CHAPTER 6

Analytical Framework for Irrigation Management Reform

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Abstract

This paper provides a framework which specifies the key components of irrigation management and indicates how they are inter-related. Considerations of management reform should include an analysis of four basic dimensions of irrigation management:

- *the water service,*
- *hydraulic technology,*
- *management functions, and*
- *organizations.*

The analysis should start from a precise definition of the water service which is required and then proceed to specify the nature of technology and management which is best suited to achieving an acceptable standard of performance in the water service. Analysis should be made of:

- *gaps between the existing and required service and*
- *gaps between the required service and the compatibility of existing technology and management.*

The analysis will largely determine whether or not reforms are actually required and, if so, how extensive and basic they should be.

Introduction

Developing countries, donor agencies and others are attempting to reform irrigation systems to provide financial sustainability and improve performance. While there have been various experiments with reform (several done by IIMI) there has been less systematic analysis of management systems and their performance. There is a need to pool internationally lessons learned about management reforms and provide guidance on the options, implications and basic modalities of strategic reform.

IIMI has developed and applied a comparative methodology for assessing the effects on irrigation performance of pilot experiments or reforms such as management turnover. IIMI has conducted research on irrigation management turnover for several years in such countries as Indonesia, the Philippines, Sri Lanka, India, China, Colombia, Mexico and Pakistan. IIMI proposes herein an analytical framework to examine irrigation management reform and provide practical guidance to professionals faced with the challenge of working through reform. This paper is a step in that direction.

This paper relates primarily to medium and large scale gravity irrigation systems (i.e., above 1,000 ha in service area). We will not discuss the important topics of pump and pressurized systems and the conjunctive use of water in irrigation. There are four basic dimensions for analyzing irrigation management alternatives:

- The water service,
- Hydraulic technology,
- Management functions, and
- Organizations

First dimension: The water service

The first dimension of this framework is the primary service which irrigation management provides, which is water delivery and drainage. The water service may include regulation of the water source, acquisition of water at the source, conveyance, distribution through the canal network and division points, application of water on fields, drainage and flood control. Measurement of water is an important aspect of water delivery.

For irrigation, the water service is primarily defined by the amount (or proportion) of water to be delivered to specified places at specified periods (or sequences) of time. These expectations are normally embodied in a water right, which may be defined at different levels, from the farmer up to the water source.

The three major challenges for managing water service for irrigation are:

- How to allocate water between watercourses and farmers and ensure that allocation rules are implemented?,
- How to manage variability in water supply, surpluses and scarcity consistent with the allocation rules and minimize negative environmental consequences?, and
- How to minimize negative environmental consequences.

The water service requires actions to be taken at one level which provide an agreed service to another level. The service delivered normally cuts across interfaces between each of the basic hydraulic levels.

In gravity flow systems, both discharge and water levels must be controlled to satisfy hydrologic parameters. The frequency and duration of water flows may also be controlled, depending on system technology. Control may be fixed or flexible and manual or automatic. The four basic variables relative to water delivery which are controlled in irrigation systems are:

- water discharge (Q),
- water level (H),
- duration of flow (T), and
- frequency of flows (F).

These variables define two basic types of water delivery management systems, each of which delivers a service differently within and between given levels of an irrigation system. These are:

- continuous flow systems (supply or demand based) and
- rotational systems (fixed or variable).

Continuous flow demand based systems target water deliveries according to requests or requirements for water. Continuous flow systems provide given proportions of uninterrupted water flow to the main canal and possibly distributary canals. Rotational systems deliver water in turns to different sub-units of the system, either in time or frequency of flow, or both. Table 1 presents a basic typology of water delivery systems which are known to exist in the world. This is an adaptation of typologies by Replogle, et. al. (1983) and Maass and Anderson (1986).

Table 1. Water delivery systems for irrigation

No.	Delivery System	Variables Controlled	Remarks
1.	Continuous on demand	Q,F,T controlled as per requests.	Continuous flow in main and possibly distributary canals. Water delivered to fields on request basis. Technology and cost requirements high.
2.	Continuous modified or arranged demand	Basic allotments for Q or F are given with option for requesting additional Q,F, or T, subject to supply constraint	Continuous flow in main canal. Used in more water abundant environments or where sophisticated information and control facilities are available.
3.	Continuous regulated flow, supply based	Regulated Q flowing uninterruptedly to a given level, throughout the system.	Continuous flow in main and distributary canals. In paddy systems in Southeast Asia and South India.
4.	Continuous variable flow, supply based	Variable Q. T,F not relevant.	Continuous flow to distributary level, terminal delivery adjusted to relative crop requirements.
5.	Fixed rotation	F, T and Q (in theory) fixed down to watercourse level	Found in warabandi areas of North West India and Pakistan.
6.	Semi fixed rotation	Fixed T and F, fluctuating Q. Generally, rotating between watercourses in distributary	Wheat and maize irrigation in China; used under scarcity for rice systems in Southeast Asia.
7.	Variable rotation	Constrained Q and F, variable T	One cusec canal design in Sri Lanka; used at distributary and tertiary level during land preparation in Asian countries.

