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IMPROVING POLICIES AND PROGRAMS FOR FARMER ORGANIZATION AND PARTICIPATION IN IRRIGATION WATER MANAGEMENT

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IMPROVING POLICIES AND PROGRAMS FOR FARMER ORGANIZATION AND PARTICIPATION IN IRRIGATION WATER MANAGEMENT

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FOREWORD

"Participatory" approaches to irrigation water management have attracted increasing interest internationally (e.g., Bottrall, 1981; Levine and Hart, 1981; FAO, 1982; F. Korten, 1982; Steinberg, 1983). Yet the policy concerns in this area have not been addressed on the basis of a systematic consideration of comparative experience, paying attention at the same time to improving our conceptualization of the tasks.

This report summarizes the conclusions of a study on farmer organization and participation undertaken by the Cornell Irrigation Studies Group for the Water Management Synthesis II Project. It focuses on policy-related issues illuminated by an analysis of 50 cases of irrigation management worldwide, augmented by additional information from experiences in other irrigation schemes. The work was guided by interdisciplinary discussions to arrive at formulations and classifications that diverse students and practitioners of irrigation management can use.

The working group that assisted us included John Ambler, Bryan Bruns, E. Walter Coward, Jr., John Duewel, Barbara Lynch, and Ujjwal Pradhan (Rural Sociology), Ed Martin and C. M. Wijayaratna (Agricultural Economics), Chris Wensley and Bob Yoder (Agricultural Engineering), Gerard Finin and Ruth Yabes (Regional Planning) and Milan Rodrigo (Communication Arts). We thank them for their suggestions and criticisms. We also thank Douglas J. Merrey, formerly in the Office of Rural and Institutional Development, Bureau for Science and Technology, USAID, who oversaw this activity for WMSP as social science advisor and who is now with the International Irrigation Management Institute in Sri Lanka.

The findings of our extensive review of the water management literature and experience are written up at some length as a WMSP working paper, Getting the Process Right: Improving Irrigation Management with Farmer Organization and Participation, by Norman Uphoff. The working paper presents in more detail the case study materials and the concepts on which this paper rests. This report is written for persons who will be interested primarily in the implications of our work for policies and programs of irrigation development. The presentation here is necessarily abbreviated and without the empirical elaboration contained in the longer exposition.

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EXECUTIVE SUMMARY

Because irrigation structures and the flows of water these provide are so visible and impressive, irrigation appears as essentially a physical process of acquiring and applying water to the land. However, without certain human activities, the goals of irrigation cannot be attained, so irrigation is better understood as a **sociotechnical** process that combines organizational and material elements. All irrigation systems need management to be productive. The question is **who** should be involved in managing irrigation systems, in what ways, and to what extent?

Management of irrigation systems can take one of three basic forms: management by government personnel (or by some private agency); management by the water users themselves; or some form of joint management by users and agency staff. The first is difficult and costly enough that it is rare. The second is more common and not restricted to small systems as often thought. Increasingly, there is interest in the third form, which shares responsibility.

Farmer participation in irrigation management can vary greatly in kind and degree. The objective—from farmers' as well as an agency's viewpoint—should be "optimum" rather than maximum participation because participation entails costs as well as benefits. Possible benefits include increased production, improved water distribution, reductions in conflict, greater local resource mobilization, and system sustainability over time.

Experiences documented in the literature show that farmer cooperation can contribute to increased flows of water reaching downstream areas, greater area cultivated, higher cropping intensity, lower costs of construction, reductions in water issue requirements, expansion of system capacity, and better operation and maintenance.

Estimating benefit-cost ratios from farmer organization and participation is difficult, but data from two programs suggest rates of return of about 50 percent, much higher than on most investments. These estimates did not include a number of valuable but non-quantifiable benefits, such as reductions in damage to irrigation structures, in conflicts over water, and in irrigation problems brought to officials.

To get beyond gross generalizations about participation, one needs an analytical framework that makes useful and conceptually sound distinctions. The framework presented here integrates three **focuses** on irrigation activity:

a) on the **water** that is to be provided to crops in an adequate and timely manner;
b) on the **structures** that give control over the water; and
c) on the **organization** that manages the structures that control the water.

Four irrigation management activities can be identified within each focus:

a) acquisition, allocation, distribution and (if necessary) drainage of **water;**
b) design, construction, operation and (as necessary) maintenance of **structures;** and

c) decision-making, resource mobilization, communication and (when necessary) conflict resolution within and between **organizations** responsible for water management.

As seen in Figure 1 (page 6), these activities interact. Farmers may participate in decision-making about design of structures for acquisition of water. They may be involved in communication about operating schedules for the distribution of water, but not in resource mobilization for drainage channel construction. There can be communication about decision making or mobilization of resources (e.g., information) for conflict resolution. The purpose of such distinctions is to be able to make judgments in planning, implementation, and evaluation about specific kinds of participation, actual or potential.

Water management activities occur at different levels of operation within an irrigation system (each level defined by a water control structure such as a partitioning weir or main channel gate). Our analysis inverts the usual terminology for describing irrigation systems by treating the lowest level of operation, the field channel that is common to all systems, as the basic (and hence "primary") level of operation. Rather than focus on the **size** of systems reckoned in terms of command area, more can be learned by looking at the **number of levels** for operation and organization (Figure 2, page 12).

Although "organization" is usually conceived of as being present or not, it is better understood as a matter of degree, and as something that can operate formally or informally. Organization for irrigation management exists at a particular level of operation **to the extent** that there is decision-making, resource mobilization, communication, and conflict resolution at that level. Activities can be carried out by water users, by agency managers, or by both together.

One major finding of the analysis of 50 cases of irrigation in a variety of developing countries is that levels of operation and organization tend to represent "orders of magnitude." The lowest level usually covers an area of up to about 100 acres. Two-level systems (or the second level in a larger system) commonly fall into the 100 to 1,000 acre range, while three-level systems (or the third level in a larger system) are generally between 1,000 and 10,000 acres, and so forth. This underlies the formation of multi-tiered systems of organization for irrigation management, with field channel level organization (often called "turnout groups") forming the basic "building blocks."

Who participates in irrigation management from the farming community—and who does not—should be a matter of concern since there is usually some heterogeneity among water users. It is unlikely that head-end and tail-end farmers, male and female cultivators, landowners and tenants, full-time and part-time operators, or old and young members of the community will have equal voice in decision-making and equal share in benefits. The modes and contexts of participation should also be considered to provide for better results.

No single approach or structure will be most appropriate for all situations where governments or donor agencies wish to increase users' role in water management. Thus, no "blueprint" can be proposed for introducing farmer participation. However, some elements of strategy can be identified that have contributed to success in different settings. Specific project efforts have to be tailored to the environment and objectives at hand.

(1) Support from top levels of the government and bureaucracy is crucial, although not to push through a preconceived plan. Rather, a program promoting farmer participation needs to have appreciation and perseverence from above that creates "space" within which bottom-up capacity can be built. The relevant actors will be in various ministries and institutions, so forging a network of supportive leadership, intellectual and administrative, is important for seeing a program through to successful institutionalization.

(2) Experimentation, phasing, and flexibility should characterize the efforts. A "learning process" approach is most appropriate, with the development of a cadre of persons who have knowledge, experience, and commitment relevant to the program's goals.

(3) A strategy of building from below, starting with base-level groups as the "building blocks" referred to above, should put the organizations on a firmer foundation than if a conventional top-down approach is followed, including calling large meetings, usually through the local elite or lower officials, to select officers, ratify a preset constitution, etc.

(4) Where possible, it is advisable to try to work with and through any existing local organizations that have capacity relevant to improving irrigation management.

(5) Questions of ownership need to be addressed. Whose irrigation system is it? Whose organization is it? To the extent that water users feel some proprietary interest and responsibility, they will participate more actively and effectively.

(6) Intrusion of "politics" into water allocation and distribution will spoil cooperation among farmers. Whether associations will be nonpartisan in their orientation and activities depend very much on whether the government will allow them to remain politically neutral.

(7) Getting administrative personnel to work cooperatively and constructively with farmers usually requires some bureaucratic reorientation. This may come, however, not all in advance of a program but as an important and necessary concomitant.

(8) The compatibility of objectives between government and water users will affect the viability of organized farmer efforts. If the government wants for farmers and their families what they want for themselves, cooperation becomes "positive-sum" and more readily sustainable.

On matters of program design, the following generalizations appear tenable:

(1) Water user associations should start with a focus on irrigation management rather than be launched as multipurpose organizations. But to the extent that members want to engage in other collective action through their WUAs and feel they can manage the additional functions, they should be able to make such decisions, since the organizations are "theirs," not the government's.

(2) The size and structure of organization should follow hydrological lines, though these will seldom be simple or symmetrical. Water users should be free to

make decisions about the amalgamation and subdivision of groups so as to form "user-friendly" structures of organization.

(3) Membership should be based on "field neighbors" rather than residential neighbors if the two sets of persons are different, in keeping with the principle of hydrologically-meaningful organization. WUA membership should be vested in the household rather than in the household head (who is usually male and older), so women and younger persons can play more active roles.

(4) Having conscientious, energetic leaders who enjoy the confidence of their peers is the key to success in participatory water management. Sometimes existing local leaders are suitable, but often new talent needs to be mobilized into leadership roles.

(5) Having legal authorization and specification for WUAs is important, but such legislation should seek to buttress entities that have their own integrity and reality, rather than turn out organizations that have to win legitimacy and status in the rural community.

(6) Technical personnel are so often overloaded with other duties that it is usually a moot point whether or not they have the talent and disposition to organize farmers into water user associations. Some of the most successful programs introducing farmer participation have relied on "catalysts," organizers specially recruited, trained, and deployed to live and work closely with rural people.

(7) A strategy of organizational development does well to start from a pilot effort, first learning to be effective, then to be efficient, and finally to expand to other areas. The sequence of efforts will usually proceed from initial organizational efforts on an intensive scale, to consolidation efforts on a more extensive scale, and then maintenance activities for the long run. Social infrastructure requires certain maintenance investments to remain effective just like physical infrastructure.

(8) Nongovernment organizations—private voluntary organizations and/or knowledge building institutions—can make significant contributions to a program because of their different styles of operation and different skills and orientation.

(9) There is no substitute for leadership from within the agency or agencies concerned. Promoting farmer participation requires a participatory mode of operation within the agency, and building linkages with professionals, administrators, researchers, and others outside. An increasing number of agencies are likely to embark on such efforts based on a growing record of positive experiences with farmer participation in the irrigation sector.

I. INTRODUCTION

Irrigation as a Sociotechnical Process

The process of irrigation that sustains agriculture under conditions of insufficient natural rainfall appears to be preeminently physical. Flowing water is visible and impressive as are the irrigation structures that capture, convey, and distribute water to support crop growth. However, many management activities are required to make technical structures perform their water control functions. Since social organization surrounds the establishment and operation of physical systems, irrigation needs to be understood as a **sociotechnical** process combining people and material elements.

There are many ways in which an irrigation enterprise can fail. Engineering designs and technical operations need to be correct and efficient; otherwise water cannot be acquired and applied as necessary. If soils are not suitable for irrigation, productivity will be poor and may decline. Factor and market prices have to be "right" as economists are fond of reminding us, or the system, for lack of adequate material incentives, will not yield resources of more value than it consumes.

But physical and economic factors will not be productive unless the many activities associated with irrigation are integrated into an operational system. The human efforts that transform material relationships to make irrigation feasible establish a sociotechnical process that is much more complex than the observable acquisition and distribution of water to fields. Getting this larger process "right" is essential.

Agency Management, User Management, and Joint Management

The various management activities needed for effective irrigation performance can be carried out by some combination of (a) water users, and/or (b) specialized personnel—administrators, engineers, technicians, accountants, field staff, etc. Which of these possible irrigation managers will have responsibility—and which responsibilities—depends on many considerations, such as the size and complexity of irrigation systems, historical traditions, past government policies, the extent and capacity of public administration, and the stake farmers have in getting adequate and reliable water supplies.

The management of an irrigation system can be undertaken

- by some **agency** of a government or of a private enterprise;
- by the **users** of the system, that is, by the cultivators who use the irrigation water; or
- **jointly** by the users and some agency.

Systems that are entirely agency-managed are rare. It is hard to operate a system where all irrigation decisions and activities are in the hands of specialists, with cultivators responsible only for managing the water that is delivered to their fields. Moreover, it is exorbitantly costly.

The alternative of pure user management is more common, but it is found most often in smaller, dispersed irrigation schemes. Pump technology is more amenable to this mode of management, although gravity-flow canal systems of several thousand hectares can be found under user control (e.g., Pradhan, 1983; Siy, 1982).

The majority of irrigated acres operate under some system of **shared** responsibility between agency and users, with different tasks assigned to technical personnel and farmers, respectively, at various levels. In many joint systems, farmers are given responsibilities below the outlet (the control structure serving the channel supplying their fields) while the agency has responsibilities above this level. Whether farmers should have larger responsibilities above the outlet, and if so, what kind, is a matter of debate.

A strong case can be made that the most serious shortcomings in irrigation operation are found at the level of main system management where agencies are in charge (Wade and Chambers, 1980). Many of the inefficiencies and failings observable at lower levels can be traced to defects in management at higher levels. If the main system does not provide a reliable and adequate supply of water, there cannot be effective performance at lower levels. Conflict and confusion will certainly reign.

Initiative to improve such situations must rest with policy makers and system managers. But the solution lies partly in the organization of water users so that they can participate more effectively and continuously in the decisions and activities of water management.

Why Have Farmer Participation?

In user-managed systems, farmers are already carrying out a full range of responsibilities. Agencies can seldom make any cost-effective improvements by taking over the management of such schemes, although a number of LDC governments when rehabilitating such systems have in recent years encroached on operation and maintenance duties previously handled by farmers (Coward, 1983; Morfit, 1983).

For an agency to try to manage water all the way down to the field level is unnecessarily expensive. Both the information and staff requirements make this alternative infeasible even if it is not rejected simply on budgetary grounds. The question thus is not **whether** to have farmer participation, but **what kind, how much, and at what levels?**

Obviously there will be no universal answer to these questions. Participation should be optimal rather than maximum, according to the situation. Decision makers must take into consideration the costs as well as benefits, both to irrigation users and to the broader society.

Better irrigation management should fulfill some combination of the following objectives, among which there are interactions and trade-offs:

- greater production or productivity due to increases in yield, area cultivated, and/or cropping intensity;
- improved water distribution, whether judged in terms of the reliability or equity of distribution;
- reductions in conflict among users and between users and government agencies;
- greater local resource mobilization, labor, materials, funds and information, for original design, construction, rehabilitation, operation and/or maintenance;
- system sustainability over time, with soil and water resources retaining their productivity, while possibly supporting a larger population through intensified production.

Farmer participation can contribute to achieving each of these benefits.

Although inefficiency in water use may stem from deficient operation and maintenance at higher levels or may arise from inadequate design and construction, at the field level one often finds deterioration of control and conveyance capacity due to lack of maintenance, damage to structures, stealing or hoarding of water, and wasteful cultivation practices. These are things that farmer concurrence and cooperation can counter to improve system performance.

Benefits and Costs

There is no assurance that greater user participation will always produce beneficial results, but there are encouraging outcomes of many efforts to move from predominant agency responsibility for irrigation management to arrangements that give farmers a greater role and voice.

