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Research Report

Institutional Design Principles for Accountability in Large Irrigation Systems

Douglas J. Merrey

International Irrigation Management Institute

Research Reports

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Summary

This report draws on the substantial literature on successful self-governing irrigation systems and applies their principles to the design of institutions on government-managed systems. Its basic hypothesis is that single irrigation systems managed by autonomous system-specific organizations accountable to their customers perform better and are more sustainable than systems managed by agencies dependent on the government (organizationally and financially), or by agencies responsible for many different systems. A matrix of autonomy-dependence and single-multiple systems is used to classify selected cases. These are discussed to establish the plausibility of the basic hypothesis. Further detailed research would be useful to refine the hypothesis. This will be difficult to do with existing data, but the report makes several suggestions for further research. The findings are sufficiently persuasive that policy makers can use them in designing reform programs.

Institutional Design Principles for Accountability in Large Irrigation Systems

Douglas J. Merrey

Introduction

This report addresses a question that is fundamental to the future productivity and sustainability of irrigated agriculture in many developing countries: what institutional conditions and principles are most conducive to achieving and sustaining high performance in those gravity irrigation systems currently owned and managed by government agencies? The report explores the hypothesis that irrigation systems managed by financially and organizationally autonomous system-specific organizations that are accountable to their customers perform better and are more sustainable than systems managed by agencies dependent on the government and agencies responsible for many systems.

There is a substantial literature on indigenous farmer-managed irrigation systems. Researchers have generally emphasized the strengths of such systems, identified underlying principles believed to be the foundation of their success, and proposed ways governments can support their continuation and improvement. But a large proportion of the total irrigated area in developing countries receives its water through systems constructed, owned, and administered by government agencies. Most of these systems are individually relatively large compared with farmer-managed systems in a given country. Researchers have documented the experiences with water users associations (WUAs) at the tertiary and secondary levels of government-managed systems, focusing on methods for organizing WUAs and the potential roles, benefits, and advantages of WUAs (and rarely the disadvantages and costs of WUAs). Some of this work recommends that government agencies must themselves change to enable them to support WUAs.

However, this literature makes a crucial assumption: that the government agency will continue to retain primary responsibility for overall system management in the larger systems and will share some of these responsibilities with farmer organizations. Although there are variations in what tasks and responsibilities are shared, turned over to farmers, or retained by the government, the most frequent pattern in Asia is one in which the government retains overall ownership and financial responsibility for the system and control over the water resource, reservoirs, and main canals. Maintenance and (perhaps) operation of lower-level canals are turned over to WUAs. Representatives of farmers may or may not be consulted on policy issues affecting the larger system.

The fundamental problem is that while public organizations, under various forms of pressure, have agreed to share many of the responsibilities—especially the expenses and hard work—of system management with farmer organizations, there is no significant change in the power relations between officials and farmers. Mutual accountability is absent. Officials have no incentives to foster independent WUAs. Farmer organizations remain dependent on the public organization legally, financially, and psychologically. "Joint management" as currently practiced is often business as usual with cosmetic changes.

This report selectively synthesizes recent research results and introduces a conceptual framework for classifying systems that links two basic institutional design principles. It then proposes five interrelated hypotheses on the institutional determinants of performance. Although further research would be useful to refine the hypotheses, they are sufficiently plausible that policy makers can act on their basis in designing policy and institutional reforms. The report therefore concludes with a brief discussion of the methodologies that could be used for further research and makes recommendations for policy makers.

Institutional Principles for Irrigation Management

Self-Governing and Government-Managed Irrigation Systems

We can distinguish between systems that are controlled and managed (and in most indigenous systems, owned) by local user organizations and systems that are owned and, to varying degrees, controlled by government agencies. The first category includes both indigenous systems, which often have long histories, and systems that have been turned over by the government to user groups for management. Both types are widespread throughout both developing and industrialized countries. Terms for this category include "irrigation communities," "communal irrigation," and "farmer-managed irrigation systems." In a few countries (e.g., USA, Mexico, Colombia), governments transfer management control to publicly chartered user-based district or irrigation associations. In this report all these systems are referred to as "self-governing" after Ostrom (1992). There is considerable though not unlimited variety in the size, technology, and organization of self-governing systems.

The other class of systems—those constructed, controlled, and almost invariably owned by government agencies—also includes both ancient and modern systems. Various types of government agencies are involved including centralized departments usually dominated by civil engineers, area or river-basin development authorities, and agricultural agencies. The dependence of these agencies on the control of political authorities, their financial dependence or autonomy, and the extent to which government control extends to the farm gate or is shared with local user groups at lower levels also vary.

There is no perfect or deterministic relationship between governance arrangements and size or scale (Hunt 1988). There are very large self-governing systems (in Nepal, USA, and Argentina, for example) and quite small government-managed systems (in Indonesia and Sri Lanka, for example). The general tendency in countries having both types of systems, however, is for self-governing systems to be relatively small and for government-controlled systems to be relatively large.

There is a consistent though not perfect relationship between governance arrangements and performance. Tang's (1992) comparative analysis of 47 systems shows clearly that the performance of government-controlled (or "bureaucratic") systems is consistently lower on several dimensions than that of local self-governing systems. Tang (1992, 50-57) used three outcomes as measures of the relative performance of irrigation systems on which data were available: adequacy of water supply, level of system maintenance, and "degree of rule conformance among cultivators." Arranging these measures on a Guttman scale, he found they are closely related (coefficient of reproducibility = 0.99). A chi-square analysis of rule conformance and maintenance by adequacy of water supply found that all 21 of the systems with a good water supply had a positive rating in both rule conformance and maintenance, but of the 26 cases with an inadequate water supply, only 8 were rated positive on both rule conformance and maintenance ($P < 0.0001$) (Tang 1992, 56-57, tables 4.1 and 4.2). In comparing self-governing and bureaucratic systems, he found that among the 36 having collective-choice arrangements, self-governing systems were more likely to be rated positive on both rule conformance and maintenance ($P < 0.05$). For bureaucratic systems, the result was the same—those with collective-choice arrangements (n = 14) tended to be rated positive on both dimensions, while none of those without such arrangements were rated positive on both ($P < 0.05$) (Tang 1992, 109, 116, tables 5.12 and 5.13).

A comparative analysis of a sample of 127 self-governing and government-managed systems in Nepal came to the same conclusion (Benjamin et al. 1994). Performance was measured in terms of cropping intensity, technical efficacy of infrastructure, and water availability. On all three dimensions, the performance of self-governing systems was higher than that of government-managed systems ($P = 0.00$ in all cases) (Benjamin et al. 1994, 84-85, tables 6.1 to 6.5).

These findings, based on statistical comparative analyses using specific performance data, support the general perception that self-governing systems, by and large, perform better than government systems.

