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SOCIO-ECONOMIC DETERMINANTS OF FARMER PARTICIPATION IN IRRIGATION PROJECTS IN INDIA*

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I. Introduction

The subject of farmer participation in irrigation projects has attracted considerable attention in the recent past. The term 'participation' has different connotations for different people. For the policy makers at the political level and the planners at the politico-administrative level, participation means sharing in a wider sense by the beneficiaries in the process of setting up development goals, formulating policies and implementation of projects[1].

For the actual implementors of the projects, the term evokes varied response. It ranges from a feeling of suspicion about the ability of the beneficiaries to fear about consequent delay in implementation. For some of them, the term simply means asking the beneficiaries to legitimize or ratify projects formulated by the government and letting them wait for the end-results to flow from the project[2]. For an enlightened few in the bureaucracy, however, it means consultation from the start in regard to project design, implementation and management. The first category of bureaucracy regards the hardware aspects of technology as above the 'heads' of the beneficiaries and hence, for them, participation does not go beyond minimal inputs in implementation and hand-over phases of the project. On the other hand, the second category of bureaucracy recognizes the importance of software components, namely acceptance and support by the beneficiaries of the intended technological changes and their

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active association in promoting these induced changes[3]. In the process, the bureaucracy reeducates itself by gathering insights into the thinking at the grassroots not only in their individual but also in their collective capability to accomplish things[4]. The latter is indeed valuable to the bureaucracy engaged in remote irrigation project areas when most of its members are not familiar with project areas having been bought from outside[5]. The farmers' knowledge of the social environment and their skills can also be an important source of detailed information necessary for appropriate design, rehabilitation and operation of the system especially at the terminal level. Thus, the term participation would also mean mobilization of local resources, and tapping of hitherto neglected knowledge and skills of the prospective beneficiaries[6].

For the beneficiaries of an irrigation project, the term participation would mean consultation on and awareness of decisions made by the project management in so far as they affect their farm systems operations, sharing in the implementation process and its benefits and a 'say' in evaluation. At the sustained level of operations and management of the systems, which will be the focus of the paper, the term would pointedly refer to active involvement of farmers in the management of irrigation at all levels, including the main system, and supplementing the Government's efforts and resources in the maintenance of the system as a whole through collective and voluntary maintenance of the tertiary system, the secondary and primary being the responsibility of the Government. Further, it would also signify institution building by which human talent and skills can be matched optimally with technology and other imputs[7].

However, in India, much of these interpretations and aspirations have remained only on paper and have hardly been translated into action. The reasons are not far to seek. The public sector irrigation projects in India have yet to provide a conducive atmosphere for effective participation by farmers through there have been some "top-down" efforts in setting up institutions. The resultant effect is that there has been a great deal of hesitancy on the part of the farmers in fulfilling their participatory role drawing heavily upon their time, resources and energy which do not appear in their perception to commensurate with the gains they have derived from the projects. Obviously, there are certain forces which determine their willingness and scope of participation. The present paper seeks to examine these determinants. The conclusions stem from the field studies undertaken by the author in a major irrigation project in Gujarat, India with which he was associated for about five years. The paper is organized into three sections. The first section gives a brief background of the project, whereas the second section presents some of the relevant results of the field studies. The last section offers some conclusions.

II. Project Background

1. Project for Field Studies

The empirical field studies were conducted in the Mahi-Kadana irrigation project during 1980–82 in the State of Gujarat. The Mahi river rises in the Vindhya Hills in the State of Madhya Pradesh in central India and flows through the State of Rajasthan and then traverses the middle of Gujarat from the north-east to the south-west before discharging into the Gulf of Cambay, 580 kilometers from its source.

The project consisted of two phases. The first phase related to the construction of a diversion weir across the river at Wanakbori in the District of Kheda whilst the second phase referred to the construction of the dam at Kadana village in the District of Panchmahals, 140 km upstream and development of command area of about 220,000 hectares with 210,000 ha on the right bank of the more or less flat terrain of Kehda and 10,000 on the left bank falling in the hilly tracts of Panchmahals. The first phase of the project was completed in 1960 and the second phase in 1978. The distribution system has very recently reached the completion stage on the left bank but a large part of the area on the right bank has been receiving irrigation supplies for the last two decades due to the completion of the first phase of the project. The diversion weir has enabled fairly substantial irrigation in the monsoon (*kharif*) season from July to October and limited irrigation in the winter season (*rabi*) from October to March, and in hot weather from March to June, depending upon the river flow. After completion of the dam in 1978 at Kadana, year-round irrigation has become a reality with greater areas under irrigation both in the winter and in the hot weather seasons.[1]

2. Command Area Development Authority

For the purpose of implementation of the command area development component of the project, a high level coordination committee known as the Command Area Development Authority (CADA) with the Area Development Commissioner (ADC) as Chairman and representing concerned Government departments such as the Public Works Department dealing with roads, Irrigation Department, Agricultural and Coperatives Department, dealing with agricultural support serivces and the Revenue Department dealing with land tenure was set up.[2] Besides these official members, who

[1] For a detailed project background, as well as agricultural development in the area, see T. K. Jayaraman, "Multiple Cropping and Crop Diversification in Mahi-Kadana Irrigation Project," *Commerce*: Annual Number: 1979. Bombay: Commerce Ltd., 1979, pp. 87–94.