- Within the first year of introducing farmer organization, there was a 30 percent increase in the flow of water reaching the downstream half of the 15,000 acre Minipe scheme in Sri Lanka (de Silva, 1985).
- Irrigable area in the Pochampad scheme in India was extended by 25 to 35 percent through water rotations operated after Pipe Committees were established; also the time required for land development of turnout areas was cut from one year to 4-6 months with farmer participation (Singh, 1983).
- Cropping intensity was raised from 50 percent to 90 percent in two years time through work - with farmer organizations in the Nong Wai scheme in Thailand (Kathpalia, 1984).
- A "participatory" approach to expanding the Buhi-Lalo scheme in the Philippines saved costs by avoiding unnecessary construction. The channels built by farmers were better than average quality and done four months ahead of schedule (Illo and Chiong-Javier, 1983).
- Water issues were reduced by one-third in the Left Bank of the Gal Oya scheme in Sri Lanka with organized farmer cooperation. Tail-end areas that had not had irrigation water for 10 to 20 years were able to get water in the dry season through farmer-operated rotations (Uphoff, 1986).
- In China, irrigation authorities adopted farmers' strategy for water storage and

distribution (called 'melons-on-the-vine'), and with farmer help, constructed 21 small reservoirs and over 6,000 ponds to add over 29 million cubic meters of storage capacity to the 27 million cubic meter main Meichuan reservoir (Nickum, 1981).

- Pump groups formed by the SAED agency in Senegal take effective responsibility for organizing and completing land development (in as little as four months), handling day-to-day operations, and keeping pumps supplied with fuel (Fresson, 1979).

These are examples of contemporary efforts to improve irrigation management through greater farmer participation. They represent a tapping of the kind of indigenous irrigation management capacity previously reported in a number of countries: e.g., Peru (Mitchell, 1976), Kenya (Ssennyonga, 1983), Indonesia (Geertz, 1967), and the Philippines (Siy, 1982).

The Chattis Mauja irrigation system in Nepal indicates how much management skill and capacity can exist within a mostly illiterate farming community. This scheme, designed and built over 150 years ago, serves 3,000 hectares and is managed by a three-tiered structure of organization (54 village committees, 9 area committees, and 1 central committee). The 4,000 farmer-members elect officers annually and contribute 60,000 man-days of labor each year for main canal maintenance. Additional labor is contributed for O&M for branch and field channels (Pradhan, 1983).

In this Nepal case, there are no costs to the government since farmers cover all costs of O&M themselves, including payment of salaries to their officers and to the technical supervisors and messengers employed by the organization. In the other cases cited, there was some investment by the irrigation agency in establishing the organizational capacity for farmer participation.

It is difficult to make a precise comparison of the costs and benefits of efforts by governments to increase farmer participation. Even when costs are reasonably well measured, many of the benefits elude quantification. We can report on two systematic attempts at benefit-cost analysis that show substantial returns to such investments:

- A study of 19 pilot irrigation schemes in the Philippines found direct quantifiable benefits (savings) in the construction phase of $US 24 per hectare, compared with a cost of $US 49 per hectare for the farmer participation program. The value of resources mobilized for O&M was calculated at $US 12 per hectare per year. So the investment should be recouped within two years, a very high rate of return. Benefits should continue thereafter with little additional cost (Bagadion and Korten, 1985).[1]

- In the Gal Oya scheme in Sri Lanka where organizers were fielded to help establish water user associations in a pilot area of 4,000 hectares, the total cost of the program including training, supervision, and salaries came to about 50 rupees per hectare per year, whereas direct recorded benefits per season were about 75 rupees (Wijayaratna, 1985).[2] After the first two years, when inputs from the government side have been reduced, the cost should be lower, while the level of benefits should continue or even increase.

Investments in irrigation "hardware" are considered justified if they have rates of return in the 10 to 20 percent range. These programs of farmer participation providing irrigation "software" appear to have payoffs closer to 50 percent per annum.

One can look at the benefits of farmer participation conversely, that is, considering the difficulties and costs when irrigation projects are operated <u>without</u> user involvement in management, even at lower levels of the system. According to Afifuddin (1978), when the 80,000-hectare Muda irrigation scheme in Malaysia was first operated under administrative direction, there was "anarchy." This situation improved subsequently after farmer organizations were introduced and users were given some role in management.

The 700,000-hectare Gezira project in the Sudan was one of the first major agency-planned and -operated systems, and its initial economic success encouraged other countries to embark on similar regimented large-scale schemes. Unfortunately, crop yields in Gezira have been stagnant for the last 20 years, and case studies suggest that this is due more to social and organizational factors than to technical constraints. The "tenants" (as farmers in the scheme are called) do not see themselves as partners and thus have not been responsive to opportunities for innovation (Simpson, 1976; Elder, 1982).[3]

Introducing greater farmer participation can have noneconomic costs in the administrative

and political spheres. Farmer involvement can limit the discretion of technical and bureaucratic personnel who must consult users and formulate programs to mutual satisfaction. Where corrupt practices exist, greater resistance to making changes may be encountered (Wade, 1982). There may also be some fear that organized farmers will acquire political influence or will seek more favorable prices and incomes.

Such considerations may make initiatives to increase farmer involvement unacceptable to a government, but they do not obviate its desirability. Entrenched corruption and extraction of resources deemed to be unfair can represent constraints on improving the productivity of irrigation systems just as much as shortages of water or ineffective distribution. Increased farmer participation may enhance irrigation system productivity as much by helping make government performance more responsive and equitable as by improving systems' operation and maintenance.

NOTES

[1]One benefit reported but not counted in this estimate is that, with farmer consultation and involvement, field channels constructed in these schemes remained intact and were used, whereas in many other Philippine schemes, field channels (costing US $38 per hectare to build) have been ignored or torn up after a few years.

[2]The benefits included only the value of maintenance work done by farmers after organizations were established and had increased output from almost 300 hectares brought into production after farmers introduced rotational water deliveries. Not included were reduced damage to irrigation structures by farmers and animals, reduced conflicts over water (farmers and officials agreed these had declined), and yield increases attributable to more reliable water distribution, which encouraged adoption of new technology. Also, according to the District Minister, the Government Agent and the Deputy Director of Irrigation, farmer complaints about irrigation problems dropped by 95 percent or more (Uphoff, 1986).

[3]Similar problems have been reported from the large Rahad scheme, also in the Sudan, but this scheme is now seeking to introduce and institutionalize more farmer participation (Benedict et al., 1981).

II. ANALYZING FARMER ORGANIZATION AND PARTICIPATION

Even if greater farmer participation in irrigation management is accepted in principle, any recommendations about participation need to be framed in specific terms. Participation possibilities can be analyzed explicitly and thoroughly so as to be better able to identify those kinds and circumstances of participation that are most likely to contribute to desired results.

The following analytical framework of concepts and categories was developed as part of a review of irrigation experience in 30 countries worldwide. Its purpose is to aid practitioners and researchers in working more systematically on participatory irrigation management.[1]

Kinds of Participation

Irrigation management has three distinct focuses of activity—activities that can be carried out either by farmers or by agency personnel, or jointly by some combination of users and agency managers.

1) Some activities focus on the water that is to be provided to crops in an adequate and timely manner.

2) Other activities focus on the structures that give control over the water for its application to crops.

3) Still other activities focus on the organization of effort to manage the structures that control the water. (We are dealing here with water users' organization, but the analysis applies equally to any agency organization for irrigation management.)

This is to say that irrigation enterprise can be approached from any of three perspectives: (a) how water is managed; (b) how the structures that control the water are managed; or (c) how the activities of users and/or agency personnel are managed to control both water and structures.

Four main kinds of management activity can be identified within each of these three sets. The management activities that one finds under each heading are quite familiar and concrete. There are also significant parallels and interactions among them.

1) The first set of management activities focus on the **water** needed for agricultural production.

A) **Acquisition** of water from surface or subsurface sources, either by creating and operating physical structures such as dams, weirs or wells, or by actions to obtain some share of an existing supply.

B) **Allocation** of water by assignment of rights to users, thereby determining who shall have access to water.

C) **Distribution** of water brought from the source among users at certain places, in certain amounts, and at certain times.

D) **Drainage** of water, where excess supply must be removed.

Farmers may be involved in any or all of these water-related tasks, directly or through representatives. These activities can be undertaken at each and every level of an irrigation system as analyzed below.

2) Other management activities deal with the **structures** required for water control. There is already a standard classification that is used by engineers to delineate these activities.[2]

A) **Design** of dams, diversions, or wells to acquire water, of systems of rules to allocate it, of channels and gates to distribute it, and of drains to remove it.

B) **Construction** of the structures to acquire, distribute and remove water, or implementation of the rules that allocate it.

C) **Operation** of the structures that acquire, allocate, distribute, or remove water according to some determined plan of allocation.

D) **Maintenance** of these structures in order to have continued and efficient acquisition, allocation, distribution, and removal of water.

3) Concurrent with each of these activities that focus on control structures or on water are certain basic **organizational** activities

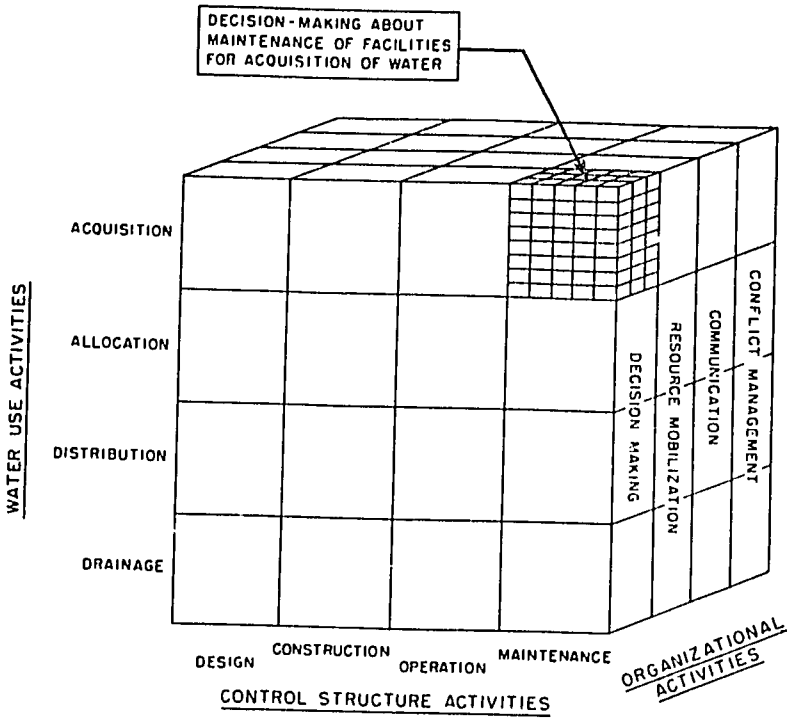

Figure 1: Matrix of Irrigation Management Activities

necessary to sustain human efforts. These activities can deal with the structures, with the water resource, or with the irrigation organization itself.

A) **Decision making** for acquisition, allocation, distribution or drainage of water; for design, construction, operation or maintenance of structures; or for the organization that deals with these activities. **Planning** is a major form of decision making.

B) **Resource mobilization and management,** the marshalling and utilization of funds, manpower, materials, information, or any other inputs needed to control water through structures and for various organizational tasks. (For simplicity's sake, we will speak only of "resource mobilization" though proper management of resources is certainly needed to sustain their mobilization, so the two are linked.)

C) **Communication,** conveying information about decisions made, about resource requirements, etc. to farmers or any other persons involved in irrigation management. This activity area includes **coordination.**

D) **Conflict resolution,** dealing with the differences of interest that arise from activities of acquisition, allocation, distribution, drainage, design, construction, operation or maintenance, or to organizational activities generally.

By making such analytical distinctions and distinguishing whether the irrigation activity is directed at water, structures or organization, farmer participation can be considered either in general terms:

- how much user participation is there to decision making about system management?
- or in construction of irrigation systems?
- or in making allocations of water rights?

or more specifically:

- how much labor is being contributed to resource mobilization for maintenance?
- who is involved in the conflict resolution associated with water distribution by deciding disputes over users' "turns"?
- are farmers involved in the communication of any changes in the operating schedules for water delivery?

These three sets of activities focusing on water, structures, and organization form a three-dimensional matrix, represented in Figure 1.

This diagram makes it clear that when participation in irrigation management is approached from any angle, it intersects with other kinds of participation.

- To be effective, farmer participation in decision making (3A) or in resource mobilization (3B), for example, must have some specific object, such as the allocation of water rights (1B) or carrying out system maintenance (2D).

- Similarly, participation in system operation (2C) needs to be specified: does it include farmers making decisions (3A) and resolving conflicts (3D)? or do they only contribute information and labor (2B) and handle communication and coordination (3C) among themselves?

- Farmers' participation in acquisition (1A) could involve them in doing the work to build a dam or diversion structure (2B and 3B), or also in making decisions about location, schedule and cost (2A and 3A), or in negotiating with upstream users about sharing access to water (3C and 3D).

It will be seen that the fourth activity in each set is "residual." Drainage efforts (1D) are not needed with certain types of soil, topography, etc. The amount of maintenance (2D) is variable, affected by water quality, design, operation, etc. There may be little need for conflict resolution (3D). But to the extent that are needed, all three activities must be adequately discharged for irrigation systems performance to be sustained.

This analysis makes the subject of farmer participation somewhat more complex than found in previous discussions. However, it has the advantage of making the subject much more concrete. Dealing with it in simpler terms unfortunately makes it too abstract and ambiguous. The conceptualization introduced here should make it easier to plan and implement better policies and programs for irrigation management.

Implications for Policies and Programs

Based on our review of the literature, some suggestions about farmer participation in irrigation management can be offered.

(1A) Relevant farmer participation in **acquisition** will vary depending on the size of the irrigation system, discussed below in terms of the number of levels of operation rather than simply in terms of irrigated acreage. In small systems relying on a run-of-the-river diversion barrage, small catchment dam or tubewell, acquisition activities can be carried out fairly reliably by users.

In contrast, within huge systems such as in India, Pakistan, Egypt or Sudan, farmer involvement in acquisition is quite different. It may involve lobbying with the agency that controls the water to get both allocation and distribution to a particular part of the command area. Acquisition may require farmers to protect the water allocated to them to be sure it reaches their channels, or there may be stealing of water allocated to others.[3]

The need for collective action to acquire water for irrigation, whether the activity focuses on physical structures or on people, presents the most compelling incentive for farmer participation in water management. Consequently, where farmers have no problems in acquiring water, their organizations are likely to be weaker (Martin, 1986).

(1B) Farmer roles in **allocation** likewise can vary. At the level of the small channel serving their fields, this is a matter of determining how water will be shared among users, according to some rule or criterion. At higher levels in a large system, allocations are made in an abstract way, with duties of water assigned to areas within the command according to measures such as cusecs. These activities can be seen, respectively, as "retailing" and "wholesaling" irrigation water. Farmers should certainly have a role in the former, but they can also participate with agency managers in deciding on the latter.

Plans for the implementation and operation of an allocation scheme, i.e., **distribution**, must contend with the universal problem of locational advantage, where upstream users have greater opportunity to obtain their share (or more than their share) than do users downstream. In the absence of organization (or of powerful users downstream), inequalities in distribution are commonly observed. Water user organizations are often set up to prevent maldistribution, but they are not uniformly successful.

There are many examples in the literature of user-devised techniques and incentives to

promote proper distribution, e.g., using proportioning weirs or giving those persons distributing water some land to cultivate at the tail of the command area. Farmers' ideas and energies need to be enlisted in distribution since poor retailing can negate even the best wholesaling of water.

Where there are marked differences between wet and dry season irrigation, users should be able to operate seasonally different schemes of distribution, e.g., in Indonesia (Duewel, 1982), Mexico (Downing, 1974), Peru (Mitchell, 1976), and the Philippines (Robinson, 1982). Governments often unwisely expect or require uniform rules of distribution year-round. Users themselves, however, are in the best position to make adjustments to meet seasonal and locational variations.