Other studies have also documented improvements in irrigation performance (defined in various ways in different studies) of government systems resulting from organizing WUAs (Uphoff 1986, 1992; Aluwihare and Kikuchi 1991; Jopillo and de los Reyes 1988; Wijayaratna and Vermillion 1994; Plusquellec 1989; Pradhan 1993; Paul 1994[1]). However, as Ostrom (1990, 167-173, 180-181) has noted in reference to one of these cases, it is not clear how robust and enduring these newly established WUAs will be. Ostrom, Schroeder, and Wynne (1993, 219) further point out that temporary decentralization and local organizations established as part of construction or rehabilitation projects often do not have a significant long-term impact because the basic institutional framework is not changed. Pakistan provides a classic example of this observation (Byrnes 1992).

Design Principles for Local Irrigation Organizations

Scholars have been fascinated for decades by the numerous successful examples of locally constructed, owned, and managed irrigation systems found throughout the world. This interest has resulted in many excellent case studies and comparative analyses—a recent example is a study of the Chhattis

[1]See also Meinzen-Dick et al. (1994, app. I) for a review of this evidence based on four broad categories of performance indicators used in the literature: technical impact, productivity impact, financial impact, and environmental impact.

Mauja system in Nepal by Yoder (1994a). An important objective has been to identify principles and lessons that can be used in promoting or improving farmer organizations in large government systems (Coward 1980). Here I synthesize the major principles emerging from the most recent work aimed at identifying the institutional principles characterizing successful self-governing systems.

1. A supportive policy, regulatory and legal environment, that recognizes the irrigation community's water rights (Ostrom 1992; Uphoff 1986; Vermillion 1991; Yoder 1994b; Svendsen and Vermillion 1994; Vermillion and Johnson 1995).
2. Capacity to mobilize resources adequate to meet the costs of operations and maintenance including emergency repairs (Yoder 1994b; Freeman 1989; Svendsen and Vermillion 1994) and modernization (Harald Frederiksen, personal communication).
3. Benefits exceed costs of participation, with proportional equivalence between benefits and costs for each irrigator—that is, those with larger benefits pay a larger share of the costs (Ostrom 1992; Ostrom, Schroeder, and Wynne 1993; Freeman 1989; Hunt 1989; Vermillion 1991; Vermillion and Johnson 1995).
4. Effective collective choice arrangements or "organizational control of water" by users (Hunt 1990), which will normally have the following characteristics:
   - Organizational autonomy, with clearly defined boundaries (area and membership), in which the users control the allocation of water,[2] and officials derive their legitimacy and authority from users and are accountable to users ("internal charter of authority" in Robert Hunt's terms) (Hunt 1989, 1990; Freeman 1989; Ostrom 1992; Uphoff 1986; Svendsen and Vermillion 1994; Garcés-Restrepo and Vermillion 1995).
   - Financial autonomy, i.e., an institutional arrangement in which the irrigation management organization relies on direct methods to raise most or all of the resources needed for operation and maintenance (Small and Carruthers 1991, 48-49; Svendsen and Vermillion 1994) as well as capital investments (Harald Frederiksen, personal communication).
   - Single organizational entity manages a single infrastructural system (Ostrom, Schroeder, and Wynne 1993).
   - Maintenance and conflict resolution are tightly connected to the allocation and distribution of water and the organization can enforce rules among its members (Ostrom 1992; Freeman 1989; Hunt 1989; Svendsen and Vermillion 1994).
   - Transparent arrangements for monitoring performance (including financial) (Ostrom 1992; Hunt 1989; Vermillion 1991; Vermillion and Johnson 1995).
   - Nested (or federated) organizational structure (Ostrom 1992; Freeman 1989; Hunt 1989; Uphoff 1986; Vermillion 1991).

Other proposed principles whose universality is less certain are the use of graduated sanctions (Ostrom 1990, 1992), maintenance of written accounts and records (Yoder 1994b), water sufficient to meet crop water demands (Freeman 1989),[3] general assembly of members that chooses a commit-

[2]The literature based on indigenous self-governing systems emphasizes that capture of water at its source should also be under the users' control; in modern systems where self-governing organizations obtain water from a wholesaler, enforceable contracts are the equivalent.

[3]Uphoff, Wickremasinghe, and Wijayaratna (1990) argue, based on data from Sri Lanka, that farmers are more willing to manage and maintain systems when water is neither absolutely scarce nor abundant, but is relatively scarce.

tee of officials (Uphoff 1986), use of specialized paid staff for regular maintenance (Freeman 1989), and local recruitment of staff (Freeman 1989). "Leadership" is often proposed as a necessary factor, but it is not an institutional variable. Although leadership can substitute for good organization in the short run, dependence upon individuals' leadership qualities alone in the absence of strong institutions threatens the sustainability of an organization.

Shared Management of Large Irrigation Systems

Several pilot projects and national programs have demonstrated the benefits of using social organizers as "catalysts" or management consultants to help farmers to organize effective WUAs (e.g., Uphoff 1992). These programs involve establishing WUAs at the tertiary level to improve cooperation among farmers for local operation and management. They differ primarily in how far "upstream" the role of WUAs is extended and the extent to which WUA representatives are involved in overall system management policy decisions. WUAs are often limited to tertiary-level rehabilitation and operation and maintenance (O&M) only (Pakistan, India, Egypt); sometimes, tertiary WUAs are federated at the secondary canal level and given responsibility for O&M at this level (Sri Lanka, Philippines). In some cases, representatives of these secondary-level WUAs are involved in overall system-level decision making, for example through a joint project management committee (Sri Lanka).

However, two related issues that remain problematic are (1) the relationship between the WUAs and the government agency and (2) the nature of the agency itself. The relationship between the agency and WUAs may be formally contractual, such as an agreement to deliver a given quantity of water in return for an agreed fee or an agreement that the WUA will carry out maintenance and operational responsibilities in return for a payment. The latter may be accompanied by a rebate on the irrigation service fee the association collects on behalf of the government, as in the Philippines.

The key to success is *accountability.* Both evidence and theory suggest that financially autonomous public irrigation agencies, which depend for a substantial portion of their funding on farmers paying fees, provide better services (Small and Carruthers 1991; Svendsen 1992). But it is rare to find a country where the farmers can obtain compensation for losses resulting from bad irrigation service. That is, even where contracts exist, their enforcement is difficult.

Accountability is especially problematic in large public service agencies with many different stakeholders. Such agencies are usually structured hierarchically, with officials' primary accountability upward to their supervisors and to the political level. Stakeholders of a large government irrigation department include politicians, the civil service hierarchy, the users of the services (who are themselves not a homogenous group), other government departments and ministries, private firms, and donors. Even where corruption and other such problems are minimal, it is difficult for politicians or senior officials at the central level to effectively understand and represent the specific interests of local users. Decentralization within an agency may be a partial solution, but that does not solve the problem of accountability upwards. An accountability system based on hierarchical control alone will not serve the interests of the most relevant stakeholders (Ostrom, Schroeder, and Wynne 1993; Paul 1991) because the charter of authority is external, not internal. In other words, officials are not accountable to users.

