency component.

Though fewer in number, and making smaller expenditures, there have also been some interesting government programs that are based on an indirect investment strategy in which government makes resources available to effective user groups (in the form of grants, subsidized loans, technical assistance and so on) to support irrigation development activities that are identified and implemented by the users themselves. Some examples of this approach are the Village Subsidy Program in Indonesia and assistance to local systems through community development programs in India and Nepal. These programs reflect a division of labor between agency and users in which the agency is playing a supporting role to the local groups (somewhat like the case just discussed though usually with more emphasis on supplying finances and materials and less on technical backstopping). The indirect investment approach, because it channels resources through the local group and permits them to stay in control of their affairs, also encourages the continued mobilization of local resources by the users---usually matching, or surpassing, the resources provided by government. For example, in a recent field study in a region in Indonesia it was found that the local irrigation group had combined the resources received from the Village Subsidy Program with an amount triple in size collected among themselves to implement improvements to their small system.

In short, the indirect investment strategy is a fourth approach for achieving the mix of agency and user involvement that we have been discussing.

5. The Turnover Strategy

A fifth novel approach to redefining the agency-user mix is one with which there is less in-depth experience---nonetheless it has sufficient merit to note here. We have called it the turnover strategy---an approach in which the irrigation agency takes small commands (or sometimes segments of large commands) for which it has had lead responsibility and relinquishes that lead responsibility to the users of the systems---one might say, transforms the system from agency-managed to farmer-managed. In experimental programs, as in Indonesia, for example, a policy has been announced by the government to turn over all agency-managed systems with commands of 150 hectares or less. The irrigation department, collaborating with various other groups, is now in the process of working out the program details for implementing this principle.When accomplished, there will be a fundamental alteration in the mix of government and user rights and responsibilities in these small commands. Users will be responsible for routine operation and maintenance activities while the irrigation agency will provide technical and financial backstopping and deal with various multi-system problems such as river course management and regulation.

Another example of this turnover approach is the Bangladesh experience with the privatization of small, tubewell systems. In the initial period of rapid tubewell expansion in Bangladesh the government took a leading role in creating these systems. However, in more recent years, under the label of privatization, there has been a reduction in the state's role and an increase in the responsibility of the local users for routine operation and maintenance functions.

This brief review has examined five approaches to small-scale irrigation development that exhibit innovative arrangements for combining agency and user activities. Some of the approaches may be most appropriate if one is dealing with existing commands---the augmentation approach or the turnover strategy. The other three would be applicable with new commands or with both situations.

One or more of them might be suggestive for the situation with which you are working---or none of them might seem feasible. No matter---they are not presented as programs to be replicated. But note that one attractive feature of all of these strategies is that they assign to the agency and to users, respectively, responsibility for tasks which that group is best positioned to perform. Our purpose in introducing them to the discussion is merely to demonstrate the variety of ways that the issue of mix can be handled and to encourage the reader to think creatively as to how it might be accomplished in other settings.

Technology in Support of the Mix

As suggested in our discussion of the sociotechnical perspective---technology and social organization go together. In this chapter we have been focusing on one key issue of social organization---the right mix of agency and user rights and responsibilities. Our view is that too many past policies and programs have been built on a mix in which agency actions dominate over those of the users. In many cases the technical interventions of the government have reinforced this agency dominated mix. Facilities have been installed or operational rules initiated that are pro-agency---requiring, and required by, government involvement.

The point to be restated is that getting the correct organizational mix requires policies and programs that also foster the design and installation, whenever possible, of what we previously called, locally-manageable technology. That is, facilities and rules amenable to routine operation and maintenance by local people. Because of the fundamental importance of this issue we devote fuller discussion to technical design in Chapter Four.

Water User Organizations As Part of the Mix

Our proposed strategy of local rights and responsibilities for routine operation and maintenance requires an effective local management group. Many programs are counting on so-called water user organizations to perform these tasks---though the agency record for establishing such groups is quite poor. What can be suggested about this matter? We raise three points for consideration.

Especially when working in the context of existing irrigation commands local irrigation groups may already exist---though in a form invisible to outsiders. They may not be formal groups, not be registered with the government, and not have legal rights and responsibilities. But, they might be reasonably effective in operating and maintaining their small commands---often based on complex water distribution practices and locally supported field staff who perform well. Over the past twenty years such groups have been "discovered" in various regions of the world. Agencies have to systematically look for these local groups. If they exist they should be considered as important resources and attempts

made to work with their practices and staff, to strengthen them, if necessary, rather than replacing them with some "modern" organization.

A second and related point is that we have discovered that in some locations it is not a user's group, as such, that has responsibility for local irrigation operations but a unit of local government---perhaps the village headman and an assistant that he appoints or who is selected by the users. Again, if this is the existing arrangement, consideration should be given to using this institutional pattern rather than imposing some standard water user organization---local arrangements should be given preference over outside models.

But the third point is that not all existing local groups will be effective and suitable for assuming responsibility for the facilities in which government or the users have invested. Some may be active but so coercive and exploitive of the weaker members of the irrigation group as to be unacceptable to a progressive government. Sometimes local groups will have been weakened by factors such as growing social hetergeneity, declining traditional authority or changes in available manpower. In still other cases local groups will simply not exist. In these cases the agency will have to take some affirmative steps to create effective local groups---assisting existing groups to reform, bolstering groups that have become ineffective or helping new groups organize. We understand that need and merely wish to emphasize that this should be done only after careful reconnaissance indicates there is an inadequacy. And, moreover, if the agency decides to act on this matter it has to do so with seriousness of approach and commitment---commitment of budget, staff and time. Organizational development is no simple task that can be

assigned to just anyone or merely added to the responsibilities of the agency's ditchtender or the agricultural extension worker. Agencies have demonstrated that they can help develop effective water user organizations. But, those who have done so have accomplished this by committing resources to staff specifically trained and exclusively assigned these tasks (as with the community organizers discussed above) and by carefully reviewing their own procedures to eliminate any that might actually impede the development of effective local groups. It cannot be a part-time, secondary activity assigned to regular field staff.

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In summary, the irrigation agency and the users can both make important contributions to small-scale irrigation development. Their strengths can be complementary. Agencies usually have limited staff and budget to carry out their assignments, so it is necessary that they direct those resources to essential tasks that otherwise would not be accomplished. They need to avoid using these resources for activities that can be handled by the users themselves.

The prevalence of farmer-managed systems is indicative of the capacity that many user groups have to mobilize the resources needed for routine operation and maintenance of small commands. Regrettably it is not uncommon for local resource contributions to decline after government involvement. We believe that this often occurs because the policy and related program operations, consciously or otherwise, are designed to give prominence to agency responsibilities not only for

project planning and infrastructure design but also for routine operation and management of these small commands.

But alternative policies and programs are possible---and desirable. This chapter has explored what those new approaches should be and how they could be implemented. In the next chapter we turn our attention to the key activity of system design---an activity for which the irrigation agency usually has lead responsibility but in which users need to be involved, as well. The task of designing the irrigation facilities and technical rules for operating them is a fundamental one that can greatly influence success in achieving the correct blends of technology and social organization and agency and users that we have discussed thus far.

Chapter Four

DESIGNING WITH A SOCIOTECHNICAL PERSPECTIVE

Much of the success or failure of small scale irrigation development depends on getting the technical design process right---selecting the right structures to capture the water supply, proposing an effective means to convey water to the agricultural area, or formulating appropriate technical rules for rotating the water supply, for example. If this does not occur, irrigation development will not have been achieved. To reach this end, the irrigation agency needs an effective technical design process---a coherent set of actions by which a final plan for building a new facility or improving an existing one is produced---a plan for placing specific hardware components in definite locations and the accompanying technical rules for operating that hardware.

From our perspective, a good design process is one that both uses and supports the sociotechnical perspective and produces, in a timely fashion, sustainable solutions to small scale irrigation problems. That is, good designing should result in physical facilities that support an effective agency-user mix of rights and responsibilities---yielding locally-manageable technology whenever possible and agency-essential technology when the situation requires such.

But the reality of current activities to design small systems is that they are very much technical, not sociotechnical, exercises dealing nearly exclusively with various technical components that we identified in Chapter Two---the built facilities, the natural resources and the crops.