[2] For a full background of CADA, see T. K. Jayaraman, M. D. Lowdernilk and

were either of the rank of Secretary to the Government in charge of each Department or Chief Engineers, representation was also given to the elected representatives in the project area. All the directly elected members (four in all) of the State Legislative Assembly in the project area and the Presidents of the Districts Panchayats, the apex elected body in a three-tier local administration, (two in number) were members of the CADA. As this body meets only once in six months to approve the budget and consider policy questions for making recommendations to the Government, the forum did not function as an effective two-way communication forum between farmers and the project authorities. However, the non-official representatives did bring issues of current importance affecting the farmers in regard to irrigation supplies to the attention of the project management. But more effective discussion and follow-up action were facilitated by the monthly Project Level Cordination Committee Meetings, again chaired by the ADC and attended by project level officials besides the District Panchayat Presidents and Taluka (the middle tier of local administration) Panchayat Presidents. Here, at these meetings, the project level officials belonging to different departments, irrigation, agriculture and cooperatives could more effectively communicate with the non-officials and there was a regular follow-up of the points raised as the minutes of the previous monthly meeting were to be approved in the subsequent meetings[8].

3. Farmers' Complaints

The complaints brought at these meetings by the representatives of elected local bodies were quite pertinent to command area development. They related to canal construction work, distribution system, breaches in particular areas, closure of canals without prior notice, wrong location of outlets at the head of the bloc (normally 40 ha) of farmers' fields, low level of water supply at the canals resulting in low or no discharge at the outlets and the like. These complaints were immediately looked into and redressed and an update on the position was always given in the following monthly meeting. The *Panchayati* leaders were quite keen to pursue these complaints as the latter gave them an opportunity to cultivate the farmers who formed an influential part of the electorate. The redressal of these grievances were assuredly effective, if the *Panchayati* representatives also happened to be irrigators in the area.

4. Limitations of Coordination Bodies

Though in a way the Panchayati leaders represented the irrigators' interest, there were limitations. They were mostly well-to-do farmers, having

W. Clyma. *Command Area Development Authorities for Improved Water Management*, Fort Collins, Colorado: Water Management Synthesis Project, Colorado State University, 1982.

larger sized holdings, and they belong to the leading castes such as Patels and Banias. These groups have long dominated the political scene both in the State and in the District. None of them was from the *harijan* (scheduled caste) community. Further, they also held official positions in the primary cooperatives societies and processing societies which placed them far ahead of the rest of the farmers in relation to both asset holdings and access to credit facilities. These limitations came in the way of their truly representing the interests of all irrigators.

For the officials, however, it was convenient to relate to them as it assured them opportunities of much needed political support. Through them there was also a tendency to take the rest of the farming community for granted which contributed to restricting the contacts with the farmers only at a low level as that of canal inspectors or at the *chowkidar* (lowest link). The deputy engineers and above were content with having their contacts with their political leaders.

Perhaps for these reasons, the officials could not really get through some of the more difficult problems. For example, the long overdues of farmers in regard to repayment of on-farm development (OFD) costs prorated on a per hectare basis from the irrigators, signing up for new on-farm development works in the remaining command areas as the farmers were doubtful about irrigation possibilities, damage to outlets, or deliberate closure of these outlets and opening up new outlets on their own, disputes among farmers in regard to irrigation supplies, thefts of water directly from the canals by putting up pump sets in the night, non-payment of irrigation dues before the new season and yet insisting on water and disputes with canal inspectors leading to violent scenes and the like. The Panchayati leaders at the monthly meetings usually expressed their sympathy and extended oral support but were unable to pursue them at the field for at least two reasons: (i) they did not want to fight for unpopular administrative causes and antagonize the electroate and (ii) they were aware that they did not truly represent the irrigators' interests in all their ramifications.

5. Poor Performance of Systems

The resultant situation was one of chaos: uncertainty in irrigation supplies at the farm level adversely affecting the crops especially in the *rabi* season, and general scrambling for water by everyone all the time with no one getting water in adequate amounts at any time, lack of confidence in the irrigation bureaucracy and accusations by weaker sections of farmers that irrigation personnel sided with the well-to-do and upper caste farmers and the like. The effects were many: (i) administrative: (a) set back to timely execution of OFD works; and (b) low rate of collection of OFD dues and water charges, which were often the subject of adverse reporting by the Public Accounts Committee (PAC) of Legislature, and intense

discussion at the PAC meetings with officials and debate in the Legislative Assembly[9]; (ii) economic: low cropping intensity and poor yields of crops with low application of inputs under uncertain conditions[10]; and (iii) financial: (a) low rate of cost recovery in terms of water charges through accumulation of overdues for the past irrigation supplies as well as unwillingness to go in for irrigated crops and consequently not applying for water though available generally in the winter for whole the command area and in the upper reaches of the command area in the hot weather; (b) low farm incomes as the farmers did not go in for high valued water intensive crops but simply settled for drought-resistant crops with poor applications of inputs such as maize in the *Kharif* and fodder sorghum in the *rabi* seasons; (c) deterioration of OFD works inclusive of field channels and field drains due to poor maintenance by farmers[11].