Many researchers and practitioners recognize that sharing control with WUAs as well as providing effective support to self-governing systems have important implications for the roles, functions, attitudes, and organizational structures of public irrigation agencies. The most frequently recommended solution is that the agency undergo a process of "bureaucratic reorientation." The National Irrigation Agency (NIA) of the Philippines is an oft-cited example of a public irrigation agency that has been undergoing bureaucratic reorientation with some success (Korten and Siy 1989).

To recapitulate the key point, most scholars and practitioners advocating WUAs for government-managed systems assume that such organizations are compatible with the continuation of traditional public agencies managing the higher levels of the system. The special difficulties of designing effective institutional relationships in such systems are acknowledged, but not explicitly or adequately addressed. Hunt (1989) is one of the few scholars to question the assumption that WUAs in large systems are analogous to irrigation communities managing self-governing systems.[4]

Institutional Arrangements for Large Irrigation Schemes

We have noted so far that the few specific institutional design principles that underlie successful self-governing systems support a high level of accountability between leaders and irrigators, that ensuring a high level of accountability to water users by officials in charge of government-managed systems is particularly problematic, and that interventions based on an assumed analogy between irrigation communities and water users associations in large government systems have been only partially successful at best. A more holistic approach is required to design robust performance-oriented institutions for managing larger irrigation systems that are currently owned and managed by government agencies.

Three of the four institutional principles discussed above are broadly applicable to all irrigation systems: supportive policy, regulatory, and legal environment; capacity to mobilize adequate resources; and user benefits being greater than costs and proportionally equivalent. This section focuses on effective collective choice arrangements—the fourth principle—and on the interactions between two of its characteristics: (1) financial and organizational autonomy and (2) management of a single infrastructure by a single organization. These two characteristics may be particularly powerful predictors of performance of large irrigation systems.

Relationship of the managing agency to the government

The relationship between the management agency and the government ranges from "autonomy" to "dependence" in both the financial dimension and the organizational dimension. To simplify the presentation, I have combined these dimensions of the continuum between autonomy and dependence.

Financial dimension. An irrigation management agency can be either financially autonomous, that is, self-financing, or financially dependent on outside sources (generally the state treasury) for most or all of its funds. In the latter case, it is the outside source—the government—that controls and allocates the level of resources available to the managing agency. An irrigation manage-

[4]Hunt (1989, 1990) notes the "weak analogy" in the literature between irrigation communities—self-governing systems—and WUAs. WUAs often have only duties, but none of the rights, local control, and integration with higher levels characteristic of self-governing systems.

ment agency may be considered only partially independent if it receives some funding from outside sources (such as capital funds for construction) that are not repayable, but is dependent on generating operational funds internally.

Organizational dimension. The concept of "organizational autonomy" is based primarily on work by Hunt (1988, 1989, 1990), Ostrom (1990, 1992), Ostrom, Schroeder, and Wynne (1993), and Freeman (1989). Whether authority over decisions and activities is internal or external depends on the source of the "charter of authority"—the state or the user-members. Hunt (1990) extends this idea of a charter of authority to the hypothesis that "organizational control of water" is the key variable affecting farmers' willingness to participate in irrigation management tasks.

Therefore, to define the variables clearly, *autonomous* refers to a charter of authority that is internal, i.e., by the consent and agreement of the members or shareholders, though the state may define the rules governing such charters. It is thus autonomous from the state and accountable to the shareholders—usually its customers. *Dependent* refers to a charter of authority that is based on an external source, usually the state. It is thus closely articulated with the state and is a mechanism for state control. Government-managed irrigation systems are by definition dependent in terms of their charter of authority.

Relationship of the managing agency to the irrigation system

Ostrom, Schroeder, and Wynne (1993) have suggested that infrastructure management by local entities is more effective when the entity manages a single system. I have adapted this idea to large irrigation systems. In many countries, a government agency is responsible for hundreds, even thousands, of small systems scattered over a wide area. Monitoring performance and ensuring accountability for achieving defined performance objectives is a daunting task.

This variable has two extremes:

- a single agency or organizational entity whose primary business is management of one irrigation system (which includes related drainage and flood control as well as water supply infrastructure)
- an organization or agency managing a multiplicity of systems

Institutional Design and Performance: Five Hypotheses

In comparing institutional design principles, it is critical to examine their effects on the performance, sustainability, and adaptability of irrigation systems.

Performance, sustainability, and adaptability

Many irrigation performance indicators are described in the literature (Rao 1993 provides the most comprehensive review). Several useful conceptual frameworks for assessing irrigation performance have also been proposed (e.g., Small and Svendsen 1992; Murray-Rust and Snellen 1993; Bos et al. 1994). More recently, IIMI has proposed and begun testing a "minimum set of performance indicators," of which the most crucial describes the additional economic value of irrigated agriculture per unit of water (Perry 1996). However, at present two basic constraints make it impossible to apply a universal performance indicator for comparative analysis of irrigation systems:

- There is no agreement among specialists on what such a universal indicator (or set of indicators) might be, because of the variation in types of irrigation systems, in their physical, social, and economic conditions, and in their objectives. This complexity is growing as irrigation systems increasingly function as water supply systems with multiple uses.

- There are little data on the performance of irrigation systems that can be used for comparative analysis. Tang (1992), in one of the few attempts, is dependent on making rather heroic assumptions about the quality of performance data, and because of the constraints imposed by available data, he uses a sample of systems that is highly skewed toward South Asia.

The present report is not definitive because of these problems. It seeks only to show the plausibility of its hypotheses, not prove them in a scientific sense. Therefore, *performance*, as used here, refers to whether an irrigation system is achieving its objectives (where these are clearly defined) or meeting the users' expectations. This judgment is based on data presented by the researchers cited below where possible, complemented by the researchers' own judgments. In the cases discussed below, I have tried to state what criteria are being used, but clearly the usage is subjective and imprecise.

The long-term sustainability of irrigation system performance is an important issue, but there are even less data available than for short-term performance. I use *sustainability* to refer to whether an irrigation system continues to meet its users' expectations over time. It is conceivable that a system generating a high economic value per unit of water in a given period collapses because of mining of a resource—water tables decline or soils become saline. Further, in many systems, rising water demand (including expansion of nonagricultural uses of water) and increasing pollution are forcing changes in irrigation. Sustainability thus represents the time dimension of performance.

Because both conditions and expectations change over time, I assume that *adaptability* is a key factor underlying sustainability. By adaptability I mean the capacity to make changes—in organization, objectives, or infrastructure for example—to solve problems, enhance users' welfare, and continue to meet users' expectations over time. Again, lack of data is a limiting factor.