Second dimension: Hydraulic technology

Each of the above delivery systems varies in the sophistication of hydraulic technology required to manipulate water flow according to the service required and in the level of management intensity required to measure water and manipulate the hydraulic technology. Hydraulic technology constrains the type of delivery system which is feasible. Structures can determine whether or not it is feasible to have upstream or downstream control, flexible versus fixed distribution, manual versus automatic gate adjustment, and so on. It would be difficult or impossible, to introduce rotational irrigation in a system with no cross-regulating structures.

Water resource systems can be divided into six hydraulic levels, as follows:

- the water source,

- the main system (including the intake and main canals),
- the distributary system (including distributary and minor canals),
- the watercourse (including tertiary and field channels),
- farmers' fields, and
- the drainage system.

In an irrigation system the conveyance and distribution system consists of a network of channels or pipes with structures to regulate, control and measure water flows. Management of gravity irrigation systems involves use of hydraulic technology from the level of the intake to the drainage system. Although drainage systems are often a distinct network below the level of water application on fields, management of drainage is generally incorporated in the management of structures from the main system to farmers' fields. Irrigation management functions occur within each level and at the interfaces between them. The four key interfaces for irrigation system management then, are:

- interface between the water source and the main system,
- interface between the main system and the distributary subsystem,
- interface between the distributary and watercourse subsystems,
- interface between the watercourse and farmers' fields.

Typical technologies at the interface between the water source and the main system are dams, diversions and lift structures. Cross regulators, offtake structures and proportional dividers are typically found at the interface between the main, distributary and watercourse levels. Sliding gates, pipe outlets, syphons or simple cuts in channel bunds may be found at the interface between the water course and farmers' fields.

With the two dimensions of the water service and hydraulic technology we can analyze what management functions need to occur at different levels of an irrigation system. Careful definition of the service and management functions required helps determine what types of irrigation organizations will be most appropriate.

Third dimension: Management functions

The role of management is to provide the primary service of water delivery and drainage through the performance of all necessary management functions related to the service. The five basic management functions of irrigation management are:

- capture of the water resource,
- operation of structures,
- maintenance of structures,
- dispute resolution, and
- resource mobilization.

Each of these can be broken down into specific activities which can be defined in terms of human actions, use of resources, performance standards, information requirements, and decision criteria.

Capture the water resource is the function of acquiring water from its condition outside of an irrigation system and bringing it into the system for use in delivering water for agriculture.

Operation of irrigation structures includes control and measurement of water from the intake to farmers' fields through the use and manipulation of hydraulic technology. The nature of the water service and technology determines the requirements for gate operations, water measurement and information management which are needed to implement the service.

Maintenance involves the allocation of scarce funds, labor, and equipment to the repair, cleaning, de-silting, lubricating, protection and beautification of irrigation system infrastructure and property. The nature and level of maintenance required is largely determined by a comparison between the service required and the ability of hydraulic structures to provide it.

Dispute resolution is the settling or containment of conflicts among water users, management staff and other users outside the irrigation system who are effecting or are effected by it. Unresolved conflicts can severely disrupt water distribution, maintenance and resource mobilization. But disputes can be difficult to settle in systems where water rights or management responsibilities are not clearly specified. High performing and sustainable irrigation systems have effective dispute resolution arrangements which can be handled rapidly and locally. These come in various types, such as special water courts in Spain, judicial systems in the USA and Japan, and traditional village or water organization bodies in Indonesia. Planners often fail to incorporate effective dispute resolution arrangements into management reform in the irrigation sector.

Resource mobilization includes the acquisition, allocation, expenditure of, and accounting for, funds, labor, equipment and other resources used in irrigation management. It may also include mobilization of skills through training. The level of resources required is largely determined by the sophistication and intensity of hydraulic technology and human resources which are required to provide the irrigation service. Whether the resources are mobilized from the farmers, government subsidies, or sideline income is determined largely by political dialogue at policy and system levels.

Most reforms in irrigation management in recent years have been prompted by a failure to mobilize sufficient resources to cover the costs of management. The rapid expansion of irrigated area from the 1950's up to the 1980's created an ever increasing demand for funds to pay for routine O&M. Over time governments became less and less capable of financing recurring costs and O&M budgets declining on a per hectare basis in many developing countries. Often, governments resort to management turnover only after failing to mobilize sufficient funds from the central treasury or collect adequate water charges from farmers.