6. Better Management Initiatives

An increased awareness of inefficiencies at the farm level wiping out the apparent gains from main system imporvements such as canal lining and other physical improvements was one of the reasons behind welcoming the initiatives of the World Bank towards better farm level irrigation in the project. One of the chief objectives of the initiatives was to remove inequities in irrigation supplies at the farm level. Although the project financing period was over in 1976 and the Project Completion Report was under preparation in 1979, the World Bank chose the Kadana Project once again for introducing a scientific version of traditional rotational water distribution (RWD) at the farm level known and practised as Warabandhi in the Northern parts of India.[3] Under the improved system of RWD which is followed in the *rabi* rather than the monsoon season, crop water requirements for the two main crops, wheat and tobacco, are ascertained from the nearby campus of the State Agricultural University and the right amounts of water at the predetermined intervals made known in advance to the farmers are applied during the cropping season. Taking into account the flow of water at one cubic feet per second from the outlet, per hectare water hours are worked out and each field in the outlet command area is assigned a specific day in a week. While working out irrigation

[3] A kind of rotational water distribution has been in vogue in the northern states of India for quite a long time. Under this system a farmer is provided a share of available water supply according to the number of acres owned by him. But he has no control over the timing and quantity of this water; he does not know when he would receive his share nor how much of his total share he would receive in any given time. Such a system of rotation with no concern for crop-water requirement gives rise to a substantial degree of uncertainty in water supply which leads to disappointing performance with respect to yields and utilization or irrigation potential. See for greater details, R. B. Reidinger, "Institutional Rationing of Land Water in North India: Conflict between Traditional Patterns and Modern Needs," *Economic Development and Cultural Change*, Vol. 23, No. 1, (1974), 80–84.

schedules, the location of the farm land also influenced the time alloted for that particular land since the losses due to conveyance in the field channels are also taken care of. Thus, a farm area in the tail part of the outlet command area has more time for irrigation than the corresponding area located in the upper reaches of the outlet[12].

7. A Pilot Project

Before introducing the RWD in the 1978–79 rabi season as a pilot scheme in the Rawalapura sub-minor command, the CADA took sufficient care and precaution in ensuring the required discharge in the canals in the proposed RWD pilot area. This took the form of clearing the sub-minor of weeds and undertaking some repairs including installation of control structures for rotating and regulating water supply at one cusec from each of the 15 outlets in the sub-minor. For ensuring the latter, the take off portion from the branch was lined and a measuring device was also fixed at the lead to keep a watch on the flow of water in the sub-minor, so as not to fall below the desired capacity level. At the outlet level, some additional physical investments were made. These include repairs to the existing field channels and replacements of various control structures such as division boxes, siphons and road crossings. Additionally, measuring devices were installed at each outlet head besides the initial lining.

In all, an area of 2,000 hectares for the pilot RWD in the *rabi* season of 1979–80 was planned for. The plans were discussed in meetings with the farmers in the pilot area in village groups spread over a month and the meeting were sponsored by CADA in close association with the extension wing of the local administration. The officials belonging to CADA were assigned specific villages and they took the entire machinery of irrigation beginning with the lowest functionary, the *chowkidar*, up to the executive engineer. The irrigators were at first curiously surprised to meet top officials gathering in the villages and discussing the RWD schedules and implementation procedures and listening to their complaints in regard to canal supplies but later were convinced of their genuine desire to implement the innovative measure. It was agreed at the meetings that the irrigation schedules for each piece of land would be displayed on a board fixed at the head of the outlet and they would be overseen and observed by farmers without the irrigation department's intervention. The farmers were encouraged to make an informal arrangement among themselves to solve any disputes in the observance of the irrigation schedules and, in case the water level was observed to be lower than the optimum level indicated in red paint on the measuring device, they were asked to contact the canal inspector immediately. Further for each outlet command area, farmers were encouraged to form an association which proceeded on the following lines: in each outlet farmers of, for example, the Monday group to whom irrigation supplies were to be made available on that day

were asked to form a sub-group with an informally elected leader and, thus, in an outlet command area, there would be two to four sub-groups on an average, not exceeding seven sub-groups signifying the seven days of the irrigation schedule, and these sub-groups would have as many sub-group leaders as there are sub-groups. These sub-group leaders would form an informal committee with a commonly agreed leader to serve as the spokesman for the entire group who was expected to maintain liaison with the irrigation bureaucracy.

The farmers' readiness to cooperate with the CADA can be traced to the following factors: (i) completeness and functionality of the field channel network along with structures below the outlet; (ii) assurance of an adequate and reliable irrigation supply; (iii) candid and sufficiently early communication of the irrigation schedule and readiness to discuss and accomodate farmers' suggestions; and (iv) consideration of the farmers' grievances whenever there are short falls in the water delivery and immediate corrective action[13].

The impact of the farm level irrigation improvements on the production and subsequent effects on the farmers attitudes towards the participatory role are discussed in the next section dealing with the results of the field studies.