Hypotheses

I propose five hypotheses about the likely relationship between institutional principles and performance. Figure 1 summarizes the hypotheses. It is a matrix that relates autonomy-dependence (both dimensions combined) and whether an agency manages a single system or multiple systems. The first hypothesis is the most basic; the other hypotheses are derived from it.

Hypothesis 1. Fully autonomous organizations accountable to their customers and managing single irrigation systems (those in cell 1 of figure 1) will exhibit the highest performance, will prove most adaptive to changing conditions, and therefore will prove to be most sustainable.

Hypothesis 2. Dependent agencies managing single systems (cell 2) will exhibit mixed but generally low performance; adaptability to changing environments will be poor, and therefore sustainability will be problematic.

Hypothesis 3. Autonomous agencies managing many systems (cell 3) may try to be innovative and customer-oriented, but dispersal of attention among a multiplicity of systems will limit accountability for particular systems (except those politically favored), and therefore will limit their performance; sustainability and adaptability will vary among systems but will generally be lower than those in cell 1.

Hypothesis 4. Agencies that are only partially autonomous (i.e., organizationally or financially but not both) (cell 3) will have only limited accountability to the users, which will limit their performance, adaptability, and sustainability; their performance and sustainability will be closer to those in cell 4 than to those in cell 1.

Hypothesis 5. Dependent agencies managing many systems (cell 4) will exhibit a wide range of performance levels, but with a preponderance of low levels, and low (though variable) adaptability and sustainability.

In a recent stimulating paper, Perry (1995) suggested there are three determinants of "proper" irrigation management:

- defined water rights
- infrastructure capable of providing the service embodied in the water rights
- assigned responsibilities for all aspects of system operation

Perry argues that all other common issues (e.g., good maintenance, sound institutions) are really either a subset or a combination of these three basic elements. Water rights, infrastructure, and responsibilities interact and are interdependent—change in one will lead to changes in the other elements. The quality and interaction of these three elements can be used to distinguish between functional and dysfunctional systems, a distinction that Perry argues is of fundamental importance in formulating interventions. The question is, are these three determinants alternatives to the hypotheses proposed in this report?

FIGURE 1.
Matrix of irrigation system governance arrangements: Performance hypotheses.

	RELATIONSHIP OF AGENCY TO GOVERNMENT	
	Autonomous	Dependent
Agency manages a single irrigation system	1. Achieve highest performance Most adaptive to changing conditions Most sustainable [Hypothesis 1]	2. Mixed but generally low performance Low adaptability Sustainability threatened [Hypothesis 2]
Agency manages multiple irrigation system	3. Performance will vary among systems but overall will be lower than cell 1, higher than cell 4 Adaptability and sustainability will vary among systems but overall will be lower than cell 1, higher than cell 4 [Hypotheses 3, 4]	2. Wide range of, but generally low, performance Low adaptability and sustainability, with variation among systems based on local factors [Hypothesis 5]

I argue they are not. While granting their importance, they beg the issue of what institutional framework is most conducive to defined water rights, appropriate infrastructure, and organizational arrangements for implementation. How are water rights to be defined and then enforced? How will infrastructure be designed and subsequently maintained to provide a service that fulfills users' rights? And how will implementation be organized to ensure its effectiveness through accountability to the users? This report addresses these issues and therefore complements Perry 1995 in that, through hypothesis 1, it proposes such an institutional framework.

Are the Hypotheses Plausible? Analysis of Selected Cases

A proper test of the five hypotheses would require precisely operationalizing terms like performance, sustainability, and adaptability. A sufficient number of cases would need to be selected randomly to enable statistical analysis. Hunt (1988), Uphoff (1986, 1991), and others have discussed the difficulties in meeting such rigorous standards in irrigation research. As noted above, there is no single, universally acceptable measure of irrigation performance that can be used to compare systems. The data are inadequate, especially for government-managed systems. Nevertheless, an analysis of cases found in an exploratory review of literature suggests that the proposed hypotheses are plausible. Figure 2 groups selected systems according to the cells depicted in figure 1.

Autonomous Agencies Managing Single Systems (Hypothesis 1)

Single systems managed by autonomous agencies (cell 1, figure 1) ought to exhibit the best performance, be most adaptable as conditions change, and be the most sustainable. This group includes all indigenous self-governing systems, many of which have certainly demonstrated their sustainability and adaptability by surviving and continuously adapting for hundreds of years. It also includes cases of very large irrigation systems that have substantially autonomous management organizations; the largest reported case irrigates 458,000 hectares (Hunt 1988, table 1). Maass and Anderson (1978) describe contemporary cases that are large scale, have high performance in terms of water productivity, and have demonstrated their adaptability and sustainability by surviving for long periods of time.

The irrigation associations of Taiwan are famous for their high level of performance in terms of high crop yields and the adequacy, equity, and reliability of water distribution (Levine 1991; Bottrall 1981[5]). The governance arrangements have gone through several stages since the occupation of the island by Japan in the early twentieth century and continue to evolve today. Irrigation associations are financially autonomous, as well as largely autonomous from direct government control, though closely supervised by the government. A representative assembly of water users elects a chairman who hires staff and has overall executive responsibility. In these systems, some of which are quite large (up to 87,000 ha), system managers are highly accountable to the users.[6]

The province of Mendoza in Argentina is another interesting case. Five river basin systems totaling 360,000 hectares are under

[5]Bottrall (1981) compares four systems one of which is an irrigation association in Taiwan.

[6]For the past 2 years, the irrigation service fees have apparently been paid by the government, not farmers, for political reasons; and, in 1994, the government began appointing presidents of irrigation associations because elected representatives "were serving their own purposes" (Chung-Huang Huang, personal communication, January 1996).

FIGURE 2.
Matrix of irrigation system governance arrangements: Examples.

	RELATIONSHIP OF AGENCY TO GOVERNMENT	
	Autonomous	Dependent
Agency manages a single irrigation system	1. Mendoza, Argentina Irrigation districts, USA Irrigation districts, Colombia Taiwan systems Communals, Philippines Farmer-Managed Irrigation Systems, Nepal Irrigation districts, Mexico (post-reform) Self-governing systems, by definition	2. Egypt Haryana, India Punjab & Sind, Pakistan ORMVAs, Morocco[a]
Agency manages multiple irrigation systems	3. National systems under NIA, Philippines[b]	4. Irrigation districts, Mexico (pre-reform[c]) Sri Lanka Nepal Indonesia technical systems (>500 ha) Most West Frontier Province & Baluchistan, Pakistan

[a] ORMVAs (Office Regionaux de Mise en Valeur Agricole) are a partial case: they are partially autonomous financially, but their charter of authority is derived from the government.