We argue this way even though we recognize that the conventional design process frequently is influenced by political decisions such as the priority locations for the agency's work. We also recognize that the current design processes are acted on by the requirement of many funders to report the results of conventional economic analyses as part of the plan.

It is because of the present state of designing in irrigation agencies that we tackle a central question about design procedures in this chapter---how can a process for designing small-scale irrigation systems that incorporates a sociotechnical perspective be put in practice?

Before delving into that question let's just briefly reassure ourselves that alternatives to the present conventional approach may be possible. To animate our later discussion consider the experience mentioned in the previous chapter---the KKU program of assistance to village groups building small irrigation facilities. It is a strong example of what can be achieved when the designing process is taken to the field and an intense effort is made to involve the users in the design process with backstopping by a well-trained technical staff working in a flexible mode. The KKU experience suggests to us that it is possible to design in a sociotechnical manner, and prompts us to look for ways to go beyond the conventional design procedures now used by irrigation agencies.

The Need for a New Approach

A frequent criticism of the technical designs that agencies have produced for small systems is that they failed to "fit" the local situation. The facilities didn't work as intended, they quickly fell into disrepair or

they proved costly to operate and maintain. A typical outcome was that farmers did not make use of structures that were installed or significantly altered them---placing variable gates in fixed positions, creating turnouts in new locations or modifying the rules of water turns. When assisting existing systems a common disappointment has been that agency projected expansions in area served have not been achieved. Poor fit has meant facilities, layouts and technical rules that were inappropriate for the physical setting. In addition, designs often have been ineffective because of their unsuitability for operation and maintenance by either the agency or the local group. In our terms, agency design procedures now too frequently result in agency-essential technology when locally-manageable facilities would be better.

The above are common consequences of the conventional planning processes used by most irrigation agencies---processes that give primary attention to technical components such as the water resource, topography, soil characteristics and crop water requirements. These are all components that we agree are necessary for effective designing, but they are not sufficient to do the job.

Before we turn our attention directly to the sociotechnical perspective there is another observation to be made about the present design process. While it emphasizes physical items and technical decisions the actual process often is a mere pretense. Too often, designing as practiced is a caricature of sound technical decision-making because the data available to the designers is of dubious quality and the handling of that data is pro forma---incomplete information on the water source, lack of field-based observations, and speculative information

about cropping patterns to name a few. So, part of the solution to improving design will include better procedures for supplementing or otherwise treating the limited technical data that will be available. In fact, some of this can be achieved through more systematic exchange between the technical design staff and the users. We will return to this point.

In short, there is a strong need for a new approach to designing the facilities and technical rules needed for small irrigation works. The current processes have two weaknesses: 1) they allege to be technical processes but often are mere imitations of such and 2) they certainly are not sociotechnical in character---generally no such claims are heard. But this double weakness can be seen as two sides of the same coin and a single solution is proposed. We suggest that planning a design process with a sociotechnical perspective will also positively effect the quality of the technical components of the design activity.

The Sociotechnical Design Process

As we see it, putting in place design procedures with a sociotechnical perspective involves attention to five elements.

1. Policy-oriented design procedures: Unchecked, there can be a tendency for the design process to take on a narrow focus---crafting a technologically elegant layout with as sophisticated structures as the budget will allow. We think the best way to curb this is to set a clear policy objective to which the designers will contribute. As we have discussed earlier, we believe that programs of small-scale irrigation ought

to rest on the principle of high user involvement in everyday activities of the small commands complemented by essential agency assistance---favoring what we have called locally-manageable technology over agency-essential technology. If this is a key government policy objective then it should become the underlying purpose of the design process and the motto of the design staff.

2. Field-oriented design procedures: There need to be procedures and resources that permit the design staff to be in touch with the physical realities of the project location for which they are designing---to travel to these locations and walk through them observing surface water sources, drainage patterns, topography and so on. While we recognize that this can be costly and time-consuming because of the scattered, and sometimes remote, locations of the systems, nonetheless we urge that such field reconnaissance is essential. Designers should not be expected to be desk-bound, relying solely on the quantitative information and maps provided to them by others.

3. User-oriented design procedures: Similarly, procedures and resources are needed to insure that the design staff are in contact with the users, or potential users. Particularly in locations where irrigation is already being practiced, the design staff need to both learn about and learn from these irrigators. They need to know about how irrigation activities are now arranged----what organizations exist? What rules are in place for water distribution? How are the existing facilities used and maintained? And, they need to learn from the farmers gaining

information for use in designing the structures and layout of the system: information about the nature of the water resource, the lands to be irrigated, the current operational problems and so on. At later stages in the process, when preliminary design choices have been made, the design staff needs further contact with the users to gain their comments and suggestions regarding the emerging system design.

4. Holistic design procedures: Being in contact with the field situation and with the water users and having a clear policy objective are all essential conditions but they will have their best impact if the information gained is utilized in an holistic manner---fitting technology and social organization together. The two points we discussed earlier regarding the fit of technology and social organization should be utilized. (1) the two sets of components are interactive---choosing a particular structure has implications for the organizational arrangements needed to operate and maintain that structure. And (2) the two sets of components have limited substitutability---there are limits on the extent to which you can replace organizational arrangements with technical devices or do the opposite. This means asking simple, but fundamental, questions while "designing." Whenever the designer proposes a particular structure, say a division box, for a particular location and purpose, there is need to consider such questions as: Is that purpose likely to be shared by the users? What actions will be required to operate that structure and who will do this? What rules will need to be in place to organize these actions? Are those rules different from what now exists?

5. Learning-oriented design procedures: Designing small-scale systems no doubt is both an art and a science---in either case the process will be improved if the design staff have an opportunity to learn from their previous actions. The simplest way to accomplish that is to be sure that procedures and resources are in place that encourage the design staff and their supervisors to spend time in the field with systems that they previously designed---observing their operation and maintenance, discussing with farmers and agency staff the good and the bad, and examining the modifications that may have been made in the design with a view to understanding why these changes were desired. In this way incremental improvements can be incorporated in the design process and any past mistakes avoided.

In short, the sociotechnical design process is more field-oriented and less desk-bound than the conventional ones---it shifts our image of the designer from someone sitting at the drafting table to someone in intense conversation with a small group of farmers under a tree. The new approach puts the design staff in contact with the physical location of the project and with the present, or future, users of the systems---both in the very early steps of the design process as well as after construction has been completed and operations are underway so that something can be learned from these completed actions. And, this field-driven process is given direction and coherence by two over-arching concerns. One, a focus on contributing to the clear policy objectives regarding the desired agency-user mix of rights and responsibilities. And, two, the use of procedures to combine, rather than isolate, the

technical and social organizational components when design choices are being made.

Related Issues in Sociotechnical Designing

Most agencies do not design in a sociotechnical manner---their design procedures do not incorporate the five essential features that we discussed above. We need to ask why this is the case and what can be done to change this situation? Just to be clear about how large the difference can be between our suggested sociotechnical approach and a real situation, consider this example from South Asia. In this particular project, field staff who are in contact with the project location, and to some extent the farmers, produce a preliminary design. But this field design is reviewed and usually modified by a central design staff who do not go to the field either before or after the project. Moreover, their work is not systematically sensitive to the issue of locally-manageable technology and there are no procedures in place to review technological choices to examine their organizational implications. In too many cases the results have been structures and layouts that are very costly and ineffective.

No doubt, there are numerous reasons for this state of affairs---including the absence of clear alternatives. But among the most important causes we believe are the following: (1) lack of a clear policy about the end objectives and the implications of those objectives for choice of technology, (2) staff with limited experience and training relevant to designing small works, and (3) a continued dependence on

information-intensive technical procedures adopted from the design of large-scale irrigation works.

Policy Direction. The undesirable impact that the absence of a clear overall policy can have on design activities has been discussed previously and need not be repeated here. Let's just be clear that there have been numerous in which the skills of competent design staff has been misdirected because the design work has not been sharply focused on solving critical problems or on creating irrigation facilities with a high possibility of local management.

Design Staff Expertise. Putting in place the procedures and resources to allow agency designing activities to have the five characteristics we have discussed above will go a long way toward establishing designing with a sociotechnical perspective. But there are some important complementary actions to be taken and our attention will now turn to those.