There are certain situations where farmers may prefer to have an agency handle tasks of distribution as a way of reducing conflicts or avoiding laborious efforts. Lowdermilk et al. (1975) report that Pakistani farmers are glad to have the agency distribute water among groups according to strict rules. However, they wish to handle water distribution within the groups themselves, modifying the official **warabandi** rotation through informal, ad hoc arrangements for water trading (which the agency had declared illegal) so as to better meet farmers' respective irrigation needs.

(1D) There is little reference in case studies to farmer involvement in **drainage** activities. This reflects one of the "blind spots" in the irrigation literature. Improving water control among users can help alleviate drainage problems, so this activity should not be viewed in isolation. Any reuse of water, which farmers are often able to plan and manage better than agency staff, will increase irrigation efficiency. Drainage activities must be performed by someone whenever they are needed. The analytical framework proposed here calls attention to this commonly neglected activity so that some explicit decisions can be made about who will have responsibility for drainage.

(2A) Participation in the **design** of structures to control water from a source (acquisition) to farmers' fields (distribution) and beyond (drainage) according to some guiding rules (allocation) can be done by users and/or specialists. Generally, the larger and more complicated the system, the more the latter are needed to introduce scientific principles and technical information into the design. However, this does not mean that farmer participation in design activities should be limited to small schemes.

The technical knowledge of water users, even if not formalized, is substantial. In Quinua, Peru, one finds impressive irrigation systems designed to serve land in a vertical series of environmental zones, each with different conditions. A limited amount of water is distributed in a parsimonious way at successive times in different places at different altitudes to be used for different purposes "in a most economical dovetailing of functions" (Mitchell, 1976: 39).[4] One finds similar technical ingenuity documented in other countries, such as Kenya (Ssennyonga, 1983) and Nepal (Pradhan, 1983; Martin and Yoder, 1983).

Participation in design does not necessarily mean drawing up plans, but it can usefully involve consultation. The literature documents cases in Mexico, Nepal, and the Philippines where farmers told engineers that the dams they were designing would not withstand the force of rainy season flows. In all three cases, engineers were sure their calculations were adequate and correct. Much to their embarrassment, the dams did wash out (Cernea, 1984a; Shrestha, 1980; D. Korten, 1980). If farmers without formal education in hydrology or material sciences can be correct about factors involved in dam design, their questions and their cautions should have some value.

(2B) **Construction** is a task frequently undertaken by users, often under the direction of technical personnel. The skills of the Marakwet in constructing their schemes in Kenya have been described by Ssennyonga (1983).

> In some places, water canals are suspended up to 15 feet above the ground. The construction of these pole-supported structures demanded considerable ingenuity; for example, the constructors had in some cases to be suspended by a network of ropes manually held by a team of strong men. In other instances two or even three water furrows flowing in different directions had, due to physical barriers, to pass through one narrow point. In such cases, wooden aquaducts (dug-out tree trunks) were used to enable at times several furrows to flow on top of one another.

Similarly inventive techniques are found in Nepal where channels often need to be tunneled through the sides of mountains (Martin and Yoder, 1983).

This suggests that farmer participation in construction should not be restricted to simply providing labor, which is essentially a resource mobilization activity. Participation can also include management responsibilities and technical problem-solving.

(2C and 2D) **Operation and maintenance** (O&M) are generally treated together, perhaps because they so often occur concurrently, although they are in fact quite separate activities.

There is little disagreement that farmers can handle O&M "below the turnout." Indeed, it is usually necessary for economic reasons for users to distribute water and maintain the physical system at the field channel level because the cost of government attempting to do this would be prohibitive.

The policy question is how much if any O&M responsibility farmers should have "above the turnout." There has been relatively little documentation or evaluation of this question (Chambers, 1984). User-managed systems such as the Chattis Mauja scheme in Nepal, discussed above, show that there is considerable capability among farmers for effective O&M activity over fairly large areas.

Programs in the Philippines, Sri Lanka and Thailand have shown that through systems of farmer organization that provide channels for representation at higher levels, farmers can make substantial contributions to O&M above the turnout—giving ideas as well as their labor and funds (F. Korten, 1982; Bagadion and F. Korten, 1985; Uphoff, 1985 and 1986; Kathpalia, 1984).

(3A) Farmer participation in **decision making** requires an organizational structure, possibly informal, which is recognized by users and agency personnel as legitimate. The level at which users should participate, for example, in planning water allocations or authorizing budgets for maintenance, may be controversial.[5] However, not only can better decisions result, but users may cooperate more readily.

There can be a lack of decision making at the field channel level or decisions may be unreliable or inequitable because no proper organization exists among water users. In irrigation systems created by governments, although there may be some informal organization, too often there are no established forums for the identification and solution of problems and no channels for collective action. When there are no institutionalized means of decision making, we also find that there will be less resource mobilization, communication, and conflict resolution.

(3B) **Resource mobilization** is the kind of participation that agencies most often want from farmers. Indeed, farmer contributions of money or work may be the only kind of participation sought. We stress, however, that farmers' information is also a valuable resource to be mobilized for irrigation management through farmer organization.

Material resource mobilization can be substantial. The Chattis Mauja organization in Nepal mobilized and managed over 60,000 man-days of labor a year from its 4,000 farmer-members. In the smaller systems of Argali and Chherlung, 1,500 to 2,500 days (25 to 75 man-days per hectare) were raised, in addition to cash contributions (Martin and Yoder, 1983).

For such contributions to be productive and to be sustained, there must be good resource management, with minimal losses due to technical failings, inefficiency, or corruption. In indigenous irrigation organizations such as those documented in several Southeast Asian countries, precise accounting methods and definite organizational procedures are employed to ensure that fair shares are contributed and all resources are properly used (Birkelbach, 1973; Potter, 1976; Siy, 1982).

Depending on users' circumstances, it is often easier for them to contribute labor than cash. Especially where money incomes are low, farmers usually prefer providing labor. On the other hand, when there are good opportunities for wage labor or other claims on farmers' time, they may wish to make payments instead of participating in work parties. Often hybrid systems of resource mobilization raise both cash and labor (Coward, 1976; Duewel, 1984).

Resource mobilization from users appears more likely to be successful when decisions on means and shares are left up to the users.[6] Also, it is advisable to permit a number of different means of mobilizing resources to cover organizational and investment costs.[7] A standardized system cannot tap resources that are most accessible and plentiful or those sources from which people are most willing to contribute.

(3C) **Communication** is an organizational activity that generally is overlooked because it is so obvious yet essential and continuous. A

number of indigenous irrigation systems have members specially assigned to communication roles, such as the "blowers" among the Marakwet in Kenya, the "messengers" in the Chattis Mauja scheme in Nepal, and the "runners" in Thai irrigation systems.

Failures in communication can exact heavy costs in terms of system operation and maintenance. Studies in India and Pakistan found that between 70 and 83 percent of farmers did not know when they were expected to do maintenance and repair work or even the dates when water issues would end (Lowdermilk, 1985). In such cases, even one-way communication (to farmers) is inadequate, and two-way communication conveying farmers' needs and capabilities to system managers is still more deficient. Without regular communication among farmers, they cannot cooperate to use available water to best advantage.

(3D) **Conflict resolution** is difficult to assess because where there is much visible "success," it may be because low-key efforts to avert conflict did not succeed. Where there is little or no strife, rules and procedures may have been devised and followed that handle problems and disagreements so smoothly that they are resolved before disputes or blows result.

Some communities and cultures appear to have a disposition for conflict, whereas in others there seems to be an aversion to conflict (Bhatty, 1979; Merrey, 1982). Where irrigation is important for survival, the need to cooperate may overcome propensities for conflict that may exist in the community (Wade, 1982).

Generally, conflict management works better through informal mechanisms, such as those provided by "traditional" roles and institutions. However, having formal-legal procedures available may be a good idea, to put some pressure on all concerned to make the informal channels work more quickly and fairly. Informal conflict resolution may be attempted at lower levels of organization, with the possibility of appealing to more formal structures at higher levels if necessary.

This is one reason to have a system of irrigation organization that starts at the field channel level and spans as many levels of organization as there are levels of operation, as discussed below. Such a multitiered structure will provide opportunity for timely decision making at appropriate levels and also for resource mobilization, communication, and conflict resolution.

These four organizational activities can be carried out "internally" within any particular association of water users (or for that matter, within an irrigation bureaucracy). Of particular relevance for farmer participation in irrigation management is the extent to which these activities occur "externally," i.e., between levels of organization:

- whether farmers' representatives participate in decision making at higher levels;
- whether water user associations are able to mobilize resources from outside—loans, technical assistance, etc.—to help solve their problems;
- whether farmer groups communicate freely and frequently with technicians and administrators, and vice versa; and
- whether farmers get involved in resolving conflicts between and among groups of users rather than simply deal with problems within their local groups.

Although organization is commonly said either to "exist" or not, it really should be considered as a matter of degree—how organized are irrigation activities? One seldom finds no organization at all among water users or no connection with agency managers where they are relevant. The organization may be informal, without written rules or legally recognized roles and sanctions, but it is still organization.

Organization exists to the extent that there is some recurrent decision making, resource mobilization, communication, and conflict resolution. Organization should be assessed in terms of its sufficiency, whether it can handle these four functions to the satisfaction of all or most users and consistent with government policy objectives.

Where these various activities could be better performed with a greater degree of user participation, there is reason to encourage appropriate initiatives to develop farmer organization, since participation is seldom sustained or broadly productive when undertaken on a purely individual basis.

Before getting into policy and project design considerations, however, it is necessary to think about more than what farmer participation activities are to be promoted. Where will they occur? Who will be participating? And how? In particular, one needs to look at the levels at which farmer participation can be promoted. Although we have already touched on this issue, we need to analyze it more systematically.

Levels of Operation and Organization

Levels within an irrigation system are socio-technical in that they can be defined either physically or organizationally. First, there are levels of operation, which are established by physical points of water control—such as a gate or partitioning weir—between the water source and the fields.

Any control structure that can give or withhold water from a command area below it creates a level of operation. Such an area may be divided and further subdivided by subordinate control structures, which each create a lower level of operation by dividing the water into smaller flows.

The lowest operational level is created by a turnout structure that provides water to a field channel from which a number of fields receive a flow of water that is distributed among them. The preoccupation of farmers with getting and applying water are fairly similar at this level whether the scheme is 10 hectares or 100,000 in size.

Paralleling this are levels of organization that are established socially when some number of persons—water users and/or agency personnel—carry out decision-making activities, resource mobilization, communication, and conflict resolution at and for a certain level of operation.

One can say that to the extent these tasks are being carried out—by water users and/or by technical staff—there is some organization at that level, which corresponds to a level of operation in the irrigation system. Generally, there will be at least some organization at each physically-defined level of operation, but how well it functions can vary greatly. Organization at a particular level may be informal rather than formal. It may be quite perfunctory, even unsatisfactory. But any performance of these tasks establishes a level of organization in practical terms.

Rather than compare irrigation systems according to their size, measured usually in irrigated or irrigable area, more insight can be gained by examining the number of levels of operation and organization.

The simplest (and smallest) systems have only one level of water control and organization. Their common feature is the relative independence of their water sources as the amount of water taken from one spring, tubewell, or small reservoir will have little if any affect on other systems.

To be sure, the wells in an area share a common water table, and river sources can be diminished by offtakes. If there is some interdependence of supply (relative to demand), sooner or later one will find organizational linkages establishing capacities for conflict resolution, comunication, etc. at more than one level.

Two-level systems are found with larger water sources and command areas or where several small systems are interdependent. In such circumstances, a second level of organization is necessary to allocate water among the lower-level units and to arbitrate disputes among them. Also, some resource mobilization is needed for maintenance of common facilities. Organization can be quite informal, as in the **ahar** systems in Bihar State of India (Sengupta, 1980), or quite formalized, such as in the **zanjeras** in the Philippines (Siy, 1982).

Three-level organizations for irrigation represent additional complexity and possibilities. Usually some degree of formality is needed at higher levels, although the primary level of organization can operate quite informally (Meinzen-Dick, 1984; Pradhan, 1983; de Silva, 1981; Stavis, 1982).

Beyond three levels of organization, the role of users usually becomes attenuated. Water users may be actively involved in various management activities from below at the first and second levels, and sometimes at the third, but not higher unless special provisions are made for some form of representation, as for example, in the Muda scheme in Malaysia (Afifuddin, 1978). To show how systems can be compared in this way, we have sketched examples of one, two, three, and four-level systems in Figure 2.[8]

From our analysis of case studies, we have observed some orders of magnitude characterizing the number of levels in irrigation systems of different sizes. There are some variations due to natural factors, such as topography, as well as man-made causes, such as engineering design. The average size of holdings affects whether the area served at a particular level of operation and organization is in the upper or lower end of the range indicated below. But generally speaking, we find the following pattern:

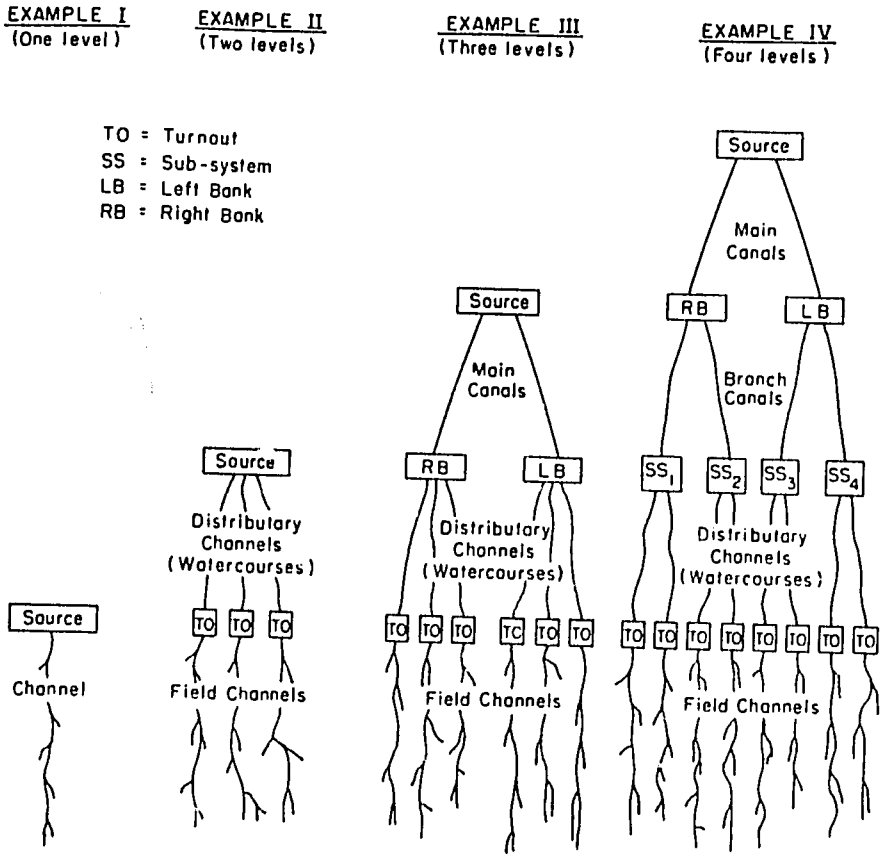

Figure 2: Configuration of Systems with Different Numbers of Levels

One-level systems or the first level of larger systems	Generally under 100 acres
Two-level systems or the second level of larger systems	Generally 100-1,000 acres
Three-level systems or the third level of larger systems	Generally 1,000-10,000 acres
Four-level systems or the fourth level of larger systems	Generally 10,000-100,000 acres
Five-level systems or the fifth level of larger systems	Generally over 100,000 acres

We list these ranges in acres rather than in hectares because the order of magnitude effect is clearer. These are not invariant ranges, but about 80 percent of the cases reviewed fit this pattern.