[b] NIA is a partial or mixed case: it is partially, but not fully, autonomous in financial terms, and its charter of authority is derived from the government.

[c] In transition through a turnover program and therefore moving into cell 1 (autonomous, single system).

the overall supervision of the General Irrigation Department (DGI), described as an "autonomous and autarchic" agency (Chambouleyron 1989). The DGI is managed by a superintendent appointed by the Provincial Senate, and he is assisted by an administrative council consisting of farmer representatives. The DGI is primarily a regulatory agency, with its own budget and rule-making capacity. Irrigation management is carried out by the users through water users associations (WUAs), which are autonomous from the DGI and self-financing. The Mendoza system is adaptable—for example, a process of consolidating WUAs is currently underway to further reduce management costs (Chambouleyron 1995). The system's performance is good in terms of water delivery equity and the ratio of water deliveries to targets (Bos et al. 1991). Again, accountability of the DGI and the WUAs to the users is clearly very important.

Irrigation districts in the USA and Colombia are organizationally and financially autonomous and manage single water supply systems. Recent case studies in both countries show that returns to agriculture have been rising, costs have been contained, financial viability achieved, and the level of service has at least not deteriorated after the systems were turned over to the districts (Svendsen and Vermillion 1994; Garcés-Restrepo and Vermillion 1995). Mexico is well along in making similar reforms (Gorriz, Subramanian, and Simas 1995).

It is likely that a comparative study would confirm the relatively high performance and capacity for sustainability of these types of systems, and thus confirm the first hypothesis.

A Dependent Agency Managing Single Systems (Hypothesis 2)

Single systems managed by a dependent agency (cell 2 in figures 1 and 2) are usually large systems. Some are sufficiently independent physically that programs to change them to an autonomous single system (cell 1) are feasible and could lead to improved performance in the long run (e.g., ORMVAs in Morocco). Other cases involve extremely large highly integrated systems that are central to the prosperity of entire countries or provinces and that have multiple (including nonirrigation) uses (e.g., Egypt, Haryana in India, Punjab and Sind in Pakistan). There is considerable variation in the performance of these systems, and no single indicator is adequate for comparing them.

Egypt by many measures has a high level of performance: its crop yields and cropping intensity are high compared with large systems in other developing countries. If irrigation efficiency is measured on a basin-wide basis, it is very high because of substantial water reuse (Keller, Keller, and El-Kady 1995). But this system is not, as yet, water-short; the managers attempt to, and largely succeed in, meeting water demands. High macro-level performance is a product of having sufficient water to meet demands and excellent climatic conditions for crop growth. But users have no clear water rights, and there is no administrative capability or other institutional means to manage water scarcity. Although macro-level performance is high, there is wide variability in crop yields and cropping intensity, in part reflecting differential access to water, and yields are far below the potential, given the growing conditions (John Mellor Associates 1995). There are serious concerns about the system's future performance and sustainability as demand continues to increase for a fixed water supply, compounded by increasing water pollution (IIMI 1995a).

Haryana State in India is often cited as a system with high performance in terms of equity, reliability, and productivity per unit of water (Malhotra, Raja, and Seckler 1984a, 1984b), but it is also facing serious waterlogging and salinity problems. Pakistan's Indus system (especially the provinces of Punjab and Sind), which is based on design principles similar to Haryana's, suffers from low and stagnating productivity and salinity (e.g., Kijne and Vander Velde 1992; Murray-Rust and Vander Velde 1994; Kijne and Kuper 1995). Unlike Haryana, its institutions seem no longer able to manage the system effectively (Bandaragoda and Firdousi 1992). It has been argued that overcentralized management has led to an inability to solve local problems and prevent them from threatening the integrity of the system (Merrey 1987). Like Egypt, both Haryana and Pakistan face increasing scarcity and competition for a limited water supply as demand increases.

These three cases are characterized by hierarchical management agencies in which decision making is centralized, and accountability is upward to senior civil servants and politicians, and not directly to their customers.[7] They are organizationally and financially dependent. The governments of Haryana in India and of Punjab and Sind in Pakistan collect water rates, but these go into the general treasury—there is no link between the agencies' budgets and collections. Egypt charges no fee for irrigation services. In all three, there are either proposals or ongoing efforts for policy and institutional reform aimed at decentralizing decision making and making the management organizations more autonomous and self-reliant in both organizational and financial terms (for Egypt, see IIMI 1995b, 1995c; Merrey forthcoming).

[7]During a presentation of the previous version of this paper in the Netherlands, Jan Ubels pointed out that all modern cases of highly centralized management organizations for large systems were colonial creations and are therefore a legacy left by the colonial powers. Consistent with the "Wittfogel hypothesis" (Wittfogel 1957), these organizations were an important basis for colonial governments' control of populations.

But given their size and complexity, making these management organizations completely autonomous is risky; reforms need to be carried out step-by-step. Some of these systems are characterized by high rates of rent-seeking and are controlled by powerful stakeholders. These stakeholders will resist reforms, and may also capture the benefits of well-intended reforms. However, governments should persevere with reforms to improve incentives and accountability, while exercising overall control through strong regulatory and consultative mechanisms. Subsystems may be made completely autonomous and user-based, with enforceable contracts as the basis for receiving and paying for water services from the larger entity. Policy making and regulation can be separated from provision of service as suggested by Frederiksen, Berkoff, and Barber (1994).

Morocco is an interesting intermediate case. Irrigation administration is decentralized to nine ORMVAs (Office Regionaux de Mise en Valeur Agricole), which are semiautonomous regional offices. They are supervised by the Ministry of Agriculture and Agrarian Reform and the Ministry of Finance. Water charges are collected and used to pay for O&M, but they are not adequate to cover all costs; the government fixes the price of water and makes up differences with subsidies (Hofwegen 1994). ORMVAs are created and controlled by the government, which is the source of their authority. They are therefore not accountable to users.

Autonomous Agencies Managing Multiple Systems (Hypotheses 3 and 4)

Cell 3 in figure 2—autonomous agencies operating many systems—is nearly empty. One well-known case, the National Irrigation Administration (NIA) in the Philippines, does not fully meet the criteria. First, NIA is only partially autonomous financially. It continues to receive various subsidies, and it cannot set the amount of fees or effectively enforce fee payment. Second, its charter of authority is from the government, with no user control over NIA itself; NIA is dominated by its parent ministry. Therefore, NIA illustrates both hypothesis 3 (even autonomous agencies will show limited performance if they manage many systems) and hypothesis 4 (partial autonomy limits performance).

NIA is an interesting case because its relative autonomy has made its organizational culture more innovative and performance-oriented than most systems in cells 2 (single systems, dependent) and 4 (multiple systems, dependent). NIA has been a pioneer in developing methodologies and policies to promote strong irrigation associations in both "communal" systems (self-governing systems) and "national" systems, those owned and controlled by the government through NIA (Korten and Siy 1989).

