EPTD DISCUSSION PAPER NO. 61

WHAT AFFECTS ORGANIZATION AND COLLECTIVE ACTION FOR MANAGING RESOURCES? EVIDENCE FROM CANAL IRRIGATION SYSTEMS IN INDIA

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June 2000

Acknowledgements: This study was funded b y the Ford Foundation, as part of a broader study of Institutional Reforms in Indian Irrigation (Gulati, Meinzen-Dick, and Raju 1999). An earlier version of this paper was presented at the Indian National Conference on Participatory Irrigation Management, Hyderabad, 19–23 January, 1999, and the 8th Biennial Meeting of the International Association for the Study of Common Property, Bloomington, Indiana, May 31-June 4, 2000.

ABSTRACT

Policies of devolving management of resources from the state to user groups are premised upon the assumption that users will organize and take on the necessary management tasks. While experience has shown that in many places users do so and are very capable, expansion of co-management programs beyond initial pilot sites often shows that this does not happen everywhere. Yet, much is at stake in this, with more widespread adoption of irrigation management transfers and other forms of community-based resource management. It is therefore important to move beyond isolated case studies to comparative analysis of the conditions for collective action.

This paper identifies factors affecting organization of water users' associations, and collective action by farmers in major canal irrigation systems in India, based on quantitative and qualitative analysis of a stratified sample of 48 minors in four irrigation systems (two each in Rajasthan and Karnataka). Using key variables suggested by the theoretical and case study literature, the study first examines the conditions under which farmers are likely to form formal or informal associations at the level of the minor (serving several watercourses, and one or more villages). Results indicate that organizations are more likely to be formed in larger commands, closer to market towns, and in sites with religious centers and potential leadership from college graduates and influential persons, but head/tail location does not have a major effect. We then examine factors affecting two different forms of collective action related to irrigation systems: collective representation and maintenance of the minors. Lobbying activities are not more likely where there are organizations, but organizations do increase the likelihood of collective maintenance work.

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1. INTRODUCTION

The devolution of responsibility and control over natural resources from government agencies to user groups has become a widespread policy trend that cuts across countries and natural resource sectors, encompassing water (especially irrigation), forests, rangelands, fisheries, and wildlife.[1] Such programs go by a range of names (e.g. Community Based Natural Resource Management, co-management, or management transfer), and range from those that simply try to increase users' involvement in management as a supplement to state management, to those that transfer full responsibility and control over resources to organized users. A common feature, however, is the emphasis on increasing the participation of resource users in the management of the resources.

The devolution trend has been fueled by recognition of the limits of government agencies in managing resources at the local level, along with political moves toward democratization and public participation. Analyses of the deficiencies of forestry, fisheries, and irrigation departments in developing and enforcing appropriate rules for

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[1] Devolution of resource management to user groups is distinct from, but often accompanied by, policies of decentralization or transfers of state powers from central or provincial governments to local government. See Meinzen-Dick and Knox, 1999.

management of the resources placed under their stewardship have accumulated; so also have studies demonstrating that local user groups can devise institutions to manage the resources sustainably (for examples see Baland and Platteau 1996; Bromley 1992; Ostrom 1990, 1992). The contrast between these two bodies has challenged the notion that the state is the only, or even the best, institution to manage critical natural resources. Instead, local users who live and work in the area are seen to have a comparative advantage over government agents in monitoring resource use and, because their livelihoods depend on the resource, are assumed to have the greatest incentives to maintain the resource base over time. With growing pressures to use resources more efficiently, equitably, and sustainably, optimism that communities or user groups may be able to manage the resources more effectively than government agencies forms the basis for many programs that attempt to create or recreate local common property management regimes (World Bank 1996).

While these studies have been influential in creating a paradigm shift in resource management, the policy shift toward devolution in the irrigation sector has received its greatest impetus from the fiscal crisis of the state. The salaries of government staff and budgets for travel, equipment, and other management costs mount up rapidly, especially where a country has a large area under a resource, and needs to provide local field staff for its management. When governments face resource constraints, budgets are stretched thin, and the performance of government agencies in managing the resource generally suffers further, creating further pressures to devolve management. If this by itself does not push governments to devolve responsibility for resource management, donors who are approached to bail out a government in a debt crisis are likely to push for such reforms, either out of a belief that users can be more effective managers, a commitment to participation, democratization, or privatization, or fiscal responsibility.

As devolution trends become widespread, affecting the management of vast areas of critical water, land, and forest resources as well as the livelihoods of millions of people, it becomes essential to examine the experience of such programs. To what extent have the apparent successes of community-based resource management in selected locations been generalizable as programs have attempted to "scale up" beyond the areas in which users have spontaneously organized to manage their resources or pilot projects with major investments in organizing communities to take on an expanded role in resource management? While in many cases state agencies have not been performing these tasks effectively, it cannot be assumed therefore that farmers will automatically be willing or able to take on those roles. The policies call for considerably more time and cash contributions from farmers. We need to carefully examine their willingness to become involved. Identifying factors that create incentives for user participation is critical for developing better policies and effective implementation of any devolution policies. This paper addresses these issues with an empirical study of participatory irrigation management programs in India.

The combination of performance deficiencies under government management, examples of effective farmer-managed systems and serious fiscal problems have been manifest in the irrigation sector, and have contributed to adoption of devolution policies in many countries.[2] Although India has a long history of farmer-managed irrigation systems, as well as numerous studies of low irrigation efficiencies and performance deficiencies in the irrigation sector (e.g. Chambers 1988), so long as the government gave priority to funding irrigation systems, suggestions to increase farmer involvement as a means of improving irrigation performance had little impact on policy (Brewer et al. 1999). But as the area irrigated expanded, the resources required for adequate operation and maintenance (O&M) also expanded. The state and national governments treated irrigation as a welfare measure, and kept service fees low. With budget constraints and priorities shifting away from irrigation, by the 1990s neither government subsidies nor foreign funding were able to make up the difference between what was collected in irrigation fees and what would be required for adequate O&M. Systems deteriorated, and both the physical as well as financial sustainability of many irrigation systems came under threat.

In response to these pressures, India is currently adopting a wide range of policy reforms aimed at increasing farmer participation in irrigation management. But these policy reforms will have no effect on improving the performance of irrigation systems unless farmers respond by increasing their involvement in system management. Information on the conditions under which farmers are most likely to be willing and able to take on this role would improve the likelihood of success of these policies. Identifying which of these factors play a significant role requires moving beyond the case studies and

[2] A 1994 international conference on Irrigation Management Transfer (IMT) drew participants representing 28 countries (Johnson, Vermillion, and Sagardoy 1995), and an International Network on Participatory Irrigation Management (INPIM) has been set up to further the exchange of information among those involved in devolution programs (www.inpim.org).

pilot projects which form the basis of our knowledge to date. What is required is more rigorous comparative study of the conditions under which users are most likely to be organized and take part in irrigation management.

One of the first major challenges is to identify what we are looking for in terms of farmer participation. Simply looking for registered societies is not adequate, as informal groups may be more active. But how can we recognize informal organizations? And what constitutes "good" (or "strong") organizations? In disentangling these issues, it is useful to distinguish between the organizations that exist at the local level, and the activities undertaken collectively by farmers themselves or by the organizations on their behalf.

Organizations alone will not have an effect on irrigation performance unless they are active. The extent of collective action enables us to differentiate between organizations that exist only "on paper", and those that are alive. In this study, we focus on collective maintenance of the canals above the lowest-level outlet, and collective interaction with officials on irrigation-related issues. We do this by asking about collective maintenance work on watercourses and minors—how often it is undertaken, and the labor and cash contributions for this work each year—and farmers' collective efforts to lobby for more water or services. The value of cash, labor, and in-kind contributions provides an estimate of resource mobilization.