III. Results of Field Studies

1. A Production Function Analysis

The impact of improved irrigation service on farm production in the pilot area was closely supervised and evaluated. Specifically, the results of RWD in the Rawalapura sub-minor were impressive. A comparison with the previous *rabi* season showed that total irrigated area increased by 13 per cent (Table 1). A Cobb-Douglas production function was fitted to the farm management survey data collected from the sample farms numbering 107 by survey method for the *rabi* season of 1978–79 and by recall method from the same farmers for the *rabi* season of 1977–78. The fitted equations estimated by means of the ordinary least square method are presented below:

1977–78 (*rabi*)

$$\log Q = 2.842 + 0.631^{*} \log LD + 0.107^{*} \log F + 0.107 \log L$$

(8.74) (6.25) (2.81) (1.46)

$R^2 = 0.942$ Degrees of freedom = 103

1978–79 (*rabi*)

$$\log Q = 2.719 + 0.799^{*} \log LD + 0.164^{*} \log F + 0.269^{*} \log F$$

(9.93) (3.87) (2.12) (3.26)

$R^2 = 0.896$ Degrees of freedom = 103

(Figures in parentheses denote 't' values)

* denotes significance at the 0.05 level by a two tailed test. Where,
Q =output of wheat in kg.
LD=Land in hectares
F =Fertilizer in rupees and
L =labor in man-days

Table 2 presents the output elasticities, average and marginal products of land and labor and fertilizer before and after RWD. It may be seen that the average products of land, labor and fertilizers went up over the period. Output elasticities of land and fertilizer registered increases during this period. Since, of the three variables considered only the output

TABLE 1 AREA UNDER IRRIGATION BEFORE AND AFTER RWD

	Before RWD (1977–78: Rabi)	After RWD (1978–79: Rabi)	Increase in Percentage
Number of Farmers	289	315	9
Total Area Irrigated	168	190	13
Wheat	103	117	14
Tobacco	43	46	7
Vegetables	15	17	2
Others	7	10	43

TABLE 2 OUTPUT ELASTICITIES, AVERAGE AND MARGINAL PRODUCTS OF LAND, LABOR AND FERTILIZERS BEFORE AND AFTER RWD

	Before RWD (1977–78: Rabi)	After RWD (1978–79: Rabi)
Geometric Means		
Output (kg)	902.8	986.9
Land(ha)	0.3	0.3
Fertilizer (Rs.)	203.6	220.7
Labor (man-days)	25.4	21.1
Production Elasticities		
Land	0.631*	0.799*
Fertilizer	0.107*	0.164*
Labor	0.107****	0.269*
Sum of elasticities	0.738**	1.012***
Average Products		
Land (kg/ha)	2875.2	3257.3
Fertilizer (kg/Rs.)	4.4	4.4
Labor (kg/man-day)	35.5	46.7
Marginal Products		
Land (kg/ha)	1814.2*	2602.6*
Fertilizer (kg/Rs.)	0.5*	0.7*
Labor (kg/man-day)	–	12.5*

* Significant at 0.05 level
** Significantly different from unity
*** Not significantly different from unity
**** Not significant at 0.05 level

elasticities of land and fertilizer were found to be significant both before and after RWD, only their marginal products are compared. While the marginal product of land substantially increased due to RWD, the marginal product of fertilizers rose only very slightly. Evaluation by means of production function analysis reveals that RWD had certainly led to an upward shift in the production function and the marginal products of land and fertilizers recorded increases and the contribution of labor also emerged significant[14].

The pilot schemes of RWD continued for another *rabi* season in 1979–80 and a much wider area came under the RWD in the *rabi* season of 1980–81 as part of the World Bank financed scheme for about 60,000 ha in the project area under the Gujarat Second Irrigation Project (1980–1985). In the Rawalapura sub-minor command area, the gains from RWD continued to be felt. The farmers were convinced that the irrigation supplies were certain and that the irrigation officials were bound to maintain the level of designed discharge at the outlet since the system above the outlet had also been ensured to provide an adequate and reliable flow during the season.

2. Emergence of Farmers' Initiatives

Without any effort on the part of the bureaucracy, an informal executive committee of farmers in the Rawalapura sub-minor came into existence in May 1980 after two years of the RWD experiment. The chief objective behind the formation of the committee was to maintain the assets created for irrigation at the farm level. It should be mentioned here that the farmers in the pilot area were not specifically told that they were to pay for additional investments such as measuring devices and the initial lining and repairs though they were aware that they had to pay for the earlier provision of OFD works. But the deliberate silence on the part of CADA was eloquent enough to convey the message that the expensive additional infrastructure facilities provided at government cost would be able to give returns each year only if they were well taken care of.

The committee consisted of four irrigators and the *chowkidar*, the lowest ranking government servant of the irrigation department. The functions of the committee were two fold: (a) to maintain the infrastructure below the outlet level and (ii) to keep liaison with the irrigation department on behalf of all the irrigators. The committee collected subscriptions for the farmers at the rate of Rs 5 before each agriculture season for carrying out maintenance work through the hiring of labor. Originally two outlets were taken up for repairs but the response from other outlets in the sub-minor was so spontaneous that the committee decided to enlarge its operation for the entire sub-minor which covered three villages. Since the time schedule for irrigating each field was fixed and made known to all the farmers in an outlet, and since the time schedule cannot be easily

TABLE 3 DISTRIBUTION OF IRRIGATORS INTO DIVISIONS AND CATEGORIES

	Size			Location			Education			
	Marginal	Small	Large	Head Reaches	Middle	Tail End	No Schooling	Primary	Secondary	College
Number of Irrigators (N=279)	114	114	69	84	116	97	45	170	70	12
	(38)	(38)	(24)	(28)	(39)	(33)	(15)	(57)	(24)	(4)
Area in ha	47.30	67.88	80.18	72.66	80.81	42.29	25.69	102.88	49.43	17.36
(Total: 195.36)	(24)	(35)	(41)	(37)	(41)	(22)	(13)	(53)	(25)	(9)

