Manipulating Irrigation Management Models: Institutional Requirements for Social Engineering

Jamie Morrison and Ian Carruthers

WHEN THE DOMINANT theme in the development profession was planned change there was a relatively small group within the profession that stressed the structural, social and political barriers within organizations to the smooth implementation of central and project plans. These structuralists were admired but the technocratic enthusiasm for planning was such as to keep them in a minority and with relatively little influence.

When the pendulum rapidly switched about fifteen years ago from central planning to the use of markets, the structuralists were by-passed in the new enthusiasm for the magic of markets

Structuralists in development practice have remained consistent in arguing for a focus on the institutions within the economy and in particular upon the social, political and economic organizations which determine the outcome of economic events. They criticize conventional market models for ignoring the non-economic environment in which individuals make decisions.

In this paper we examine some of the ideas coming from this literature and approach and consider the implications for the current dominant theme in the large-scale public irrigation field: The turnover of considerable elements of responsibility for operation and maintenance to farmer groups and the charging of farmer customers for publicly provided services, and ask questions about maintenance management after turnover

IRRIGATION MANAGEMENT TRANSFER: A NEW MANAGEMENT MODEL

Is the turnover of irrigation management to farmers a new management fad dreamt up by weak governments tired of trying to exercise authority and failing, or is it the latest management whiz that will rapidly and effectively transform the sub-sector and realize the pent-up potential in irrigation systems?

In proposing turnover, the advocates of the turnover consensus are calling for a wholesale redesign of current management models. The term management model is used throughout this paper to describe the main actors involved in irrigation management together with the activities that they are expected to complete, or more specifically, their roles and responsibilities. In short, the institutional context.

The enthusiasm for the turnover of responsibility for irrigation management from government to community-based organizations certainly implies some degree of failure of state involvement. Researchers in the irrigation sub-sector are not alone in their belief that the farming community, as the greatest beneficiary of irrigation investment and often possessing untapped wisdom and local knowledge, has a more prominent role to play in the decision making process. For example, within the Rural Water Supply and Sanitation (RWSS) sub-sector, the impetus is very much towards community management of the rural water supply. "Let the beneficiaries manage" may be an impoverished government's equivalent to "let the polluter pay" principle. In any event, downsizing of central government activity is on the agenda of most countries today.

Maintenance Management

This paper concentrates on one aspect of irrigation management, namely maintenance management. The authors have previously reviewed the issues involved in irrigation maintenance (Carruthers and Morrison 1994). The central thesis developed in that report was that the neglect of maintenance has occurred not only because of the scarcity of resources common in LDCs but also because unsustainable organizational structures have been created without regard to existing institutions and that this has led to the sub-optimal allocation and management of those scarce resources which are available.[1]

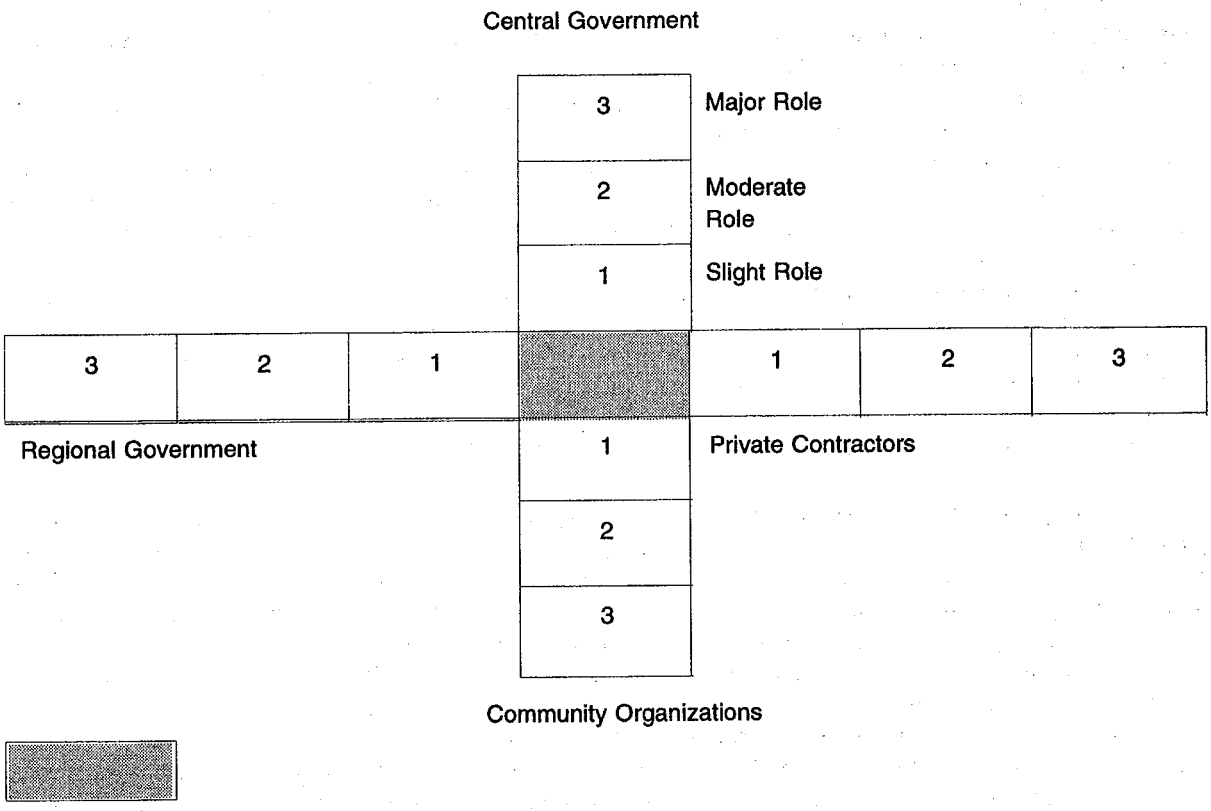
In this paper we extend the argument to the case of Irrigation Management Transfer (IMT). We attempt to establish that the imposition of the organizational structures that are created in the process of IMT may be occurring without regard to the existing institutional setting and that failure to take note of the ideas of the structuralists may once again result in maintenance performance being below expectations