It might seem surprising that these levels are denominated in terms of acres rather than the number of farmers. Unfortunately, the latter number will always vary because average holding sizes differ so much across systems. In situations where the average landholding size is small, the area subsumed under any particular level will tend to be at the lower end of the range. Conversely where holdings are large, the area will usually be in the upper end of the range.

Implications for Policies and Programs

Our suggestion above when discussing farmer participation in different activities that the nature of management tasks will vary between lower and higher levels of irrigation systems, becomes clearer with this conceptualization and differentiation of "levels." A number

of observations can be stated from a review of irrigation experiences.

There is no necessary point at which responsibility for management tasks should be taken over by the agency. We saw in the Chattis Mauja case that farmers could handle all functions at the third level, encompassing an area of 3,000 acres, and there was an informal fourth level established by joint consultation with other user-managed systems also drawing water from the Tinau River. At the other extreme, in the Mwea system in Kenya, the agency planned for virtually no user participation in irrigation management even at the lowest level. Water was to be delivered to farmers' fields by agency personnel (Chambers and Moris, 1972). This has proven to be not only exceedingly costly, but it did not contribute to good irrigation results.

One observable tendency is for higher levels of organization to operate more formally, although informal procedures and consensual norms will exist even at the highest levels. Where the number of persons involved in irrigation management is larger and the distance between points in the command area is greater, more explicit decision-making processes and written records become necessary. Social pressures that could elicit cooperation in small groups with informal modes of operation are no longer as effective.

Direct participation of farmers in decision making is more feasible and invariably needed at lower levels. At higher levels, engaging all water users in deliberations becomes difficult or impossible. Instead, representatives of groups or associations at lower levels are incorporated into higher-level organization, and executive or committee styles of decision making become more common than assemblies of all members.

Mobilization of labor contributions for irrigation management is more feasible and useful at lower levels. These contributions are usually more difficult to mobilize and manage at higher levels of operation. There, cash becomes more important for paying salaries and buying materials and equipment. The Chattis Mauja case shows that mobilizing substantial labor along with money is feasible with good organization operating above the secondary level.

The correspondence between technical levels of operation and social levels of organization should always be considered. One recurring issue is whether in water users associations it is better to join together residential neighbors or "field neighbors"—cultivators who share a common source of water but who are not necessarily members of a social community. This question will be considered in discussing project design, but we note here that the set of persons in the organization at a level should be those who are involved in the <u>operation</u> at that level.

The kind of multi-tiered system of organization suggested above to deal with the various tasks of irrigation management is easier to conceive and plan once the reality of "levels" is appreciated. Any such system will depend greatly on having strong, base-level units of organization—<u>groups</u> of cultivators whose fields are served by a common source.

Such groups constitute the "building blocks" for larger irrigation management structures. Just as physical control structures, such as gates and pipes, are needed to prevent water from flowing freely and wastefully at lower levels, there is need for <u>social control structures</u>.

Across dozens of different irrigation systems we find the size of these "turnout groups" to range between 10-15 and 25-30 users, depending on whether average holdings are large or small. The area served by a turnout is typically 50-75 acres (20-30 hectares), although the range is 25-100 acres (10-40 hectares). Membership can be as low as 5 or as high as about 50 persons, but at these extremes, groups are less viable and cannot serve as solid organizational building blocks.

Where such groups are federated into larger water user organizations, decision making, resource mobilization, communication, and conflict resolution can be undertaken at levels best suited to the problem at hand. While strong base-level groups are needed for effective higher-level organization, the latter can in turn bolster the functioning of the constituent base-level groups. What should emerge is a dynamic of mutual reinforcement.[9]

<u>Who Participates</u>?

No homogeneous "flow" of participation in the various tasks of managing water, structures, and organization should be assumed. Water users do not all have the same interests, incentives, or capabilities. There is reason to be concerned not simply with <u>who</u> is participating in various management activities, but also with who is <u>not</u>.

The following factors often contribute to unequal participation in the activities and benefits of irrigation:

Location. Locational differences, usually between upstream and downstream water users, are almost universal in irrigation systems. One of the goals of farmer organizations may be to reduce these differences by involving downstream farmers in decision making, for example, or by establishing channels to resolve competing water claims in an equitable manner.

Gender. This is often an "invisible" differential because it is frequently taken for granted that irrigation is "man's work," even though women are heavily involved in the actual work in the fields. Commonly, membership in water user associations is assigned to "household heads," which is understood to refer to male representatives.

Landholding. This has two aspects, differences in amount or quality of land and in tenure status. For example,

- The mobilization of labor resources for construction and maintenance may come mostly from smaller farmers while it is farmers with larger holdings who make most of the decisions about water allocation and distribution.

- Membership on the council that resolves water disputes may be restricted to landowners, so that tenants are at a disadvantage in the resolution of conflicts over water.

There may be different rates of membership or meeting attendance between large and small operators or between owners and tenants that affect the outcomes of irrigation management.[10]

Economic Activity. This includes two important aspects:

- Where a substantial number of cultivators are part-time farmers, their stake in operating and maintaining the system, or in expanding it or making it more efficient, will be different from that of full-time farmers. Equal participation in certain management activities can be interfered with by competing demands for labor time.

- Where irrigation water has nonagricultural uses, significant conflicts of interest can arise—for example, between farmers and fishermen, or with makers of beer, paper or other products, or with operators of water-driven mills. Divergences of interest and activity between agriculturalists and non-agriculturalists can crucially affect allocation decisions or investments in maintenance of supply.

Other Characteristics. Other distinctions like age or ethnic background may in certain cases be important to consider.

Implications for Policies and Programs

When seeking to increase farmer involvement in irrigation management, governments and donors should first monitor irrigation activities. They should determine not only how much participation is occurring in the different facets of water acquisition, design of structures, decision making, etc., but who is participating in them. Where certain deficiencies in participation can be anticipated, such as of tail-enders or women or tenants, efforts should be made to support more broad-based involvement of bypassed categories.

One possibility for dealing with locational disadvantages is to introduce a system of weighted representation or voting that favors tail-enders. However, distributing water at the field channel level requires a high degree of voluntary cooperation. Agencies lack the personnel and information to enforce schemes of water "retailing" at this level so having organizational channels for working out some consensus between upstream and downstream farmers appears more promising than legally-based procedures (Uphoff, 1982).

The kind of small, base-level groups discussed above have usually been able to fashion workable means of moving water so that fair shares are received. The kind of federated structures of organization suggested there should permit water users together with agency personnel to devise rules for allocation and distribution that divide water appropriately between and within levels.

Changing attitudes among men and women toward the participation of women in "public" roles is a protracted process, which irrigation projects cannot be expected to accomplish by themselves. But one measure to increase the participation of women in irrigation management suggested in a World Bank paper is to vest membership for water user associations in "households" rather than explicitly or implicitly in "household heads."[11]

The Rahad irrigation project in Sudan has taken the unusual step of reserving six seats for women on each Village Council, which is authorized to deal with some irrigation management activities (Benedict et al., 1981). Whether this will add much to women's participation is doubtful because the Councils themselves are relatively unempowered to deal with water problems.

The participation of cultivators owning little or no land is likely to be constrained by barriers of economic power if not of cultural discrimination. Reserving seats for them as done on the Cultivation Committees in Sri Lanka over almost two decades perhaps contributed somewhat to the influence of poor farmers on irrigation matters at lower levels, but unless the organizations themselves are effective, membership yields no advantage (Moore, 1979).

Probably the most important step is for project managers and government administrators to bear in mind that economic interests among water users are not identical and to encourage broad participation in all aspects of irrigation management. Employing "catalysts" to initiate and sustain organizational efforts as discussed below can make it more likely that farmers with less income, education, and status will get brought into responsible positions.

The same holds true for increasing the participation of other less advantaged groups. Potential leaders from among the young, for example, or from among groups socially discriminated against, can be identified and given training and encouragement by organizers who have built up bonds of friendship within the community.

Modes of Participation

Just as one should not assume homogeneity among participants in irrigation management, neither should one expect participation to occur in the same way everywhere. There are qualitative differences in how participation is undertaken and these can affect the sustainability as well as the productivity of farmer involvement.

How participation occurs can be understood in a number of ways. Here we identify the most salient dimensions and suggest their implications for irrigation policies and programs.

Initiative. Decisions and investments to create an irrigation system can come from farmers themselves or from some government agency or private entrepreneur. This will affect perceptions of "whose" system it is. The same thing applies to users' roles in managing the system. It makes a difference whether this role is determined by the users themselves or by some outside agency, since initiative is usually seen as indicating in whose interest the effort is made.

Users are more likely to accept and demonstrate responsibility when they feel a system is "theirs," rather than "the state's." Where irrigation has been introduced by the state, users may even be reluctant or unable to initiate a role in management, so agency initiative may be necessary if any change in attitude is to come about.

Even if farmers have not been involved in the design or construction phases, giving them a voice and a hand in O&M through water user associations can enhance their identification with the system. In this way, state-initiated systems can evolve into jointly-managed ones (Bagadion and Korten, 1985; Uphoff, 1985). In the Philippines, the National Irrigation Administration is handing over full management responsibility to WUAs in some large blocks of government-initiated schemes, with a view to eventually turning whole schemes over to management by WUA federations. This approach is similar to the way irrigation is managed in Taiwan (Abel, 1975; Bottrall, 1977; Stavis, 1982).

Incentives. Most considerations of incentives focus on financial or economic benefits relative to costs. There are, however, other bases for people to cooperate with one another or to comply with decisions, such as voluntary action based on normative considerations or compulsory action based on coercion.

Voluntarism has both advantages and disadvantages. People do not have to be paid for their contributions, and there can be more enthusiasm and creativity. At the same time, voluntaristic action is subject to much variation and may not be reliable. Coercion can be more predictable, but it can have great costs in application, as well as being ethically objectionable.

To the extent that participation is purely voluntary, it implies that the activity is meeting people's needs and is congruent with their values. Other considerations besides individual

economic benefit can come into play, such as the expectations of friends, political alliances, a sense of fairness, or wanting to promote social harmony and cooperation.

Material interests may create the most tangible and predictable incentives, but irrigation management should not overlook the possibilities of cooperation based on social values. Where economic benefits are great enough, even comparatively coercive management may be accepted, as in the early years of the Gezira scheme in Sudan. However, compulsion alone does not provide a sustainable basis for efficient system operation.

Frequency. Farmers need to be frugal with their time and energy. Attending meetings, communicating with one another, rotating water deliveries, and doing maintenance work will all have "negative rates of return" past some critical minimum level of effort.

Participation in different aspects of irrigation management may be

- continuous (e.g., communication)
- periodic (membership meetings)
- intermittent and ad hoc (emergency repairs)
- once-and-for-all (design and construction)

Some activities, like maintenance, could be any one of these, depending on the nature of the system and the willingness of users to engage in them.

Participation is often seen by outsiders as a repetitive activity for which strict, continuous schedules should be set and kept, such as holding regular meetings throughout the year (Fortmann, 1985). Yet farmers' lives are arranged according to cropping seasons rather than calendar months. Soil-water requirements do not always match up with water delivery rotations fixed according to seven-day schedules.

Agencies' expectations about irrigation management activities should reflect this reality. Arrangements for participation need to make allowances for cropping and other demands on farmers' time and should be both flexible and pragmatic. Rigid and apparently unproductive requirements for weekly meetings, labor campaigns, or collection of information will discredit such participation in users' eyes. There is nothing wrong with ad hoc meetings or intermittent maintenance so long as necessary tasks are adequately performed.

Formality. Similarly, participation need not always occur in "formal" modes so long as the performance of the system is satisfactory. We have not been able to do a systematic evaluation of this variable, but a quantitative analysis of 150 rural local organizations including a subset of water user associations, found a significant and positive correlation between the organizations' performance and their working more informally (Esman and Uphoff, 1984:141-144).

Some formalization of organization may be desirable, with written constitution and by-laws, prescribed offices, detailed accounting procedures, government recognition, registration or regulation, etc.[12] Water users themselves may want to have little ambiguity about rights and obligations. But they are the best judges of how much formalism they need in their management activities—of how much needs to be written down or formally ratified rather than simply left to verbal consensus and precedents.

Also, as suggested previously, within a structure of water user organizations that operate at various levels, the lowest levels of organization can carry out their tasks with a minimum of formalization, while higher levels proceed more according to written prescriptions and procedures.

Directness. Participation can be either direct or indirect, by the water users themselves or by persons acting, deciding, or contributing in their stead. Participation in decision making at second, third, or higher levels of a system is usually indirect, through representatives. Payment of fees can be by richer farmers on behalf of a whole community. Communication and conflict resolution can also be through intermediaries rather than face-to-face. In indigenous systems, it is common to find water management "specialists" recruited and paid by farmers to distribute water on their behalf. This is another form of indirect user participation (Meinzen-Dick, 1984; Duewel, 1984; Bhatty, 1979).

Indirect participation may be quite acceptable and even necessary or beneficial. Farmers who had remunerative employment opportunities between cultivation seasons (when they are expected to clean channels) might hire unemployed persons to do this work on their behalf.

Each case should be considered for its implications for efficient and equitable system operation. We have already noted that it is

Farmers' Knowledge of the Area	Farmers' Knowledge of Irrigation: High (I)	Farmers' Knowledge of Irrigation: Low (II)
High	Farmers in traditional irrigation system (Chattis Mauja, Nepal) or long-established irrigation culture (Abu Raya, Egypt)	Irrigation being introduced into settled farming area (Matam, Senegal)
	(III)	(IV)
Low	Resettlement of farmers familiar with irrigation into new system (Muda, Malaysia)	Resettlement of rainfed farmers into irrigation (Mwea, Kenya)

Figure 3: Alternative Irrigation Contexts

probably not desirable to have indirect participation by women in WUAs "making decisions" through male household heads. The same can be true for young farmers who are doing field operations but who have no role in WUAs because their elders "speak for them." This can contribute to dissatisfaction and also obstruction (Weeramunda, 1985).

Contexts of Participation and Implications

Before making judgments about what kind of participation, or how much might usefully be promoted, the context needs to be considered. Historical, physical, and other variables modify the feasibility or desirability of certain activities and extents of farmer participation.

Historical Factors. The knowledge and skills that water users can bring to the tasks of management will depend in part on the history of each irrigation system. This determines how much farmers know about irrigation and about the area. Four alternatives can be delineated as suggested in Figure 3.

In the first situation, farmers can make the greatest contribution to management because they have experience both with irrigation and with the area, its soils, its rainfall patterns, etc. Also, they have experience in working together unlike the third and fourth situations of resettlement.

Where irrigation is being brought into a rainfed cultivation area, some technical assistance and training in water management principles and techniques may initially be necessary. But farmers' roles can be fairly quickly expanded, as, for example, in the Matam area of Senegal (Fresson, 1979).

In the third situation, efforts need to be directed more toward group building and social relations than toward giving technical training on irrigation. The fourth situation is the most difficult, and some of the problems observed in the Mwea scheme can be attributed to the context apart from the manner of its administration (Chambers and Moris, 1973).

Historical factors also include initiative, already discussed—who created the physical and social system for irrigation? The pattern of prior investment by creating concepts and claims of "property" will have an effect on water rights and responsibilities for system performance (Coward, 1983; Siy, 1982).

It is also important to apply an historical perspective to the irrigation system itself. Every system is continually changing along a number of dimensions, such as water availability, intensity of use, population pressure, cropping patterns, market conditions affecting the profitability of production, etc. These will affect the incentives water users have to accept and carry out responsibilities for efficient management; agency expectations and requirements need to take these influences into account.