TABLE 4 ATTITUDES OF IRRIGATORS IN RAWALAPURA SUB-MINOR (N=297)

Statements	Agree	Do Not Know	Disagree	Weighted Mean	't' Statistic
Pre-Conditions					
1. RWD is working satisfactorily	284 (95)	5 (2)	8 (3)	2.929	46.23*
2. Irrigators are able to self-regulated the observations of RWD schedule	235 (79)	3 (1)	59 (20)	2.592	12.748*
3. It is desirable to have an irrigators' organization	211 (71)	14 (5)	72 (20)	2.468	9.399*
Type of Organization					
1. The organization should be formal	66 (31)	4 (2)	141 (67)	1.168	16.33*
2. The present system of outlet committees and sub-groups is satisfactory	161 (54)	34 (12)	102 (34)	2.198	3.704*
Resources for Organizations					
1. Existing rates can be raised by a certain percent and the incremental proceeds can be handed to committees for maintenance of OFD works	164 (55)	14 (5)	119 (40)	2.152	2.712
2. The outlet committee can collect fees from members for maintenance	210 (71)	15 (4)	72 (25)	2.465	9.343*
Involvement of Non-Irrigators					
1. It is desirable to associate village leaders although they may not be irrigators	144 (49)	24 (8)	129 (43)	2.051	0.916
2. It is desirable to associate panchayat with irrigators' organization	65 (22)	37 (12)	195 (66)	1.562	−9.114*

* Significant at 0.05 level

Figures in parameters denote percentages of total

altered or extended, each farmer was keen to get the maximum flow in the allotted time for which the channels had to be kept in top condition. This particular anxiety made them accutely aware of the importance of maintenance.

The frequency distribution of irrigators in the Rawalapura subminor by size of land holdings shows that 76 per cent of the farmers were small and marginal farmers owning land up to one hectare (Table 3). The average size of landholding in the pilot area was 0.70 ha. As regards caste position, the Patels were 55 per cent of the irrigators followed by Rajputs and Thakors. All the four farmers in the committee were Patels. However, the rest of the farming community felt that their interests in so far as they covered maintenance and liaison with bureacuracy were all protected by the committee. It is also worth noting that the economic interests were identical in that the average size of the holding was less than one hectare and for them access to irrigation supplies was critical for survival.

The leadership came from the traditionally land owning and self-cultivating class of Patels. Furthermore, the leader had also a background of social economic service in that he had been the president of the village milk cooperative society which collected milk and sent it to the cooperative milk processing plant at Anand which was 4 kilometers away. The past record of service to the village naturally helped him to assume stewardship in irrigation infrastructure maintenance and the farmers seemed to have rallied around him. As regards socially disadvantaged sections of the community who were in the minority, no special consideration was shown. They along with the farmers, had to contribute a fee of five rupees for labor charges but as the functions of the committee were minimal, there was no basic opposition from them to the initiatives displayed by the committee.

From the foregoing discussion it is apparent that certain minimum conditions need to be fulfilled before farmers come together for group action at the outlet level. These minimum conditions relate to the demonstration of reasonably adequate, predictable and controllable irrigation supplies and to the presence of a receptive bureacuracy in the CADA. With a view to assessing the attitudes of the irrigators in the Rawalapura subminor toward a formal type of function with more complex functions such as processing of irrigation applications at the start of each season and collection of water charges on behalf of the government, an attitude survey was conducted. There was a 97% (297 faremrs) response from the farms in the subminor and the remaining 3 per cent (8 farmers) were away from their homes on the particular day of interview.

3. A Survey of Attitudes to Organizations

The irrigators were classified into three divisions with reference to (a) size of the farms-marginal (holding size: below one ha), small (holding size: above one ha and up to two ha) and large (holding size: two ha and

above), (b) location: upper reaches of the field channel from the outlet, middle portion and the tail part and (c) educational background: no schooling, primary, high school and college. The distribution of 297 farmers into different categories is given in Table 3. The irrigators were mostly marginal and small farmers, forming 76% of the total sample. In terms of educational background, 15% of the farmers had no schooling, whereas a major part of them (57%) had only primary education; farmers with secondary education comprised 23% and farmers with higher education formed a negligible proportion (4%).

The attitudes of the farmers can be grouped into four categories:

(i) pre-conditions for formation of irrigators associations;
(ii) types of organization—formal or informal;
(iii) resources of organization; and
(iv) involvement of non-irrigators.

Nine statements prepared for the above categories were included in a non-disguised and structural questionnaire. The statements were graded on a simple Likert scale ranging from "agree," and "do not know" to "disagree" instead of a conventional five point scale, since most of the irrigators were unable to distinguish between the two views "strongly agree" and "agree" in a pilot test of the questionnaire.

To reflect the facilitating pre-conditions, the irrigators were asked about their perception of the working of RWD and their ability to self-regulate the schedules and the need for organization. Ninety six per cent of the farmers expressed satisfaction, 79% felt confident about the ability to self-regulate and 71% agreed that there was a need for an organization. The weifihted mean was higher than the simple arithmetic mean and was found to be statistically significant by the two-tailed 't' test, the level of significance chosen being 5 per cent (Table 4). Thus, the null hypotheses that the irrigators were indifferent to RWD, to their ability to self-regulate and to the need for an organization are rejected. It can, thus, be safely concluded that the area could be considered to be ready for organizational efforts to involve the farmers in irrigation management at the outlet level.