A common sequence is for planning or finance department to reduce subsidies to irrigation agencies. The agency may react by first attempting to raise more fees from farmers. Additional pressures can lead to turnover of management which, in effect, transfers responsibility for resource mobilization to farmers. A key issue for management turnover is whether the additional cost to farmers for irrigation will be offset by improved economic productivity.

Fourth dimension: Organizations

In the foregoing we have seen how hydraulic technology and a defined water service can require widely different levels of management intensity, in terms of resources, information and control.

There are two basic roles which irrigation organizations play: governance and management. It is important to realize that the two are different and may involve two separate organizations. Governance of an irrigation system includes establishing the charter of authority for the management organization, developing by-laws and rules for use of the irrigation system, developing water rights, selecting organization leaders, setting and regulating basic policy, commissioning services, and resolving conflicts which can not be settling by established management procedures.

Organizations differ in their capacity to provide management services at different levels of management intensity and accountability. This capacity is determined primarily by the organization's basis of authority, mode of financing and incentives for members to achieve performance standards.

There are eight basic types of organizations which are used for managing medium to large scale irrigation systems in the world. These are:

- government agency,
- public utility,
- local government,
- farmer association,
- irrigation district,
- mutual shareholding company,
- private company, and
- contractor.

Government agencies which manage irrigation systems generally are mostly or entirely financed by central revenues and regulated by standard civil service codes and budgeting procedures. They may exist at the central or provincial levels and normally have jurisdiction over many systems. They may be line departments or more integrated agencies.

Public utilities are generally fully or mostly financially autonomous and have mandates from government to provide a monopoly water supply service within a given jurisdiction, such as a region or river basin. Utilities are regulated by commissions or boards of directors which generally consist of government officials from line departments and local governments, users and other stakeholders. Examples are the National Irrigation Administration in the Philippines (only partly autonomous) and the Bonneville Power Corporation in the USA. Revenues are obtained mainly from sale of water.

Local governments such as villages or townships sometimes manage irrigation systems. This is often the case with small scale irrigation systems or watercourses of larger systems where viable local organizational alternatives to villages and towns do not exist. Examples are found in Turkey (where the government is often turning over management of irrigation systems to village governments; Cagil, 1995). In China villages and townships are often responsible for developing and managing distributary and watercourse levels of medium and large scale irrigation systems. Village governments in India (panchayat) and Indonesia (desa) are often responsible for irrigation management within village boundaries. The main revenue source tends to be land taxes.

Farmer associations In countries like Indonesia and Nepal traditional farmer associations are federated to manage medium scale irrigation systems (i.e., above 1,000 ha). The Chattis Muja system in Nepal (Yoder, 1994) and Balinese subak in Indonesia are examples. Farmers directly manage the systems themselves and with staff selected by farmers. The system is self-financing, although it may occasionally receive assistance from the government.

Irrigation district The irrigation district model of the USA, Spain, Mexico, Colombia and Taiwan is a common model for management of medium to large scale irrigation systems. The district is considered as a "semi-municipality" or a kind of function-specific local public organization, which allows certain privileges and immunities not available to other private sector organizations. The members are water users who elect a board of directors. Typically, the board of directors recruits a general manager and professional staff assigned full time to manage the system. They are employees of the district. The board supervises the general manager and provides overall policy guidance. The general manager supervises other staff. Districts are financed primarily by water charges and possibly some sideline revenues.

Mutual company A mutual irrigation company is a limited liability corporation established through stock shares in the irrigation system which are owned by water users. Generally, share prices are based on a valuation of the assets of the irrigation system and a division among members. In a mutual company shares are normally sold only to farmer water users. As with the district model, farmers elect a board of directors which has oversight for company management. The board selects a general manager who in turn recruits professional management staff. Main revenue sources are water charges, but as a company, the management has the freedom to raise sideline revenues to "cross-subsidize" the cost of irrigation in the private sector. It can also raise profits and enter into joint ventures with other organizations, private or public. This model usually exists in irrigation systems in the USA which had been developed largely through farmer or private sector financing. China is currently adopting the mutual company shareholding model in pilot areas in Shandong and Hunan provinces, even though in China "ownership" formally means long-term leasehold status.

Private company In the case of plantation agriculture or large farms managed by private companies, irrigation systems are sometimes managed by the private company which manages agricultural production in the irrigated area.

Contractor Irrigation management by contracting organizations is done when the governing organization enters into a contract with a third party firm for a limited period of time to manage an irrigation system. In China, village governments provide franchise contracts to local "professional irrigation management teams" to take over management of deep tubewells for profit. In Hunan province "water auctions" are held by water conservancy bureaus or irrigation districts for open competitive bidding for 1 to 3 year contracts to manage O&M for medium and large scale irrigation systems. The contractor is paid by the entity which commissions its services.