[1]This thesis is in line with current thinking on the sustainability of infrastructure. For example, Brinkerhoff (1994) in an examination of a sample of World Bank projects found that "in certain instances, institutional weaknesses have been overcome in the short run through the provision of sufficient amounts of external funding, material and expertise, but that ultimately, by-passing institutional development condemns countries to dependence upon continuous infusions of outside resources". He states that "self-sufficient long-term institutional capacity cannot be bought, it must be built".

DEFINING MANAGEMENT MODELS

Roark et al. (1992) proposed a star diagram (see Figure 1) as a way of portraying the relative importance of actors involved in the operation and maintenance of rural water supply and sanitation management. They used the diagram to show the continuum of shared management models in the RWSS and to explain, in the light of the factors influencing good maintenance management, why different models are more or less appropriate in different situations.

Figure 1. Star diagram for depicting relative roles of actors in management systems.



Source: Adapted from Roark et al. 1992.

We would suggest that in the irrigation sub-sector the picture is predominantly as shown in Figure 2, whilst the current dominant development philosophy of empowering the community involved in development initiatives would suggest that the model depicted in Figure 3 is more appropriate.

Thus, governments are redefining the roles and responsibilities of the various actors involved in management and researchers are attempting to manipulate management models to reflect these changes.

In designing new management models, researchers and planners must however be aware that the currently applied models vary widely, in both shape and success, across and within societies. Furthermore, broadly similar models are more or less effective in different settings. This suggests that it is factors external to the model itself which influence the success with which new models can be introduced.

Investigating this proposition will involve establishing answers to the following sets of questions:

(i) What is the current management situation and what is the scope for shifting the focus of responsibility for maintenance management? These questions can be addressed in the context of the roles and responsibilities of the various actors involved.