As regards type of organization, of the 211 farmers who desired an organization, two-thirds rejected a formally structured organization, their rejection being statistically significant. Ninety-two per cent of the 211 irrigators preferred the present level of informal organization.

While the irrigators positively responded to the raising of resources for the organization, there was some disagreement about the manner of mobilizing resources. Forty per cent disagree with the suggestion to increase irrigation rates and earmark the incremental proceeds for the committees whereas 70% of the farmers reacted favorably to the current procedure of collecting fees from the member. Thus, it is obvious farmers prefer their own mode of raising resources to the Governmental efforts of

increasing irrigation fees.

On the subject of involvement of outsiders other than irrigators, the respondents were more or less equally divided. The null hypothesis that they were indifferent to this specific idea cannot be rejected since the 't' statistic was found to be non-significant. However, they clearly rejected the idea of associating *panchayati* bodies with irrigators' organizations as evidenced by a 't' test of significance.

4. Functions of Organization

Six possible functions of the irrgators' organizations were suggested to the respondents for ranking them in order of importance:

(a) solving disputes among the irrigators;
(b) liaison with the irrgation department on behalf of the irrigators;
(c) observance of the RWD schedules;
(d) maintenance of field channels and structures;
(e) collection of charges and processing the applications from farmers on behalf of the irrigation department; and
(f) extension in water management.

These ranks were analysed by major divisions. For example, the ranks assigned by marginal, small and large farmers and their frequencies are presented in Tables 5 to 7. For each function, aggregate scores are computed by assuming the total marks arrived at for each rank by multiplying the frequencies of farmers occuring in that rank with the score of that rank on the basis of the first rank being equal to 6 marks, the second rank to 5 and so on. The final rank is given to each function by ranking aggregate

TABLE 5 RANKS ASSIGNED TO FUNCTIONS OF IRRIGATORS' ORGANIZATIONS: MARGINAL FARMERS

Functions of Irrigators' Organization	Frequencies of Irrigators in the Rank Assigned						Aggregate Score	Final Rank
	1	2	3	4	5	6		
1. Solving Disputes among Irrigators	10	12	24	37	16	15	374	4
2. Liaison with Irrigation Department on Behalf of Farmers	11	15	36	18	23	11	376	3
3. Observance of RWD Schedules	31	53	13	11	6	0	554	1
4. Maintenance of Field Channels and Structures	48	22	14	15	12	3	526	2
5. Collection of Irrigation Charges and Processing of Applications of Irrigators on behalf of the Irrigation Department	0	3	9	14	39	49	220	6
6. Extension in Irrigation Management	14	9	18	19	18	36	330	5

TABLE 6 RANKS ASSIGNED TO FUNCTIONS OF IRRIGATORS' ORGANIZATION: SMALL FARMERS

Functions of Irrigators' Organization	Frequencies of Irrigators in the Rank Assigned						Aggregate Score	Final Rank
	1	2	3	4	5	6		
1. Solving Disputes among Irrigators	6	7	19	43	18	21	333	4
2. Liaison with Irrigation Department on Behalf of Farmers	10	16	36	23	20	9	402	3
3. Observance of RWD Schedules	29	56	20	8	1	0	560	1
4. Maintenance of Field Channels and Structures	54	17	19	15	7	2	546	2
5. Collection of Irrigation Charges and Processing of Applications of Irrigators on Behalf of the Irrigation Department	11	6	7	8	43	39	273	5
6. Extension in Irrigation Management	4	12	13	17	25	43	280	6

TABLE 7 RANKS ASSIGNED TO FUNCTIONS OF IRRIGATORS' ORGANIZATIONS: LARGE FARMERS

Functions of Irrigators' Organization	Frequencies of Irrigators in the Rank Assigned						Aggregate Score	Final Rank
	1	2	3	4	5	6		
1. Solving Disputes among Irrigators	6	8	12	19	10	14	215	4
2. Liaison with Irrigation Department on Behalf of Farmers	11	9	26	12	9	2	271	3
3. Observance of RWD Schedules	12	32	12	8	4	1	313	2
4. Maintenance of Field Channels and Structures	27	12	14	9	5	2	317	1
5. Collection of Irrigation Charges and Processing of Applications of Irrigators on Behalf of the Irrigation Department	6	4	3	4	32	20	164	6
6. Extension in Irrigation Management	7	4	2	17	9	30	169	5

scores. Thus, the marginal farmers gave the rank of one to observance of RWD schedules, the second rank to the maintenance of field channels, the third rank to liaison work, the fourth rank to the resolution of disputes, the fifth rank to extension and the last rank to the collection of water charges on behalf of the government. The large farmers also followed the same pattern but the small farmers had a very slight variation in ranking

TABLE 8 SUMMARY OF RANKS ASSIGNED TO FUNCTIONS OF IRRIGATORS' ORGANIZATION BY CATEGORIES

	Ranking of Functions of Irrigators' Organization						
	Solving Dispute among Farmers	Liaison with Irrigation Department	Observance of RWD Schedule	Maintenance of Field Channels & Structures	Collection of Water Charges & Processing of Application	Extension in Irrigation Management	Kendall's Coefficient of Concordance
Category of Irrigators							
I. Size:							
(a) Marginal	4	3	1	2	6	5	
(b) Small	4	3	1	2	5	6	0.947
(c) Large	4	3	2	1	6	5	
II. Location:							
(a) Head Reaches	4	3	1	2	6	5	
(b) Middle	4	3	1	2	6	5	1.000
(c) Tail-end	4	3	1	2	6	5	
III. Education:							
(a) No Schooling	3	4	1	2	6	5	
(b) Primary	4	3	1	2	6	5	0.696
(c) Secondary	4	3	2	1	6	5	
(d) College	3.5	3.5	1.5	5	6	1.5	

with respect to collection of water charges and extension in water management.