The level of experience and expertise of the design staff working with small-scale irrigation systems can be a major limitation. Sometimes this is the case because the agency working on this topic is new and its staff may be inexperienced. At other times, small-scale work is being implemented by a large well-established irrigation agency but the work with small-systems may be assigned to junior staff because it is seen as less challenging and less central to the agency's mission than involvement with large civil works. And remember, this design staff is sometimes contained within the irrigation agency but sometimes located within

private firms who contract with the state to provide design services. For purposes of this discussion we will assume that the agency has available to it staff with basic engineering skills (if this is not the case then some steps prior to those we are discussing here will need to be taken). But we also think it plausible to assume that this staff has limited experience with designing small works---either because they are young engineers with little practical experience, or if they are experienced, their work has most likely been with large civil works. We think this is the situation from which most government programs of small-scale irrigation development will begin. The challenge is how to provide a setting for design activities that will allow this design staff to more sharply hone their skills for designing appropriate small-scale facilities.

Additional technical training may be an essential element in this upgrading process---for example, suppose that water lifting will be an important technology in the small systems. The design staff may need additional training on various technical problems such as pump selection, lift design and so on. But technical training should not be seen as the single solution to poor design outcomes---it is a necessary but not sufficient answer. Well trained design staff, or better trained staff, will be an asset to the agency if they are provided a larger sociotechnical context in which to carry out their design activities.

Not infrequently, the solution that agencies have used to deal with the dilemma of too few well trained design staff has been to centralize the design function---to concentrate design decisions in the hands of a small headquarters staff composed of individuals with strong technical

skills. The limitation of this approach is that centralization too often becomes synonymous with isolation---the designers are neither in touch with the actual field conditions and users at the time of initial planning nor do they get feedback on the results of their designs after the systems have been built and are operating. They operate in a kind of cocoon in which blueprints become reality, designed commands become irrigated fields. We believe that central design teams with technical expertise that may be superior to that of the agency's field staff can make an important contribution---though as usual, we think this is likely to be the case only if other conditions also are met. The most important of these is avoiding isolation of the expert group---assuring that they are in close contact with the physical conditions of the locations as well as with the agency's field staff and the irrigators. Of course, complementary to this strategy will be that of continuing to upgrade the design expertise of field staff so that more design work can be done at that level and only the more complex and sophisticated problems passed to the central team.

Information-Intensive Approaches. An additional group of design problems arise because of the difficulty of attempting to use information-intensive design procedures in a situation where such information typically is unavailable. The collection and analysis of proper design information has been one bane of effective engineering design for small-scale irrigation projects. The basic assumption of the standard design approach is that appropriate designs are possible to create if only one

has access to the "right" information---which often assumes some type of time-series data---and the correct methods of analysis are used.

However, this seldom is the case and the information problem is complicated, in part, by the patchy nature of the small systems---having to lay out technical facilities in small and scattered locations whose physical and socioeconomic conditions may be highly diverse and for which little formal data exists. Many routine design procedures assume the designer has available in-depth information such as historical data on streamflow. But, typically, historical hydrologic data are not available in the locations where small systems are being designed and there is insufficient time available for collecting such data. Therefore, approximations and assumptions must be made in order to use standard methods for calculations---which can be a risky approach. There are several steps that can be taken to deal with this problem.

Field engineers have often tapped the knowledge of local people to gain a better understanding of local conditions. Design staff can make such procedures a more regular part of their data collection procedures and develop systematic methods for obtaining information regarding stream flow patterns, extreme events such as flooding, rainfall regimes, and other such information from knowledgeable local informants.

Under conditions of insufficient data the design staff also can choose to concentrate on structural improvements that are essential to good system performance but less sensitive to inadequate data. For example, in improving a small diversion system it may be that there is need both to improve the diversion structure and also construct a gate at the headworks to protect the canal network in the time of floods.

Now, it may be difficult to design an appropriate diversion structure because of poor data on stream flow. However, construction of the gate may be possible based on the data available, or information that could easily be collected. In this situation the choice could be to design the headworks gate and begin collecting stream flow data with a view to design and construction of an appropriate diversion structure at some later time. The principle of this incremental approach is: focus improvements on those structures for which either data is available, or which are relatively insensitive to inadequate data, while beginning to collect needed information for future structural design.

A related issue that often arises has to do with the use of standardized structural components and rules of thumb for use by design staff. For example, some programs have attempted to provide designers with "catalogs" that contain a number of pre-designed and pre-tested designs for small structures---presented perhaps in a few pre-selected sizes. With such an information resource the design staff can select from this menu the structure that best fits the particular field situation with which they are dealing. Such an approach has long been used by the Soil Conservation Service of the U.S. Department of Agriculture. Again, we believe that such a resource could be very valuable when used in the proper context---the context that would be established by a sociotechnical design process as discussed above. If the "catalog" is used in the field setting the designer will have a better opportunity to evaluate fit between the actual physical situation and the structure depicted in the catalog. Likewise, if farmers are given opportunity to comment on the alternatives identified in the catalog, choices may be

enhanced, and so on. And last, but not least, if the design process has a learning orientation there will be the opportunity to modify the "catalog" over time based on what has and has not worked in practice. In brief, the use of standardized components can make an important contribution to small system design if they are utilized in a sociotechnical context.

Our conclusion is this: a number of different approaches and tools can be used to significantly improve agency design activities---staff can be better trained, expert staff can be deployed in centralized teams, strategies to deal with information-intensive design methods can be arranged, and standard structural components can be developed as aids for staff. But none of these is likely to be have full effect unless used in a sociotechnical context that keeps the design staff in close contact with the field and encourages them to learn from their past actions.

Farmers and the Design Process

Farmers are not trained engineers and they should neither be expected, or encouraged, to assume lead responsibility for overall technical design decisions. But---they can be effective collaborators with agency staff in the design process. This is the case both because they can contribute essential information on the logic of their household enterprises---making clear where irrigated farming fits in their strategy for household maintenance and income generation---as well as useful technical information on matters such as soils, topography, water flows and so on. To say it differently, because effective designing is not just a technical procedure nontechnical people can contribute. Farmers can

help designers avoid important mistakes because of their intimate familiarity with the micro-environment. They can assist in the selection of alternative layouts, take-off points, water control structures, rules of water distribution, at least.

Farmers can also participate in the design process by taking more complete responsibility for designing certain portions of the layout; for example, the location of field channels below the main network to serve sets of individual fields. Such work can be especially time-consuming for the design staff because of the detailed field information that is required and the frequent need to negotiate rights of way. Farmers, with some technical backstopping from the agency, can be encouraged to take the lead in designing (and constructing) this portion of the system. This approach builds on the principle that the agency should focus on the design tasks that farmers cannot do themselves while leaving to farmers primary responsibility for those design activities that they can handle.

But for there to be effective farmer participation in designing two conditions are needed. Farmers have to be organized so that they can present their case in an articulate manner. This means that they have to prepare themselves for communicating with the design staff---carefully identifying their objectives, concerns and recommendations. For example, a few years ago in Indonesia a pilot program developed strategies for increased farmer involvement in a tertiary development program---a program to improve the physical facilities of large state systems at the lowest levels in the hydraulic network. One important step in this process was the work of community organizers to assist the group of farmers in a particular tertiary prepare for their consultation with the

tertiary design team. As part of this preparation the tertiary group first drew a map of their tertiary area indicating the location of all the temporary and permanent canals and other water control structures. They then used this map to identify those locations where they experienced particular problems and needed state assistance. Thus, when the design team arrived at a tertiary location the cultivators were ready to present their case in terms with which the agency could deal. But the other side of the coin is that the agency's design team has to be prepared to receive such information and utilize it in making design choices. For this to happen there needs to be both an attitude on the part of the designers such that they value this farmer information and input and agency procedures that allow the staff to do so---for example, procedures that permit design staff to be in contact with farmers, rules that allow designers to modify standard layouts when feasible alternatives are suggested by farmers and so on.

There are several techniques that can be used to implement this exchange of information between design staff and farmers. For example, frequent village meetings between the design staff and farmer representatives can be effective mechanisms. A technique developed in the Philippines for use when improving existing systems is called the "walk-through"---an event in which the design staff and farmers together walk through the system jointly observing present conditions and discussing what changes are proposed to be made where. When the walk-through occurs early in the design process it provides an opportunity for farmers to carefully describe the problems they are facing and for the design staff to visualize the context for which a

solution needs to be developed. After an initial design has been prepared the walk-through serves the dual purpose of assisting the farmers to better visualize what the design staff is proposing and for the design staff to see the actual context in which their new structure (or whatever) will be located.