Physical and Economic Factors. Farmers' investments of time and effort in irrigation management activities reflect particularly their need for adequate and reliable water. Where water is abundant, there may be little or no need for individual or collective effort to acquire, allocate, and distribute it (although there may be need for drainage activities under certain soil and topographic conditions).

Water scarcity gives impetus to farmer organization and participation, but we also observe that where the supply is quite small or unpredictable, the return from farmers' investment of resources in irrigation facilities and activities can be too little or too risky. Of course, supply and demand need to be considered in relation to one another. A very small supply might be adequate for a few farmers if it could be obtained at an acceptable cost. This moves consideration from physical to economic and even social and ethical concerns.

Supply of water for irrigation depends both on the source of water and on available technology to acquire and convey it. Topography and soils will affect both accessibility and adequacy, so they also come into consideration. A particular cropping pattern establishes a certain demand for available water, but it reflects cost and price relationships, which in turn affect the profitability of irrigated farming. Fairly quickly one finds a complex of physical and economic factors interacting to influence the incentives farmers have for participation in management and for investing in the organization that will institutionalize this.

Farmer dependence on irrigation—whether or not they have economic alternatives—is a key factor. If farmers' livelihood revolves entirely or mostly around their irrigated crops, the organization that manages water is very important. On the other hand, we often find rainfed crops as important complements to or competitors with irrigated ones within the farming system (e.g., Leach, 1961). In such cases, agency expectations about farmer responsibility need to allow for these other activities.[13]

Sociocultural and Political Factors. The contextual factors noted thus far are reasonably tangible and measurable. However, the role of more abstract traditions, values, and ideologies in shaping farmer orientation toward participation and organization should not be ignored.

Ethnic and other social differences can form lines of cleavage and potential conflict among water users, especially if these correspond to differences in land tenure status or in access to water. Fortunately, more often we find ethnic and social solidarity within a group of cultivators contributing positively to their willingness and ability to work cooperatively, for example, the **zanjeras** in the Philippines or the Marakwet case in Kenya.

There may be culturally sanctioned forms of conflict resolution, such as those deriving from Islamic law, that help in the operation of water user groups (Fernea, 1970; Wilkinson, 1977). On the other hand, cultural values do not always favor cooperation. The concept of **izzat** (honor) is a source of considerable strife in the Pakistan community studied by Merrey (1982), and charges of witchcraft based on traditional beliefs kept two irrigating hamlets of Wamira in Papua New Guinea divided through much of their history (Kahn, 1983).

Just as cultural ideology affects the degree of cooperation among farmers, so does political ideology have an important influence on working relations between farmers and an irrigation agency.[14] Strong populist sentiments are the exception rather than the rule in government agencies, especially where technical staff have much higher levels of education and social status than farmers. As discussed below, the orientation of the bureaucracy toward working with farmers is a key factor affecting participatory management.

NOTES

[1]A diverse sample of 50 irrigation systems (or sets of irrigation systems) was selected and analyzed according to almost 100 variables. The data from these cases are used extensively in the working paper referred to in the Foreword. A listing of the cases is given in the Annex to this report. The majority of cases found in the literature were from Asia, but that should be acceptable since this region contains about 85 percent of the irrigated area in LDCs.

[2]While structures for the acquisition, distribution and drainage of water are basically physical, those for its allocation are essentially legal, contractual, or consensual. Still, even if allocation activities are less palpable than those for acquisition, distribution and drainage, their management requirements are parallel. We know that all "structures" need planning and designing, some construction or other methods of implementation, some process of operation, and some efforts made to maintain them in functioning condition.

[3]In a Tamil Nadu system, farmers hire people to patrol the main supply channel to ensure that their tank receives its share of water (Meinzen-Dick, 1984). These water guards use or mobilize force to prevent encroachment on "their" water. Such acquisition methods, as well as paying bribes to officials if necessary, are reported in Andhra Pradesh state by Wade (1982 and 1982a). Patrols are necessary in hill irrigation systems in Nepal to minimize landslides' interruption of water supply acquisition (Martin and Yoder, 1983).

[4]The canal system begins in moist forest regions and ends in the low dry montane thorn steppe. The two major reservoirs are filled during the night and used during the day to irrigate fields near the central town, with some water for fields along the way also being drawn from the main canal. A network of minor canals permits separate use of reservoir and canal water. A simple system of gates has been designed to control the flow since overflowing would destroy the canals.

[5]This latter "radical" sharing of authority was introduced with good results in 1979 in the Minipe scheme in Sri Lanka by the present chairman of the Mahaweli Engineering and Construction Authority (de Silva, 1985). It is now government policy in Sri Lanka that farmer representatives should discuss and pass on maintenance plans and budgets since farmers are supposed to pay a per-acre O&M charge levied in all major schemes.

[6]Lees (1973) in her study of 24 communities in the Oaxaca state of Mexico found a great diversity of methods. Nine levied direct charges on farmers for water according to their land area or the time water was received, while others had more complicated systems that took into account individual contributions of time to village activities.

[7]Two systems in Thailand studied by Sirivongs (1979), for example, used a number of methods for resource mobilization including cash contributions, grain contributions, fines, selling shares of water, and selling land or conferring usufruct rights.

[8]Such analysis of levels suggests an inversion of the standard irrigation nomenclature of "primary," "secondary," and "tertiary" levels. The first usually refers to the whole command area of a system, whether large or small, and requires what has come to be known as "main system management" (Wade and Chambers, 1980). The level at which farmers get and utilize water, on the other hand, is the basic one, and it is the one that all systems have in common. It makes more sense to regard this level as primary. A next level up would be secondary and beyond that would be tertiary or quaternary levels. The usual terminology invites confusion as the "tertiary" level of community-managed irrigation systems in the Northwest Frontier Province at Daudzai bears little resemblance to what is called the "tertiary" level of irrigation in the Indus Valley systems of Punjab Province in Pakistan.

[9]The creation of a federation combining nine zanjeras in the northern Philippines added greatly to the performance of constituent units (Siy, 1982). One impetus for their cooperation was a change in the channel of the river from which they diverted their water supply. As it became increasingly difficult to obtain water, they benefited from coordinating their construction of weirs.

Small pump irrigation groups in the Bakel region of Senegal, even though their sources of

water were independent, set up a federation after several years of operating separately. They felt that they could better deal with the agency (SAED) with which they were working if they could take some decisions together. Also, joint mobilization of funds and labor was possible, and the groups could help each other keep their respective pumps supplied with fuel and spare parts (Adams, 1977).

[10]Adoption by donors and governments of the term "water user" was intended to promote participation of all cultivators in management regardless of landholding status, but practical or political problems still often impede equal involvement.

[11]"Experience (in the Philippines) shows that while women participate actively in the (WUA) meetings, generally they are not formal members because it is assumed that each household will have only one member, in which case it is normally the man. This means that women cannot be officers of the association—even though often they are well qualified. Mechanisms to allow joint membership from each household have been discussed to avoid this problem..." (F. Korten, 1982:16)

[12]"Traditional" water user associations may be quite formal in their organization. WUAs in the Northwest Frontier Province of Pakistan covering 14,000 hectares and 89 villages operate according to a code (**Riwaj-i-Abpashi**) believed to have been formulated in 1526, with subsequent revisions in the 1600s, 1870, 1895, and 1930 (Bhatty, 1979). Near Chiengmai in Thailand, indigenous WUAs set forth rules and regulations governing the system in a written contract each time new officers are selected (Sirivongs, 1979).

[13]One of the problems in the Mwea case in Kenya arose when the agency sought to restrict the size of unirrigated gardens and supplemental businesses in order to get tenants to work harder on their irrigated plots. However, rice was primarily a cash crop, while the families depended on traditional, unirrigated crops for home consumption. Moreover, the price the government paid farmers for rice was below the market price, making irrigated farming unprofitable. That farmers resisted agency management is not surprising.

[14]One of the most striking examples of this was seen in the Meichuan system in China, where agency technicians worked alongside farmers during a crisis to gain their confidence (Nickum, 1981). Similar close working relations are often reported from Taiwan as well, where technicians are employed by the farmers' Irrigation Associations.

III. SUPPORTING FARMER ORGANIZATION AND PARTICIPATION

We have seen that irrigation management is carried out with various objectives, promoted through a multiplicity of activities, at several levels of operation and organization, in different ways and under diverse conditions, with persons often having divergent interests and capabilities. This should make it evident that no single formula or solution is appropriate everywhere.

This means that the particularities and permutations of given situations need to be analyzed and allowed for when formulating and applying policies or when planning and implementing programs. This advice will be unwelcome in some quarters, but one of the principal sources of ineffectiveness in irrigation management has been the failure to tailor efforts to specific contexts and goals. While water may be the most uniform of resources, the circumstances in which it is used are anything but constant.

Having begun with this note of caution, there are some generalizations that can be extrapolated from the variety of irrigation experience documented in the literature. We will consider in turn

- decisions about strategy and resource allocation that arise at the level of policy, setting the framework for developing water user capabilities to engage in management;
- design decisions that shape the organizational channels through which farmer participation can occur; and
- improving relations between technical staff and farmers as a requirement for bringing about more effective user organization and participation.

The orientation toward farmer participation should not be one of maximizing its extent but of identifying and promoting the kinds and degrees that will further certain irrigation objectives.[1] Here, we will review overarching issues and approaches, mapping out a strategy for enhancing farmer organization and participation within which specific project efforts would be tailored.

Policy Considerations

Support. One can identify political support from national leaders as a precondition for success. Certainly, political opposition from high levels, and even low levels, can stalemate or abort an effort to increase farmer participation. But the notion of proceeding only with full support in advance smacks of the "blueprint" approach discussed critically below.

Some crucial minimum level of support is needed, but a program may perform better if it has to prove its worth to high officials as well as to farmers, winning and sustaining their support rather than regarding this as a "reserve fund" to be drawn down. Implementers have to be more innovative and attentive as they proceed if they cannot take top-level support for granted.

Many different agencies and actors need to contribute support to a program like this. They must be kept informed about program goals, methods, progress, failings, potential and the obstacles it faces. Establishing some kind of a support network of key interested individuals able to affect the actions of involved institutions is probably one of the best strategies for enlisting and maintaining cooperation with the program (D. Korten, 1982).

The ideology of the regime does not appear to be a crucial determinant of support for farmer participation. Some of the governments most favorably disposed toward farmer organization are usually classified as "conservative." No **a priori** presumption therefore should be made about regime support or opposition for participatory water management. There are good reasons for any kind of government to favor this approach, especially if water user associations steer clear of partisan politics as discussed below.

Experimentation, Phasing, and Flexibility. Experience in the Philippines and Sri Lanka with the introduction of farmer organizations supports what is now called a "learning process" approach (D. Korten, 1980; Uphoff, 1985). This contrasts with the conventional "blueprint" method in which a program is designed in considerable detail and then implemented—as a contractor builds what an architect has drawn on paper.

While objectives may be fairly clear, the means of achieving them in a specific context are not. Considerable improvisation is needed in any program involving social and institutional change. For a program's effective operation and spread, it is necessary to have a cadre of persons who have knowledge, experience, and commitment relevant to the program's goals. Social learning comes through experimentation and evaluation by individuals and groups. It must also involve persons who are "outside" the program—not just farmers, but administrators, politicians, researchers, and others.

While the "learning process" approach is gaining in acceptance, it is still being evolved as a methodology of development administration (Rondinelli, 1983). It is not a matter of raw trial-and-error, but draws on bodies of experience and theory that appear relevant to the situation, and includes continuous evaluations to improve the course of action.

The approach emphasizes two modes of actions:

- proceeding according to phases, concentrating first on learning to be effective, then to be efficient, and finally to expand the scale of the activity (D. Korten, 1980);
- working flexibly, making modifications in light of experience and increased understanding of the situation so that the prospects for resolving problems and achieving desired results can be improved.

The policy implication of such an approach is that programs not be locked into rigid time frames, budgets or methods, and that governments maintain a certain patience, forbearing from trying to "run" before an ability to "walk" has been demonstrated.

Building from Below. Without prescribing a particular organizational structure for all irrigation systems, we note that farmer organizational capacity for irrigation management is greatly increased when there are strong user groups at the lowest level of operation. These groups usually encompass command areas of 20 to 40 hectares, although in intensively cultivated systems with small holdings, the primary area may be as small as 10 hectares, or when holdings are large, up to 100 hectares.

It is tempting for officials to begin their organizing efforts from above, convening large meetings of farmers (or small meetings of local influentials) to form a large organization at the second or third level from the bottom. If subsidiary organizations are established, they result from the initiative of officials or influentials, perpetuating old patterns of status and dominance.

To begin at the field channel level when forming organizations opens up new possibilities for identifying and mobilizing leadership that is concerned more with agriculture than with power or politics. If the only way persons can move into leadership positions is through service to and acceptance by fellow farmers at the lowest level, this orients the organizations toward being effective in irrigation, whereas the usual top-down approach invites token or politicized activities.

Existing Organizations. One of the main policy considerations is whether or not to work, where they can be found, with organizations that already function among water users. These are often classified as "traditional" and therefore as unsuitable to the requirements of "modern" irrigation. Or they may be dominated by traditional elites, which the government would like to bypass (sometimes for good reasons).

This policy choice may intersect with the decision discussed below about organizational design, whether water management should be handled by specialized or multipurpose organizations. Sometimes, of course, there may not be any existing or suitable local organizations to work with. But often there are membership organizations dealing with water management or indigenous forms of local government that have duties in various areas including irrigation.[2]

Whether indigenous organizations will be able to collaborate with agency staff in improving water management cannot be determined **a priori.** Our conclusion from seeing the capabilities that such existing organizations generally possess is that governments are well advised to attempt to build a program of participatory irrigation management in conjunction with existing local organizations, subject to the qualification that equity objectives are not seriously compromised.

There has been a tendency for donors and governments to ignore existing social organization in project planning.[3] Ironically, existing organizations may be more able to adapt and to integrate their activities with those of government agencies than vice versa.[4] Existing organizations will not always be effective and

appropriate channels for farmer participation but they should be given an opportunity to perform on behalf of the community.

Ownership. To the extent that water users feel some proprietary interest in the irrigation system, they are more likely to take responsibility for its use and preservation. This is seen in the better maintenance and more efficient operation of "communal" systems compared to schemes seen as belonging to the "state."

Government policy in several countries has been to take over user-owned and managed systems after "modernizing" them, often without consulting the users about this (Coward, 1983; Morfit, 1983). This appears quite unwise.

Where an irrigation system has been created as public property with government funds, handing it over to private producers may not be possible. This problem may be handled by some system of payment for all or part of the capital costs, or by enlisting farmer participation in construction or rehabilitation work. One alternative may be to lease the physical facilities to users on condition that they perform necessary maintenance activities. Any system is likely to be better operated and kept up (and at lower cost to the government) if users regard it as "theirs."

This applies even more to the organization required for irrigation than to the physical structures. Even if water user associations have been set up at the instigation of outside agencies, it is essential that the organizations have considerable scope for adaptation and initiative. Otherwise, farmers will regard the WUAs as "the government's" responsibility, not theirs. The organizations will consequently not mobilize talents, resources, and ideas to the same extent as if WUAs are clearly seen as "belonging" to users.

Nonpartisan Associations. A very delicate but important subject is whether water user associations will be kept divorced from "politics." Where privileged access can be gained to water through political manipulation or influence, there is great temptation to do so. Yet almost universally we find that "politicization" of water allocation and distribution leads to irreconcilable conflicts, reducing the effectiveness of WUAs and often causing their demise.