This paper presents evidence on the extent of farmer participation in organizations and collective maintenance, based on empirical evidence from major canal systems in Rajasthan and Karnataka. We examine the links between the physical and socioeconomic environment and the strength of farmer involvement, to identify the conditions under which farmers are most likely to participate in irrigation systems. The methodology of this study is described in Section 2 and descriptive information on the factors considered which may affect different forms of participation is presented in Section 3. The next part of the paper presents findings on organizations (Section 4) and collective action (Section 5). Within each of these sections, we present evidence on the frequency of that type of farmer involvement, qualitative analysis of the role of that form of participation with examples, and then relate that quantitatively to key physical and socioeconomic parameters to identify the environmental factors that are most conducive to farmer participation. In Section 6, we look at the outcome of farmer participation in terms of resources mobilized, and conclude with a brief summary of findings and implications for devolution programs.

2. METHODOLOGY

A number of synthesis studies have attempted to identify principles for success in farmer participation in irrigation (and other types of resource management), based on reviews of the case study literature (e.g. Baland and Platteau 1996; Bardhan 1993; Maloney and Raju 1994; Meinzen-Dick et al. 1997; Ostrom 1992; Tang 1992; Uphoff 1986). A review of this literature engenders considerable optimism for the potential of devolution to Water Users' Associations (WUAs) to solve many of the problems of natural resource management. The casual reader may even assume that all that is holding farmers back from achieving all this is government unwillingness to transfer systems. A few authors (e.g. Hunt 1989) have questioned whether the forms of farmer organization found in small-scale systems would apply to large-scale systems in which the government controls the headworks, but the transfer of even large-scale systems to farmer organizations in Mexico, Argentina, and Colombia have been used to counter these doubts.

The optimistic picture stems, in part, from a selection bias in the case studies on farmer participation. Examples with strong local organizations are far more likely to be written about than those where farmers are not organized. There are several natural reasons for this: In traditional farmer-managed systems, where the organizations are not strong, the systems fall out of service or are taken over by the government.[3] If there is no farmer participation in a government-managed system, there is little to write about. But by omitting cases of organizational failure or lack of organization, we are left with a misleading impression based on what Chambers (1988) terms "islands of salvation". This is illustrated by the number of articles written about Mohini, an early “successful” water users' cooperative in Gujarat (e.g. Patil 1987; Chambers 1988; Kalro and Naik 1995), and the thousands of Indian and international visitors that have gone there. Little attention is given to the fact that some 25 similar WUAs have been formed elsewhere in the same command area, but only three of those WUAs ever became functional.

The evidence on success of participation and devolution programs is mixed. In fact, devolution of irrigation management is not easy, as the experience of many such programs has shown. Success depends, in large part, on having some form of water users' associations strong enough to assume management. Otherwise, any state withdrawal leaves behind a vacuum, and amounts to a disinvestment in irrigation systems. Some of the problems are attributable to poor program design, where states are unwilling to transfer

[3] Mortality creates a similar sampling bias in studies of famines: those who do not survive cannot be interviewed.

both responsibility for resource management and the authority to follow through with management decisions (see Vermillion 1999). Likewise, where the additional direct and indirect costs farmers (including intangible transactions costs) are asked to assume are not balanced by benefits that the farmers value, individuals will not participate.

Analyses of the conditions under which collective action emerges, becomes effective, and is sustained over time are of great value in developing programs to increase farmer participation. Ostrom (1992) has developed "design principles of long-enduring, self-organized irrigation systems" that point to the importance of clearly-defined boundaries; proportional equivalence between benefits and costs; collective choice arrangements (i.e. users' ability to set and modify rules); monitoring; graduated sanctions; conflict resolution mechanisms; external recognition of rights to organize; and nested enterprises (i.e. federations). These deal primarily with the structure and process of self-governing organizations. But under what conditions are we likely to find groups that apply these principles?

It is useful to think of critical conditioning factors in terms of the environment (broadly defined to include the physical, socioeconomic, and policy environment) affecting the strength of organization and collective action, which in turn affects the performance of irrigation systems (see Fujita, Hayami, and Kikuchi 1999; Lam 1998; Meinzen-Dick et al. 1997; Tang 1992). The environment can either facilitate or constrain organization, create incentives or disincentives for people to work together.

Identifying the extent of farmer participation and the factors that influence its emergence requires comparable measures of the environmental parameters and of the institutions themselves. To improve the generalizability of the findings we have gathered data from a larger number of sites (48) than is usually done, and made explicit efforts to avoid the sampling bias inherent in many case studies.

The study selected Rajasthan and Karnataka—two states in which water is scarce, irrigation development is critical, and which are developing policies regarding farmer participation in irrigation. Within each state, we selected two major irrigation systems that represent different traditions of irrigation development, and different approaches to farmer participation. In Rajasthan, Chambal Irrigation System in the eastern part of the state has higher rainfall, more abundant water supply, and a longer history of irrigation; and Indira Gandhi Nahar Pariyojana (IGNP, formerly known as Rajasthan Canal) in the dry western part of the state represents a project that is still being developed, holding sizes are larger, water is very scarce, and farmers are being resettled from a variety of backgrounds. Similarly in Karnataka we collected data in the Krishna Raja Sagar (KRS) system, the oldest major irrigation system in the state, that has incorporated a number of even older tanks, and which might be expected to have a stronger tradition of local management, and Upper Krishna Project (UKP), a large system still being developed, in an area with less history of irrigation. All four systems were chosen because they also have various types of irrigation reform programs in progress. Descriptive statistics of key variables from each system are given in Table 1.

The sampling unit for the field data collection is the basic hydrologic unit within which farmers might organize for irrigation management. This varies somewhat from system to system: in Chambal, it is the minor, which covers roughly 200 ha, but in IGNP, where minors serve much larger areas, 1-2 watercourse commands (chaks) were selected

Table 1 Mean values of physical environment variables, by system

System	Head	Middle	Tail	Wells	Command area	Villages
	(dummy variable)			*(number)*	*(ha)*	*(number)*
Chambal	.25	.50	.25	7.1	304.6	2.3
	(.45)	(.52)	(.45)	(11.8)	(135.1)	(1.1)
IGNP	.42	.25	.33	1.2	1300.3	7.1
	(.51)	(.45)	(.49)	(2.3)	(758.2)	(3.6)
KRS	.42	.25	.33	6.0	328.5	3.1
	(.51)	(.45)	(.49)	(5.7)	(328.2)	(1.8)
UKP	.50	.42	.08	4.2	296.2	2.1
	(.52)	(.51)	(.29)	(6.0)	(213.9)	(1.1)
Total	.40	.35	.25	4.6	557.4	3.6
	(.49)	(.48)	(.44)	(7.4)	(602.3)	(2.9)

Source: Rapid rural appraisal data, 1996/97.
Note: Figures in parentheses are standard deviations.

per minor. The primary unit of analysis for this study is thus above the farm level (which is the normal focus for most surveys).

To collect data at this level, the study relies primarily on rapid rural appraisal (RRA), combined with government secondary data. The RRA used a combination of techniques to collect a consistent set of data from direct observation and interviews in each location. Semi-structured interviews with groups of farmers elicited much of the information on key socioeconomic environmental factors, as well as indicators of irrigation organization and collective action. Separate interviews with key informants (including government officials and farmer leaders) provided supplementary information. After the interviews, the research team walked through the system with farmers to examine the condition of the irrigation infrastructure and fields. This, together with records from the Irrigation Department or Command Area Development Authority (CADA), provided much of the information on the physical environment of the sites.