But let's be clear---this discussion is not meant to imply that farmers are always right and that everything they request should be granted---farmers can request quite extravagant work to be done, especially if they have no obligation to cover any of the costs---but it does imply that the design process needs to be opened to farmer input. It also suggests that the agency and its design staff need to recognize that while the process of designing usually is presented by the agency staff as a set of "technical" decisions it also is a process that incorporates many personal and professional preferences. Seen in this way, there is further reason to organize the process in a manner that allows effective expression of farmer preferences as part of designing. The end result may be more of a negotiated design rather than a technically-imposed one.

Designing Improvements in Existing Systems

As we have noted previously, a surprizing number of small-scale irrigation development programs include the rehabilitation, or modernization of existing small works---facilities that may be either state-managed or locally operated. In Chapter Two we discussed using the sociotechnical approach in existing commands, emphasizing that the most significant point about these locations is that both technology and social

organization for irrigation are already in place. Now, let's examine the implications that this has specifically for design activities in these situations.

The first step will be determining what problems are affecting the performance of the irrigation system and what opportunities exist for its improvement. This reconnaissance activity should be a joint one---involving both the design team and local irrigation leaders. Ideally, the irrigation group should be contacted prior to the first meeting with the design team to allow them to hold discussions among themselves and come to some agreement about the most pressing problems they have and/or the significant changes they would like to see occur in their system. A key event that should occur early in this initial period is a "walk-through" along the lines discussed earlier in this chapter.

One of the challenges of designing in this context is for the design team to understand and value what is already in place---both the built facilities and the organizational arrangements. There is an almost predictable tendency for the designers to observe the simple facilities that may exist---the brush dam, the crude proportioning weir or the indigenous tank sluice---and immediately imagine its replacement with a more sophisticated structure, e.g. replacing the proportioning weir with a structure with variable gates. Focusing on what really needs to be improved, what genuinely would make a difference in system performance, and what actually would be sustainable changes is the real problem. It is easy to see simple structures and imagine their "modern" replacements but it is far more difficult to understand the local situation well enough to be certain that the replacement is also an improvement and that the

replacement can be operated and maintained over time. Again, these comments are not meant to suggest that all existing systems are without problems or offer little opportunity for improvement. But, they do suggest that the opposite assumption by the agency is a weak one. What is needed is a more open approach to reconnaissance in which we ask about an existing system: are there problems (or opportunities) and , if so, what are they? Moreover, the definition of the problems and opportunities needs to be done in close collaboration with the current users. Without this, it is highly likely that the design process will put in place facilities that either do not work as needed or which are simply not used.

Among the most important points to consider when working with existing commands is that the design process requires a heavy upfront investment toward learning what is already in place and how it works. This means taking time to carefully map facilities that are used by the irrigators to acquire water, distribute and control it and so on (remember that depending upon the time that the reconnaissance is done some temporary structures may or may not be in evidence). In addition, it requires taking time to understand the irrigation organization that may exist and the various functions that it performs---including fundamental tasks such as distributing water, maintaining and repairing facilities and so on. These are not easy tasks because they are labor-intensive and because they may require investigatory skills outside the capacity of the design team. Thus, in addition to the assistance that the designers will need from the farmers themselves they may also require help from persons such as the community organizers that we discussed earlier (see

Chapter Three). Several good guides for use by agency staff for gathering preliminary technical and social information about existing commands are available and can be used by the design team.

As the design process proceeds, the local irrigators need to be involved in discussing alternative layouts, structures and other elements of the emerging design. There is special need for the users to be made aware of and understand elements of the proposed plan that will impact on the irrigation organization---creating new maintenance tasks, changing procedures of water distribution or whatever. They need to understand and agree (or disagree) that these changes are both acceptable to them and capable of implementation by them. Finally, farmers have an important part to play, along with the design team, in later evaluating the changes that have been made in the system. Getting farmer feedback on how the new structures operate, what modifications in them might be considered and so on will be a valuable part of the learning orientation that we discussed earlier---allowing the design staff to further develop their expertise for design improvements in subsequent existing systems.

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For most technical staff designing is at the heart of irrigation development---small- or large-scale. We agree on the essential importance of the design process and see it as a crucial component in improving public policies and programs for the development of small-scale irrigation. The design process both influences, and is influenced by, the larger sociotechnical perspective with which we are concerned. It will not be possible to achieve the overall goal of focusing scarce agency

resources on backstopping tasks essential to small-scale irrigation development while creating a positive environment for water users to assume a large portion of the total set of routine operational and maintenance rights and responsibilities unless design procedures follow a sociotechnical perspective. That perspective means a set of design procedures that gives attention to policy objectives, is field- and user-oriented, considers the interactions between technical and social components, and continues to learn from past actions. In short, getting design staff into the field and in communication with irrigators, along with other actions discussed in this chapter, will contribute a great deal to improving design outcomes.

Chapter Five

FINANCING SMALL-SCALE IRRIGATION DEVELOPMENT

Introduction

Small-scale irrigation development always involves commitments of cash and other resources, such as labor. Who should pay for what in small-scale development is not always obvious, however. In this chapter we discuss a number of issues related to financing development and routine operation and maintenance (O&M) in the framework that we have used in earlier chapters. The essential starting point is the same as that laid out previously---in small-scale irrigation development, routine operation and maintenance is a local function. The role of agencies is to provide support for activities that are usually beyond local resources, such as initial construction, modernization and improvement of existing facilities, and extraordinary repairs. This scenario assumes that users will cover the costs of routine O&M. Thus an important requirement in proper small-scale irrigation development is that facilities be provided whose operation and maintenance costs can be covered by local people.

Programs, and the agencies that implement them, face three important policy questions when decisions are made about financing small-scale irrigation development. The first is deciding when small irrigation development is worthwhile. When should agencies commit public funds to small-scale irrigation development. When should they not? This question applied to technology choice was briefly addressed in the last chapter. Here we would like to consider it in more detail. The answer determines

whether public resources will be available at all for improving local systems.

Assuming that agencies decide to commit their resources to a program or project, then a second policy question must be answered: who should pay the initial construction/improvement/repair costs that small-scale irrigation development entails? If an agency uses public funds, how much of the cost should be recovered from farmers? Cost recovery is very much a political question intimately linked to overall government policies. With the resource scarce context in which most governments are operating today, it has special significance. We argue in this chapter that the proper mix of agency and user financial resources usually requires that both contribute to initial development costs. We also suggest that who controls the use of resources in small-scale development is just as important as who supplies them.

The final policy question is simply this: if agencies do provide resources for initial construction and improvement, how should these funds be channeled into the development process? Are there funding mechanisms that encourage or inhibit appropriate small-scale irrigation development? A variety of ways for channeling funds into small-scale irrigation development have been successfully tried by various programs in various countries. The last part of this chapter discusses some of these, focusing on how each achieves a proper mix between agency and local funds, and how the question of resource control is resolved.

When is Small-Scale Irrigation Development Worthwhile?

Public agencies have become involved with small-scale irrigation development for a large number of reasons. The list of stated objectives that donors and governments have had when they start small-scale irrigation programs is long and varied. There is one requirement, however, that most donors insist upon before committing resources to small-scale irrigation development: the program must provide sufficient economic returns. In most cases this means that the program will result in an internal rate of return (IRR) of at least 12 percent. At times, as in the case of a USAID project in Himachal Pradesh, this criteria is even applied to individual projects.

Sufficient economic returns means that total economic benefits must exceed economic costs by a sufficiently large margin. Unfortunately, accurately calculating economic rates of return is a difficult and time-consuming task under any circumstances. In the case of small-scale irrigation projects it is particularly problematic. Assigning values to inputs and outputs is difficult, since in many cases products and inputs are outside the formal market sector (i.e., crop production is consumed within the home, and much of the labor has the family as its source). Add to this the scanty base line information that exists for most areas where small systems are located, and the number of small projects that may be incorporated in one program, and the results are extremely complex IRR exercises.