An organization may have jurisdiction for the entire irrigation system or only for certain levels. A single system may be managed by a combination of organizations, such as is the case with so-called "jointly managed" irrigation systems, where a government agency manages the main and distributary levels and farmer associations manage the tertiary or watercourse levels.

Joint management (between government and farmer associations) is the approach followed in countries like India, Sri Lanka and Indonesia, where a government agency and farmer organizations are responsible for management at different levels and important managerial decisions, such as regarding cropping patterns or rotational irrigation, are, in principle, made jointly between government officials and farmer representatives (Chambers, 1988). In medium to large scale systems in Sri Lanka, "joint management committees" meet at distributary and main system levels to make key management decisions. Also, in Mexico in large irrigation systems the government commonly manages the intake and main canal while water users associations manage distributary and watercourse canals. Representatives from both sides constitute a "hydrologic committee" to ensure proper coordination between the interface between main and distributary canals.

Another variant of joint management is when an agency focuses on managing the main and, possibly distributary, system and farmer organizations manage the terminal or watercourse level. Instead of joint decision-making about important management decisions, a dual management system functions where the agency delivers an agreed service to the point of organizational interface with farmer groups. Both organizations operate at separate levels relatively independently.

An example of dual management is the north China plain, where irrigation "districts" (similar to public utilities) have agreements to deliver specified amounts of water down to turnouts from the main or distributary canals. Water management, maintenance and crop patterns below the turnout points are strictly the responsibility of the users or villages (with the qualification of there being crop quotas in some places). Otherwise, the agency and farmer organizations are managed relatively independently of one another.

Organizations and hydraulic levels

To simplify, we can collapse our types of organizations into three: a central authority, an intermediate organization and a farmer group. A central authority is a governmental or quasi-governmental organization (such as an agency or utility) whose jurisdiction is an administrative area which includes several irrigation systems. An intermediate organization exists between a central government authority and a primary group of farmers. By a farmer group, we mean relatively small and informal groups which function mainly through direct interpersonal interactions, of generally less than about 50 farmers. A larger water users association which functions above the level of a single interpersonal group is considered herein as an intermediate organization.

The following matrix (Table 2) compares these three types of organizations with the three hydraulic levels identified above and displays nine organizational configurations known to exist for medium to large scale irrigation systems.

The first configuration in Table 2 is found in state managed irrigation schemes in Africa, such as the Gezira or Rahad schemes in Sudan (before recent changes in the last two years). In these schemes water is managed down to the watercourse level by government. Even cultivation has been state managed in pump schemes along the White Nile.

Table 2. Hydraulic Levels and Organizations in Irrigation Systems

	Main System*	Distributary Subsystem	Watercourse Level	Example
1.	CA	CA	CA	Parastatal in Sudan
2.	CA	CA	IO	Schemes in Indonesia with formal WUAs
3.	CA	CA	FG	Schemes in India with small informal groups below outlet
4.	CA	IO	IO	Columbia Basin, USA and Mexico
5.	CA	IO	FG	Large districts in China and Philippines
6.	IO	IO	IO	Irrigation districts in USA and Latin America
7.	IO	IO	FG	Medium irrigation districts in China, Federated FMIS in Nepal
8.	IO	FG	FG	Small farmer managed schemes with formal management
9.	FG	FG	FG	Small farmer managed schemes with informal management

* For simplicity, main system includes management of the intake at the water source and the main canal. In some cases, the intake and main canal could each be managed by different organizations. CA = central authority; IO = intermediate organization; FG = small, informal farmer group. It is not possible to include all the permutations which exist. In some cases there could be more than one central authority or intermediate organization managing sub-levels of the three basic levels above. Also, for simplicity, Table 2 only includes three basic levels. However, in larger systems with numerous layers, it is possible that more than three organizations are involved in managing the entire system.[2]

An example of the second configuration is found in "jointly managed" irrigation schemes where a formal water users association exists at the watercourse level, such as in medium to large systems in Indonesia, the Philippines and India. Type 3 only differs from type 2 in the smaller size and less formal nature of farmer groups at the watercourse level.

Type 4 has a central authority at the main system level and formal intermediate organizations at distributary and watercourse levels. An example is the large scale Colombia Basin Project in the USA where the government US Bureau of Reclamation manages the diversion and main canal and irrigation districts manage the distributary and watercourse levels and deliver water directly to farm turnouts. This also occurs in large scale irrigation districts in China where a government bureau manages the main system, an autonomous irrigation district manages the distributary system (IO1) and a formal village irrigation management group manages the watercourse (IO2).

Type 5 has three separate organizations, one at each level. An example is in irrigation schemes in China where a government agency (water conservancy bureau) manages the main system, an irrigation district manages the distributary system, and farmers informally distribute water at the watercourse level. This also occurs in the Philippines where the National Irrigation Administration manages the main system, a formal water users association manages the distributary subsystem and an informal group of farmers manages the watercourse.