Rajasthan and Karnataka are both developing policies for irrigation reform that includes attention to farmer participation, but the content and implementation of those policies differ. Including both in the study thus ensures broad variability in devolution policies. Within each state, the selection of one of the oldest and one of the newest major irrigation systems providing irrigation gives variability in historical experience. There are other important differences within the selected systems in terms of approaches to farmer participation. All four systems have programs to promote farmer organization through CADA staff, but these organizational efforts have not yet extended over the full system. Therefore, in each system we selected some sites that have had external organizational efforts, and some that have not.

Water scarcity has been identified as a key aspect of the physical environment that affects farmer participation in irrigation (Bardhan 1993; Uphoff 1986). Measuring water scarcity is difficult because actual water deliveries and demand are costly to measure, especially over a large area, with much accuracy (Jurriëns 1996). However, location along the canals serves as a reasonably good proxy in most systems. After discussion with engineers and extension officials, and examining system maps, schematic diagrams, and lists of minors and distributaries, the developed area of each system was divided into head, middle, and tail, based on distance from the headworks. Three minors were then randomly selected from each section, giving a random sample of 9 per system.

Because this random sample was not likely to include the cases in which formal organizational efforts had taken place, a purposive sample of 3 other minors was added per system, from the list of sites that had registered societies. These were selected in consultation with CADA staff, to include the most active organizations. In IGNP, there were relatively few registered societies, so the third purposive sample was an area in which Urmul Trust, a local NGO, had been involved in assisting an informal organization. This allows comparison of those sites with formal organizations with a random sample that should be more representative. This gives a total sample size of 48 (9 randomly selected sites plus 3 purposively selected sites with official organizational activities in each of 4 systems).

Many of the key concepts affecting farmer participation are difficult to put into concrete terms for measurement. The complexity of measuring water scarcity is one example, because it is influenced by many sources of supply, as well as by variations in water demand.

Particular attention was given to developing indicators that would capture formal and informal organizations and collective action of various types. Only after identifying the patterns of collective action did we ask farmers whether there is an identifiable organization, how leaders are selected, and if it is registered or has formal by-laws. In addition, we asked whether there is a standing fund for the group or organization, its total value, how it is administered, and spent. The questions related to organization were asked last, in order to avoid biasing the information collected on collective action (i.e. after reporting that they had an organization, farmers may have felt obliged to report that they cleaned canals, or after saying there was no organization, they may have thought the work they did was not relevant).

One further complication in measuring participation should be recognized: many organizational or group activities may not occur on a regular basis. Organizations may remain dormant during certain seasons or years, and only become active in the face of a particular challenge (e.g. a drought year, or proposed changes in water allocation). For example, one site in UKP practiced warabandi and cleaned the minor two years ago, but is no longer engaged in these types of irrigation activities. The group interviews attempted to explore any changes over time, but still may not have captured these effects.

While we have tried to develop clear and measurable indicators for many of the key variables, the analysis combines quantitative techniques with qualitative assessments and illustrations of the concepts, as well as insights derived from particular cases. The quantitative analysis includes both presentation of descriptive statistics (e.g. frequency of organization and collective action by system) and econometric analysis. To identify the relative importance of various physical and socioeconomic factors on organization and collective action for irrigation in the study sites we use a two-stage logistic regression model. Logistic regression allows us to examine the likelihood of an observed yes/no variable (e.g. the presence of an organization or of collective action) as a function of a number of other variables. The first stage analyses the likelihood of some form of water users' organization as a function of a number of physical and socioeconomic variables. The second stage examines likelihood of collective maintenance as a function of (predicted) organization and other factors.

3. FACTORS AFFECTING FARMER INVOLVEMENT IN IRRIGATION

If farmer participation is being realized in some sites but not others, what accounts for these differences? This study examines the role of different aspects of the physical and socioeconomic environment, with variables that have been operationalized as follows:

PHYSICAL ENVIRONMENT

Water supply: Water availability/scarcity is affected by location within systems, alternative water sources, condition of the minor, and cropping pattern. As mentioned above, this study uses head/middle/tail location as a proxy for water scarcity. Based on the hypothesis of an inverse U-shaped relationship between water scarcity and participation (because those with plentiful water don't need to be active, and those who expect too little water have no incentive to be involved—see Bardhan 1993), we would expect greatest participation in the middle.

In addition to supply from canals, water availability is affected by alternative sources of supply, especially rainfall and groundwater. Rainfall differs primarily from scheme to scheme, with an average of 840 mm per year in Chambal, 100 to 360 mm per year in IGNP, 680 mm per year in UKP, and 700 mm per year in KRS. In areas of higher rainfall (e.g. Chambal), we would expect farmers to be less dependent on irrigation than in very dry areas (e.g. IGNP). Availability of private wells not only increases water supply, but also allows individual farmers to "opt out" of collective action to improve their water supply. Thus, we could expect less organization where there are many private wells. Table 1 shows that the most wells were found in the oldest systems: Chambal (average of 7 per minor command), followed by KRS (average of 6 per sample site), and lowest in IGNP (1 per site), where water tables are lower, and farmers have been settled for less time.

Size: The appropriate size of WUAs has been a matter of considerable theoretical and policy debate. The experience of traditional WUAs in Asia has suggested that it is more difficult to organize WUAs if the units are too large, and this is reinforced by game theory. The size of effective water users' organization represents a balance between increasing transactions costs and economies of scale. Theoretically, smaller groups have an advantage in cooperation because strategies are more likely observable; the share in the loss from not following the rules are larger; interlinkages among group members are likely to be more important; and negotiation costs are lower (Bardhan 1993; Meinzen-Dick et al. 1997). However, the effect of size needs to be empirically determined, because transaction costs of organizing within the group are likely to increase with size, but the payoffs in terms of decreased transaction costs between groups and the government will also increase with size. As a result, the agencies responsible for organizing farmers may target larger command areas. Several indicators of size of command are available: cultivated command area (CCA) in hectares, number of outlets, number of farm households, and number of villages. Of these, CCA and number of villages are the most straightforward. The average size command of each minor or lateral is approximately 300 ha in Chambal, KRS, and UKP, but 1300 ha in IGNP. A minor or lateral command covers an average of 2 villages in Chambal and UKP, but 3 villages in KRS (where settlement density is higher). IGNP has a more dispersed settlement pattern, with an average of 7 abadis (hamlets) per minor. In IGNP there may be more correspondence between residence and fields, but there differences in the village of origin may be important.

SOCIOECONOMIC ENVIRONMENT

Heterogeneity: In general, we would expect less participation where farmers live in different villages or are from different caste backgrounds because such types of social heterogeneity make communication and cooperation more difficult. By contrast, where people are used to interacting in a common neighborhood or other social sphere, the marginal cost of getting together for irrigation is lower, and enforcing rules is easier if people want to protect their reputation and goodwill because of linkages between irrigation and other activities. Available information from the RRA on heterogeneity of background includes data on number of villages, castes, dependence on irrigation and non-agricultural income of farmers in a hydrologic unit. KRS had the most homogeneous caste distribution, with less than 3 castes per site, while Chambal had 3.7 castes, UKP 4 castes, and IGNP had greatest variability, with 4.4 castes per site.[4] Newer settlements are also likely to have less tradition of coordinated activity, a factor that will be captured by the dummy variables for system.