Internal rates of return ideally tell an agency whether a particular project or program is worthwhile, and help the agency to choose between competing projects. In small-scale irrigation development, IRR values are

seldom meaningful for the reasons discussed above, especially in the case of individual projects. In fact, one must recognize that when an agency chooses a project, the choice may be based as much on political considerations as it is on some objective measure of project value, or the probability of project success. When IRRs are the only formal selection criteria, agencies will be tempted to make assumptions about unavailable data, such as expected changes in cropping patterns or yields, so that the desired IRRs are obtained. Economic analyses such as calculating internal rates of return are essential because they force donors and agencies alike to at least try to quantify potential program impacts. However, as a method for selecting a given project or determining its chances of success in the long run, such economic analyses have little practical value.

Previous chapters have already suggested a second "absolute" criteria for selecting projects that complements economic analyses. Projects should only be chosen if they are financially feasible in the sense that farmers can pay for routine O&M costs. This type of financial feasibility is relatively easy for agencies to determine, compared to standard benefit/cost analyses. The cash costs necessary for operating a given technology are usually simple to calculate. For instance, the yearly fuel costs of a pump system are a direct function of the cost of fuel and the expected amount of use. Often times, yearly maintenance costs can be estimated based on the experiences of neighboring systems that use similar technologies. Once an agency has estimated expected yearly O&M costs, farmers themselves can usually answer the question of whether they are capable of supporting those costs.

In addition to these two "absolute" requirements for project selection---economic viability and financial sustainability---there are other guidelines for project selection that various programs have used before committing public resources to small-scale irrigation development. A few of the more important ones are listed below. Established, clear-cut selection criteria limit the political leverage that special interest groups can use for initiating "poor" projects---projects doomed to failure.

1) Can users repay part of the initial investment expenses?

Small-scale projects often do not provide enough returns for users to repay all of the initial construction, improvement, and/or repair costs of their systems, especially when production focuses on the users' subsistence needs. In some counties, subsidizing food production may be such a priority that the amount of public funds invested in expanding irrigation are far beyond the repayment ability of beneficiaries. In large-scale systems, for instance, farmers rarely contribute to initial system costs. But, as we will argue later in this chapter, there are several benefits that result when farmers cover at least some of the initial investment expenses required for small-scale irrigation development.

The level of repayment required is a policy decision that an agency must make. It will depend in part on the capital resources available to local users, and in part on the expected use of the irrigated produce---whether it is for home consumption or market sale. In fact, there are examples of successful programs that require full repayment of initial investment costs from poor populations. One such example is the Grameen

Bank's loan program in Bangladesh. Another is the National Irrigation Administration's participatory small-scale program in the Philippines. A third is the USAID-funded village irrigation project in Guatemala. In all three cases, farmers ultimately confirm their ability to repay by agreeing to repayment terms established by the agency involved.

2) Does the initial installation cost fall within some predetermined value?

In many cases, the number of prospective interventions can be limited by crude cost estimates. The underlying principle is that it is much easier to determine costs, especially those occurring initially, than it is to estimate potential benefits. If the construction of one project will cost ten times as much as a second, then one might guess that the first would never be as economically as attractive as the second, even without estimates of benefits. A criteria that is currently used in a USAID-supported project in Himachal Pradesh places a ceiling on the cost per hectare of any prospective project. This, of course, depends on the number of hectares an agency expects to be served, a number that historically has been grossly overestimated.

Firm ceilings on total investment costs are a stricter condition on project acceptability. Programs that disburse public funds as loans to beneficiaries usually incorporate such a ceiling implicitly by limiting the size of available loans. This type of selection criteria is less common in programs that directly channel public funds through agencies into small-scale irrigation. An agency that has a fixed amount to spend in a fixed time period is under tremendous pressure to move money---one result of

this pressure are capital-intensive projects that would never satisfy ceilings on total investment costs per project.

3) Did the request for help come from the potential beneficiaries?

If past agency interventions in small-scale irrigation were successful from a farmer's perspective, then one would expect that an agency would not have to be the prime motivator for additional interventions. When a program is in its infancy, before farmers have gained confidence in its results, the agency will have to seek out intervention opportunities. However, there should come a point when the initial task of an agency is not "drumming up business," but instead selecting the most promising opportunities from many farmer requests. This should even be true when the agency is primarily involved with the development of new command areas, not just when it is improving existing systems.

The USAID-funded village irrigation project in Guatemala provides a good example. At the start of the program, agency staff had a difficult time persuading farmers, who were suspicious of every government program, that gravity-fed sprinkler irrigation had great potential for improving their lives. But once one village was persuaded to try, and the installed system was a visible success, the agency had no lack of requests for assistance from neighboring villages.

If an agency becomes involved with a system without users requesting or at least affirming the project, then the appropriateness of that intervention must be suspect. Even if the agency is satisfying some fundamental government or donor objective, without farmer confidence

and cooperation the intervention will likely fail in the long run. Basing project selection of farmer requests guarantees the cooperation of the beneficiaries. Of course, this is not an infallible test---if an agency lavishes enough public resources on individual projects, then farmers will respond with requests for help.

4) Does the socio-physical situation fit the agency's technical/ organizational expertise?

The number of potential projects can be reduced if an agency limits its attention to situations that fit its technical and organizational abilities. Most agencies involved with small-scale irrigation development have at most a few technologies they know best. Agencies are seldom experts in all forms of small-scale irrigation technologies. For example, an agency might understand weirs, but have no experience in pumps. Or, it may understand low-lift pumps used in conjunction with surface sources, but have no experience in locating and sinking tubewells. Or, it may be adept at developing groundwater sources, but inept when it comes to tank construction.

While there are examples of agencies becoming involved with technologies that they do not understand, a much more common problem is when agencies apply their favorite technical solutions to situations where they are clearly inappropriate or financially not viable. The same holds for organizational abilities. An agency may have a physical situation that suits its technical strengths and yet not have the skills to organize effective farmer organizations to run and maintain the technologies once the agency has pulled out. This is more worrisome

when new command areas are being developed than when strong irrigation organizations already exist.

Who Should Pay the INitial Costs of Small-Scale Irrigation Development?

Farmers rarely have enough capital free to pay for small-scale irrigation development by themselves without some kind of external financial help. This is especially true when the initial costs of hardware construction are included. For small-scale irrigation development to take place, at least some resources will have to come from public or private agencies, particularly when development programs target poor or landless populations. Assuming that public agencies will have to help finance small-scale irrigation, how much of this expense should farmers repay? The amount farmers must repay is primarily a political question. We will argue later in this section that it is important for farmers to bear at least part of the cost. In fact, as the Grameen Bank's loan program in Bangladesh illustrates, even the poor are capable of some repayment. On the other hand, there are very few projects where total cost recovery from farmers is expected. Even when a program requires farmers to eventually repay the public funds used for system development, interest rates are usually so low and repayment periods so long that small-scale irrigation development is still substantially subsidized.

Public funds are necessary for small-scale irrigation development to proceed. Given this fact, is there any other reason for an agency to commit monetary resources to the small-scale irrigation development process? At this point, a distinction must be made between supplying and controlling resources. An agency can supply resources without

controlling the way in which they are used. But, an agency will have little control over resources it does not supply. Maintaining control over the way small-scale irrigation development proceeds is a second important reason for agencies to supply resources. The amount of control an agency has depends on the type of channel it chooses for funneling public resources in small-scale irrigation development.

There are valid reasons why an agency might want to maintain control over resource flows. Number one is accountability. When funds originate from donor groups, there are usually stringent accounting requirements for the way money is spent. Number two is the need to ensure that government and donor objectives are met. An example is the common objective of equitable development. By using funding as leverage, an agency can force local user groups to include segments of the population that would otherwise by bypassed. An agency might make funds available to only a specific portion of the population. Development programs in Bangladesh have used this form of funding to target disadvantaged groups.

A third reason is the need to ensure that hardware design standards are satisfied. If hardware components within a project fail, the agency will most likely be held accountable, whether it was to blame or not. The easiest way to make sure contractor work is of good enough quality is to hold payment ransom until the agency is satisfied with the quality of workmanship. Hardware quality becomes particularly important when an agency expects to recapture some of its monetary investments in the form of farmer repayments---inadequate or inappropriate hardware will compromise production and hence farmers' ability to repay.