Water users generally recognize this. When farmers in the Chattis Mauja scheme in Nepal are elected to its management committees, it is understood that they will abstain from any active role in partisan politics. Farmers in the Gal Oya system in Sri Lanka, a highly politicized country, have carefully kept their personal political attachments out of organizational affairs.[5] Peasants in the Bakel irrigation perimeters in Senegal have emphasized that their farmer associations are "nonpolitical" organizations (Adams, 1977).

Where there is a dominant party, the decoupling of politics from water management is itself "good politics" if it improves the efficiency of irrigation and enhances citizens' satisfaction with their government. Keeping partisan politics out of water management is more difficult where party competition is keen.

WUAs cannot operate without any connection to "politics." Contacts with and favors from politicians are bound to be necessary. This is where the policy of government toward WUAs is crucial. Farmers can have a "truce" among themselves within WUAs to put aside their respective political preferences, but this is not enough.

If a government wants to politicize WUAs in a single-party-dominant or in a competitive party system, it can do so easily by injecting partisan criteria in water distribution. The question is whether it will refrain from seeking short-run partisan advantage in the realm of irrigation management. Assuring that WUAs can operate without political favoritism or interference should produce positive results both for itself and for farmers.

Bureaucratic Reorientation. One of the main deterrents to farmers' assuming or accepting more responsibility for irrigation management is the orientation of the agency personnel with whom they must work. If government staff are arrogant, indifferent, or corrupt, water users will be hesitant to work in a collaborative mode with the personnel of government departments.

There is no basis for criticizing or indicting all engineers, technicians, and administrators. A great many are cooperative, hard-working, and upright. But too many, whatever their competence, do not appear willing to work respectfully, seriously, and fairly with water users in a joint enterprise of improving irrigation efficiency.

This problem has given rise to the concept of "bureaucratic reorientation" (BRO), which reflects experiences in the Philippines and Sri Lanka with efforts to change irrigation bureau-

cracies' attitudes and practices toward farmers (Korten and Uphoff, 1981).

BRO should not be attempted by orders or indoctrination. To create a more positive attitude toward user participation, the approach itself should be participatory. It should involve engineers and technicians in a process of collaboration with farmers, political leaders, administrators, and consultants. The agency's doctrine and self-image should change to support a new relationship with water users on the basis of persuasion and positive experience.

Bureaucratic reorientation, whereby government personnel become more willing and able to interact constructively with members of the public, will not happen without policy support. However, BRO is not necessarily a precondition for establishing farmer participation and organization for better irrigation management.

BRO will not occur all at once or in a vacuum. It is an evolutionary process in which demonstrations of farmer competence and conscientiousness can encourage changes in officials' attitudes and performance. Conversely, such changes from the bureaucratic side can prompt farmers to assume and discharge greater responsibility.

Compatibility of Objectives. Probably the overriding aspect of policy affecting farmer participation is the extent to which the governments' and water users' goals coincide. There is often a divergence, and water users themselves can have competing objectives.

If government goals include attempts to maximize production while maintaining a low price for foodstuffs to keep consumers satisfied, farmers' crops will be less profitable. They will have little interest in "efficient" use of water if it means they must do more poorly remunerated work. Under such conditions they may irrigate "excessively" (in officials' opinion) to reduce weeds or to facilitate land preparation. They may maximize their returns to labor by working on activities other than irrigation, not cleaning channels to a technical standard, for example.

Governments can have legitimate concerns with aggregate food production, export possibilities and balance of payments improvement, just as farmers have a pressing requirement to sustain themselves and their families through profitable production. Regimes can be shortsighted or pursue narrow interests just as surely as can sectors of the public.

Each conflict of interest needs to be examined in light of the competing justifications offered. A resolution of divergent interests will more usually reflect the balance of respective power between the government and various sectors of the public than some systematic weighing of values and priorities. The crucial policy consideration is the extent to which, in any irrigation management situation, the government wants for water users what they want for themselves, their families, and their communities.

One should not expect that regime and user goals will always be congruent or that they need to be the same. Channels of organization, among farmers and between them and government agencies, have as one of their main purposes the identification and resolution of competing objectives, to build a basis of adjustment and cooperation despite divergence of initial positions.

Program Design

Scope of Activity. Whether water user associations should be limited to irrigation management activities has been greatly debated. Since projects are usually administered by an irrigation department, it commonly sets such a restriction, if only to avoid "encroaching" on other agencies' bureaucratic turf. But from farmers' perspectives, such boundaries can be irrelevant.

Obtaining the full benefits of better irrigation practices requires improvements in extension, input supply, even roads, and organized farmer participation can contribute to these. On the other hand, irrigation management itself is an immensely complicated undertaking, and nonirrigation tasks can overload an organization's capacity.[6]

There are good examples of narrowly-focused WUAs and of farmer organizations that deal with many related functions besides irrigation. Our conclusion is that where WUAs are being started, they do well to begin with irrigation tasks only. Burdening them with other management responsibilities at the outset is likely to overwhelm them.

On the other hand, WUAs should have scope to expand into other activity areas once their members recognize the need for diversification and have sufficient confidence in their ability to handle other tasks.

This is where experimentation and flexibility discussed above are particularly important as a matter of policy. No "blueprint" for WUAs should be uniformly laid down, especially not in advance of experience that shows what farmers want to and can manage for themselves.

Size and Structure. The considerations in favor of a multi-tiered system of organization, with base-level groups as the foundation, have already been stated. The number of levels of organization will reflect the number of levels of operation, as described above.

Having small groups at the field channel level facilitates the tasks of communication and coordination. Decision making and conflict resolution are also easier. Social pressures can operate more effectively to ensure resource contributions. Small size imposes a limitation on the amount of resources that can be mobilized for large tasks, but groups can surmount this through federations.

Even if hydrological considerations are uppermost in setting the size of organizations and their structure, actual systems are seldom regular or symmetrical in their command areas. Water users themselves should be able to decide on amalgamation or subdivision, according to physical, social, and other criteria. Such choices help to make the organizations "theirs."[7]

Membership. The principle of forming WUAs along hydrological lines suggests that members be "field neighbors" rather than residential neighbors when persons who cultivate from the same water source do not live together (Coward, 1979).

We have already suggested that membership be vested in the cultivating household as a whole, rather than in the (usually male) household head. This should also make it possible for younger members of the household—with their greater education and energy—to play a larger role in improving irrigation management.

The biggest problem of membership eligibility usually arises with regard to cultivators who do not own the land they till—who operate as tenants, paid laborers, or encroachers. In some countries, only landowners may be recognized as WUA members, even if they are not doing the field work themselves. Irrigation management is best carried out if the actual cultivators are involved in decision making. Yet to accept tenants as members would sometimes compromise landowners' property claims according to land reform legislation.

No standard solution can be suggested. Legal and political considerations may take precedence, but certainly non-owning cultivators need to be brought into any scheme of irrigation management, informally if not formally. They are likely to be more productive members of the community if their status can be regularized.

Leadership. Effective water user associations require capable, committed local leadership which is accountable to the users. Project designers cannot ensure the first two qualities, but they can try to build accountability into the WUA system, e.g., through the kind of decision-making structure established, and to expand the pool of prospective leaders by minimizing the tendency for a few persons to monopolize all positions and activities.

In some circumstances, the existing local leadership is agriculturally oriented and disposed to promote development benefiting all households. WUA efforts at irrigation improvement can take place fairly quickly under such leadership as it is already experienced and accepted. Often, however, a new cadre of leadership must be identified and brought into responsible positions.

The methods for attracting and supporting a new cadre of leadership are still in the experimental stages. Experience in a number of countries suggests the value of using organizers as "catalysts," discussed below, to enhance the prospects for mobilizing such leadership. The policy orientation suggested already of "building from below" will contribute to this as well.

The question of payment for WUA leaders can be argued either way. Unremunerated leaders have performed successfully in many situations. If the level of group solidarity is high and WUAs produce broad and tangible benefits, having leaders work on a volunteer basis appears feasible (Kathpalia, 1984; Uphoff, 1985).

The answer also depends on the amount and complexity of the work required. If leaders become "managers" or "staff" rather than "representatives," if they must take much time away from their farming, and especially if they must carry out commercial activities on behalf of the WUA, payment may be desirable or even necessary. If there is some salary or in-kind

remuneration, it should come from WUA members to promote greater accountability of leaders (Meinzen-Dick, 1984).

Expectations about leaders' responsibilities should be realistic, for example, taking the pattern of seasonal activities into account. Uniform, year-round duties such as weekly meetings are alien to the cycle of the seasons. It should not be regarded as a dereliction of duty for organizational work to slacken when competing labor demands are great. Formal work requirements should be kept within reasonable limits.[8]

Legal Basis. There is reason to have some legal framework within which WUAs operate. Otherwise, lacking official recognition, they can be ignored by administrators and engineers. They may be unable to operate bank accounts or to raise funds for their activities. Members and leaders may have unclear recourse in the event of misdeeds.

Several problems have been noted with the strategy of creating WUAs through legal enactment:

- If their existence is mandated, it is likely that "paper" WUAs will be set up by officials or farmers to satisfy the letter of the law. Purely nominal WUAs add little to management capacity.

- Legal provisions tend to be unform, i.e., all WUAs should have the same set of officers, the same dues, etc. Yet standard arrangements produce suboptimal organizations because their terms of operation are often not appropriate and members will have a lukewarm commitment to what is not of their own creation.

- Legal instruments tend to regard rights and obligations asymmetrically, stressing the latter in a way that dulls farmer incentives for participation.[9]

The tendency of officials to assume that behavior can be "legislated" needs to be resisted. WUAs should exist and operate first and foremost as social entities that have legal identity and backing. The reverse kind of organization—legal entities that have to gain public support and loyalty—will be less likely to produce the management capacity desired.

Certainly some legal basis for WUAs is needed. It is preferable that initial organizational work proceed with temporary or ad hoc authorization until such time as experience shows what kinds of arrangements are most suitable for and congenial to water users. Devising a legal framework for farmer participation in irrigation management appears to be a necessary but not sufficient condition for generating a sense of local responsibility for operation and maintenance.[10]

Working through Catalysts. Rather than introduce water user associations through regular government personnel, programs may use specially recruited, trained and deployed organizers, whose assignment is to release a potential that already exists, but not themselves to be incorporated into the solution. They can and should be removed once the desired processes have been activated—hence the designation "catalysts."

The NIA experience in the Philippines using Community Organizers is the best documented example of this approach (F. Korten, 1982), but the same methodology has contributed to improved relations and performance on the part of both farmers and engineers in the Gal Oya scheme in Sri Lanka. Organizers are now being used in the Sederhana project in Indonesia (Morfit, 1983).

In some instances, farmer organizations have been introduced through technical personnel. In the Minipe scheme in Sri Lanka, however, some of the initial organizing work was done by volunteers who came through a Buddhist service society. When that arrangement lapsed, the organizing work was completed by government staff. Retrospectively, it can be seen that the intensity and quality of water management is better in those areas where catalysts were used at the outset (de Silva, 1985).

In the Nong Wai scheme in Thailand, water user groups had previously been formed at the direction of Cooperative Department officials (not by irrigation staff), but nothing had been done to "activate" these groups. Donor agency consultants worked with a special unit of the irrigation department charged with responsibility for working with farmers on O&M.[11] In effect, the staff of this unit became "catalysts" who worked with farmers in a nonbureaucratic manner.

Nong Wai, like Minipe, suggests the value of having persons with special responsibilities and skills undertake the task of initiating and supporting farmer organization. Typically, techical personnel, if assigned such work, are less

likely to have appropriate talents and temperament for organizing. Moreover, since this kind of work is unfamiliar and may be uncongenial, they are likely to neglect it or do it hastily, if only because they still have other duties to carry out.

Strategy of Organizational Development. Water user associations represent "social infrastructure," which has many similarities to the physical infrastructure of reservoirs, channels, diversion structures, etc. There is a need to make explicit investments in the development of farmer organizations if they are to perform effectively and reliably over time. There must also be some ongoing investments in their maintenance if their capacity is to be retained. To use the terminology of computers, user organizations constitute some of the "software" needed to make the "hardware" of physical structures productive.

In his analysis of the "learning process" approach to development planning and implementation, Korten (1980) emphasizes three phases, beginning from a pilot project (learning laboratory) stage:

- learning to be effective, to be able to achieve intended results;
- learning to be efficient, to achieve results at acceptable, even minimum costs;
- learning to expand, to bring program benefits to larger numbers of persons.

Throughout these phases, a key element is building up a cadre of capable, committed and confident persons, able and willing to improvise and persevere, motivating and disciplining others for the furtherance of program goals.

The sequence for effort will usually be as follows:

1) organization, when efforts are directed toward establishing the base-level groups, to bring farmers into the program with an understanding of its goals, such as productivity, participation, and equity;

2) consolidation, when the groups are strengthened and higher level organizations are established, to build two-way communication and cooperation with agency personnel;

3) maintenance, when on-going training, monitoring and trouble-shooting are continued, to sustain the structure of organization put in place.

The work of catalysts will be most intense in the first period. Once base groups are started, work can be on a more extensive basis, and the number of organizers can be reduced. Attention will focus more on training farmer-representatives and on second- and third-level organization than on direct contact with all farmers.

In the third period, there will be new representatives to train (there should be a continuing turnover and renewal of the leadership cadre). Groups that lose momentum will need to be identified and revitalized. When problems arise that the groups cannot readily solve themselves, someone in an "ombudsman" role will be necessary to keep the system of organization from weakening. These examples suggest the kind of "maintenance investments" that sustain social infrastructure.

Work with Nongovernmental Organizations. Experience with devolving responsibility to private voluntary organizations is not very extensive, but the performance of an agency like CARE in Bolivia shows the kind of contribution that a PVC can make (Lynch, 1983). Fragmentary reports on working with private contractors are not as encouraging. Contractors have no incentive to consult with farmers or to accept delays unless their terms of reference are very carefully written and their bases of compensation are set accordingly.

One kind of organization that should be considered for involvement in the promotion of participatory management are what can be called knowledge-building institutions, especially those with an orientation toward action research.[12] It is not simply that such institutions can contribute more flexibly and creatively to a program of farmer participation than would a government agency, but their knowledge and status reinforce the ideas and initiative of agency personnel who want to see an innovative program succeed.

Bringing about new and more productive relations within farming communities and within government agencies, as well as between communities and agencies, is obviously a complex process. It involves changing ideas and values as well as incentives and procedures. Thus, it is necessary to reach beyond the bureaucracy to get fruitful impetus and innovation.

Improving Agency Capacities for Change. At the same time, it is clear that change will not come without some active leadership from

the official side. A partnership is needed among various actors, both inside and outside of the government. Project designers and managers can support networks of interested persons—professionals, administrators, researchers, organizers, and others—who will think through, observe, monitor, evaluate, and redesign programs.[13]

The style of operation should be more collegial and non-hierarchical than usually found in government bureaucracies. We know that organizations tend to replicate in their environment the same kinds of values and working relations that they exhibit in their own operation. If the resulting farmer organizations are to be participatory, flexible, and concerned with results rather than status, such norms and practices should be evident in the work of the agency that seeks to promote new modes of involving farmers in irrigation management.[14]

In several countries, we have seen substantial reorientation of irrigation bureaucracies, and in the next ten years we may expect other countries to follow suit. The levels of efficiency in most irrigation management are unjustifiably low, and farmers are increasingly being understood as part of the "solution" rather than being the major source of "problems." The growing fiscal crisis in LDCs will make the present costly technocratic approaches to O&M untenable. Fortunately, there is enough positive experience to warrant more experimentation with and institutionalization of farmer participation in the irrigation sector.