Markets: The effect of market penetration on collective action has been considerably debated. On the one hand, we might expect a negative relationship between market distance and participation, because sites closer to market have lower costs for interaction with the government, both for registering a society and for making their

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[4] Dependence on irrigation and non-agricultural income were not used in the analysis because they were too highly correlated with the system dummy variables. Patterns of landholding, including holding size and extent of tenancy, were difficult to get from group interviews, and difficult to compare across sites. Moreover, Baland and Platteau (1996) suggest that heterogeneity of asset structure is less likely to be a barrier to collective action than heterogeneity of social background and objectives.

demands heard. Furthermore, sites closer to market are likely to be more commercially oriented, and therefore have higher payoffs to effective irrigation. However, Fujita, Hayami, and Kikuchi (1999) point out that in rural communities with little exposure to urban market activities, members expect to continue their interaction indefinitely, and hence have incentives to cooperate. Access to markets often decreases this interdependence, and therefore might reduce the likelihood of collective action.

Other organizations: The presence of other local organizations provides information on organizational density and social capital.[5] In the regression analysis, the number of temples and cooperatives are used as two indicators of social capital. Maintaining a temple requires considerable amounts of collective action, and the resources mobilized to support temples are often quite large.[6] These festivals and irrigation work can be complementary, as seen in one example from UKP, where part of the fines from maintenance defaulters was paid to the festival fund. Thus, temples can be a unifying force, and provide experience in raising resources for common purposes. However, the presence of many temples in the local area can also represent considerable factionalism that divides, rather than unites. The net effect of temples should therefore be determined empirically. Cooperatives (e.g. for credit, marketing, or milk) are expected to

[5] The RRA collected information on whether there are active village panchayats, informal caste panchayats, cooperatives (other than for irrigation), and other organizations within the villages. Village panchayats provided no variability, because all sites reported that this institution exists. The presence of any NGO in the area is also noted, as a potential stimulus for cooperation. The only NGO operating in the study site areas is Urmul Trust, which has been instrumental in organizing sangatans, or societies for a number of purposes, in 3 of the sites in IGNP.

[6] Other religious centers, such as mosques or churches, could have a similar effect, but only temples were found in the study sites.

increase the likelihood of irrigation organization, by providing existing networks among farmers; by providing local people with experience in setting up and operating a formal organization (especially where WUAs are set up on the cooperatives model); and by drawing the attention of CADA Cooperatives Wing staff, who are generally charged with organizing WUAs.

As might be expected of a new settlement scheme, IGNP had the lowest incidence of social capital: less than 60 percent of sites had a temple, and less than half had a cooperative (see Table 2). By contrast, 58 percent of Chambal sites reported cooperatives, and there was an average of 3.4 temples per site. Karnataka had more temples (5.8 in KRS and 9.0 in UKP), and KRS had the highest proportion of cooperatives (75 percent of sites). KRS also had the most other organizations, including youth associations, religious or festival societies, and farmers' associations.

Leadership: Information on leadership potential was collected by asking about college graduates and influential people in the village. The former are expected to have education and ideas that will enable them to deal with formal organizations. An “influential” person refers to someone who has external recognition and influence, such as an MLA or other politician, retired army officer, or other official. We did not pre-define "influential", but tried to elicit examples from the group interviews.

Table 2 Mean values of socio-economic environment variables, by system

System	Castes	Market Distance	Temples	Cooper-atives	Influential Persons	Graduates	Tractors
	(number)	*(km)*	*(number)*	*(number)*	*(dummy variable)*	*(number)*	*(number/ household)*
Chambal	3.7	27.2	3.4	.58	.25	4.9	.09
	(1.6)	(14.7)	(1.5)	(.51)	(.45)	(3.8)	(.06)
IGNP	4.4	27.2	0.58	.42	.42	1.1	.14
	(2.2)	(22.6)	(0.51)	(.51)	(.51)	(1.8)	(.09)
KRS	2.7	10.9	5.8	.75	1.0	16.7	.01
	(.60)	(5.9)	(2.8)	(.45)	(.0)	(14.1)	(.02)
UKP	4.0	13.6	9.0	.50	1.0	7.9	.05
	(1.0)	(10.2)	(5.1)	(.52)	(.0)	(5.8)	(.06)
Total	3.7	19.7	4.7	.56	.67	7.6	.07
	(1.6)	(16.1)	(4.3)	(.50)	(.48)	(9.6)	(.08)

Source: Rapid rural appraisal data, 1996/97.
Note: Figures in parentheses are standard deviations.

Karnataka had the highest average levels of leadership potential, by these indicators, with some form of influential persons identified in all sites, and an average of 8 graduates per site in UKP and 16.7 in KRS (Table 2). By contrast, IGNP had only 1 graduate per site and only 42 percent reported influential people; KRS had 5 graduates, on average, but only a quarter of sites had influential persons.

SELECTION OF VARIABLES

The sample of 48 sites in this study permits quantitative analysis; however, it does not provide enough degrees of freedom to examine all the factors that have been suggested as influencing organizations or collective action, especially because certain variables (e.g. rainfall, average holding size) are highly correlated with the dummy variables for system. Furthermore, because predicted values of organization are used in estimating the models for collective action, somewhat different sets of variables must be used for stages I and II (Johnston 1991). Thus, we have had to choose those factors that seemed most likely to influence each type of outcome.[7] Because outsider organizers (usually from CADA) have played a major role in formation of organizations, the presence of organizations reflects a combination of factors that draw CADA attention as well as those that make farmers likely to be receptive to their efforts. The variables for the organization equation are therefore those that are generally known by CADA and similar outsiders. Other internal factors that are more likely to affect local cooperation, but may not be readily known from outside, were used in the models for collective action.

For example, location along the canal is well known to CADA, and is an important proxy for water availability. The density of wells also influences water availability, but is not easily known by outsiders. Whereas head or tail end of the system affects all farmers on a minor (though those at the tail of the minor suffer most), wells provide an alternative source of water for some farmers, allowing some individuals to "opt out" of collective action for canal irrigation, if they so choose. Therefore, this study uses WELLS—(the number of wells in the minor command, standardized by number of farming households) as an additional indicator of water availability in the collective action models.

As an indicator of size, CADA evaluates minors based on command area (CCA), so this is used as an indicator of size in the first stage. However, the models for collective action use number of VILLAGES (or chaks in IGNP) as an indicator of size and social heterogeneity, because this is likely to have more relevance when it comes to

[7] For a more complete discussion of the methodology and selection of explanatory factors, see Gulati, Meinzen-Dick, and Raju 1999.

getting people together to accomplish something. The number of castes (CASTES) in the command area is included as a key locally-known social variable, to see if difficulties in getting cooperation across caste lines are a barrier to collective action.

Only one indicator of potential leadership was included in each of the collective action equations: GRADUATES in the maintenance equation because in a number of sites, it was graduates that were spearheading maintenance activities; and INFLUENTIALS in the collective lobbying equation, because those with outside connections seemed likely to provide a focal point for joint interaction with outsiders. The collective lobbying equation also included a variable for TRACTORS (number in the command area, standardized by number of households) because tractor trolleys provided a means of transport, especially for bringing groups of farmers to irrigation department offices.

4. FARMERS' ORGANIZATIONS FOR IRRIGATION MANAGEMENT

FREQUENCY OF FORMAL AND INFORMAL ORGANIZATIONS

Setting up organizations has received considerable attention in devolution programs, and the number of organizations registered or in the process of forming have often been used as the benchmark of success. But despite this activity, when we look across the total set of minors in the sample systems, local organizations for irrigation management are not common, except where special programs have been conducted. Table 3 presents findings of the extent of organizations and collective action, by sample system. Among the 36 randomly selected sites (i.e., excluding those which had pilot organizational activities by CADA), only 1 (in UKP) had a formal organization, and even that had been initiated by CADA staff. The existence of formal irrigation organizations reflects both outreach on the part of the agency, and receptivity on the part of the farmers.