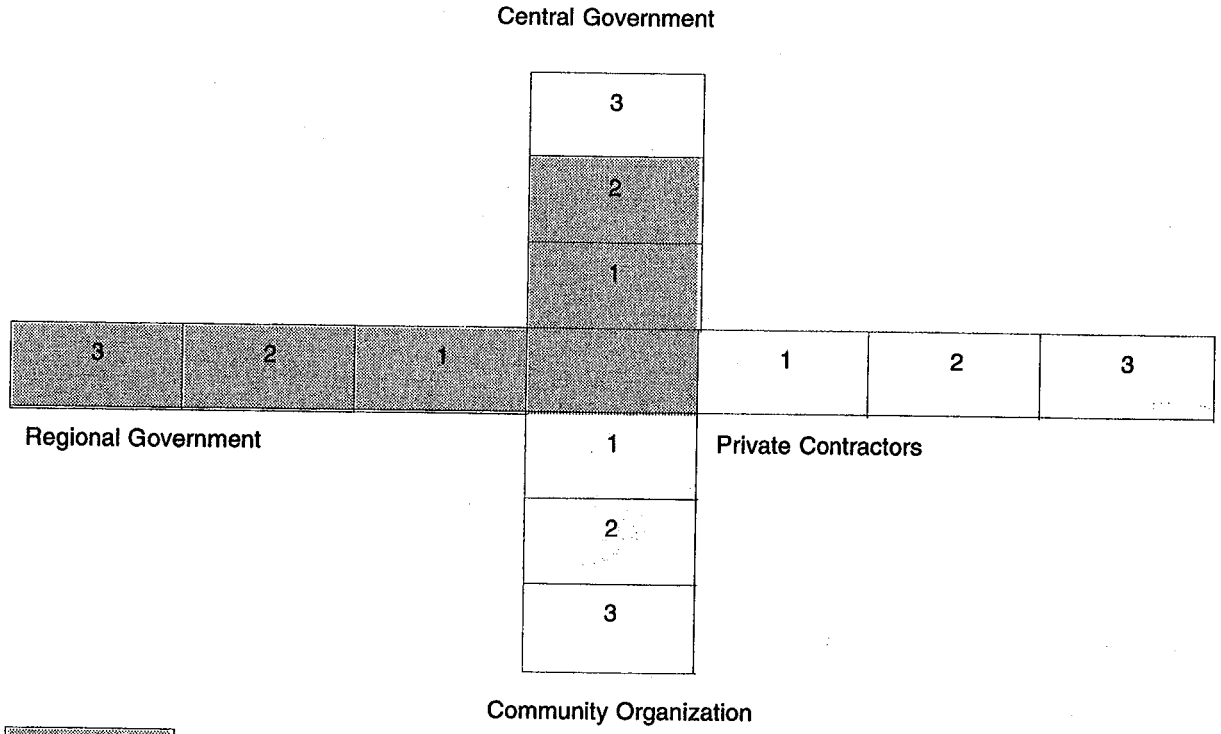
(ii) One trend is increased rhetoric calling for the strengthening of public irrigation agency management, a call coming at a time when their role is being circumscribed by resource shortages and a reduced confidence in

their competence and capacity to reform. The second set of questions must establish what the central problems associated with public irrigation agencies which inhibit their performance are.

(iii) Thirdly, why do we find similar management models being more or less effective in different settings?

(iv) Finally, when can Irrigation management transfer be carried out and what are the institutional requirements for its success?

Figure 2. The current irrigation management model.