NOTES

[1]Such an approach is supported by a detailed comparative study of irrigation system performance by Montgomery (1983). In this article, 20 irrigation case studies were examined. Judgments were made on how well three key tasks were handled: water allocation, land preparation, and fee assessment. Farmer participation improved the first activity more than the second. However for all three activities, the percentage of cases in the "good" category, compared with "fair" or "poor," was higher when decision making involved water users than when decisions were made entirely by a bureaucratic agency.

[2]Examples of the first would be the **subaks** in Indonesia (Geertz, 1967) or the **tramos** in Mexico (Downing, 1974). The latter would include the council of elders in northwest Pakistan (Bhatty, 1979) or the civil-religious authorities in Peru (Mitchell, 1976) that supervise irrigation activities, often through specialized roles.

[3]The Palsiguan project in the Philippines is a clear example of this, where approximately 8,000 of the proposed 10,000 hectares to be given more integrated and assured water supply were already cultivated and managed by more than 170 user groups (**zanjeras**) with an impressive and extended performance record (Coward, 1985). Donor-assisted plans that redesigned the water distribution system without regard for existing organizational arrangements amounted to disinvestment in the social infrastructure represented by indigenous WUAs. Fortunately, this approach was reconsidered.

[4]In Kenya, "indigenous modes of organization (the patrilineage and the neighborhood) merge almost imperceptibly with modern organizations (the sub-location and location)" (Fleuret, 1985:115). Informal irrigation organizations called canal committees are chaired by lineage elders. Disputes that cannot be resolved within the jurisdiction of a canal committee are taken to sub-chiefs or chiefs, legally-recognized authorities within the official, local government structure.

[5]To indicate their neutrality, farmer-representatives who organized a huge convention to mark the third anniversary of their organizations, with about 3,000 attending, decorated the roads and podium with white bunting, a politically neutral color, even though they had invited the Ministers of Lands and Agriculture as guests.

[6]A Nepali farmer told our colleagues, Ed Martin and Bob Yoder, when asked why his WUA did not install a hydro-powered grain mill that would benefit members, "We have all we can do to manage the irrigation system; there are so many conflicts." Several years later, a mill was built.

[7]To give an idea of how this can work, in the Gal Oya scheme in Sri Lanka, almost 400 field channel groups, with an average command area of 65 acres, have been formed by farmers with the encouragement of organizer "catalysts." But farmers have combined some short field channels and have subdivided most of the long ones organizationally, so that the farmer-

representatives chosen are each responsible for about 50 acres.

Where distributary channels are short, they have usually been amalgamated into a single D-channel organization (or linked up with a longer channel). So most second-level organizations cover two or more D-channel command areas and about 300 acres. These decisions have been made with farmers rather than for them.

Area councils set up (at farmer initiative) as a third level of organization are composed of all the farmer-representatives within a subsystem and they deal with irrigation and related problems in their respective areas of 6,500, 7,000 and 6,900 acres (Uphoff, 1985).

[8]A World Bank project in Pakistan sought and obtained legal passage of a covenant enumerating WUA leaders' responsibilities. The resulting ordinance detailed nine functions for each member of a WUA's board of directors, which could amount to a full-time job. Yet, board members were enjoined by law from enjoying any special benefits by virtue of their elected positions. Sanctions could be imposed on them if the functions were not properly executed (Cernea, 1984). Such an approach gives the appearance of control over WUA performance, but is likely to be counterproductive.

[9]The Pakistan act referred to in note 8 provided 14 "powers of association," such as improving, rehabilitating, operating and maintaining the watercourse, participating in programs of improving on-farm water use, setting and collecting general and special assessments, conscripting labor for emergency repairs, removing obstructions in watercourses, and ensuring that all members contribute their fair share of labor, money, etc. Only one appeared to be an unambiguous benefit to farmers—ensuring that all members' rights under the law are respected and that each member gets his fair share of water in a timely fashion. Sanctions could be imposed if any of these powers (really duties) were not carried out. Essentially the same ordinance was proposed for Sri Lanka though not enacted (Uphoff, 1982).

[10]The program of introducing participatory water management in the Philippines began with some changes in the relevant laws, empowering groups of water users to assume responsibilities otherwise vested in the National Irrigation Administration. However, implementation proceeded gradually and experimentally. Once WUAs are well established, with the help of NIA organizers, real powers could be handed over to them, balanced by obligations that are reasonably well understood and accepted by farmers (F. Korten, 1982; Bagadion and F. Korten, 1985).

[11]According to Kathpalia, the staff of this unit were "trained to be persuasive and instructive and not to have an authoritarian attitude. Once farmers' confidence was gained through open and frank discussion by explaining the reasons for every suggestion and change made, their cooperation was forthcoming. The process was slow but succeeded, more so than a directive approach." (1984:18) The special staff brokered between farmers and the regular irrigation personnel, whose areas of responsibility were reduced by one-third to permit more intensive interaction with farmers.

[12]Examples would be the Asian Institute of Management and the Institute of Philippine Culture at the Ateneo de Manila University (also later the Ateneo de Naga), which worked with the NIA program in the Philippines on process documentation and sociotechnical profiles (de los Reyes, 1984), or the Agrarian Research and Training Institute and Cornell University, which assisted in the Gal Oya project in Sri Lanka.

[13]The Communal Irrigation Committee, which operated in the Philippines (D. Korten, 1982), is one model for such a network. The program in Sri Lanka supporting farmer participation in the Gal Oya project had to operate more informally.

[14]This applies similarly to donor agencies working with governments on this task. They should set an example for the kind of irrigation organizations they want to result—able to solve problems, mobilize new talent, be flexible, etc.

LIST OF CASES ANALYZED

ASIA

South Asia	Command Area (acres)	Type of Management	Source
India			
1. Pochampad (Andhra Pradesh)	60,000	Agency + users (organized by agency)	Singh (1982, 1983a, 1984)
2. MNC-TNC (Andhra Pradesh)	400,000	Agency + users (organized by users)	Wade (1979, 1984a)
3. Ahar-Pyne (Bihar)	100*	Users (informal organization)	Sengupta (1980)
4. Sone (Bihar)	1,450,000	Agency + users (organized by agency)	Pant and Verma (1983)
5. Bhakra (Haryana)	4,000,000	Agency (warabandi water rotation)	Vander Velde (1980); Reidinger (1974)
6. Sananeri (Tamil Nadu)	440	Users (agency responsible at higher level)	Meinzen-Dick (1984)
Pakistan			
7. Upper Bari Doab (Punjab)	1,000,000	Agency (warabandi water rotation)	Lowdermilk et al. (1975)
8. Chaj Doab (Punjab)	1,680,000	Agency (warabandi water rotation) (Note: both Punjab cases are supplied by the same large Indus River system)	Merrey (1982, 1983, 1983a, 1984)
9. Daudzai (Northwest Frontier Province)	35,000	Users (liaison with agency management)	Bhatty (1979)
Sri Lanka			
10. Pul Eliya	132	Users (indigenous organization)	Leach (1961)
11. Minipe	15,000	Agency + users (organized by agency)	de Silva (1981, 1985)
12. Gal Oya (Left Bank)	60,000	Agency + users (organized by agency)	Abeyratne et al. (1984); Uphoff (1982, 1985, 1986); Widanapathirana (1984); Wijayaratna (1985)
Nepal			
13. Argali, Chherlung and Tallo Kulo	116, 850 and 34	Users (variety of indigenous organizations, liaison with agency)	Martin and Yoder (1983); U. Pradhan (1982); Yoder (1986); Martin (1986);
14. Chattis Mauja	7,500	Users (indigenous organization)	P. Pradhan (1983)
Bangladesh			
15. Pultan Para	75	Users (liaison with agency)	Howes (1984)

Southeast Asia	Command Area (acres)	Type of Management	Source
Philippines			
16. Bacerra-Vintar (zanjera)	1,260	Users (federated organizations)	Lewis (1971); Siy (1982)
17. Lalo and Baris (government systems)	7,000 5,440	Agency + users (organized by agency)	Illo and Nestor (1981); Illo and Chiong-Javier (1983)
18. Aslong and Taisan (communal systems)	1,250 and 425	Users + agency	Inos (1981)
Indonesia			
19. Tihingan (subaks) (Bali)	575	Users (indigenous organization)	Geertz (1967); Birkelbach (1973)
20. Pakalen Sampaen (Java)	685,000	Agency + users (rotations)	Taylor and Pasandaran (1979)
21. Bima and Tayuban (Dharma Tirta) (Java)	395 and 1,030	Agency + users (organized by agency)	Duewel (1982, 1984); Adams (1983)
Thailand			
22. Seraphi and Sankaemphaeng	2,500 and 4,000	Users	Potter (1976); Sirivongs (1979)
23. Nong Wai	25,000	Agency + users (organized by agency)	Kathpalia (1984)
Malaysia			
24. Muda	200,000	Agency + users (organized by agency)	Afifuddin (1978)
Laos			
25. Nam Tan	2,600	Agency + users (traditional roles)	Coward (1976)
Papua-New Guinea			
26. Wamira	1,250	Users (agency technical intervention affects traditional organization)	Kahn (1983)

East Asia	Command Area (acres)	Type of Management	Source
China			
27. Meichuan	20,000	Agency + users	Nickum (1981)
Taiwan			
28. Chang Hua	15,000	Users (Irrigation Association) + agency	Stavis (1982)
29. Namton, Taoyuan, Yunlin, and Chianan	33,000 to 267,000	Users (Irrigation Association) + agency	Abel (1975); Moore (1983)
South Korea			
30. "SY" FLIA	26,500	Agency + users (organized in Farm Land Improvement Association)	Wade (1982b)
MIDDLE EAST			
Iran			
31. Deh Salm and Nayband	70 and 60	Users (quanat system)	Spooner (1974)
Iraq			
32. Daghara	250,000	Agency + users (tribal associations)	Fernea (1970)
Oman			
33. Izki	200	Users (quanat system)	Wilkinson (1977); Sutton (1984)
Egypt			
34. Abu Raya	200,000	Agency (village area within larger system; no user organization)	CSU/CID (1980) and other project publications

AFRICA

	Command Area (acres)	Type of Management	Source
Senegal			
35. Bakel (many systems)	10-15	Agency + users	Adams (1977)
36. Matam (many systems)	37-62	Users + agency	Fresson (1979); Diemer and van der Laan (1983); Patterson (1984)
Mali			
37. Office du Niger	125,000	Agency	de Wilde (1967)
Ghana			
38. Tono	6,000	Agency	Chambas (1980)
Zimbabwe			
39. Sabi River (9 schemes)	112-928	Agency	Roder (1965)
Tanzania			
40. Sonjo	500	Users (indigenous organization)	Gray (1963)
Kenya			
41. Marakwet (many systems)	21-384	Users (indigenous organization)	Ssennyonga (1983)
42. Mwea	15,000	Agency (some user organization introduced)	Chambers and Moris (1973)
Sudan			
43. Gezira	1,850,000	Agency (some user organization introduced by agency)	Gaitskell (1959); Simpson (1976); Bailey et al. (1981); Elder (1982)
44. Rahad	315,000	Agency + user (organized by agency)	Benedict et al. (1981)

LATIN AMERICA

	Command Area (acres)	Type of Management	Source
Brazil			
45. Morada Nova,	2,875	Agency	Hall (1978)
San Goncalo,	1,500	Agency	
and Sume	650	Agency	
Chile			
46. San Pedro de Atacama	3,750	User + agency	Lynch (1978)
Peru			
47. Quinua (Lurin Sayoc and Hanan Sayoc)	2,000	Users	Mitchel (1976)
Ecuador			
48. Quimiag (Huerta Redonda)	1,500	Users	Cornick (1983)
Mexico			
49. Zapotec (Diaz Ordaz)	375	Users	Downing (1974)
50. Oaxaca (24 systems)	3,750*	Users + agency (latter's role is undermining users' organization)	Lees (1973)

*Average area

REFERENCES

Abel, Martin E.
1975 Irrigation systems in Taiwan: management of a decentralized public enterprise. St. Paul: Department of Applied and Agricultural Economics, University of Minnesota.

Abeyratne, Shyamala et al.
1984 Improving irrigation management through farmer organization: responses to a program in Sri Lanka. Paper presented at the SSRC/IIMI-Bangalore Seminar, January 4-7.

Adams, Adrian
1977 The Senegal river valley: what kind of change? Review of African Political Economy 10:33-59.

Adams, M.E.
1983 Water management extension among small farmers in central Java. FAO Economic and Social Development Series, No. 1. Rome: FAO.

Afifuddin bin Haji-Omar
1978 Peasants, institutions and development in Malaysia: the political economy of development of the Muda region. Ph.D. dissertation, Cornell University, Ithaca.

Bagadion, Benjamin U. and Frances F. Korten
1985 Developing irrigators' organizations: a learning process approach to a participatory irrigation program. Pp. 52-90 in Michael Cernea (ed.), Putting People First: Sociological Variables in Rural Development. New York: Oxford University Press.

Bailey, Charles, Robert Chambers, and Roberto Lenton
1981 Final report: water management consultancy, Egypt and Sudan. New Delhi: Ford Foundation.

Benedict, Peter et al.
1981 Sudan: The Rahad Irrigation Project. AID Project Impact Evaluation Report No. 31. Washington: USAID.

Bhatty, K.M.
1979 Social Determinants of Water Management in Daudzai. Peshawar: Pakistan Academy for Rural Development.

Birkelbach, Aubrey
1973 The Subak association. Pp. 153-169 in Indonesia. Ithaca, NY: Southeast Asia Program, Cornell University.

Bottrall, Anthony W.
1977 Evolution of irrigation associations in Taiwan. Agricultural Administration 4 (4):245-250.
1981 Comparative study of the management and organization of irrigation projects. Staff Working Paper 458. Washington: World Bank.

Cernea, Michael
1984 The social organization of water users: experience with water users associations in bank projects. Draft staff paper. Washington: World Bank.
1984a Can local participation help development? Mexico's PIDER program shows it can improve the selection and execution of local development projects. Finance and Development 21 (4):41-44.

Chambas, Mohamed Ibn
1980 The politics of agricultural and rural development in the Upper Region of Ghana: implications of technocratic ideology and nonparticipatory development. Ph.D. dissertation, Cornell University, Ithaca, NY.

Chambers, Robert
1984 Farmers above the outlet: irrigators and canal management in South Asia. Sussex: Institute of Development Studies. Draft paper.

Chambers, Robert and Jon Moris, eds.
1973 Mwea: An Irrigated Rice Settlement Scheme in Kenya. Munich: Weltforum Verlag.

Cornick, Tully
1983 The social organization of production in Quimiag, Ecuador: a case study of small farmer production systems in the Highland Andes. Ph.D. dissertation, Cornell University, Ithaca, NY.

Coward, E. Walter, Jr.
1976 Indigenous organization, bureaucracy and development: the case of irrigation. Journal of Development Studies 13:92-105.
1979 Principles of social organization in an indigenous irrigation system. Human Organization 38:28-36.
1980 Irrigation and Agricultural Development in Asia. Ithaca, NY: Cornell University Press.
1983 Property in action: alternatives for irrigation investment. Paper presented at Workshop on Water Management and Policy, Khon Kaen, Thailand.
1985 Traditional irrigation systems and government assistance: current research findings from southeast Asia. DVWK Bulletin 9 (1):1-30.