The formal organizations in Chambal were set up as pani panchayats, and in KRS and UKP as irrigation cooperatives. This was not a reflection of local farmers' choice of organizational form, but of official policy regarding the type of organization to promote. Registration of a society under any act is not an easy process. Even after farmers are able to get a consensus among a minimum number of members to form an organization, and to collect the initial share capital from members, there are long delays due to the location of the office of the registrar of cooperatives in district headquarters. The very procedure of registering a society causes delays: getting approvals at different levels, inspection of the proposed society place, and other activities by the registrar office personnel. Farmers are not generally familiar with all these procedures, and required supportive documents are not readily available. For example, some of the farmers' groups in Chambal issued receipts for share capital on receipt books purchased in the bazaar, and not on the proper type of receipt books, and were told their records were therefore not valid.

Because of these difficulties with registration, many local farmers' groups do not opt for registration of their 'organization' unless it is essential. Three of the randomly selected sites had informal organizations (1 in IGNP,[8] 2 in KRS). In KRS, the

[8] The second informal organization in IGNP was from the purposive sample.

organizations build upon traditional institutions for local management of tanks, which predated the construction of the system in 1931.[9]

Table 3 Indicators of farmer participation, by scheme

	Organization			**Collective Action**			
System name	Water Users' Associations			Joint interaction		Maintenance of minor	
	None	*Informal*	*Formal*	*No*	*Yes*	*No*	*Yes*
Chambal	9	0	3	2	10	8	4
IGNP	8	2	2	5	7	5	7
KRS	7	2	3	2	10	2	10
UKP	8	0	4	3	9	4	8
TOTAL	32	4	12	12	36	19	29
Percent of sites		8.33	25.00		75.00	60.42	

Source: Rapid rural appraisal data, 1996/97.

FACTORS INFLUENCING FARMERS' ORGANIZATION FOR IRRIGATION

What accounts for where we find organizations? Because CADA staff or other outsiders have initiated many of the farmers' organizations for irrigation, the presence of an organization must be understood as a combination of government (or other organizations') attention and farmers' initiative and/or willingness to be part of such an organization. Using the theoretical factors suggested in the literature (as operationalized above), logistic regression analysis is employed to modeling the probability of farmers' irrigation organizations as a function of:

[9] One of the formal organizations in UKP was also established in an area with a tank that predated the canal system.

- dummy variables for system (IGNP, CHAMBAL, KRS, and UKP), which capture the effects of different state government and local project policies, plus old and new systems and rainfall differences;
- dummy variables for head and tail (HEAD and TAIL) of the system, as a proxy for water availability/scarcity (with middle of system as default);
- size of hydrologic unit, indicated by command area of the minor (CCA);
- distance to market (MARKET), as an indicator of market access and transportation costs;
- social capital of the minor command, indicated by presence of other cooperatives (COOPS) and temples (TEMPLES) in the minor command;
- leadership potential, indicated by number of college graduates (GRADUATES) and by a dummy variable for an influential person (INFLUENTIALS) in or from the command.

Results of the analysis are presented in Table 4. The coefficients for all system dummy variables are significant, but the sites in Karnataka are significantly less likely to have an organization than those in Rajasthan, once other factors were controlled for. This is not surprising for Chambal, because they have had an active participatory irrigation management (PIM) program. The IGNP authorities had seemingly not made as much progress at the time of the study, but once the physical and socioeconomic factors were controlled for, IGNP was seen to be doing almost as well as Chambal. Neither the dummy variables for head or tail were significant; indicating that location on canal (and, by extension, ease of water availability) did not have an effect. Size of minor command did, however, have a significant positive effect, which means that larger commands are more likely to have an organization. That may be somewhat surprising to those who expect it to be easier to organize a smaller group, but smaller command areas are less likely to attract CADA's attention and organizational efforts.

Market distance has a significant negative effect, implying that those who are farther from the market centers are less likely to have organizations, consistent with the hypothesis given earlier. This may be because the commercial opportunities are less available to make irrigation profitable in more remote sites, but it is more likely to reflect the ease of access to towns (and townspeople, like government agents). Those who are closer in are more likely to be visited by CADA organizational staff, and will have lower travel costs for the many visits required, especially for registering an organization.

Table 4 Results of logistic regression model for probability of any type of farmers' organization for irrigation

Variable	B	S.E.	Wald Statistic	R
IGNP	-8.15**	3.95	4.26	-.184
CHAMBAL	-8.82**	4.36	4.08	-.177
KRS	-15.67**	6.51	5.79	-.239
UKP	-15.31**	6.00	6.51	-.260
HEAD	1.46	1.85	0.63	.000
TAIL	1.94	2.23	0.76	.000
CCA	0.0031**	0.0015	4.17	.180
MARKET	-0.092**	0.04	4.33	-.187
COOPS	3.21	2.08	2.39	.077
TEMPLES	0.60**	0.28	4.70	.201
GRADUATES	0.17*	0.09	3.56	.153
INFLUENTIAL	4.83**	2.19	4.84	.206

Model Chi-Square = 40.586 with 12 degrees of freedom; p=.0001
Percent correctly predicted = 91.67.
Source: Rapid rural appraisal data, 1996/97.
** Significant at 0.05 probability level
* Significant at 0.10 probability level

Somewhat surprisingly, the presence of other types of cooperatives in the command of a minor does not significantly increase the likelihood of an irrigation organization. However, the number of temples in the villages of that command area does have a significant positive influence on the likelihood of organization for irrigation. The social capital generated by religion seems to have a stronger influence on organization for natural resource management than that created by cooperatives. This is despite the fact that organizing WUAs has been largely entrusted to the cooperatives wing of CADA, and familiarity with cooperative structures would presumably facilitate dealing with the registration and management process for formal WUAs. However, it is possible that many of the cooperatives are not active enterprises or that the links created between members of a cooperative do not have as strong or pervasive an effect as the links created by temples.[10]

Among leadership variables, both the presence of college graduates and influential persons have a significant positive effect on irrigation organization. Graduates would presumably offer innovation and have the skills required for setting up and managing a formal organization. Influential people from the local area offer networks of contacts (both within and outside the local area) that could draw officials' attention to the area, and could be useful in starting an organization for irrigation.

Overall, this model predicts 92 percent of the cases correctly. Despite the somewhat small sample size and large number of variables, the model is still significant. It appears that in addition to scheme (state) characteristics, physical size and location, and

[10] It would be desirable to test the effect of other types of organizations, as well, but due to the limited degrees of freedom, this model has to select two that were thought to have the strongest effect on irrigation activities.

social capital and leadership play an important role in influencing where organizations are likely to become established, and these outweigh water scarcity (as indicated by head/middle/tail of the system).

5. COLLECTIVE ACTION FOR IRRIGATION MANAGEMENT

Irrigation organizations are not an end in themselves. For devolution reforms to achieve objectives of financial and physical sustainability of the irrigation systems requires some form of collective action among the farmers. In this case, we focus particularly on collective action for maintaining the minors and collective lobbying activities by farmers.