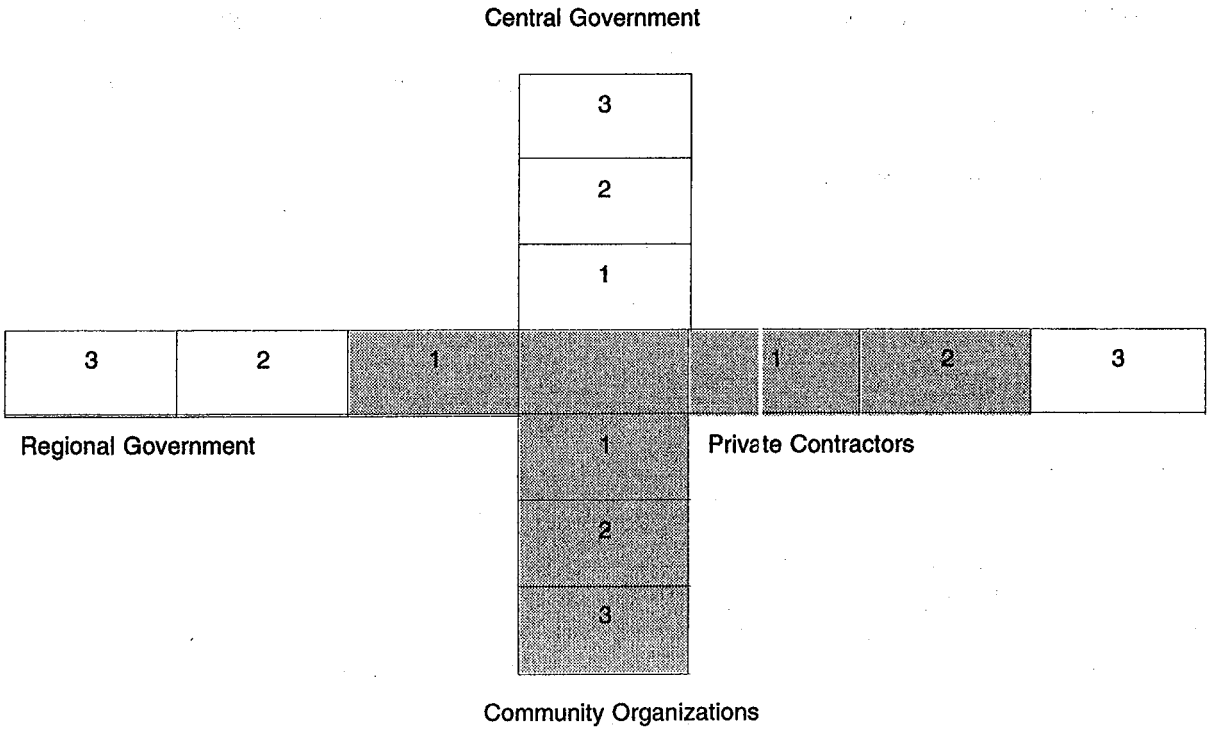
RECOGNIZING THE IMPORTANCE OF DEFINING THE ROLES OF THE ACTORS

To investigate the possibility of the imposition of these seemingly more appropriate structures to promote effective resource management, we must look at the roles and responsibilities of the actors involved. The actors can be broadly classified following the star diagram, namely, central government, regional government, private contractors and the community. The first three groups are fairly clear cut, however, the last term, community management requires further investigation.

What is the Irrigation Community?

The community comprises a number of sub-groups with differing roles and responsibilities. Researchers at the International Resource Centre (IRC 1993) have identified them as users, caretakers, traditional leaders and water committees as commonly found in the RWSS sub-sector. Analogous entities can be found in the irrigation sub-sector.

Figure 3. Turning over the responsibility for management to the community.



(i) *Users.* The actual users are not always easy to define in the irrigation sub-sector. Hunt (1989) has previously addressed this issue. Are the land owners or the tenant farmers, or even the tenants' hired help, who physically apply the water the actual users? The responsibilities of the various users could include routine maintenance without payment, but obviously, their degree of participation will depend on the strength of their commitment.

(ii) *Caretakers.* Those elected by the community and given a clear job description concerning daily and weekly maintenance routines.

(iii) *Traditional Leaders.* Depending upon their precise roles in the community, these actors may be more or less cooperative in the initial decision making process. However, whose interests do they really represent?

(iv) *Water Committees.* Analogous entities in the irrigation sub-sector may be termed Canal or Watercourse Committees. These are the formal associations usually elected by the community. They are generally the irrigation community's contact point with other actors, that is with the irrigation agency, other community organizations and private contractors. Their responsibilities include the organization and supervision of O&M activities. It is through the canal committee that each section of the community will seek an equitable share of the costs and benefits of decisions taken. In general, the performance of the committee has a marked influence on community commitment and hence contribution (IRC 1993a).

This brings to the fore an important distinction between water user associations (WUAs) as characterized by a grouping of category (i) above, and what Hunt (1989) has termed Irrigation Communities, which comprise an interrelated combination of all of the above-listed categories. Hunt records that to many observers, the two are analogous, but he concludes that irrigation communities have several properties that WUAs do not possess:

(i) Irrigation communities have clear charters of authority for the leadership roles and there is accountability of those leaders to the farmers.

(ii) Irrigation communities have responsibility not only for maintenance but also for allocation and conflict resolution, therefore the dirty work, generally unrewarding in the short term, is connected with some benefit.

(ii) The sub units of irrigation communities are strongly and clearly articulated to every other subunit, making the community highly integrated.

(iv) Irrigation communities have systems of rewards, rights and duties; whereas the WUAs have only a disaggregated bundle of duties and no control over the allocation of resources (Hunt 1989).

Within each sub-group of the community it is possible to imagine responsibilities being carried out more or less effectively depending on what Roark et al. (1992) term the capacity of community organization. This capacity is but one of many interrelated factors affecting the choice of management model, but is increasingly seen as one of the most important. What is not always recognized is that community organizations whilst having the greatest stake in successful O&M, and hence the general call for their full participation, usually have the fewest resources available to them, both capital and human, and thus have multiple limitations in managing the infrastructure.

There is always a real danger that the irrigation community may conflict with power bases or other decision making structures inside or outside the community or that it may involve only the elite of the village and so antagonize the rest. Only the community can decide what structures it will use to undertake its management tasks (IRC 1993). Therefore, whilst the establishment of a canal committee is the most common approach to the institutionalizing of community management, it is not the only approach.

The management of drinking water supply or irrigation by communities is nothing new. It has occurred for thousands of years since farmers first settled. The important thing to note however, is that new systems and new technology imported from outside the traditional community may make fresh demands and require new approaches to management (IRC 1993). This has provided past justification for the wider governmental and donor agency involvement in the management of infrastructure, although with hindsight this may not have been a logical deduction and better methods of overcoming the insufficient capacity of communities to manage new technology, such as human resource development, may have existed.

What New Role for the Public Sector?