NIA has created cost centers for most national systems, and it evaluates staff and system performance using a viability index—the ratio of costs to expenditures. This procedure is intended to motivate NIA staff to reduce costs and improve services to encourage farmers to pay irrigation service fees. Central to this program is the promotion of irrigation associations to take responsibility for O&M as well as fee collection in specific subsystems (for example, a lateral). NIA has three models of joint management in the form of contracts:

- Type I contracts involve maintenance contracts for certain canal lengths.
- In Type II contracts, the irrigation association also undertakes operations and

TABLE 1.
Status of irrigation association development in national irrigation systems in the Philippines, 1992.

	Associations		Area		Members	
	no.	%	ha	%	no.	%
NIA						
Total	—		645,789	100	496,760	100
Irrigation associations						
Organized[a]	1,745	—	531,635	82	409,215	82
Registered[b]	1,522	87[c]				
Irrigation associations with contracts						
Total[d]	1,315	75	405,814	76	278,560	68
Type I[e] (maintenance)	369	28	118,610	29	74,810	27
Type II[e] (maintenance & collection)	900	68	273,143	67	190,525	68
Type III[e] (complete turnover)	46	4	14,061	4	13,225	4

Source: NIA 1992, 22.

[a] Percentages relative to total NIA.

[b] With Security and Exchange Commission.

[c] Relative to organized irrigation associations.

[d] Percentages relative to organized irrigation associations.

[e] Percentages relative to irrigation associations with contracts.

fee collection, keeping a certain percentage of the amount collected over a specified minimum.

- In Type III contracts, the association assumes full O&M responsibility and also amortizes a portion of the construction costs over a period of time.

Table 1 shows the status of the development of irrigation associations and the three models of joint management in the Philippines as of December 1992 (NIA 1992). At that time, 75 percent of the "organized" irrigation associations had taken a contract; of these, two-thirds held Type II contracts (maintenance and collection). Only 4 percent had taken Type III contracts ("complete turnover").

Type III systems are not equivalent to farmer-managed or communal systems and the use of the term "complete turnover" by NIA is inaccurate today.[8] In the provisions on the obligations of NIA and the irrigation associations under these contracts, NIA retains a stronger role than it does in communal systems. More important, NIA retains the water rights, whereas communals have their own legally recognized water rights. The contracts contain no explicit reference to ownership of the system being turned over to the irrigation associations, and NIA retains a great deal of *de facto* control (Oorthuizen and Sloot 1993, 26-27). Wijayaratna and Vermillion (1994) discuss the disincentives for NIA to turn over more systems completely to the irrigation associations. Most Type III ("turned over") systems to date are the least viable in terms of covering costs from irrigation service fees; the systems that are most viable financially tend not to be turned over as they are a source of income ("profit") to NIA.[9]

[8] Jopillo and de los Reyes (1988, 3) refer to Type III as "transforming a government-operated or national system into a farmer-managed or communal system." This was the original intention (Romana de los Reyes, personal communication) but was later changed.

[9] In a case study of a Type III system, Oorthuizen and Sloot (1993, 36–40) found that the annual amortization payments exceeded the irrigation services fees the system farmers used to pay; and both operational performance and maintenance quality remained at a very low level. The irrigation association was successful only in recovery of fees.

Data on performance of the Philippine systems are mixed. Jopillo and de los Reyes (1988, 210-212, table 77) show that irrigated area and cropping intensity increased after farmers became involved in system management in the first set of national systems where irrigation associations were organized, but they note it is difficult to separate the impacts of physical improvements and farmer organizations. Svendsen (1992) shows that based on official data on a sample of irrigation systems, NIA's reforms have apparently reduced system operational costs, while improving equity of water delivery, and yields per hectare have remained constant. Merrey, Valera, and Dassenaike (1994) compare performance data for three systems, one each in the Philippines, Nepal, and Sri Lanka, and show that the Philippine system performs substantially better than the other two as measured by water delivery and agricultural and economic variables. They attribute this difference to the institutional strengths of the Philippine system (specifically, a performance orientation and accountability for service to customers) that are lacking in the other two.

On the other hand, Oorthuizen and Kloezen (1995), in a case study of the impact of NIA's financial policies in a single system, found that although fee collection rose, the quality of the service declined (see also Oorthuizen and Sloot 1993). Lauraya and Sala (1995), based on a study of four systems in Bicol Province, Philippines, show that performance is not very good. Average yield per hectare is half the highest yields in all four systems. The authors suggest this demonstrates a significant yield gap. They also suggest that the use of the viability index as a measure of performance is leading to underinvestment in maintenance and possible deterioration of the systems. Researchers carrying out a restudy of the economy of a village in central Luzon have found that the irrigation system managed by NIA has "collapsed," and only those farmers who can afford pumps for groundwater are able to cultivate (M. Kikuchi, personal communication, 1995). These observations raise questions about system sustainability.

Given the hypothesized relationship of autonomous organizations managing single systems to performance, the obvious direction for future reform would be to create fully autonomous user-based management entities in each scheme (i.e., carry the current policy of turnover to its logical conclusion). These organizations should acquire clear water rights, thus converting such systems into true "communals." It would be necessary to devise incentives for NIA to pursue this path, and it would require further reorientation of NIA to provide technical and management support to irrigation associations.[10] Otherwise, the present limited and dispersed accountability may inhibit improving and sustaining performance over the long term.

Dependent Agencies Managing Multiple Systems (Hypothesis 5)

The cases in cell 4 of figure 2 are more difficult to analyze because of the lack of systematic data on the range of variation in, and overall performance of, irrigation systems . A large number of the systems in this category are performing poorly, and the responsible agencies have been only partially successful in implementing reforms. Mexico has embarked on a program to shift its government-managed systems to management by autonomous organizations accountable to users (Gorriz, Subramanian, and Simas 1995). This entails transforming these systems into single systems managed by autonomous agencies (cell 1), which we pre-

[10] Oorthuizen and Sloot (1993) emphasize the failure of NIA to achieve its "democratization" objectives in the system they studied—the irrigation association was controlled by a few influential people.

dict will in the long run lead to improved performance. At present little data are available on the performance impacts of this program.[11]

Sri Lanka and Nepal, like the Philippines, have been experimenting with informal joint management arrangements for about a decade. Sri Lanka and Nepal have similar organizational models for joint management of government-owned irrigation systems. Both include informal groups at the tertiary levels that choose representatives to more formal organizations at the distributary level (distributary canal organizations in Sri Lanka). A joint project management committee including representatives of farmers and government departments is intended to make overall water allocation and seasonal scheduling decisions in Sri Lanka. In Nepal, this joint decision-making process seems less formal. Some systems in Nepal have formal water users associations at the system level; these are less common in Sri Lankan systems—until recently they were not officially encouraged—and their role is not clear. In Indonesia, reforms have clearer objectives but remain weak in terms of accountability of managers to users.