COLLECTIVE ACTION FOR MAINTENANCE

Much of the success of participatory irrigation management as a means to improve system performance and reduce the fiscal burden of irrigation systems on the government hinges on farmers' willingness to take on an expanded role in operation and maintenance above the outlet. Currently farmers are responsible for all maintenance of watercourses below the outlet, and all sites reported that farmers were doing some form of watercourse maintenance. In some instances, this was done by farmers as individuals whenever the channel supplying their fields needed repairs. However, in a number of cases even watercourse cleaning and repairs were done collectively by calling a number of workdays when each needed to supply labor. In some instances, defaulters were fined unless it was due to exceptional hardship, in which case the other farmers would do the maintenance for the defaulter. In two cases in IGNP, if a farmer did not clean the watercourse, the work was auctioned among other farmers, starting at Rs 5–10 per foot of watercourse. One of the downstream farmers would do the work, and the group would force the defaulter to pay.

Responsibility for maintenance of minors and distributaries above the outlet into watercourses currently rests with the government. However, in over 60 percent of cases, farmers reported that they were undertaking some form of maintenance activities above the outlet (Table 3). Chambal was the only system in which less than half (4 of 12) of the sites reported farmers working above the outlet, while 10 of 12 sites in KRS had a high degree of farmer maintenance. Clearing weeds and desilting were the most common forms of maintenance, although some other types or repairs may also be undertaken. Some villages have collective action for canal cleaning and repairs on certain days of the season (usually twice a year at the beginning of the season). Absentees have to pay a penalty ranging from Rs 30 to Rs 60 per day per person. When farmers refuse to pay the penalty, the group stops the water supply to their particular fields and doubles the penalty amount to restart the water supply. Examples of the range of maintenance activities include:

- In one village of UKP, farmers collectively attend to the minor cleaning and repair works on every Monday and absentees have to pay Rs 25/person/day. In this village one large landholder with 30 acres incurred Rs 1200 on his own to realign the lateral so it would have a better slope. In another village, farmers decide to work for a half or one day before the season begins to clean the unlined minor and field channels.

- In KRS, it is mainly tail enders who get together and desilt the canal, clear stones and stubble, before irrigation starts. Sometimes, soon after the rainy season, farmers in small groups do this kind of work to repair the canals. In at least one case, farmers of one distributary worked for desilting a neighboring distributary, and participation was nearly 80%. But this was mainly owing to good mutual relationships among the farmers of two villages.
- In Chambal, CADA emphasizes cleaning of minors as one of the indicators of success in its PIM efforts. Young men in some of the pilot organized areas as well as in minors without an organization have mobilized farmers to clean the minor, assigning each to desilt a certain length of the canal.
- In IGNP, sandstorms cause heavy siltation of the canals. Farmers have done much of the work to clean the minors because other laborers are not available in this settlement area with low population densities. In some cases, only the poorer farmers have done the work as employees of the irrigation department. This was not included as instances of collective action. But in other cases, farmers have done the work on a voluntary basis, or all farmers have participated and contributed their labor, with any payment going into a collective fund. Where farmers do not have strong organization or leadership, baildars or other irrigation department staffs are instrumental in calling the workday and mobilizing the farmers to clean the canals. In many instances the farmers reported that they preferred to do the work themselves, because when contractors did the job, they did not do it as carefully, and the silt that had been removed blew back into the canals. For the contractors,

> maintenance work represented the chance to make more money, but farmers who depend on water from those canals preferred to do a more thorough job.

While such examples demonstrate farmers' capacity to do collective maintenance, these initiatives were not found in every site. If farmer maintenance of minors is to be an objective of devolution programs, to relieve the state of such recurring expenditure and/or allow it to redeploy staff to new activities, what accounts for whether or not farmers will be willing and capable of taking over the maintenance of the system at higher levels (e.g. distributary and minor)?

The models for collective action are similar to the organizational model in that they include dummy variables for each system, for head and tail location within the systems, and for distance from market. The collective action models also include the predicted value of whether there would be a Water Users' Association (WUAp). This model also substitutes VILLAGES for CCA, and adds WELLS and CASTES, but only includes GRADUATES among the leadership variables, as mentioned above.

The logistic regression model for farmer maintenance of the minors is presented in Table 5. Results indicate that a greater number of villages on a minor reduce the likelihood that farmers will get together for maintenance. This may be because of the greater physical as well as social separation when people farming in the same hydrological unit do not also live together. It is noteworthy, however, that the predicted value of irrigation organization (WUAp) has a significant positive effect, indicating that organizations do facilitate maintenance activities. No other factors in the equation were significant, but factors that were significant in the equation for organization (e.g. CCA, temples) exert an indirect influence on collective action via their effect on organization.

Table 5 Results of logistic regression model for probability of farmer maintenance of minors

Variable	B	S.E.	Wald	R
IGNP	3.56	2.27	2.45	.082
CHAMBAL	0.74	1.59	0.22	.000
KRS	1.83	1.81	1.02	.000
UKP	1.55	1.56	0.99	.000
HEAD	0.72	0.89	0.65	.000
TAIL	1.12	1.14	0.96	.000
VILLAGES	-0.39*	0.21	3.41	-.146
MARKET	-0.04	0.03	1.37	.000
WELLS	-4.22	6.00	0.49	.000
GRADUATES	0.05	0.07	0.37	.000
CASTES	-0.15	0.26	0.31	.000
WUAp	2.28*	1.17	3.81	.165

Model Chi-Square = 18.721 with 12 degrees of freedom; p = .0955.
Percent correctly predicted = 77.08.
Source: Rapid rural appraisal data, 1996/97.
* Significant at 0.10 probability level

After all that has been invested in forming organizations, it is encouraging to see that irrigation organizations do increase the likelihood that farmers will undertake maintenance of the minors. The higher likelihood of farmer maintenance where organizations have been established may stem from government efforts to promote farmers' involvement. Alternatively, the legal recognition of registered organizations may empower farmers to undertake maintenance, where unorganized groups are prohibited from doing work on "government" canals. Theoretically, organizations should facilitate collective action for maintenance because maintenance activities require coordination, e.g. in calling working days, determining the labor and cash contributions of each person, and monitoring and sanctioning those who do not participate. Particularly regular maintenance is more likely when there is an organization that makes these issues routine.

The significant relationship between organization and maintenance is important because, by taking on a role in maintenance, farmers are contributing resources for system management and taking action which improves the efficiency of irrigation deliveries and the physical sustainability of the irrigation system (provided it is well done). But beyond the contribution to the financial and physical sustainability of irrigation systems, the involvement of farmers' organizations in maintenance can improve the sustainability of the organizations themselves. Literally thousands of farmers' organizations have been set up for irrigation management, but if they have no role, they become defunct. If farmers' involvement in maintenance, rather than simply societies registered, becomes the indicator of success in participatory irrigation management programs, it is more likely that the efforts devoted to such reforms will have a stronger impact on the performance of irrigation systems.

Nevertheless, it is also important to note that not all formal organizations have been involved in maintenance. This indicates that further attention is required to ensure that the organizations become (and remain) active after they are set up.

COLLECTIVE LOBBYING ACTIVITIES

Although PIM programs focus on maintenance activities, farmers themselves are more likely to get together for a variety of lobbying activities. Joint interaction with irrigation agencies is quite widespread: farmers in 75 percent of the sites reported this type of collective action. Representing the common interests of irrigators in making demands on the government appears to be one of the easiest types of collective action to organize. In this, farmers are trying to mobilize "external" (i.e. government) resources, which represents a positive sum activity in which all farmers on a minor or watercourse can benefit. By contrast, sharing a fixed amount of water or mobilizing resources of the farmers to maintain facilities are zero-sum, at best.[11]

The exact form of the collective action ranged from submitting joint written petitions, to sending a delegation of local leaders to various offices to request water issues or system repairs, to mobilizing groups of ten to fifty farmers to go to the irrigation agency offices with requests. In several cases, the farmers even organized agitations or demonstrations to press their demands. These trips and other forms of interaction are often funded by an ad hoc collection from all the farmers, or if farmers each pay their own way, they may pool their funds to meet all expenses. Tractor trolleys were often used to transport groups. Despite the variation in forms of interaction, collective representation can be distinguished from individual interaction with agencies because those who go to meet with the officials go as representatives of the collective, not on their own behalf.