Government agencies are facing pressures for their management role to be reduced. This is not just because of shortages of public finance. In a recent article in The Economist (1994) this year's World Bank World Development Report is reviewed. The article begins by noting that of the US$200 billion spent annually on infrastructure, much is squandered. It lists the four reasons given by the Bank as: Facilities not being maintained, infrastructure in the wrong place and using the wrong technology, inefficient operation and prices being set below costs. All of these reasons have long been visible in the irrigation sector. The article reflects the Bank's conclusions that at the root of the problem is the pervasive presence of the government. Nothing new so far. The interesting part lies in the Bank's three part strategy. First, infrastructure should be run like a business, second, competition should be increased and third, consumers should play a more active part in project planning and design. This is well in line with the turnover consensus, the Bank once again is "harnessing the power of the market," this time to provide better infrastructure. The worrying thing is that there is no mention in the article about the ideas coming from the structuralists' literature.

This is not to say, however, that they have been totally neglected in the Report itself. In a background paper, [Wade (1994)] compared the way gravity fed designs are operated and maintained in India and Korea. He discussed the various problems associated with bureaucracies, most notably the fact that O&M operations are conducted by highly dispersed operators, often in closer contact with farmers that their peers and superiors, and thus susceptible to local influences, including corruption. The crucial aspect of a successful agency is identified by Wade as the incentive structure required to ensure conscientious work by the organization's employees.

However, the balance between the enthusiasm for markets and the perceived need to pay heed to the structuralists appears, if the Economist's article is a fair reflection to be tipped in favor of the market.

How Does the Private Sector Fit In?

The role of the private sector, by this we mean those not solely involved in irrigation maintenance, for example, local mechanics, has also been promoted recently. As stated above, public organizations are criticized for inefficiency due to poor incentive structures. The private sector is seen to be motivated primarily by the need to make profit. However, we must also recognize that there have been problems associated with cheap and quick operations designed to improve short-term profit. It is therefore necessary to have provision for monitoring and regulating the private sector's roles including technical work, operation, revenue collection, and supplies of spare parts (IRC 1993a).

Although the government normally regulates private sector initiatives, the community can assume such regulating and monitoring roles. However, even where Community management makes sense, there is always going to be a residual role for government as part of that community. This is especially so in large systems where some form of centralized agency management is essential. Decentralization of roles and responsibilities can also be difficult when there is a dearth of skills, finance, resources, or the lack of community capacity. Indeed, the power of the community in relation to the outside world is important, for example, with respect to its ability to pursue contracts with private sector operators. (Morrison 1994).

As a half way compromise to full community management or to the full involvement of agencies in running the systems, agencies can be made directly accountable to individual communities. As an example from the RWSS sub-sector, in Tanzania there is a split in responsibilities between the public and community actors; the main public works agency runs the system to a village entry point, and from there management is taken over by village committees. In order for this to function effectively, the water must be bulk metered at the entry point and its level and regularity must be guaranteed. The users are thus responsible for the maintenance of the infrastructure and management of water distribution from the entry point (van-Wijk, pers comm., 1994). In many irrigation systems similar watercourse management is devolved to users but the agency is not made to guarantee regularity of supply and the benefits of such splits in responsibility are not realized.

WHAT IS COMMUNITY MANAGEMENT?

Community management includes but differs from community participation in that it puts the people fully in charge of their own systems, giving them legitimate authority and control over the management and use of the water supply, in a flexible partnership together with supporting public agencies, which provide advice but do not play an active role in decision making (IRC 1993b).

Participation in the past has meant little more than the water users providing labor and material resources, with government agencies retaining control over decision making. Community management allows for a much greater range of organizational alternatives which may be adapted to fit different situations.

Community management has the potential to create a direct link to the sustainability of systems, by involving those who benefit from the systems in all the decision making processes from decisions about system design which can be selected with an appreciation of future maintenance requirements and adapted to local conditions, to decisions about the level and categories of resources to commit to maintenance activities (IRC 1993b). Most of the literature on community management identifies community involvement in decision making from project identification as being of utmost importance. It should be noted however that in turnover, the starting point will be with a project not designed for community involvement. The following are examples of questions that now arise: Can the community afford the financial cost of O&M? Does it have the necessary skills to carry out the required activities? If not, what technical changes are required to allow full community control? What will be the division of responsibilities? What support, including training, can the water agency give? Should there be trial period and how are activities to be monitored? In short does the community have the institutional capacity to fully manage the infrastructure and if not can it be developed, or is it necessary to initiate the development of such capacity from project inception?

COMMUNITY CAPACITY

The capacity of the community to organize and make decisions has been identified above as critical to enabling the institutionalization of the community management of irrigation infrastructure.

In order to explore policy options to foster development of institutions, it is first necessary to study the existing structures in order to identify the capacity of community organizations to organize and to take decisions. It would then be possible to address such questions as the following: How easily can maintenance requirements be identified and completed by the community? Will this be any better than a government agency can achieve? And, as discussed by Helmi in a separate paper to the conference, can community groups go further still and broaden the scope of their

activities beyond water management into other socially valuable or profitable activities such as construction or general contracting?