Type 6 has an intermediate organization managing at all three levels. This is common in the USA and Latin America where irrigation districts manage entire irrigation schemes, from the main system to the watercourses.

Type 7 is found in China where medium scale irrigation districts manage main and distributary levels while small, informal farmer groups manage the watercourse. Another example is federated farmer managed irrigation systems in Indonesia and Nepal, where formal organizations exist at the main and distributary levels but not at the watercourse level. Type 8 is a slight variation of 7, which is found in smaller schemes where a formal farmer organization manages at the main system level but distributary and watercourse levels are handled only by informal, interpersonal interactions.

Type 9 is found normally only in very small irrigation systems, generally less than 150 hectares in service area, where informal farmer groups manage the entire system.

Organizational configurations for medium to large irrigation systems

We will now apply this matrix to the question, "Which of the above organizational configurations are likely to be most appropriate for medium to large scale irrigation systems in developing countries where governments are attempting to turn over irrigation management to non-governmental, intermediate organizations?" We answer with the following working hypotheses which are based on general observations.

After the financial stresses and structural adjustments in developing countries over the last 15 years, type 1 is practically extinct. It is too costly and is generally poorly managed. Type 2 is still very common in many developing countries, especially in Asia, but is generally under financed, has poor accountability between government and farmers, is under performing and is in need of reform. Type 3 has the same problems as type 2, except that informal groups are probably in an even weaker position relative to the central authority.

The problem with type 5 is that informal farmer groups are likely to be increasingly ineffective in an emerging environment of greater competition over water and a rising need for accountability over water use and financing. The same could be said for types 7 through 9. Increasingly, formal intermediate organizations will be needed at both distributary and watercourse levels, in medium and large scale irrigation systems.

This leaves types 4 and 6 as the best candidates for experimental adoption of new management configurations. Type 4 is most likely to be appropriate for large scale irrigation schemes where a central authority must still maintain control over the main system. There could either be a single federated intermediate organization managing distributary and watercourse levels or there could be two separate organizations at these two levels. This would depend in part on the relative independence or integration of water control and financing at the interface between the distributary and watercourse levels.

Type 6 will be appropriate where one or more intermediate organizations can manage the entire system without a central government authority. Again, the nature of the water service and financial interface between the three levels will largely determine whether two or three organizations will be needed overall. We hypothesize that generally a single organization will be less effective in managing an entire large scale irrigation system because it lacks the inter-organizational "creative conflict" often needed to achieve accountability among stakeholders of irrigation systems (see the discussion below).

The challenge of accountability

People who have a direct interest in the performance of irrigation systems can be referred to as "stakeholders". Core stakeholders in irrigation systems include farmers, farm laborers, and irrigation management personnel. More broadly, they include providers of agricultural inputs and support services, buyers and processors of agricultural products, other users of land and water who are connected to the irrigation system, and less directly, to urban consumers of agricultural products.

How accountability between core stakeholders (i.e., management staff and farmers) is to be achieved is perhaps the greatest challenge for irrigation organizations (Merrey, 1995). The degree of accountability of organizations to provide agreed services and resources is partly determined by how services and resources are exchanged at the interfaces between hydraulic levels and organizations.

Accountability of staff within organizations can be achieved in various ways, such as through financing methods, personnel policies, incentives, contractual agreements, terms of compensation, bonuses, awards and sanctions. Centrally-funded government agencies often have the weakest degree of staff accountability. Staff are supported by civil service codes which make it impossible to release staff. Salary rises are given solely on the basis of longevity in the agency. Bonuses and penalties based on job performance are generally not permitted under civil service codes. At the other extreme organizations in the private sector are often free to hire and fire staff, employ staff on renewable contracts, and incorporate into contracts incentives, bonuses and penalties linked to job performance.

The ability of an organization to impose accountability of staff depends partly on these internal mechanisms, but also--probably more importantly--on forces external to the organization which make the organization itself, as a single entity, <u>need</u> to achieve agreed performance standards. One of the verities of modern economics and organizational theory, most often forgotten in state-sponsored development strategies, is:

> **Unless the basic welfare of an organization depends on its achievement of agreed performance standards, it will not have the political will to impose effective internal mechanisms for accountability.**

There are five basic strategies for achieving organizational accountability:

- internal governance arrangements,
- central regulation,
- competition,
- inter-dependence between organizations,
- common property arrangements.

<u>Internal governance arrangements</u> This is the oversight, supervision and monitoring of management procedures and practices by a unit appointed by the main governing body of the irrigation organization. An example is a board of directors elected by a water users association which appoints persons to review annual O&M plans, budgets and management performance, where management is implemented by professional management staff.