Similar exercises were undertaken for the three categories of farmers by physical location and the four categories by educational background. For want of space, the Tables are not reproduced here but a summary of their rankings is given in Table 8.

To determine whether the ranks assigned by the three categories of irrigators with regard to size and location and by the four categories with regard to educational background differ considerably among themselves, Kendall's Coefficients of Concordance were also calculated. The values of the coefficients were high for all the three major divisions. The maximum value of unity was recorded for the second major division—physical location—as there was virtually no difference between the three categories in their ranking of functions. It is obvious that farmers assigned a high priority to maintenance of field channels, regulation of RWD schedules and solving of disputes and a low priority to the collection of irrigation charges and extension in water management.

5. A Discriminant Function Analysis

Utilizing the same survey data and incorporating three more variables (namely, age of farmer to reflect his mental maturity, his personal satisfaction or otherwise, and ability to self-regulate), a discriminant function analysis was conducted. In all there were seven variables and we had 216 farmers out of 305 farmers for whom full information on all variables was available. Out of 216 irrigators, 170 preferred to form an organization and 46 expressed themselves against forming any organization. The attitude towards organization, either for or against, is the dichotomy separating the two groups distinctly from each other.

The linear discriminant function of the following form is employed to discriminate the socio-economic characteristics of the two groups of farmers:

$$Z=\sum_{R=1}^{n} A_R X_R$$

where,

Z = total discriminant score for the irrigator who is for an association and for the irrigator who is against such an association,
X_1 = size of holding in hectares,
X_2 = age in years,
X_3 = 0, if the irrigator is illiterate,
1, if the irrigator has attended primary school,
2, if the irrigator has attended secondary school, or
3, if the irrigator has attended college

X_4=0, if the irrigator is located at the tail-end,
1, if the irrigator is located at the middle, or
2, if the irrigator is located at the upper reaches
X_5=0, if the irrigator is not satisfied with RWD, or
1, if the irrigator is satisfied with RWD
X_6=0, if the irrigator is not prepared to self-regulate, or
1, if the irrigator is prepared to self-regulate and
X_7=0, if the irrigator feels that his right to water would not be protected, or
1, if the irrigator feels that his right to water would be protected.

Before the entire set of variables was entered into an analysis, a test of difference between sample means was conducted. Table 9 presents the means and standard deviations of the independent variables for two groups of irrigators. The statistical 't' test for determining the difference between the two group means for each variable was conducted. The tests show the absence of any significance between the two groups means as regards four variables—namely, land holding, age, education and protection of rights. But in regard to the three variables of location, satisfaction with RWD and ability to self-regulate, there is a high degree of satistical significance between two group means. Thus, on the basis of the above analysis, one can conclude that if an irrigator is favorably located in the outlet command, given other things, he is more likely to be in favor of an organization as contrasted with the irrigator located at the tail-end. Similarly, satisfaction with RWD and self-reliance for regulating the supplies are also significant factors influencing the formation of an organization.

When the entire set of seven variables is entered into an analysis,

TABLE 9 MEANS AND STANDARD DEVIATION OF VARIABLES: COMPARISON OF TWO GROUPS

Variables	Irrigators in Favor of Organization (n = 170)		Irrigators Against Organization (n = 46)		't' Satistic
	Mean	S.D.	Mean	S.D.	
Area (ha)	0.59	0.63	0.56	0.51	0.1127
Age (years)	48.69	13.96	48.11	12.78	0.0716
Education	1.18	0.71	1.17	0.71	0.0072
Location	1.04	0.79	0.80	0.69	4.1081*
Satisfaction with RWD	0.96	0.19	0.85	0.36	3.9934*
Ability to Self-regulate	0.88	0.32	0.48	0.51	25.5726*
Protection of Rights	0.93	0.26	0.87	0.34	1.2368

* Significant at 0.05 level.

TABLE 10 RESULTS OF DISCRIMINANT ANALYSIS

Variables		Discriminant Weights
Area		0.0118
Age		−0.0001
Education		−0.0058
Location		0.0265
Level of Satisfaction with RWD		0.0163
Ability to Self-regulate		0.1830
Protection of Rights		−0.0440
	Mahalanobis' D^2 =1.3557	
	F (7,208) =6.8150	
	Bartlett's Chi Square Test =43.4655	
	(Degree of Freedom: 7)	

without rejecting any of them for measuring the characteristics on which groups are expected to differ, the discriminant analysis is resorted to. Table 10 presents the results reporting the discriminant weight values for the seven variables. The tests of significance, both F ratio and the Bartlett's Chi-square test, show that the function determined by all the seven variables is statistically significant. Hence, the null hypothesis of equality of group centroids (means) is rejected. Table 11 presents the means of the two group discriminant scores. The cut off point for discriminating between the two groups of irrigators, one for and the other against organization, is arrived at by taking the simple mean of the two groups' mean discriminant score. On the basis of the cut-off point, the predicted classification of the