Unfortunately, agency control over resource flows is not all positive. Unless agencies are very sensitive to local situations, resources may not be applied to the most pressing problem. Agency control also tends to make resource disbursement inflexible. Agencies prefer to allocate their funds in advance---once these decisions are made, it is often impossible for a particular project to obtain money, or spend less than what it was given. It may even be difficult to reallocate money within a project if, part way through, agency staff realize that plans must be changed. Finally, when a centralized agency controls funding, there may be insurmountable bureaucratic barriers to motivated farmer groups or creative agency field staff who wish to take the initiative in small-scale irrigation development. This is especially true when funding decisions are made several organizational layers back from the field level.

Is there any reason for farmers to contribute their resources to the small-scale irrigation development process? Resource contributions by farmers can given them a sense of system ownership. This sense is crucial if farmers are expected to assume responsibility for maintenance or operation afterwards. A sense of ownership is also crucial for ultimate system success. If farmers have contributed nothing to the improvement or development of their irrigation system, then they have nothing to lose if it fails. However, procuring farmer funds for development does not automatically imply farmer ownership of the end result, nor is the commitment of cash necessary to impart a sense of system ownership to farmers. There have been successful programs in which the agency pays for all initial costs, but demands labor contributions from the

beneficiaries, or, perhaps more importantly, gives farmers a voice as development is taking place.

A commitment of farmer resources can also lead to increased economic efficiency, or perhaps even greater equity in the end. An example is the case of tubewell subsidies in Bangladesh. Some people have felt that subsidizing tubewell installation led to economic inefficiencies since there was inadequate pressure on farmers to choose well depths and pump sizes that fit the area they intended to irrigate. The result was that farmers often purchased equipment with far more capacity than was necessary. Closely linked to this, others have claimed in the same example that excessive subsidies also led to water distribution inequities since there was little economic pressure on tubewell operators to maximize the number of people and area they served.

On a more practical level, forcing farmers to cover some of the construction, improvement, or repair resources will help moderate farmer requests. If an agency pays completely for every intervention it becomes involved with, one can expect some outlandish farmer requests. However, when resource commitments from farmers are required, farmers will be encouraged to focus on those areas that represent both the greatest problems, and the greatest potential for increased returns.

Historically, agencies have expected end-users to contribute to "their" project in some way. However, the users themselves usually have little voice in determining the type (labor, cash, etc.) and amount of the contribution. Users hardly ever have any control over the way resources are used, especially those supplied by the agency. Just as

there are important reasons for farmers to cover some of the expenses of developing their system, there are also crucial reasons why farmers should be allowed control over how resources are used. In particular, granting farmer groups some control over financial resources can have very beneficial effects on the final result in small-scale irrigation development.

First of all, when farmers control development funds they will commit those resources to their greatest need. An agency may believe that what a particular small system needs is a permanent diversion structure. Yet the community may feel that what really is required is the replacement of parts of the delivery canal prone to failure. What actually is done is decided, ultimately, by who controls the money. Of course, a community may feel that its greatest needs are outside of irrigation. If resources were made available to them, they might prefer to invest them in schools or clinics. Also, as was pointed out earlier, groups involved with small-scale irrigation are seldom homogeneous. There is no guarantee that local organizations will apply resources for the greatest common good.

Secondly, farmer control over resource allocation also means that resources are available when farmers need them. This can be a critical factor when catastrophes strike. The loss of a season's production can be irrevocable guaranteed within days of a disaster if help is not immediately forthcoming. It can also be an important consideration in more routine development work. There may be particular seasons when farmers are able to commit themselves wholly to developing or improving their system. There may be organizational problems that farmers

themselves have to overcome before they are ready to collaborate in system development. When an agency has total control over development funds, the temptation will be to spend money quickly, even if it is the wrong season, or even if it is before farmers themselves as a group are ready.

Controlling development funds is not an either/or issue. The question is not whether farmers should control the way money is spent, or whether agencies should. As in the case of who should supply development resources, the question of control is really a problem of developing the proper mix of control---developing proper funding channels that capture the benefits of both agency and farmer responsibility for the use of cash resources. The idea of arriving at a proper mix of agency and user responsibilities and resources is outlined in Chapter Three, and is a theme carried throughout our discussion of small-scale irrigation development. This chapter ends with a look at different funding channels that various programs have used, and how these various channels have approached the joint issue of who should pay, and who should be responsible for resource use.

Effectively Channeling Resources into Small-Scale Development

What is the proper mix of public and local funds, who should exercise control, and how should these resources be channeled into the small-scale irrigation development process? There is no single answer that applies for all programs for all times. This section considers four different approaches that have been used with varying success. Each, in its own way, attempts to balance the need for outside funding and

agency resource control with the benefits of local resource mobilization and autonomy.

Revenue Sharing

Revenue sharing is on one extreme of the spectrum of funding mechanisms for the support of small-scale irrigation development. The basic concept is for governments or donors to place resources in the hands of local communities and allow them to allocate resources as they see fit. The role if small-scale irrigation agencies is usually limited to providing necessary technical and organizational support when required. Agencies have very little control over the use of public funds in revenue sharing schemes once the funds are in the hands of local communities. There is no guarantee that funds will be spent on irrigation, and disadvantaged groups may be excluded from any resulting benefits.

However, as a source of revenue for small-scale irrigation development, forms of revenue sharing probably are more important than an observer would first believe. Since funds are completely independent of irrigation agencies, there is little documentation in the usual irrigation literature of successes or failures in small-scale irrigation development funded through revenue sharing channels. But we do know that in both India and Indonesia, for example, local communities have applied such funds to small-scale irrigation. Unfortunately, when small-scale irrigation agencies have their own funds to manager there may be little motivation for such agencies to provide technical support to communities who are financing development on their own.

(This still requires a good example of such a program in action, and of the results and problems.)

Credit Arrangements/Small-Scale Irrigation Grants

A second approach to channeling public funds into the small-scale irrigation development process is via credit arrangements or small-scale irrigation grants. In both cases, the source of funding is usually separated from the agency responsible for technical support. Although irrigation agencies may have a role as group organizers or motivators, local groups are responsible for applying for funds for specific small-scale irrigation projects. Credit and grant programs usually allow much greater public control over small-scale irrigation development than does revenue sharing schemes, while at the samo time allowing farmers freedom in choosing the size, scope, and timing of projects.

In both cases---credit and grants---both local and public funds are applied to irrigation development. In the case of grants, local groups are often required to match public funds with a set amount of local resources. When local groups receive public loans, interest rates and repayment periods are usually set so that there is still a substantial amount of public subsidization for small-scale irrigation development. This form of funding guarantees public resources are applied to irrigation projects, and in fact there may be stiff requirements for the way money must be spent. Farmers, however, decide if they want assistance, and if so when and to what degree.

Subsidized credit arrangements have been the backbone of much of the tubewell development that has taken place in Bangladesh. Funds for

individual projects are usually available either through commercial banks or government agencies such as the Bangladesh Rural Development Board (BRDB). Technical support has been typically provided by the Bangladesh Agricultural Development Corporation (BADC). Stringent rules on the type of technology allowed, the area that must be served, etc., have been used to encourage orderly and equitable development---although at times with only limited success.

The Soil Conservation Service (SCS) and Agricultural Stabilization and Conservation Service (ASCS) programs in the U.S. provide another example of this form of funding mechanism in action. Farmers work with SCS personnel to develop solutions to problems. Once a design has been approved by the SCS office and accepted by the farmer, farmers turn to the ASCS for help with financing, usually in the form of matching funds. While the SCS and ASCS are separate agencies, they usually share the same field office.

Funding through Intermediary Institutions

Subsidized credit and irrigation grant programs effectively focus public funds on irrigation development, and they place substantial resource responsibility in the hands of farmers. However, the ability of agencies to directly encourage development is limited. While the agency in such programs can facilitate development by encouraging farmers in their application for funds, it usually cannot undertake projects on its own. On the other hand, main-stream irrigation agencies responsible for small-scale irrigation development nationwide may not themselves have the

ability to handle the small blocks of money required on a per project basis.

An interesting alternative, already discussed in general terms in Chapter Three, is the use of intermediary institutions that can operate on a local level. Such an institution might be a university or technical school. It might be a private voluntary organization. Such an institution may or may not have the ability to provide technical support. What it does possess is a feeling for the local area, and the ability to handle relatively small chunks of money. The idea is to transfer project direction and, in particular, fiscal responsibility to the intermediary organization while the agency still provides any necessary technical backstopping.