<u>Regulation</u> Organizations are made to be accountable by rules and sanctions imposed by a central authority which exists above the level of management. Regulation is most relevant for sensitive legal, political or security matters or where natural monopolies exist, such as for the military. Governments

sometimes sponsor technical and financial audits of irrigation management organizations to see that the public interest is being served. Governments often over apply central regulation in cases where it is ineffective, expensive and where they lack the capacity to enforce regulations. Examples of this are government regulations against aquifer draw down and the use of forest guards to prevent deforestation or elimination of "protected" species of wildlife.

Competition Where natural or contrived monopolies do not exist, where there is a reasonably equal playing field for competition and where temporary inefficiencies would not have disastrous effects--competition between service providers has historically proven to be an effective way to improve services and promote efficiency over time. Many people assume that irrigation systems are natural monopolies which can only have one service provider per system. In fact, competition can be introduced into irrigation systems through contracting different services to different organizations (such as operations, maintenance, fee collection, etc.). A contractor for one service who wants to obtain contracts for other services or for the same service in other irrigation systems, must optimize cost-effectiveness in order to compete for additional contracts. Contracting with service providers can also introduce competition in a given irrigation system over time.

Inter-dependence between organizations Inter-dependence between organizations can be created where different organizations manage different hydrologic levels of an irrigation system. This most often occurs in the form of a service being provided in one direction across an interface (such as water delivery) and resources flowing in the opposite direction (such as payment for water delivery). Inter-dependence implies a rough balance of power--that one organization cannot dominate the other. Inter-dependence can create an energizing tension or "creative conflict" between organizations which makes them accountable to a common objective.

Another way inter-dependence can be created is through separating into two organizations, or at least two distinct bodies, responsibility for governance versus management. The water users association model conventionally fuses governance and management into the same organization. This makes accountability of leaders to members and leaders to performance standards difficult to achieve, especially where associations exceed 50 members. Farmers may wish to "participate" in some governance functions (such as selecting representatives or approving basic policies or annual plans) but they often lack the time and interest to be directly involved in various management functions. Furthermore, medium to large scale irrigation systems require a higher degree of management intensity and professionalism than is typically obtained through a water users association where the farmers directly handle both governance and management.

In medium to large scale irrigation districts in the USA, Mexico and Colombia, a general assembly of farmers elects a board of directors and approves basic policies, annual plans and water fees. The board of directors recruits and supervises professional staff to perform management functions. Management staff are accountable to the board for their performance. The board can hire, fire and provide bonuses or penalties relative to staff performance. Members of the board are accountable to the general body of water users. In theory, they can be relieved of their positions or extended by the general membership.

Performance audits can also be used to create inter-dependencies between organizations. Sometimes an additional organization is involved in providing independent technical and financial audits. Certain subsidies or benefits may be linked to outcomes of audits. In the USA, the Bureau of Reclamation retains the right to take over again management of irrigation districts which have been found by audits to be seriously lacking in financial or O&M performance standards (Svendsen & Vermillion, 1994).

Eligibility requirements for future rehabilitation assistance could be linked to favorable results from maintenance audits.

In the Mohini Distributary Canal of the Kakrapar Irrigation System in Gujarat, India, water is "sold" on a seasonal volumetric basis by the Irrigation Department to the Mohini Water Distribution Cooperative Society. The Department depends on the Society for revenue and the society depends on the Department for its water supply (Datye & Patil, 1987).

Another example is the Bachawa Reservoir Irrigation District in Hubei Province, China. The irrigation district (a financially autonomous local public utility) delivers water to the village level. It collects the volumetric water charges from the village irrigation management groups, but must give a certain percentage of it to the county water conservancy bureau. The bureau collects the fixed area water charge and must give a certain percentage of it to the irrigation district. The district provides data and information to the bureau and the bureau provides technical assistance and liaison services with the government to the irrigation district. The two-way requirement for resource flows and services between the bureau and the district engenders accountability for flow of services between the two organizations. (Intl. Conference, 1994)

<u>Common property arrangements</u> When local users of a resource organize to create property rights and restrictions for use of a resource, this is called a common property organization. People have done this for centuries to manage irrigation systems, forests, communal farm land, pastures and fishing waters (Ostrom, 1990). These are generally local, relatively small-scale organizations which develop their own systems of rights, rules and sanctions which may work effectively through social pressures and local arrangements for conflict resolution. (By definition then, a water user association in a large-scale irrigation system which does not have a water right is not a common property organization.) Traditional farmer managed irrigation systems appear to have valuable lessons for how contemporary management reforms can take advantage of organizing principles at the distributary and water course levels of irrigation systems (Yoder and Thurston, 1990; Horst, 1984).