For each and every situation, a somewhat different structure will be found, and any general policy recommendations will have to be adapted to suit the particular case.

The Difficulty of Making Decisions at the Community Level

We shall now attempt to investigate some of the current theories regarding institutional evolution that can guide general policy, and some of the issues regarding the possibilities and difficulties of testing new management models in particular communities.

Turning over the responsibility for management of irrigation infrastructure to the community requires them to make decisions about the allocation of scarce resources between competing activities. As we have stated above, the success of such initiatives depends, to a large degree, upon the institutional capacity of the community. This is not however a simple matter to establish. The decision to invest resources in particular maintenance activities is made by many actors, none of whom bears the full costs or derives the full benefit. In addition, each variable in the decision making process is perceived differently by different individuals. (Ostrom et al. 1993)

The resulting prevalence of individual opportunism in systems of collective responsibility has been identified as a major flaw in the market mechanism for resource allocation. We know that individuals seldom maintain social infrastructure in an optimal way even when they recognize that it is a good idea to do so. However, we accept the assumption in neoclassical economics that the rational individual acts in his or her own self interest. Thus we are interested in looking for other theories that attempt to explain how individuals, still acting in their own interest, can behave collectively to their mutual benefit.

Ostrom et al. (1993) have asserted, that it is possible for individuals to devise complex institutional arrangements, essentially on a prior agreement, that counteract the perverse incentives which result in sub-optimal allocation. Central to the problem is that individuals are uncertain about the actions of others when they have to make decisions regarding the level of resources, such as labor that they are willing to commit. In many cases, but not all, (see Bardhan 1993), they will fail to commit resources because they expect others not to match their efforts.

Roark et al. (1992) note that, by their very existence, communities have a social and institutional structure that arranges a variety of local activities. To be a member of a community is to live within a set of social institutions. Institutions can help to reduce uncertainty and ensure consistency of expectations across individuals (Knight 1992). The observed action of many water user groups to reduce the command area and number of farmers may be one attempt to reduce the uncertainty.

Rules and procedures evolve to simplify the process of collective decision making. The consequent institutional framework, by structuring human interactions limits the choice set of actors making it relatively easier for them to make decisions collectively.[2]

A New Role for Governments in Facilitating Decision Making

Formal agreements such as those that set out the water committees' responsibilities are required. These agreements establish the roles and responsibilities of the partners involved, helping to give a clear understanding and thus reduce uncertainty. These formal agreements, as contracts reflect the incentive-disincentive structure embedded in property rights structures, thus the best mix actors and the forms of organization they devise in specific contracts will be derived from the property rights structure (North 1990). Governments can assist the development of community capacity by suggesting or enacting model by laws or agreements suited to local conditions and by using the extension service and the media to publicize them.

However, governments cannot create organizations such as water user groups simply by announcing a set of formal rules. Institutions can and do emerge and change over time, and governments can promote this process. How institutions evolve, how they can be created or crafted, especially given the deep seated politicization of the water resources are therefore critical questions for the turnover consensus? To explore these questions we need to attempt to determine the conditions that lead to the formation of sustainable community groups.

---

[2]Dasgupta and Maler (1994) give an intuitive explanation of why this is so. "If you are steeped in social norms of behaviour and understand community contractual obligations, you do not calculate every five minutes how you should behave. You follow the norms. This saves on costs all round. Not only for you as an actor but also for you as a "policeman" and "judge."

Explanatory theories must explain why one institutional form has developed to regulate a community group activity as opposed to another, when a number of different institutional forms could conceivably produce the same basic benefits. North (1990) notes that it is the costliness of information that provides the key to transacting, that is the costs stemming from measuring value, protecting rights, policing and enforcing arrangements. If there was perfect information, then these transaction costs could simply be added to the transformation costs involved in a production process, and decisions taken normally.[3]

However, there are invariably asymmetries of information among players. Not only does one party know more about some valued attribute than the other party but he or she may stand to gain by concealing that information. Transaction costs are therefore positive, and can give rise to returns on opportunism, cheating, and shirking (North 1990).

Knight (1992) has stated that it is the high transaction costs of collective action that are the prime reason why members of a community cannot always agree upon new rules such as those required for the turnover of responsibility which could in principle increase the community aggregate welfare. This is one of the reasons why seemingly appropriate management models are less than successful.

At this juncture we should remind ourselves that self-interested actors want institutions that produce social outcomes that are best for them as individuals (Knight 1992). If these institutions affect the distribution of benefits in social life then we should expect individuals to seek those institutional rules that give them the greatest share of those benefits.