This was the approach used with substantial success in northeast Thailand, as summarized in Chapter Three. In terms of funding, the important advantage was the funding flexibility and responsibility the KKU program incorporated in its individual projects. Project leaders were able to make changes in the way funds were allocated for a specific project in the field, while the project was underway.

Responsive Agency Control

Funding and technical support do not have to be separated for successful development to occur. The National Irrigation Administration's (NIA) experience in the Philippines with participatory programs and communal irrigation systems provides an excellent example, with some innovative twists. In the NIA's participatory programs, funding is handled by the agency itself. The agency ultimately decides which

projects should receive funding, and how much. However, government policies require that the NIA recover most of its development costs from the farmers that it serves. This effectively links agency survival with farmer satisfaction. If the NIA designs a system that is not financially viable from the farmers' point of view, cost recovery is jeopardized. Farmers also have a serious investment in the success of the NIA's intervention---they are expected to repay what it costs. There have been cases of farmers aggressively monitoring the way the agency spends its money, not always to the agency's delight.

A USAID-funded small-scale irrigation program in the uplands of Guatemala is another success story where the technical agency handled project financing as well. As with the NIA's program in the Philippines, farmers were expected to repay the agency for system installation costs. However, farmers had the option of refusing agency help. The agency in charge of program implementation had to convince farmers of the benefits. Because farmers were intimately involved in actual design and construction of their system, they had a voice in the way money was spent. Finally, since program survival depended on farmers repaying hardware costs, the agency had a vested interest in making its projects financially viable from the farmers' viewpoint.

The case of small-scale irrigation development in Kenya, however, provides a counter example. Attempting to make its program responsive to local needs, the Kenyan agency responsible for small-scale irrigation developed regional offices that had a relatively large amount of freedom in program implementation. The one component missing, however, was control over funds. Funding approval for each and every project had to

be negotiated between central headquarters and donor groups. One result was enormous lag times between project selection and implementation.

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Chapter Six

SUGGESTIONS FOR DONOR COLLEAGUES

Dear Donor Colleague:

We were happy to hear from you recently with the news that you are considering providing support for the development of small-scale irrigation in the country to which you are presently assigned. We were also glad to know that you have looked at some of the ideas contained in our recent book dealing with better policies and programs for small-scale irrigation development. So, you know this is a topic of considerable interest to us. Since we have had the benefit of observing small irrigation facilities and the programs and policies that governments have put in place to develop them in a number of different countries we have decided to write to you. While we recognize that you have not asked for the advice contained in this letter, we hope that you will find some of our thoughts of use.

One of the things that we find most confused when we look at various projects for small-scale irrigation is the purpose of the project. Projects have been developed for a wide range of stated purposes---assisting the landless, producing basic food grains for import substitution, overcoming the effects of severe drought, reestablishing defunct commands, strengthening the capacity of the irrigation agency, making communities self-reliant---you name it! Any of these objectives may be perfectly appropriate in particular circumstances. But it seems to us that they have merit, and are likely to be achieved, only if there is the clear instrumental goal of creating new, or improving established,

small-scale commands that are self-reliant so far as routine operations and repairs are concerned. Sure, they need to be backstopped by a responsive and technically capable agency but for most things they should be able to get along on their own (we know that with new commands there may be a period before this can actually happen). But, developing small-scale irrigation should not be thought of as a process by which the irrigation agency (or any other agency) gets itself involved not only in designing and constructing irrigation facilities but also deeply involved in supervising and managing small patches of irrigated agriculture scattered here and yon. It is unlikely that the agency will have the resources and capacities to do this. It just won't work---or, not for very long! Local users should be responsible for much of the everyday activities of the system---and this responsibility should be matched with clear rights to act as required. Small commands for which the users are responsible and for which the agency is ready to provide backstopping as necessary are the ones that are likely to be around for awhile and most likely to contribute to achieving broader production and livelihood purposes.

In other words, be clear about what you are trying to achieve. Especially be clear that you (and your national colleagues) have a sharp idea about the desired features of a good small-scale system (both its technical and its social organizational features) and what a good small-scale irrigation support agency should be like (what staff it needs, procedures it should have in place and so on).

Speaking of agencies brings us to our next point---be sure to carefully examine and consider the agency that you are going to be

working with. Remember, you may have a choice since often there are several agencies that include concern with small-scale irrigation in their portfolio. Look at them all before you decide which one to work with---maybe you can work with more than one, though that approach has its own problems. If there are several agencies working with this try to get an understanding of which of those may be waxing and which waning---and try not to choose the wrong one. It is our general observation that in many countries irrigation development, large and small, is increasingly a function of a specialized irrigation agency.

Whatever you decide, we strongly suggest that you not begin with the assumption that the agency knows how to develop small-scale irrigation effectively and all they require is additional resources (they may in your case and that would be a nice surprise!). This is not meant to be a negative comment on national irrigation agencies---just a recognition that many may lack experience with either or both the technical and organizational tasks required to do the job. We have seen a wide range of situations on this matter---agencies that have had little irrigation experience of any kind or agencies that have considerable experience with large irrigation commands but not much with small ones and even agencies that have been developing small commands but with little success.

Our experiences suggest that you need to look carefully at the agency's capacity to design hardware for small facilities. We know one agency whose primary experience before launching into small irrigation commands was with the design and installation of drinking water systems. Others may have had most of their experience with designing the layout

and civil works for very large commands. While this prior engineering work will, of course, help it does not mean that designing small-scale systems will come "naturally." And, this is especially true if you are supporting a program to put in place small commands that can be self-managed to a large extent.

So, we think that concern for the "designing" process is especially important. It ought to be highlighted in your project plan in at least two ways. First, there should be sufficient budget to support any training and professional development that may be necessary to expand perspectives and upgrade technical skills. You may remember some of our points in Chapter Four---seldom are minor irrigation systems minor design tasks!

Second, if we are right that your collaborative agency has little specific experience with designing small works give them time to learn how to do this. Arrange the project so that there is a modest pace at which subprojects are designed and constructed in the initial period of the project. We realize that within donor agencies there often is pressure to commit funds and insure that they are flowing to projects. While we recognize this imperative it ought not to drive project implementation. Anticipating a slow start and the need for a learning period can be programmed through various devices such as a "year zero" for the project. What is needed is to provide the designers opportunity to collect the data and design a few systems, see them in operation and discuss their strengths and weaknesses before procedures become formal and standard. Design procedures and standards need to be formulated

and reformulated in light of the field experiences of both agency staff and water users.

You are probably wondering about training---if we are right that the agency may have few staff with experience in designing small-scale works, is there someplace where they can be sent to learn these skills? We think the best options will be in-service training of various types---training sessions in the work-environment of the staff using the data and materials normally available to them; familiarizing them with the work of other departments, perhaps in other regions or other countries, with successful small-scale projects through short visits or even assigning them to work with that agency. Remember that most academic training in civil or agricultural engineering does not give special attention to the problems of design for small irrigation facilities.

If some, or all, of your project sites are already irrigated (and you may need to do some field visits to actually determine this since we have seen several project proposals that were simply wrong about this matter!), there is one big mistake you can avoid---failing to learn about what is going on in those locations. Don't assume that the agency with which you are working will automatically do this. Irrigation can be so narrowly defined by the agency that it does not include what local people have done on their own. So, if your project is going to include previously irrigated commands, there are a few things you can do early on. For one, contact some social scientists (perhaps in your agency or in the local university) to determine if any research has been done on the indigenous irrigation of the area---this is not an uncommon topic for anthropologists, sociologists and geographers. If not, you might wish to

use some of your project development funds for at least a quick examination of this existing irrigation, perhaps by a team including both a social scientist and a technical person. There can be a lot of surprises out there (local people are doing some amazing irrigation activities) and it's better to have them now than later.