Nepal

In a recent review of Nepal's experiences with joint management Pant, Valera, and Pradhan (1992) suggest that while the short-term results are clearly impressive, the sustainability of the WUAs and the joint WUA-Department of Irrigation relationship is doubtful. Nepal has not yet developed a management system that would ensure sufficient accountability of officials to farmers, farmer leaders to members of WUAs, or WUAs to the government.[12] The large number of relatively small systems spread throughout a large country with poor communications and transport, compounded by shortage of funds and institutional weaknesses, make it difficult to envision how the department can ever manage these systems effectively and improve their performance. A comparative study of three systems in Nepal, the Philippines, and Sri Lanka showed that the Nepal system ranked lowest on all performance parameters for which there were data (Merrey, Valera, and Dassenaike 1994); and a data-based comparative study of self-governing and government-managed systems in Nepal (Benjamin et al. 1994) also found the performance of the latter to be poor.

Sri Lanka

IIMI has been closely associated with the participatory management programs in Sri Lanka since 1986 (and I have been associated with them since 1980). There are currently three sets of government agencies implementing the participatory management policy. First, the Irrigation Department is trying to implement it in the small and medium systems for which it is responsible, in the Management of Irrigation Systems (MANIS) program, usually through its own staff and with no external support until recently. Second, in 38 major schemes under the Irrigation Department, a parallel division of the ministry in charge of irrigation is promoting the development of the participatory management model as part of the Integrated Management of Major Irrigation Schemes (INMAS) program. In some of these schemes, institutional organizers, consultants, and training programs are supported by external assistance. Finally, since 1992, the Mahaweli Authority has had a program similar to INMAS for the large schemes under its control.

Reports from a recently completed comparative study monitoring the performance

[11]Preliminary results from a survey of farmers in three turnover districts show they have a perception of improved service (Palacios-Velez 1995).

[12]Wilkins-Wells et al. (1995) describe a water share system that has recently been pilot-tested; if this continues to be successful, it may become the government's policy, which is stated as being "the transformation of agency-managed systems to farmer-controlled systems" (Wilkins-Wells et al. 1995, 230).

of 199 jointly managed systems provide a mixed picture (IIMI and ARTI 1995). All INMAS schemes in the sample were reported to have project management committees, about 88 percent of the distributaries had organizations, and considerable progress had been made in the "turnover" of distributaries to farmers. However, most farmer organizations remain dependent on the department that gives them funds for maintenance. The concept of turnover is not precisely defined. It is not ownership and does not include enforceable water rights. Distributary canal organizations take contracts for O&M from the Irrigation Department, like the Type I contracts in the Philippines, but unlike in the Philippines, the government pays the farmers without collecting irrigation fees.

Overall, the comparative study by IIMI and ARTI (1995) shows that participatory management has improved water distribution and that maintenance quality in distributaries and crop yields have not changed. A significant minority of farmer organizations have expanded into other revenue-generating activities, but they depend on government assistance for their success. The government's O&M costs have not fallen, however expenditure has been shifted from distributary canals (maintained by farmer organizations, usually under a contract with the government) to main system maintenance. As in the Philippines and Nepal, the program is stalled because there is no commitment to a long-term objective and no willingness to consider more radical reforms of the government agency.

In Mahaweli systems, some turnover has occurred and a joint management structure has been put in place quickly. The systems under the Irrigation Department's MANIS program show the least progress because of the weak support. Overall, the interviews carried out by IIMI revealed a marked reluctance among both farmers and officials of all departments to turn over full O&M responsibility to farmer organizations. Studies of other irrigation systems provide a mixed picture, with examples of both strong and weak farmer organizations (see TEAMS 1992; Vimaladharma 1994). Two systems in which a local nongovernmental organization implemented experimental institutional strengthening programs have also had disappointing results (Athukorale, Athukorale, and Merrey 1994). In their comparative analysis of systems in the Philippines, Nepal, and Sri Lanka, Merrey, Valera, and Dassenaike (1994) showed the performance of the Sri Lanka system was very low on all parameters—though it was regarded by the Irrigation Department as a show-case system.

A recent review of the experience of the Mahaweli Authority prior to 1992 argues that the impediments to strengthening farmer organizations and their system management role lay primarily in the organizational structure, incentives, and philosophy of the Mahaweli Authority itself (Merrey 1995). But the problem is deeper. It is the result of the reluctance of Sri Lanka to carry the participatory management policy to its logical conclusion. Neither the Irrigation Department nor the Mahaweli Authority (nor some future amalgamation of the two) will ever have the combination of resources, incentives, and accountability to system users needed to be able to achieve a high level of performance in the hundreds of systems scattered around the island. Nor has the government been willing to address the issue of financing irrigation services. Irrigation remains free, which greatly limits farmers' interest in taking over O&M responsibilities.

Radical reform to shift Sri Lankan (and indeed Nepali) systems to single systems managed by autonomous agencies (cell 1), as is underway in Mexico, may be the most promising long-term institutional means to achieve sustainable high performance.

Indonesia

In Indonesia, the government is turning over all systems under 500 hectares to water users organizations (i.e., shifting them to cell 1). On systems over 500 hectares, the government is introducing irrigation service fees. These fees are linked to giving farmers, through their water users associations and federations, a clear voice in defining the service for which they are paying (Gerards, Tambunan, and Harun 1991; Gerards 1992). A recent carefully documented case study of this Indonesian program has confirmed the positive association between the use of "voice mechanisms" (public pressure by users on service providers) by farmers through their WUAs and the accountability of the service provider, and it has demonstrated that improved outcomes such as higher cropping intensity can be attributed at least partially to improved accountability (Paul 1994). However, the provincial irrigation services, which continue to manage these larger systems, remain hierarchical and dependent on the government both organizationally and financially and continue to be responsible for multiple systems. The next step in Indonesia's program should be reconsideration of the structure and role of the provincial irrigation services.

Recommendations

The findings stated in this report are suggestive and certainly not prescriptive. The plausibility of the basic hypothesis has been established. This basic hypothesis is that single irrigation systems managed by system-specific organizations that are financially and organizationally autonomous and accountable to their customers, generally perform better and are more sustainable over the long term. If this report is on the right track, the findings should be of great interest to countries struggling to improve the performance and sustainability of government-managed gravity irrigation systems. Certainly there is an urgent need for more research, but policy makers can initiate changes now.