The nature of demands made by the farmers include additional releases of water, better information regarding when water will be released, lifting of cropping restrictions, and repairs of breached canals or other facilities. A major cause of protest is the lack of communication between the water suppliers and water users.

Although collective representation often takes place spontaneously, without any organization, forming registered water users' associations may strengthen the effectiveness of lobbying efforts, especially for demanding a greater voice in decision-

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[11] Blomqvist (1998) refers to activities such as collective lobbying for more water as external solutions, in contrast to mobilizing resources for maintenance, which is an internal solution. See also Chambers (1988:171).

making on cropping patterns and delivery schedules for the scheme as a whole. In most schemes there is some form of irrigation management council that includes representatives of the irrigation department, CADA, and other officials. Local politicians such as MLAs are also included in the bodies, but there are no formal farmers' representatives. As various WUAs become stronger, they are lobbying to be included in these decision-making forums.

When written petitions and small group meetings with officials do not provide a satisfactory response, then water users have resorted to mobilizing large groups to draw attention to their demands. Some agitations are organized at taluk, district, and state level. Depending on the level, these demonstrations may mobilize from 50 to 5000 affected farmers. At the state level, tens of thousands of farmers may even come for demonstrations. These large group agitations, which include rallies and processions on major roads to get attention, are generally organized with the support of a political group or party.

The collective representation provides a contribution to irrigation management by improving the flow of information between irrigation agencies and farmers. Where Irrigation Department staff lack the time or transport to visit the entire irrigation system, farmer's representation alerts them to areas that need water or repairs. On the other side, farmers can learn what constraints exist in total water supply or repair budgets. However, this is a selective information flow, based on farmers' ability to make their case, and not necessarily on the severity of the problems faced.

What factors affect the likelihood of collective interaction? The model for collective lobbying is the same as that for collective maintenance, with the addition of a variable for density of tractors (which are used in transporting farmers to gatherings), and among leadership potential variables, influential persons (instead of graduates) because those individuals may spearhead or facilitate lobbying efforts. Table 6 presents results of the analysis. Farmers in IGNP were much less likely to become engaged in these activities, perhaps because of the larger distances that must be covered between farms and government offices in that project. Head enders are significantly less likely than middle or tail enders to engage in these activities, probably because they are likely to get

Table 6 Results of logistic regression model for probability of collective representation

Variable	B	S.E.	Wald	R
IGNP	-13.17*	7.17	3.37	-.144
CHAMBAL	-4.31	3.95	1.19	.000
KRS	-7.25	5.67	1.63	.000
UKP	-7.61	6.43	1.40	.000
HEAD	-4.24**	2.04	4.31	-.186
TAIL	2.41	2.74	0.77	.000
VILLAGES	0 .55	0.51	1.14	.000
MARKET	-0.07	0.06	1.29	.000
WELLS	23.91	16.18	2.18	.053
TRACTORS	26.98*	15.35	3.09	.128
INFLUENTIALS	3.01	3.91	0.59	.000
CASTES	1.73	1.10	2.48	.085
WUAp	2.70	2.02	1.79	.000

Model Chi-Square = 42.700 with 13 degrees of freedom; p = .0001
Percent correctly predicted = 85.42
Source: Rapid rural appraisal data, 1996/97.
** Significant at 0.05 probability level
* Significant at 0.10 probability level

the water anyway, due to their location. The number of tractors does significantly increase the likelihood of collective lobbying, but whether this is because tractors have a practical value in transportation for lobbying or indicate "progressive" farmers who are likely to make their demands heard, cannot be determined. Other variables have no significant effect—not even the predicted variable for irrigation organization.

Thus, not having an organization does not seem to constrain farmers from coming together to make their demands heard as the need arises (Chambers 1988). For IGNP, Ramanathan and Ghose (1994) explain that without local decision-making forums, people move immediately from "atomized relationships" of individual farmers with the bureaucracy, into mass political movements. Because these protests happen sporadically, collective efforts can be arranged on an ad hoc basis. However, this does not measure the effectiveness of the lobbying. The presence of an irrigation organization may give farmers more credibility in interacting with the government. Indeed, one of the potential advantages for farmers of organizing would be to gain a stronger voice in system management decisions (Meinzen-Dick et al. 1997).

6. OUTCOMES OF FARMER PARTICIPATION

Water Users' Associations are not ends in themselves. From the farmers' or government's standpoint, they are only worth supporting if they improve the efficiency, equity, or sustainability of irrigation systems. Because of the cross sectional nature of this study and the wide range of factors (in addition to farmer participation) affecting irrigation performance, we are not able to do a full impact assessment. To assess the outcomes of farmer participation we focus on the resource mobilization and irrigation activities undertaken collectively. Any form of collective action that improves the maintenance of infrastructure or timeliness of water deliveries is a contribution to system performance. Furthermore, the total value of farmer resource mobilization provides an indicator of what farmers contribute toward their systems. Before any moves to change formal irrigation fees, it is essential to see the issue from the farmers' standpoint, by recognizing what they are already paying. In some cases those contributions may not be channeled effectively under the present set-up (e.g. when large groups go to irrigation officials several times a season to petition for water or repairs). Identifying such situations and ways to make those contributions have a greater effect on farmers' water supply offers the opportunity for farmers as well as the government to benefit from reforms.

The total resources mobilized for maintenance are significant. Resource mobilization for maintenance of the minor includes substantial labor contributions. Among farmers' groups involved in maintenance above the outlet, the contribution per minor averaged over Rs. 16,500.[12] Contributions per site were highest (near Rs. 30,000 per minor) in Rajasthan, and lower in Karnataka. The lowest average contribution was Rs. 4,761 in KRS. This is due to both the lower average size of minors in KRS and the lower imputed wage rate (Rs. 30 per day, as opposed to Rs. 50 per day in the labor-scarce IGNP). When contributions are standardized per unit of command area, the value of farmer's collective work averages Rs. 75 per ha over all sites that have farmer

[12] Total resources mobilized could have been used in a tobit analysis, instead of the logit analysis for likelihood that maintenance would be done. However, the level or resource mobilization is affected by so many factors besides the degree of collective action that it is preferable to focus on the likelihood of collective action. Physical conditions of the infrastructure play a large role, as does the periodicity of repairs. For example, a site that had flooding might have to mobilize significant resources in a year, as would a site that had never cleaned their canal, whereas one that had been regularly maintaining the canals might have a lower level of resource mobilization because they had been working together for many years.

maintenance. On a per household basis, farmers are contributing an average of Rs. 311 per year for collective maintenance. These contributions are in addition to irrigation fees and labor contributions to clean watercourses. The value of farmers' contributions may be even greater than indicated by simple comparisons with government O&M expenditures, if farmers' associations use their resources more efficiently than the government agency. For example, farmers' groups incur only direct costs, and do not pay contractors' commissions or the overhead for maintaining a large bureaucracy. Furthermore, where farmers use accurate local information to judge where work most needs to be done, it increases the efficiency of maintenance resources. (We should not idealize, however, as farmers may also lack technical information on maintenance procedures, and undercut a canal or make other costly mistakes.)