TABLE 11 DISCRIMINANT SCORE MEANS AND CUT-OFF POINT

Group	Sample Size	Mean
For Organization	170	0.1586
Against Organization	46	0.0796
Cut-off Point $= \frac{0.1586 + 0.0796}{2}$		
$= 0.1191$		

TABLE 12 CLASSIFICATION MATRIX OF IRRIGATORS

		Predicted by Function		
		For Organization	Against Organization	Total
Actual	For Organization	151	19	170
	Against Organization	22	24	46
	Total	173	43	216

irrigators as against the actual classification into two groups is shown in Table 12. It is of interest to note that the classification matrix suggests that (151+24)/216 of 81% of the sample is correctly classified. Hence, the separation effected by the discriminant function is fairly satisfactory from the practical point of view as well[15].

IV. Conclusions

The foregoing discussion of the results of field studies in the Mahi-Kadana irrigation project in Gujarat State clearly indicates that there is room for group action if only the shortages of a valuable natural resource are reasonably within the realm of control under conditions of assuredness. It is well known that in the case of a consumption good, whether private or public, being a free good because of its infinitely plentiful nature, no scarcity relative to demand is experienced and hence there is no need for any group action by consumers. On the other hand, if the supply of a consumption good, whether private or public, is extremely short in relation to demand, group action by consumers in its distribution becomes a frustrated effort and often fails. Severity in shortage determines the degree of success or failure of group action.

Only if the shortages are reasonably manageable without causing frustration and in the process, no theft or hoarding is possible, equitable distribution with regard to the need and ability to pay for is possible. Irrigation supplies in a public sector project are no exception to this general rule. As long as the shortages are reasonably managed and the irrigators are convinced of the sincerity and efficiency of these efforts of the project management, there appears to be a reasonable scope for group action.

The management efforts would refer to the discharging of five essential management tasks: (i) keeping the distribution network in good condition; (ii) intensive operation and maintenance of infrastructure; (iii) careful planning of cropping patterns and scheduling of irrigation; (iv) care in the allocation and scheduling of water both among and within the system; and (v) equitable distribution of available water to all sections of the irrigation community[16].

The sincerity and efficiency of the management efforts are indicated by the degree of professionalization of management tasks themselves. As discussed elsewhere, presently in India, these tasks are labelled as operation and maintenance (O&M) which simply indicate the dull and dreary nature of the chores often performed by those of the irrigation department, who consider themselves less fortunate than their bretheren in the construction and design (C&D) wing and look forward to the days when they could move out to that wing[17]. The apparent lack of pride and self-esteem stems from the absence of a professionalist approach to irrigation management tasks with a concern for the client's interest as well as a com-

mitment to the discharge of specialized functions. Efforts are underway to elevate the status of the O&M personnel to the same rank as that of the C&D wing with as many promotional opportunities and privileges as available to the latter, and to provide further multi-disciplinary skills to all civil engineers and agricultural personnel of the CADA in specially set up irrigation management training centers.

The participatory role by the farmers can be facilitated only when better management practices are adopted by project authorities. The field studies conducted in the Mahi-Kadana irrigation project, located right in the heart of the Kehda district which is well known for the legendary AMUL milk cooperatives[18], integrated cotton processing societies and farmers' active role, show that unless there is technical efficiency in irrigation projects as reflected in ultimate user satisfaction at the farm level, irrigators will not come forward to assume any participatory role.

Thus, it may be concluded that if an appropriate institutional setting provided by the experience of local self-government agencies and the presence of an economic and social environment developed by the cooperative processing societies and structures is a necessary condition for farmer participation, the sufficient condition for such participation at the farm level of irrigation is the water user's satisfaction. Specifically, the socio-economic determinants of community responses to irrigation in Indian public sector irrigation projects can be summarized in the following conclusions that emerge from the field studies:

(i) certainties in irrigation supplied from the gated turnouts would be chiefly responsible for group-action among the farmers;

(ii) the relative egalitarian structure of the community as indicated by land holding size and the commonly shared interest in access to equitable and efficient water supplies are also significant factors;

(iii) the leadership has to come from the tested hands in the community in whom there is trust and confidence. Such a person or a group of persons acting as a chairman or a steering committee has to prove his or their worth by past performance or by present occupation as a local self-government leader or a chairman of a cooperative society;

(iv) the leader should also be an irrigator and share the same egalitarian structure and interests along with other irrigators; and only such a combination would convince the weaker sections of the community of the bonafides of the initiatives displayed;

(v) the form of organization should be simple and informal with a small membership at the steering committee level; being simple it covers the entire sub-minor though a canal went through the villages. Thus, a simple and an informal committee can effectively be canal based rather than village based;

(vi) the functions should remain uncomplicated and minimal such as maintenance of OFD works and liaison with the irrigation bureaucracy;

(vii) any more complex functions such as the collection of application forms for irrigation and water charges on behalf of the irrigation department as transferred functions and water management extension would lead to a complex form of organization to be backed with legal power. In the generally faction-ridden village societies, complicated functions with financial responsibilities create accute problems of accountability and financial propriety. In the nascent stages of farmer participation in irrigation projects in India, simple and informal organizations with minimal functions are likely to last longer than complex organizational structures.

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