Methodologies for Future Research

Only a few comparative studies of irrigation have attempted to test hypotheses about irrigation performance using quantitative data from samples of irrigation systems. Examples are the studies by Tang (1992), Murray-Rust and Snellen (1993), and Benjamin et al. (1994). All these studies struggle with defining variables in a conceptually meaningful way and with finding sufficient data. Data on irrigation system performance and sustainability are particularly problematic. Many studies are carried out by researchers lacking the resources and skills to measure performance adequately (though their data on other dimensions are often excellent); and even researchers specialized in performance assessment do not agree on a universally valid set of performance indicators. IIMI recently proposed such a minimum set for use in its work (Perry 1996), but at present there are few systems for which data are available to test these indicators. Establishing agreed performance indicators and collecting data on a sample of systems reflecting the diversity of irrigation conditions in the world constitute one of the most important areas for research on irrigation in the next few years.

Anticipating that this may take some time, another option is to continue using imprecise proxies as, for example, Tang (1992) does. It is not necessary to wait to find a single performance indicator (or set of indicators) applicable to all systems and data based on this indicator, to continue seeking to understand the determinants of performance and how it can be improved.

A related problem is sampling. No study has yet used a sample that can claim to be representative of the universe of irrigation. This too may be impossible as the universe itself is not well known, but certain kinds of systems favored by researchers are well-represented, while others are not represented at all. For example, two of the four cases from Pakistan used by Tang (1992) are on the same irrigation system; all the bureaucratic systems are from six Asian countries and from one Middle Eastern country. All but one self-governed system in his sample are from Asia, with the Philippines heavily over-represented (12 of 29 cases) (Tang 1992, 43-44, tables 3.1 and 3.2). A proper study using statistical measures of association among variables must be based on a more representative sample of systems. To create such a sample, it would be necessary to delineate the major irrigation areas of the world, identify what studies are available for each of these areas and how adequate they are, and attempt to develop a sample that is reasonably representative of worldwide variation.

Further refinement of the variables used here will also be necessary, such as a more precise definition of financial and organizational autonomy. But this is only the beginning of the measurement problems involved. For example, how does one measure the performance of an organization managing hundreds of systems? The earlier discussion of the Philippines implies there is considerable intersystem variation. It may be necessary to look at the data available from different studies and attempt to arrive at a median and standard deviation for performance indicators.

No single researcher could carry out this kind of rigorous, statistically valid, comparative study on a global basis. One possibility is for IIMI to establish a worldwide irrigation system database, modeled on the Human Relations Area Files[13], which contains coded data on thousands of variables from hundreds of societies around the world and is used regularly by anthropologists to test hypotheses. In principle, as an international institution, IIMI could establish a worldwide sampling frame, identify the cases to be used, develop guidelines for collecting data and coding variables, code the sample cases, and then both carry out analyses for testing hypotheses and invite other scholars to make use of the database. Such a database could be used for answering many questions about the determinants of irrigation performance.

The creation of this database would be expensive and take years; unfortunately, it is unlikely to be implementable and its cost-effectiveness is uncertain. There are several more feasible research designs, though the results may be less-conclusive. These include case studies, before-and-after impact studies, controlled comparisons, and action research. Carefully done studies of cases representing different organizational arrangements can be useful, particularly if an explicit common analytical framework and performance indicators are employed to enable comparative analyses. Some of the recent case studies supported by IIMI would have been more useful if there had been such a common framework (e.g., Yoder 1994a; Svendsen and Vermillion 1994; Garcés-Restrepo and Vermillion 1995).

[13]The Human Relations Area Files (HRAF) is a nonprofit cooperative organization of a large number of American universities which maintains a coded database of primary ethnographic and other data on a global sample of societies (Moore 1970).

Ex post facto studies of performance before and after organizational changes are introduced constitute another promising approach currently being explored by IIMI to document the impact of management turnover (Irrigation Management Reform Group 1996). A third approach involves comparative analyses of similar systems with varying organizational arrangements. Benjamin et al. (1994) use data from a large sample of systems in Nepal to compare the performance of self-governed and government-managed systems. Merrey, Valera, and Dassenaike (1994) compare three rice-based systems in three Asian countries to examine hypotheses about the determinants of performance. A related approach is "controlled comparison," in which two (or several) systems that are similar except for their organizational arrangements are carefully selected and studied in depth to test carefully constructed hypotheses. Finally, "action research" is an option that may be useful for both researchers and policy makers: organizational innovations are implemented in a few systems through a learning process approach facilitated by the researchers, combined with monitoring both these and other systems where no changes have been introduced.

What Policy Makers Can Do Now

One reviewer of an earlier draft of this report suggested that further research is unnecessary, that we already know enough about what kind of institutional framework works and does not work, and that countries should get on with reforms based on this knowledge. At the level of general organizational and management principles, there is much truth in this position. However, transferring arrangements deemed successful in one context to another entirely different context and translating abstract principles into practical reality are highly problematic. Would the USA model of irrigation districts be equally successful in, say, India or China, with their very different social, cultural, economic, and political conditions? Creating the necessary conditions for successful organizational change is usually contentious and complex. The implementation strategy and organizational design must fit the specific context, and there must be sufficient time to adapt and institutionalize. Nevertheless, policy makers who wish to improve the performance and sustainability of their water services need not wait for further research. Enough is known to design and implement successful programs.

The term *autonomous,* as used here, is not to be confused with *private*. As Ostrom, Schroeder, and Wynne (1993) note, a strong government role is necessary in most countries, not only to avoid capture of the irrigation agency by an influential minority, but also because the authority inherent in the government is necessary for enforcing rules to manage and conserve a common resource. Local authorities with specific government mandates for the integrated management of particular irrigation systems, whose charter of authority derives from the users, are an effective arrangement for managing irrigation systems.

In crafting institutions, special attention needs to be paid to incentives, both positive and negative, through accountability of users as well as managers. An integrated approach based on the whole system, and not fragmented between user groups and government departments, is essential. Therefore, countries currently promoting partial turnover programs face a serious problem: water users associations in parts of systems, partial turnover of O&M for entire systems, or shared management through joint farmer-government committees are not likely to become stable and effective institutional mechanisms for managing irrigation systems unless there is clear provision for mutual accountability between users and managers.

The recommendations for policy makers are therefore clear, though difficult to implement; some have been suggested earlier. Reform programs must be carefully designed, strongly supported at high levels, and based on pilot testing at the initial stages. Countries whose irrigation management agencies are dependent on governments financially, organizationally, or both should design strategies to make the agencies more autonomous. Countries with highly centralized agencies that manage single large systems should proceed with shifting to more autonomous decentralized structures with high levels of accountability to the users but in a regulatory framework that ensures equity and cost-effectiveness as well as enforcement of contracts without high transaction costs. Countries in which a single provincial or national irrigation agency manages a large number of systems should explore ways to encourage the emergence of autonomous user-based organizations in each system or perhaps in specific watersheds. Such reforms will be successful only if governments are willing to provide a supportive and enabling institutional and policy framework, positive incentives for local users to take full responsibility and authority for their systems, and sufficient training and technical support.

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