Collective lobbying was also costly for farmers. The cash expenses alone for interacting with various officials (especially Irrigation Department or CADA staff) averaged nearly Rs. 1,500 across all sites that do some form of joint interaction. The minimum expenditure was a nominal expense (approximately Rs. 10) for preparing a petition, but this could range up to Rs. 7,500, as in one case in Chambal where large groups of farmers were making repeated trips to the irrigation department. Farmers in Chambal traveled by tractor trolley, at a cost of Rs. 500 per trip (for 20 people). In other cases transport was by bus, but even this could be expensive, especially in IGNP, where travel distances are long. Nor does this include the value of people's time. There may be a trade-off between resources expended on lobbying and on cleaning the minor. If farmers' associations are taking large groups to irrigation department offices several times a year to request maintenance or system improvements that will give them more water (with a variable likelihood of success), it may be cheaper and take less time for those same farmers to spend the time in directly cleaning the minor themselves.

Viewed in one way, the level of resources mobilized for these activities demonstrates that farmers can and do pay considerable amounts for irrigation—in addition to the official irrigation fees. But the fact that farmers are already paying such large amounts does not mean that they will be willing to pay higher official charges, especially if they are not sure of how the money will be used, or what benefits they will get. Where they are currently undertaking this collective action, it is because they have incentives in the form of a clear need and some confidence that their work will improve conditions.

In addition to the maintenance of minors that farmers' associations have undertaken and paid for by themselves, which is considered as collective action in this study, there are also many instances in which farmers' organizations have undertaken maintenance work under contract with the irrigation agency. This is especially common in IGNP, where a lack of an alternative labor force has driven the Irrigation Department to use farmers to get the work done. Pilot registered societies in UKP and Chambal have also obtained permission to become the contractors for maintenance of their own minors, and the possibility to take up maintenance of their facilities under contract is becoming a common incentive for farmers' groups to organize. This has some potential advantages, because the farmers have a vested interest in making sure the work is done well, and therefore may be more efficient in doing the work. Further, the contractors' commission can go to the association's account, and provide a source of revenue for the organization. However, it does not mobilize additional resources for irrigation, and can even displace resources the farmers would have otherwise raised for maintenance. Where there is the expectation that they may be able to get the government to pay them to do the work, organizations may wait rather than going ahead with necessary repairs. Unless some form of linkage is made between farmers' payments and O&M work done, contracting with WUAs to do maintenance on their own facilities is likely to undermine objectives of mobilizing additional resources for irrigation systems through participatory programs.

7. CONCLUSIONS

Policies to increase farmer participation in irrigation represent a significant shift in the approach to major surface irrigation systems in India. While lessons from the experience in other countries can be valuable, it is not possible to recreate the experience of other countries. Building on existing patterns of cooperation in Indian canal systems is more likely to lead to success. But for this we need a better understanding of the factors that facilitate and constrain farmer participation.

Our empirical study in Rajasthan and Karnataka indicates that there are active formal and informal institutions and organizations for water management at the local level, although these have not expanded far beyond the pilot sites. Farmers are also engaged in collective action for maintenance of minor canals and distributaries, and quite active in collective lobbying efforts. In some cases the resources farmers commit for these activities are considerable; however, in other cases farmers undertake no such collective work on irrigation systems, even in some cases where formal water users' organizations have been established.

What factors contribute to farmers' organizing and undertaking irrigation-related activities together? Results of this study suggest that, controlling for other factors, Rajasthan has had more success in organizing farmers. Water supply (indicated by head/middle/tail location in the system) is not a major constraint. Size of the command area and distance to market play a larger role, along with leadership and social capital (indicated by influential persons, college graduates, and number of temples, but not other economic cooperatives in the village).

These findings suggest that irrigation devolution programs are most likely to succeed in establishing organizations if they begin with somewhat larger command areas (although there may be an upper limit for size of units), and those which are relatively closer to market centers, as these are the factors that are significantly related with organization in the study areas. Organizers are likely to find more fertile ground where there is established social capital, or patterns of cooperation in other spheres. This study suggests that temples or religious institutions provide better indicators of this social capital than formal economic cooperatives. Finally, leadership potential is critical. Both traditional leadership, represented by influential persons from the local area, and modern leadership, represented by college graduates, can play an important role. Taking advantage of the local social capital and leadership potential is likely to lead to more active organizations, but it may also require flexibility in approaches, to allow local people to tailor the organizations to their own needs and capacities.

Farmers' becoming active in maintenance of minors is an important objective of PIM programs, and in this case predicted organization did significantly increase the likelihood of such collective action. However, minors that involve multiple villages are less likely to have such collective action. Even though not all organizations are yet active in maintenance above the outlet, the fact that organizations have played a role in maintenance indicates there is a value to organizational activities. Moreover, if farmers are more effective in the use of their own resources than the government agency and contractors who currently do the work, the effect on long-term irrigation performance may be even greater than the cash contributions would indicate. Farmers' contributions for lobbying provide an important role in communications, though resources may not always be used in the most effective manner.

Based on these findings, efforts to promote farmers' organizations for irrigation management do have a payoff. Focusing on areas that are most likely to be receptive to organization is likely to increase the establishment of organizations. If these are successful (in the farmers' estimation), there can be further spontaneous adoption, or later efforts to promote the organizations. However, organizations should not be treated as an end in themselves. For farmers to play a significant role in all of the critical functions of irrigation management including allocation, distribution, operation and maintenance (O&M), and conflict resolution (Coward 1980), there is also a need for local institutions (clearly defined rules) to allocate and distribute water, institutions to manage conflicts, and collective action for operation and maintenance. Thus, PIM programs and the staff that implement them need to keep these larger objectives in mind. In this regard, the approach of the Area Development Commissioner of Chambal is appropriate: he stated that he judges the performance of the CADA staff charged with organizing farmers in terms of the length of minors that are ultimately cleaned and maintained by local farmers.

Structural conditions may partially explain the nature of organizations and degree of collective action, but they do not tell the whole story. It is possible to identify factors that affect the incentives to participate, but the costs and benefits are not limited to quantifiable, objective criteria. The role of seemingly 'idiosyncratic' features such as the involvement of particular people and their motivation should not be neglected. This is particularly true of leadership. The involvement of a charismatic or trusted individual reduces the transaction costs of organizing and provides assurance that makes people more willing to participate in collective action (Kolavalli 1995; Baland and Platteau 1996). At the same time, organizations that depend on particular individuals are also vulnerable to leadership disputes. Personal connections that inspire people to become involved may also create factionalism and shifting alliances that creates barriers to collective action. In many cases, the disputes affecting irrigation may arise from some seemingly unrelated issue, such as a dispute over land, marriage, or even ceremonies (for examples, see Pradhan and Pradhan 2000). To present an accurate picture of incentives for farmer participation, structural analyses need to be balanced with actor-oriented approaches, especially for the understanding of leadership.

As policies and programs to devolve natural resource management from governments to user groups are adopted in more and more countries and resource sectors, it is essential that we move beyond simplistic and optimistic views that users can (or cannot) manage the resources, to recognition that users' willingness and ability to take on additional responsibilities will vary across locations, as well as over time. Identifying the factors that contribute to effective resource management by user groups can make a valuable contribution in identifying where devolution programs will take root most easily, and where additional efforts are likely to be needed. But doing this requires moving from theoretical to empirical analysis, from isolated case studies to comparative analysis, and from looking only at recognized organization to looking for the collective action that is done with (or without) the organizations.

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