Having established the role of institutions, and the rationale for their emergence, we must then ask whether it is possible to impose or persuade them to adopt new management models.

One of the most important difficulties concerns the existing balance of power within a community. That is, will those in power be responsive to change. Wade (1987) describes villages where rich farmers are able to get enough water for their land without having to organize corporately and without having to incur large additional expenditures themselves because they own the land immediately below the canal outlets. They may even block the formation of a cooperative water control committee at the expense of small cultivators lower down the system.[4]

On a more positive note, Nugent (1993) reports that expectations are open to continuous revision on the basis of revealed behavior and the decisions of different sub-groups are potentially interrelated. Therefore even small changes in expectations by a few can generate chain reactions, and thus conversion of some of the powerful to the side of cooperation can induce many others to follow, in this way previously non-cooperative societies can achieve a relatively high degree of cooperation in a short period of time.

There is an obvious need to understand the conditions that induce irrigators to form groups that function well and endure before efforts and investments are expended (World Bank 1994).

STARTING INSTITUTIONAL REFORM

Thus far, this paper has identified conflicting constraints upon the type of decision making arrangements necessary to ensure the viability of community management.

To move forward the first stage is to establish the existing structure of property rights. By being party to contracts and being able to set rules and constraints, governments can change the nature and roles of transaction costs and information costs within existing property rights. This can promote water user groups' initiatives that reduce government involvement, which given the poor government record in the sub-sector in recent years is likely to promote more efficient irrigation system operation and maintenance. However, if poorly conceived or poorly implemented rules are promoted, then governments can magnifying the costs and create additional sources of opportunistic behavior.

One current approach to development is towards more decentralized activity, and the turnover process can be viewed as part of this trend. It is argued that decentralization generally insulates the maintenance process from control of actors in the capital who want to fashion institutional rules for their own purposes. But decentralized mechanisms also produce informal networks that embody and reinforce the asymmetry characterizing a society, thus exaggerating the informal rules governing the social organizations of a community (Knight 1992). Local inefficiency or local tyranny can be more disconcerting than the equivalent remote central government inefficiency. It is surely more hurtful to be

[3]That is, the traditional production function could be restated as the sum of costs of production consisting of the resource inputs involved in the transformation process, and the actual costs of transacting, that is, the costs of defining protecting and enforcing property rights to goods.

[4]Inefficient property rights exist because rulers preferred not to antagonize powerful constituents by enacting efficient rules opposed to their interest. As noted above, organizations are derived from the existing property rights structure, they may therefore be difficult to change. Distributional bias increases the costs for those who seek to bring about collective change. Not only do they incur the normal costs of any collective endeavour but they also have to incur the additional costs introduced by those who benefit from the existing values and who will fight redistribution change. (Knight 1992).

exploited by a relative or a neighbor than by a remote government official and hence decentralization should not mean abandonment. Government monitoring and regulation are essential especially in the early phases of new policy implementation.

Even with adequate property rights and active government interest in implementation there will still be requirements for capacity building and strengthening at all levels in many countries.[5]

The overriding general requirement is for education and training, and indeed human resource development plays a major role in all community management initiatives. Initially, assessing training needs and providing appropriate curricula and materials is one of the responsibilities of supporting agencies. But over time, the process of learning by doing or "action learning" has the potential to allow communities to become self taught, further enhancing the community's capacity to manage [(IRC 1993d)]. The donor policy on training is thus an important factor when considering a move towards community management.

If the turnover consensus is in part a consequence of donor fatigue or shifting government priorities, they must be warned that to be effective irrigation groups must be weaned and not cut off from financial subsidies. Careful sequencing of changes and shifting from directly financing maintenance to financing training of user group activists is a first requirement.

CONCLUSIONS

Without considerable confidence about their ability to affect outcomes farmers will have little incentive to participate in collective efforts in O&M. However, it is clear from the literature that management models which aim to give farmers the responsibility for decision making cannot always be successfully imposed from above. Institutions must be reformed to allow sustainable changes. Reform generally comes in the form of new rules.

Traditions are reformed rules or ways of working that cannot be created. Formal rules may be changed but the informal constraints evolve slowly. In consequence, there develops an ongoing tension between informal constraints and the new formal rules as many are inconsistent with each other. Many of the informal constraints which have become traditions had their origins when they gradually evolved as extensions of previous formal rules (North 1990).

If there is imposition of common sets of irrigation management rules on different societies we will invariably find that although the rules are the same, the enforcement mechanisms, the way enforcement occurs, the norms of behavior and the subjective models of actors are not, since they are a function of the existing institutions.[6]

This discussion has gone some way to answering our original question in that it appears that it is the institutional setting rather than the management model itself that constraints the success of community management.