This reminds us to mention the topic of special studies. They can be an important part of your small-scale irrigation program---generating the new knowledge needed for improving program operations and outcomes. Most irrigation agencies do not have a research tradition and, not unexpectedly, have few staff with research skills. Thus---if special studies are going to be part of the program (and we advocate that they should be) the irrigation agency will require some partners for this component of the work. Ideally you need local researchers to do social science studies; they have the language skills and cultural familiarity that is required. But, they may not be experienced with irrigation, and it would be useful to provide them with opportunity to interact with someone who actually has done such research. More technically oriented research may also be desirable---everything from flow measurements to agronomic topics. Staff of the local university or agriculture research division may be appropriate colleagues for this work.

Actually, special studies is just one part of a larger project orientation that you ought to encourage---a broad learning perspective. Project learning can occur through special studies, through staff training, through reviewing past activities (such as completed design and construction), and through appropriate project monitoring. And, it is not something that should be seen as detracting from the real job or merely

slowing the construction timetable. Getting things built is, of course, an important objective in most small-scale programs but equally important is the quality of what one is doing---quality of the final "product" as well as quality in the process that leads to both improved agency as well as user group capacities. A learning perspective contributes to these two objectives.

You are probably wondering how we got this far in the discussion without mentioning economics. Usually the matter of internal rates of return and the topic of cost recovery are at the top of the list of issues to cover. We don't disagree that they should be---but we do raise some cautions. One regards the use of internal rates of return or other benefit-cost calculations. There are two problems with these techniques. A major one is calculating benefits---which usually turns on the assumptions about the crops that will be grown after the project as compared to those grown in the before-project situation. These projections always have to be examined with care and the assumptions on which they are based scrutinized for plausibility---remember it can be tempting for planners to "improve" a B/C ratio by changing assumptions about the high-value crops that will be grown or about the rapidity with which farmers will switch from old to new cropping patterns.

Also, remember that less frequently do people attempt to modify the ratio of costs and benefits by reducing costs! Sometimes there is a ceiling placed on per hectare costs of a small-scale project, and this can result in modifying a plan whose costs are too high---or selecting among alternative facilities known to have different costs. But plenty of agency designs call for extravagant, and sometimes unnecessary, structures and

facilities that raise costs but do little to expand benefits. The sociotechnical approach that we discussed in our book, and its principle of farmer self-management with agency backstopping, should translate into designs that are less costly to construct and operate. When this happens there will be less pressure for planners to be overly inventive in dealing with cropping patterns. It also should mean that donor resources can go further.

Cost recovery is of concern everywhere---how can the public regain some of the funds invested in small-scale irrigation development from those who benefit from these investments. Of course this question assumes several fundamental things: that there are benefits and that those who receive them can be clearly identified. But rather than get diverted by those important, but complex, matters let's assume that your program is going to be of benefit to the users of those small commands. Can they be expected to contribute? We believe that the answer to that question is that they can be expected to contribute something! In fact, we suggest that without their required contribution one runs the risk that costs will frequently exceed payoffs: when the agency is making all the decisions but also when farmer requests are included without the need to consider repayment.

What can users be expected to contribute to complement government investments? We suggest two points. First, consistent with the approach we have taken throughout our discussion, users should have the rights and responsibilities for routine operation and maintenance of the small commands including the costs of these everyday activities. They can do this through contributing labor, cash and/or in-kind payments as

arranged locally. In addition, they also should be expected to repay some portion of construction costs of new facilities or the repair or improvement of existing ones. But, if they are expected to make such payments they also must have some voice in deciding what those facilities will be---in some cases perhaps opting for low-cost alternatives or even deciding against proposed "improvements." Indeed, only if farmers are accountable for some portion of these costs can they be expected to moderate their own demands for government assistance as well as act as a guard on extravagant expenditures by the agency. The Philippines' participatory small-scale irrigation program is filled with tales of careful scrutiny by the irrigation association officers of the agency's expenditures on system improvements since the association was to repay a portion of the total costs. This concern would have been unimaginable without this requirement to share the costs.

In short, the economics of small-scale irrigation development is an essential indicator to consider in program planning and implementation---but it should not be the factor that drives the program any more than any other single factor should. Real user involvement in project planning, responsibility for post-construction operation and maintenance, and a requirement to repay some construction costs, can do much to keep public and private costs under control. Often, controlling costs will be among the most important means for designing and constructing small commands that are economically sound and financially manageable to build and operate.

We can't forget to mention the important matters of farmer participation and water user organizations---two items that are often

joined in discussions though they need not be. It's quite clear that our sociotechnical approach both advocates and requires farmers to be involved in the irrigation activities in an organized fashion. And most policy makers and program staff have come to accept this view. But a lot of ambiguity remains as to just what these concepts mean and how they can be implemented. There is a lot of good information on this topic and you should make it available in your project library---here, we just want to highlight a few pertinent points. First, we think that starting with the specific of water user associations may be overly specific and sometimes confuse the matter. Rather, what is needed is effective organization at the local level to arrange the routine activities of O+M and other matters---however, the form of that organization may be a water users' association or some other management entity. For example, there are a number of places in Asia where irrigation at the local level is organized as a function of local government. Or the users' group may be less formal and legal than is implied in the phrase water users' association. So, effective local organization is definitely needed but its best form in your situation may be something other than an association. Second, we mentioned previously that your project may be improving some established irrigation commands. If so, be sure that attention is given to learning what form of local organization exists to operate and maintain those commands---and be skeptical about any reports that simply say nothing effective exists! If there are such groups in place they should be viewed as important resources to the project and policies should be flexible enough to accommodate their strong points. Frequently, some action will be needed to create new local organizations

or to strengthen existing ones. If this is so, be sure that your plan defines some process by which this will be done. We have seen a number of project plans in which this topic is dealt with by simply saying the "irrigation groups will be formed by the users." But the plan has no indication as to who will be responsible to achieve this and no indication in the budget that resources are to be devoted to this activity. Seldom does such local organization just appear---it takes sustained effort by staff specialists trained in organizational development as well as serious concern by the implementing agency to insure that its procedures and plans are supportive of effective local organization. Agency assistance in the development of local organization can't just be done by having the ditchtender call a one-time-only meeting of the users. A third point about farmer participation and local organization has to do with the optimal timing of these activities. It used to be that attention to organizing farmers was programmed to occur after the design had been drawn and the facilities built---now a group of farmers was needed to use them. But experimental work over the last decade has shown that successful farmer participation requires reversing that sequence---successful farmer involvement is based on early involvement in the entire development sequence; early planning, design, construction, and finally operations. In this way, the process of the project is itself used as a vehicle for getting users together, establishing group identity and solidarity, and developing the organizational skills needed for system operation. Consequently, if you are going to work on local organization ---and we believe you will have to---plan for it to start early not late in the process.

Briefly, those are our thoughts on local organization. Concern for effective local organization for small-scale irrigation development is a big deal---big because of its fundamental impact on project success and big because of the effort it requires to be done well.

Finally, we know that most of you have such heavy workloads that you will need help from outsiders, on short- or long-term assignments, to do some of the critical tasks---everything from formulating your project plan to actually working with the national agency in project implementation. But getting the right collaborators may not be easy. While we believe that the sociotechnical approach that we advocate in our book is catching on, not everybody sees the process in this way or operates in this manner. Moreover, many foreign technical groups may have less experience with small facilities than does the national agency. So, you may find yourself having to plan for orientation of the "contractor" and periodic project reviews to insure that the activities stay on track---that they are in fact leading to the self-managed, agency-supported systems that we mentioned above. One way to deal with this is through development of terms of reference that emphasize sociotechnical approaches. Another may be to team local consultants with a sociotechnical perspective with the external ones. And, of course, having a clear understanding with your national colleagues about objectives and outcomes will also help provide direction to the contractor.

We started by saying we were happy to hear from you. I hope after reading this you are happy to hear from us. We may have presented a complex and complicated picture---but we do not think it is overly so. Moreover, there are a few key strands that are woven

through the discussion that we believe set the framework for the other elaborations. If you work on the principle that you are aiming for self-managed small commands, and that this can be achieved though a set-up that gives local groups the rights and responsibilities of routine operations and management while the technical irrigation agency has various important backstopping jobs---then, many of the other elements fall in place. Designing the technical apparatus and rules, developing policies and programs for O+M costs and cost recovery, and fostering farmer participation and effective local organization are all means to the larger objectives. Thus, they are means that can and should be fashioned to be supportive of these intended outcomes. We leave the detailed fashioning to you and your colleagues as you elaborate the policies and programs for small-scale irrigation development in your situation.