Organizational choice

Herein we will briefly identify some common basic organizational requirements which appear to be present where irrigation is managed successfully and sustainably. Aside from specific features of particular irrigation organizations, there are some general characteristics which appear to be present in well functioning irrigation systems (or more broadly, in water resource management systems). We hypothesize that, generally, a successful and sustainable irrigation organization (or configuration of organizations) generally has most of the following trenchant organizational characteristics. It:

- is a self-financing utility,
- is governed substantially by the water users,
- has carefully defined and measurable water service objectives which are compatible with a recognized water right,
- has ownership of irrigation assets,
- has rights of eminent domain,
- has power to quickly enforce rules and collection of revenue,
- has transparent administration, operations and performance,
- sets and uses service charges according to strict accounting practices,
- cooperates with an independent body which provides oversight.[3]

The extent to which the above powers are contained in a single organization, and whether that organization is a public or private entity, a district or a mutual company, or a cooperative association, will largely be determined by factors which are situation specific. We hypothesize that the following are the key criteria for determining the specific type of organizations which will be required and feasible in order to embody the above set of essential organizational characteristics:

- the "maturity" of a country's institutions,
- government policy toward water resources management,
- the complexity and political sensitivity of the water service,
- the sophistication and organizational traditions of water users, and
- the degree of corruption and effectiveness of measures to contain it (Fredericksen, 1996)

Institutional maturity refers to the effectiveness of the legal/judicial system, the degree of liberalization, redundancy and competition among organizations, and the degree of socio-political recognition for institutions. Government policies about resource use and conservation constrain the set of organizational choices available, through setting boundaries for managerial control and use rights. The level of complexity, scale of management and political sensitivity of the water service determines to a large extent whether the organization can be in the public or private sector and whether externalities and liabilities can be managed internally by a single organization or by a network of organizations. Degree of literacy, availability of information, and cultural orientations toward political participation and local organizing shape how governance and accountability arrangements must be structured in a given context. And not least of all, the degree of corruption and how it can be contained will effect how financial control (often the bane of water users associations) must be achieved. Where the above "trenchant organizational characteristics" are not found, but where policy makers want to introduce them, strong, high-level commitment will be required to bring about such reforms.

Strategic questions for institutional reform

Questions of, "Whether to adopt a transfer policy?" and if so, "How to formulate the policy and program?" are strategic problems of high orders of complexity, especially in developing countries with large numbers of small farmers, scattered irrigation systems and constrained financial and information resources.Where management transfer is being planned or implemented it may involve changes in: 1) management roles and procedures; 2) lines of authority and responsibility; 3) financing; 4) water rights; 5) infrastructure; and 6) ownership of infrastructure.

Comprehensive strategic change methods generally the following components:

1) Emerging policy objectives,
2) Performance gaps,
3) Assumptions about the policy and management environment,
4) Reform options and issues,
5) Participation of stakeholders, and
6) An information system.

Strategic change generally addresses the following kinds of questions.

1) <u>What is the potential scope for reform under consideration?</u>

Policy makers and planners in irrigation ministries who are faced with internal and external pressures for change make initial assumptions about the basic level and nature of reforms that are to be considered. Will the scope for reform be limited to only operational procedures, or more broadly, to include organizational restructuring (at the sector or agency level) or changes in financing, or more broadly still--to potentially include a change in mission? Initial designation of the potential scope of reform provides the basis for determining how the strategic planning process should be organized.

2) <u>How should the planning process be organized?</u>

Through discussions at the senior management level the desired outcomes, general time frame for planning, participants involved, activities and resources for planning are estimated. Expectations are communicated to all levels and agencies involved.

3) <u>What is the set of feasible options for reform?</u>

Within the broad parameters defined in step 1 above, there may be a range of options for reform that needs to be identified and each one assessed in terms of its feasibility. Options for restructuring an irrigation agency may include such changes as divisional realignments, decentralization, changes in sources of financing, downsizing and transfer of management roles and authority.

4) <u>To what extent do performance gaps justify reform?</u>

The first step in strategic planning is to assess three kinds of performance gaps which may have prompted considering reform in the first place:

i. the gap between current performance and existing targets,
ii. the gap between current and potential performance, and
iii. the gap between current performance and a level of performance which will be needed in the future.

For the purposes of the strategic review, senior management decide which kinds of performance criteria matter most, such as cost of irrigation to the agency, financial viability, operational performance, maintenance of infrastructure, etc. Management also identify which of the above types of performance gaps is most important for the purpose of the strategic review. For the important one, an assessment is made about the extent and implications of the gap. This provides the basis for addressing the range of options for reform.

5) <u>What kind of reforms should be adopted and at what levels?</u>

Once the range of feasible options has been identified, they should be compared according to important criteria (such as, likelihood the option will fill the performance gap, resource requirements, time required, etc.). Analysis of performance gaps could determine that changes in management procedures alone can fill the gaps, so that more substantial changes are not needed.