CSU/CID
1980 Problem identification report for the Kafr el Sheikh study area. Technical report No. 6. Cairo: Water Distribution Research Institute, Water Research Center, Ministry of Irrigation.

de los Reyes, Romana P.
1984 Sociotechnical Profile: A Tool for Rapid Rural Appraisal. Quezon City: Ateneo de Manila University.

de Silva, N.G.R.
1981 Farmer participation in water management: the Minipe project in Sri Lanka. Rural Development Participation Review 3 (1):16-19.
1985 Involvement of farmers in water management: alternative approach at Minipe. In Participation Experiences in Irrigation Water Management. Proceedings of the Expert Consultation on Irrigation Water Management, Yogyakarta and Bali, 16-22 July. Rome: FAO. In FAO (1985:133-148).

de Wilde, John
1967 Mali: the office du Niger: an experiment with irrigated agriculture. In J. de Wilde et al., Experiences with Agricultural Development in Tropical Africa, Vol. III: The Case Studies. Baltimore: Johns Hopkins University Press.

Diemer, Geert, and Ellen van der Laan
1983 Small-scale irrigation along the Senegal river. ODI Irrigation Management Network Paper 8f. London: Overseas Development Institute.

Downing, Theodore
1974 Irrigation and moisture-sensitive periods: a Zapotec case. Pp. 113-122 in T. Downing and McG. Gibson (eds.), Irrigation's Impact on Society. Anthropological Papers of the University of Arizona No. 25. Tucson: University of Arizona Press.

Duewel, John
1982 Promoting participatory approaches to cultivating water users associations: two case studies from central Java. Ithaca, NY: Departments of Rural Sociology and Agricultural Engineering, Cornell University, Technical Report No. 11.
1984 Central Java's Dharma Tirta WUA 'model': peasant irrigation organisations under conditions of population pressure. Agricultural Administration 17 (4):261-285.

Elder, John
1982 Problems in Sudan's Gezira irrigation scheme. Department of Rural Sociology, Cornell University, unpublished paper.

Esman, Milton J. and Norman Uphoff
1984 Local Organizations: Intermediaries in Rural Development. Ithaca, NY: Cornell University Press.

FAO
1982 Farmers' Participation and Organization for Irrigation Water Management. Rome: International Support Programme for Farm Water Management, FAO.
1985 Participation Experiences in Irrigation Water Management. Proceedings of the Expert Consultation on Irrigation Water Management, Yogyakarta and Bali, 16-22 July. Rome: FAO.

Fernea, Robert A.
1970 Shaykh and Effendi: Changing Patterns of Authority among the El Shabana of Southern Iraq. Cambridge: Harvard University Press.

Fleuret, Patrick
1985 The social organization of water control in the Taita hills, Kenya. American Ethnologist 32:103-118.

Fortmann, Louise
1985 Seasonal dimensions of rural social organisations. Journal of Development Studies 21 (3):377-389.

Fresson, Sylvia
1979 Public participation in village-level irrigation perimeters in the Matam region of Senegal. Pp. 96-137 in Duncan Miller (ed.), Self-Help and Popular Participation in Rural Water Systems. Paris: Development Center, OECD.

Gaitskell, A.
1959 Gezira: A Story of Development in the Sudan. London: Faber and Faber.

Geertz, Clifford
1967 Organization of the Balinese Subak. In Koentjaraningrat (ed.), Villages in Indonesia, Ithaca, NY: Cornell University Press. Reprinted in E. W. Coward, Jr. (ed.), Irrigation and Agricultural Development in Asia: Perspectives from the Social Sciences. Ithaca, NY: Cornell University Press, 1980.

Gray, Robert F.
1963 The Sonjo of Tanganyika: An Anthropological Study of an Irrigation-Based Society. London: Oxford University Press.

Hall, Anthony L.
1978 Drought and Irrigation in North-East Brazil. Cambridge, London: Cambridge University Press.

Howes, Michael
1984 The social organization of deep tubewell irrigation in Bangladesh. Paper presented at SSRC-IIMI/Bangalore Seminar, January 4-7.

Hunt, Robert and Eva C. Hunt
1976 Canal irrigation and local social organization. Current Anthropology 17 (3):389-411.

Illo, Jean Frances and M. Elena Chiong-Javier
1983 Organizing Farmers for Irrigation Management: The Buhi-Lalo Experience. Naga City, Philippines: Research and Service Center, Ateneo de Naga University.

Illo, Jean Frances, and Felix Nestor
1981 Organizing Farmers for Irrigation Management: The Development of a New System, Lower Lalo National Irrigation Project. Naga City: Research and Service Center, Ateneo de Naga.

Inos, Faustino I.
1981 A survey of farmer's participation in the development, operation and management of selected irrigation systems in the Philippines. Ph.D. dissertation, Rutgers University.

Kahn, Miriam
1983 In fear of an aqueduct: irrigation systems as potentially disruptive forces. Paper presented at American Anthropological Association Meetings, Chicago.

Kathpalia, G.N.
1984 The Nong Wai Irrigation Project, Thailand. Irrigation Management Network Paper 10c. London: Overseas Development Institute.

Korten, David C.
1980 Community organization and rural development: a learning process approach. Public Administration Review 40 (5):480-511.
1982 The working group as a mechanism for managing bureaucratic reorientation: experience from the Philippines. NASPAA Working Paper No. 4. Washington, DC: National Association of Schools of Public Affairs and Administration.

Korten, David C. and Norman Uphoff
1981 Bureaucratic reorientation for participatory rural development. NASPAA Working Paper No. 1. Washington, DC: National Association of Schools of Public Affairs and Administration.

Korten, Frances F.
1982 Building national capacity to develop water users associations: experience from the Philippines. Staff Working Paper 528. Washington: World Bank.

Leach, E.R.
1961 Pul Eliya: A Village in Ceylon. Cambridge: Cambridge University Press.

Lees, Susan
1973 Socio-Political Aspects of Canal Irrigation in Oaxaca. Memoirs of the Museum of Anthropology No. 6. Ann Arbor: University of Michigan.

Levine, Gilbert and Henry C. Hart
1981 Mobilizing Local Resources for Irrigation. Report No. 22. New York: Agricultural Development Council.

Lewis, Henry T.
1971 Ilocano Rice Farmers: A Comparative Study of Two Philippine Barrios. Honolulu: University of Hawaii Press.

Lowdermilk, Max
1985 Improved irrigation management: why involve farmers? Irrigation Management Network Paper 11c. London: Overseas Development Institute.

Lowdermilk, Max, Wayne Clyma, and Alan Early
1975 Physical and socio-economic dynamics of a watercourse in Pakistan's Punjab: system constraints and farmer responses. Water Management Technical Report No. 42. Fort Collins: Colorado State University.

Lynch, Barbara
1978 A desert agricultural system in a mineral export enclave: water management and productive capacity in San Pedro de Atacama. M.S. thesis, Cornell University, Ithaca, NY.
1983 Trip report: Peru and Bolivia. Ithaca, NY: Water Management Synthesis Project, Cornell University.

Martin, Edward D.
1986 Resource mobilization, water allocation and farmer organization in hill irrigation systems in Nepal. Ph.D. dissertation, Cornell University, Ithaca, NY.

Martin, Edward D. and Robert Yoder
1983 Water allocation and resource management for irrigation: a comparison of two systems in Nepal. Paper presented at Nepal Studies Association Meetings, Madison, Wisconsin.

Meinzen-Dick, Ruth S.
1984 Local management of tank irrigation in south India: organization and operation. Cornell Studies in Irrigation No. 3. Ithaca, NY: Cornell University.

Merrey, Douglas J.
1982 Reorganizing irrigation: local level management in the Punjab (Pakistan). Pp. 83-109 in H. Mann and B. Spooner (eds.), Desertification and Development: Dryland Ecology in Social Perspective. London: Academic Press.

Merrey, Douglas J.
1983 Irrigation, poverty and social change in a village of Pakistani Punjab: an historical and cultural ecological analysis. Ph.D. dissertation, University of Pennsylvania.
1983a Irrigation and underdevelopment in Punjab, Pakistan. Paper presented at the American Anthropological Association Meetings, November.
1984 Canal irrigation, colonialism and underdevelopment: the roots of poverty in an irrigated village in Punjab, Pakistan. Paper presented at the SSRC/IIMI-Bangalore Seminar, January 4-7.

Mitchell, William P.
1976 Irrigation and community in the central Peruvian highlands. American Anthropologist 78:24-44.

Montgomery, John D.
1983 When local participation helps. Journal of Policy Analysis and Management 3 (1):90-105.

Moore, M.E.
1979 Social structure and institutional performance: local farmers' organizations in Sri Lanka. Journal of Administration Overseas 18 (4):240-249.
1983 Irrigation management in Taiwan. Sussex: Institute of Development Studies. Unpublished paper.

Morfit, Michael
1983 Community management of small scale irrigation: the high performance sedarhana irrigation system. Jakarta, Indonesia: USAID, Report to the Asia Regional Committee on Community Management.

Nickum, James (ed.)
1981 Water Management Organization in the People's Republic of China. Armonk, NY: M.E. Sharpe Publishers.

Pant, Niranjan, and R.K. Verma
1983 Farmers' Organization and Irrigation Management. New Delhi: Ashish Publishing House.

Patterson, William
1984 Village irrigation systems along the Senegal river: a comparative analysis. Ph.D. dissertation, Cornell University, Ithaca, NY.

Potter, Jack M.
1976 Thai Peasant Social Structure. Chicago: University of Chicago Press.

Pradhan, Prachanda P.
1983 "Community managed irrigation systems case study: Chattis Mauja irrigation system." Pp. 218-242 in Water Management in Nepal: Proceedings of a Seminar on Water Management Issues. Kathmandu, Nepal: Ministry of Agriculture (HMG/Nepal), Agricultural Projects Service Centre and Agricultural Development Council.

Pradhan, Ujjwal
1982 Irrigation development: whose panacea? Unpublished paper.

Reidinger, Richard
1974 Institutional rationing of canal water in northern India: conflict between traditional patterns and modern needs. Economic Development and Cultural Change 23:79-104.

Robinson, David M.
1982 Water users' organizations in two large Philippine irrigation systems: constraints and benefits of a participatory approach to water management. Ph.D. dissertation, Cornell University, Ithaca.

Roder, Wolf
1965 The Sabi Valley Irrigation Projects. Dept. of Geography Research Paper No. 99. Chicago: University of Chicago.

Rondinelli, Dennis
1983 Development Projects as Policy Experiments: An Adaptive Approach to Development Administration. London: Methuen.

Sengupta, Nirmal
1980 The indigenous irrigation organization in south Bihar. Indian Economic and Social History Review 27 (2):157-189.

Shrestna, Bihari K.
1980 Nuwakot District, Nepal. In The Practice of Local-Level Planning: Case Studies in Selected Rural Areas of India, Nepal and Malaysia. Bangkok, Thailand: U.N. Economic and Social Commission for Asia and Pacific.

Simpson, I.G.
1976 The Sudan Gezira scheme: transformation and evolution. Paper presented at the IADS Seminar on Accelerating National Agricultural and Rural Development, Reading, U.K.

Singh, K.K.
1982 Farmers' Participation in Irrigation Management: The Pochampad Experience. Varanasi: Gandhian Institute of Studies.
1983 Community Resource Management: Lessons from the Zanjera. Quezon City, Philippines: University of the Philippines Press.
1983a Assistance needs of water user associations in their first years: the example of Pochampad. Irrigation Management Network Paper. London: Overseas Development Institute.
1984 Farmers' associations in large irrigation projects: the Pochampod experience. Paper presented at SSRC/IIMI-Bangalore Seminar, January 4-7.

Sirivongs, Abha
1979 A Comparative Study of Traditional Irrigation Systems in Two Communities in Northern Thailand. Bangkok, Thailand: Social Research Institute, Chulalongkorn University.

Siy, Robert Y.
1982 Community Resource Management: Lessons from the Zanjera. Quezon City, Philippines: University of the Philippine Press.

Spooner, Brian
1974 Irrigation and society: the Iranian plateau. Pp. 43-57 in Theodore Downing and McGuire Gibson (eds.), Irrigation's Impact on Society. Anthropological Papers of the University of Arizona No. 25. Tucson: University of Arizona Press.

Ssennyonga, Joseph
1983 The Marakwet irrigation system as a model of a systems approach to water management. In B.E. Kipkorir, R. Soper, and J. Ssennyonga (eds.), Kerio Valley: Past, Present and Future. Nairobi: Eleza Services Ltd.

Stavis, Benedict
1982 Rural local governance and agricultural development in Taiwan. Pp. 165-271 in Norman Uphoff (ed.), Rural Development and Local Organization in Asia, Vol. II: East Asia. New Delhi, India: Macmillan.

Steinberg, David
1983 Irrigation and AID's experience: a consideration based on evaluations. AID Project Evaluation Report No. 8. Washington: USAID.

Sutton, Sally
1984 The Falaj: a traditional cooperative system of water management. Waterlines: A Journal of Appropriate Water Supply and Sanitation Technologies 2 (3):8-12.

Taylor, Donald C., and Effendi Pasandaran
1979 "Pasten": a key water management concept in eastern Javanese irrigation. In Irrigation Policy and the Management of Irrigation Systems in Southeast Asia. Bangkok: Agricultural Development Council.

Uphoff, Norman
1982 Contrasting approaches to water management development in Sri Lanka. Pp. 202-249 in Third World Legal Studies, 1982. New York: International Center for Law and Development.
1985 People's participation in water management: Gal Oya, Sri Lanka. Pp. 131-178 in J.C. Garcia-Zamor (ed.), Public Participation in Development Planning. Boulder, Colorado: Westview Press.
1986 Activating community capacity for water management: experience from Gal Oya, Sri Lanka. In D. Korten (ed.), Community Management: Asian Experience and Perspectives. West Hartford: Kumarian Press (forthcoming).

USAID
1984 A.I.D. policy paper: local organizations in development. Washington, DC: USAID.

Vander Velde, Edward J.
1980 Local consequences of a large-scale irrigation system in India. Pp. 299-328 in E. Walter Coward, Jr. (ed.), Irrigation and Agricultural Development in Asia. Ithaca, NY: Cornell University Press.

Wade, Robert
1979 The social response to irrigation: an Indian case study. Journal of Development Studies 16 (1):3-26.
1982 Group action for irrigation: an Indian case study. Economic and Political Weekly 17 (39):A103-106.
1982a The system of administrative and political corruption: canal irrigation in south India. Journal of Development Studies 18 (3):287-328.
1982b Irrigation and Agricultural Politics in South Korea. Boulder, Colorado: Westview Press.
1984 The community response to irrigation: management of the water commons in upland South India. Paper presented at the SSRC/IIMI-Bangalore Seminar, January 4-7.

Wade, Robert and Robert Chambers
1979 The social response to irrigation: an Indian case study. Journal of Development Studies 16 (1):3-26.
1980 Managing the main system: canal irrigation's blind spot. Economic and Political Weekly 15 (39):A107-112.

Weeramunda, A.J.
1985 Water Management in Kimbulwana Oya: A Case Study of Technical Leadership and Farmer Participation. Colombo, Sri Lanka: Agrarian Research and Training Institute, draft.

Widanapathirana, A.S.
1984 The Gal Oya experiment. ODI Irrigation Management Network Paper 10c. London: Overseas Development Institute.

Wijayaratna, C.M.
1985 Involvement of farmers in water management in Gal Oya, Sri Lanka. In Participation Experiences in Irrigation Water Management. Proceedings of the Expert Consultation on Water Management, Yogjakarta and Bali, 16-22 July. Rome: FAO.

Wilkinson, J.C.
1977 Water and Tribal Settlement in South-east Arabia: A Study of the Aflaj of Oman. Oxford, U.K.: Clarendon Press.

Yoder, Robert
1986 The performance of farmer managed irrigation systems in the hills of Nepal. Ph.D. dissertation, Cornell University, Ithaca.