How does this relate to the turnover process? The new model in principle appears more effective than those involving a high degree of government involvement. To move from abstraction to reality, we must carefully consider the sequencing of events and fully analyze the costs involved, as these elements will influence the possibilities of institutional change, before attempting manipulation of the models.

It is therefore essential that we do not by-pass the structuralists in our rush to empower the communities involved in irrigation. We must attempt to incorporate their theories of institutional evolution and change into our research in seeking the optimal management models for particular situations

To end on a brighter note, our findings leave us enthusiastic about the prospects of IMT. Since many of the costs involved in transfer are sourced in imperfect information, they can, to a large extent, be lessened by the overall intellectual development of the community. However, in the final analysis, if institutions are to be reformed successfully, the pressure must come from within the community. This is likely to occur because many irrigation farmers recognize the value of reliable irrigation but see that governments have lost authority, give low priority to irrigation maintenance activities and that the standard of public service is deteriorating. The opportunity costs of this situation are recognized to be high, and therefore, one important precondition for institutional change is in position.

---

[5]In their evaluation of a Tanzanian Project, Smet et al. (1993) identified a number of requirements:
(i) Overall human resource development.
(ii) Improving managerial capacities at village and other levels.
(iii) Imparting technical skills at grass roots level.
(iv) Ensuring the legislative backing for management at village level (and the will to implement the law).

[6]Typically, reform will not consist of wholesale transformation but marginal adjustments to the complex of norms and rules that constitute the institutional framework. Incremental change is therefore the key to institutional change, making possible new bargains and compromises between the various actors (North 1990).

References

Bardhan, P. 1993. Analytics of the institutions of informal cooperation in rural development. World Development Vol. 21 No. 4. pp. 633-639.

Brinkerhoff, D.W. 1994. Institutional development in world bank projects: Analytical approaches and intervention designs. Public Administration and Development Vol. 14(2).

Carruthers, I.D.; and Morrison, J.A. 1994. Irrigation maintenance strategies: A review of the issues. Paper Commissioned by GTZ for the MAINTAIN Project.

Dasgupta, P.; and Maler, K.G. 1994. Poverty, institutions and the environmental resource base. World Bank Environmental Paper Number 9.

Hunt, R.C. 1989. Appropriate social organization? Water user associations in bureaucratic canal irrigation systems. Human Organization. Vol. 48 No. 1. p. 79-90.

International Resource Centre (IRC). 1993. Management of O&M in rural drinking water supply and sanitation. A resource training package. IRC International Water Supply and Sanitation Centre.

IRC. 1993a. Taking care of your water supply: A manual for community-based operation and maintenance of piped water systems. IRC Training Series No. 10. IRC International Water and Sanitation Centre.

IRC. 1993b. Community management today: The roles of communities in the management of improved water supply systems. IRC Occasional Paper No. 20. IRC International Centre for Water Supply and Sanitation. 35pp.

IRC. 1993c. Action-learning: Building on experience. IRC Occasional Paper No. 21. IRC International Water Supply and Sanitation Centre.

Knight, Jack. 1992. Institutions and social conflict. Cambridge University Press.

Morrison, J.A. 1994. The possibilities and limitations of transfer of experiences with maintenance from the water supply and sanitation sub-sector to the irrigation sub-sector. A Strategic Paper commissioned by GTZ for the MAINTAIN Project.

North, D. 1990. Institutions, institutional change and economic performance. Cambridge University Press.

Nugent, J.B. 1993. Between state, markets and households: A neoinstitutional analysis of local organizations and institutions. World Development Vol. 21 No.4 p 623-632.

Ostrom, E.; Schroeder, L.; and Wynne, S. Institutional incentives and sustainable development: Infrastructure policies in perspective. Theoretical lenses on public policy. Boulder, USA: Westview Press.

Roark, P.; Hodgkin, J; and Wyatt, A. 1992. Models of management systems for the operation and maintenance of rural water supply and sanitation facilities. WASH Technical Paper No. 71. United States Agency for International Development (USAID). Washington.

Smet, J.; Evans, P.; Boesveld, M.; Brikke, F.; Oenga, I.; and Makerere, D. 1993. Health through sanitation and water: A study from a village perspective. SIDA Evaluation Report.

Van-Wijk, C. 1994. Personal communication.

Wade, R. 1987. The management of common property resources: Finding a cooperative solution. World Bank Research Observer, 2.

Wade, R. 1993. The governance of infrastructure: Organizational issues in the operation and maintenance of irrigation canals. Background Paper for the 1994 World Development Report.

World Bank. 1994. The World Bank and irrigation. Washington: World Bank Operations Evaluation Department.