Serious gaps in financing and O&M performance by the agency could suggest that more basic reform is needed, such as transfer. Decisions would then need to be made about what management roles would be turned over, what size of systems would be turned over, what levels of canals would be turned over in large systems and what type of organizations should take over management (farmer organizations, districts with professional management staff, contract companies, etc.)

Multiple reforms may be required at different levels. For example, a decision to turn over management of irrigation systems to farmer organizations may require changes at different levels, such as changes in water rights, in agency mandate and financing, rehabilitation of systems, need for new agricultural support services arrangements and so on.

6) <u>What kinds of information and experimentation are needed?</u>

Considerations about reform options and processes are greatly enhanced by information and participation of stakeholders who are involved in the reforms. The level of need for accuracy, generalizability, and rapidity of information will determine what kinds of information, data collection methods and experiments may be needed to identify appropriate options and processes. For transfer planning, information needed may include such things water rights, functional condition of irrigation structures, nature of farmer organizations, profit and so on.

7) <u>What kind of change process is needed?</u>

Once the type of reform is identified, planners and stakeholders can formulate a plan for implementation, always keeping in mind how to make the transition process become a learning and reorientation experience for those involved. It should prepare participants, from the agency and farming community, for the new roles invoked by the reforms. A comparison should be made between the current context and what technologies, skills and management functions are envisioned for the future. For management transfer, this may include considerations about the need for legal changes, institutional organizing, inputs from NGOs, negotiations between farmers and the agency, infrastructure improvements, training, development of support services and so on.

8) <u>What kind of governance and management entity is needed to take over the roles being turned over?</u>

Water users associations are commonly promoted as single purpose organizations. The function of these organizations is to manage and possibly finance irrigation for their area of jurisdiction. Another model is the multi-purpose farmer organization, which also has responsibility for providing agricultural services in addition to irrigation management. For larger or more complex irrigation environments more sophisticated organizations may be required, such as irrigation districts, mutual or contract companies and stock shareholding arrangements. Criteria for deciding among these options should be identified and considered one of the most important being the structure of incentives for local collective action.

9) <u>What kinds of resources and time schedule are needed to implement the reforms?</u>

Defined broadly, resources for implementing reform include financing, political power, technology, personnel, skills and expertise and time.

10) <u>What kinds of techniques are needed to support the change process?</u>

There is a large number of techniques and tools which may be employed to support institutional change in the irrigation sector. These can be employed in the policy formulation, planning, pilot experimentation and general implementation stages. For example, policy formulation and planning may be supported by such methods as working groups, policy review workshops, SWOT analysis, analysis of responsibility matrices, financial analysis, stakeholder analysis, and analysis of benefit/cost streams. Pilot experimentation may include such techniques as institutional organizing, farmer-to-farmer training, participatory rural appraisal, and self assessment of performance. General implementation may involve monitoring and evaluation, review workshops and rapid appraisals.

11) <u>What adjustments in the reform need to be made, after implementation has begun?</u>

If the institutional change is organized as a learning process, then information and response arrangements will enable adjustments to be made on the basis of further experience and analysis during each of the stages of policy formulation, planning, pilot experimentation and general implementation.

Questions of whether or not to adopt an irrigation transfer strategy? What should the strategy look like? How should it be implemented, are complex questions which need to be decided uniquely in each country, and in the details, in each irrigation system. An effective process of decision-making and change will likely require the participation of all the key stakeholders involved, including high level officials, field operations staff and farmers. It will require formulation of a common vision of a new future, both for the farming community and for the government.

Summary

This paper has specified the key components of irrigation management and indicates how they are inter-related. Considerations of management reform should include an analysis of the four basic dimensions of irrigation management:

- the water service,
- hydraulic technology,
- management functions, and
- organizations.

The analysis should start from a precise definition of the water service which is required and then proceed to specify the nature of technology and management which is best suited to achieving an acceptable standard of performance. Analysis should be made of gaps between the existing and the required service and gaps between the required service and existing technology and management. Effective analysis of change will determine whether or not reforms are actually required and, if so, how extensive and basic they should be.

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END NOTES

[1] This paper developed out of exchanges between staff at IIMI and others. Important contributions were made by D. Seckler, C. Perry, R. Sakthivadivel, H. Fredericksen, J. Brewer, S. Johnson, D. Merrey, T. Bandaragoda, and B. Bruns.

[2] In Mexico, in the first phase of management CA at the main system and IO at the distributary sub system. In the second phase the CA is at the water source and a federation of IOs is at the main system level. No FG exist at the watercourse level.

[3] These were adapted from a personal communication to the author by Harald Fredericksen, February 25, 1996.