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Institutional Imperatives and Coproduction Strategies for Large Irrigation Systems In India

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I

INTRODUCTION

While the rationale for pricing of irrigation water is multifaceted and indisputable especially in the context of liberalisation (for a recent review, see Sampath, 1992), the argument that pricing and other market mechanisms as a panacea for all ills of irrigation systems is somewhat misplaced. The ill-equipped administrative structure, technically and legally, coupled with the massive size of the irrigation systems makes irrigation pricing difficult under the present institutional structure. On the other hand, there is a plethora of literature suggesting that appropriate institutional mechanisms would be instrumental in ameliorating the conditions of irrigation systems (for recent reviews, Ostrom, 1992; Tang, 1992; Meinzen-Dick *et.al.*, 1995). These institutional mechanisms mainly focus on farmers' participation in the management as well as designing of irrigation projects. As most of the studies are based on the experience of farmers' participation in irrigation management in East Asian countries where irrigation systems are small, their replicability in the context of large irrigation systems such as in India is rather unclear if not a difficult proposition (Wade, 1988, a, b; Moore, 1991; Sengupta, 1991).

Hitherto the debate on irrigation management in India is polarised between 'top down' (centralised) and 'bottoms up' (farmers' participation) approaches. But institutional reforms within the irrigation department are not given due importance in the recent debates (Vaidyanathan, 1996). Instead, lack of willingness and low ability of the farmers to pay for irrigation water are often used as excuses for continuing irrigation subsidies at the policy level (especially at the state level). We argue that this is a false dichotomy and an integrated ('topdown' and 'bottoms up') approach is necessary for the success of pricing and institutional mechanisms in irrigation management. Further, the rationale for coproduction-oriented institutional arrangements in irrigation management is presented. This paper systematically analyses farmers' ability and willingness to pay for irrigation water in diverse conditions and shows that institutional reforms are a pre-requisite for implementing cost based pricing policies and introducing appropriate institutional arrangements at the local level.

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II

DATA AND METHODOLOGY

This study is based on primary data collected from 181 households spreading over twelve villages belonging to three districts, falling under two distinct agro-climatic regions of Rajasthan State of western India. Specifically, six villages fall in Jodhpur district representing the scarcity region and six villages fall in Kota and Bundi districts representing the endowed region. Of these six villages, four are located in the canal command area of Chambal project, while the others are located in the non-command region. In both the regions the sample villages differ with regard to access to irrigation water. Though the study area is located in Rajasthan, the results can be generalised for similar large irrigation systems across the country.

Both rapid appraisal and survey methods were adopted to elicit information with regard to irrigation water. Detailed household level information was collected from 92 households in the scarcity region and from 89 households in the endowed region. These households were selected randomly, but they represent more or less all sections of the village community (though not in proportion to their land size), i.e., landless to large farmers. Besides, informal group discussions with villagers, transect walks, etc., were used to get the first hand idea of the situation. Field visits were conducted during the months of January-February 1994. A structured questionnaire consisting of demographic and social aspects of the household, economic status of the household, cropwise input-output information, details regarding the source of irrigation, quality of irrigation, and money spent on irrigation was canvassed for all the sample households. And, the direct approach of contingent valuation method (CVM) was used to derive information on willingness to pay by asking the respondent about the amount of money he is willing to pay for improved irrigation water supply in the context of a hypothetical market situation (for a detailed discussion on the relevance of CVM in such situations, see Reddy, 1998a).

III

PROFILE OF THE SAMPLE VILLAGES: A RAPID APPRAISAL

The characteristics of the villages differ substantially between scarcity and endowed regions. The villages within the regions differ in terms of socio-economic attributes and infrastructural facilities. On the basis of access to and status of irrigation facilities in the sample villages, the villages in the scarcity region are divided into villages having access to irrigation and villages without access to irrigation. In the case of the endowed region we have villages falling in the canal command and villages falling under non-command areas. Within the canal command regions the sample villages located at the head and middle reaches are grouped separately from the villages located at the tail end of the distributaries. A majority of the households in all the selected villages belong to the small and marginal farmers' category (less than 2 hectares). The proportion of landless households range between 4 and 10 per cent in both the regions (Table 1).

TABLE 1. PROFILE OF THE SAMPLE FARMERS

Location	Total number of households	Number of sample households	Percentage of landless households	Percentage of marginal farmers (0-1 ha)	Percentage of small farmers (1.01-2 ha)	Percentage of semi-medium farmers (2.01-4 ha)	Percentage of medium farmers (4.01-10 ha)	Percentage of large farmers (above 10 ha)	Average farm size (ha)	Proportion of area irrigated (per cent)	Irrigation source
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I. Scarcity region											
(i) With access to irrigation	700	45	09	07	23	21	23	17	5.8	31	Tank
(ii) Without access to irrigation	550	47	04	06	19	19	37	15	6.4	0	Nil
II. Endowed region											
(i) Tail-end reaches	210	30	04	40	24	13	17	10	3.9	43	Canal
(ii) Middle and head-reaches	333	32	10	13	19	19	19	13	5.3	88	Canal
(iii) Non-command areas	220	27	07	25	21	12	23	14	3.2	35	Stream

Access to irrigation water varies widely across these locations. They range from extreme scarcity to aplenty. Locations also differ with regard to existence of markets for irrigation water. Attitudes towards irrigation water range from a market friendly to free rider type. Though there are no institutional mechanisms for managing irrigation at present, there appears to be latent potential for initiating institutional arrangements in certain cases. But in the absence of external interference it is unlikely that initiatives would come from within the system. There appears to be an inherent link between access to water and other factors like markets, potential for institutional arrangements, farmers' attitudes, etc.

People living in extreme scarcity conditions do not have any hope of getting irrigation in the near future. The only possibility, according to them, is state intervention which can bring water from a far of place. Even in these extreme conditions there are no attempts on the part of people to initiate some thing for common good though the villagers used to maintain *nadi* and *khadin*[1] earlier. Ever increasing demographic pressure makes the traditional systems unviable in the absence of state support for improving them. Community participation and management are slowly becoming things of the past in most of the villages consequent to the percolation of party politics into the rural communities. Therefore, these institutional mechanisms need to be revitalised with the help of external support.

In the locations where access to irrigation is limited and skewed (in the case of well irrigation), markets and institutions have an important role to play. Water markets do exist, though to a limited extent, in areas where groundwater and lift irrigation are possible; whereas in the areas located at the tail-ends of the canal command systems there is potential for institutional arrangements such as user associations and community management of irrigation systems. But the problem here is the interdependence across villages located on the distributary. Unless there is co-operation among villages in irrigation management, the efforts in a specific location (tail-end villages) which are not getting water presently would not be effective. One finds a distinct change in the attitude of the farmers towards water and water management as one moves from tail-end locations through middle and head-reach locations. The progressive decline in the availability of irrigation as one moves from head-reaches to tail-ends is increasing over time.

IV

AVAILABILITY OF WATER, ABILITY AND WILLINGNESS TO PAY FOR WATER

Here availability of water is seen in relation to farmers' perceptions of requirements of the crop in terms of number of waterings. The difference between number of waterings required and available is the extent of perceived shortage. Except in the head-reaches of canal commands, irrigation is available mostly for *rabi* crops (wheat and mustard) and hence we focus our analysis on these two crops. The three sample villages which do not have access to irrigation are also excluded from the analysis. Irrespective of the region water shortages seem to be quite prevalent across the villages. The shortages range from 0 per cent in head-reaches of canal commands to 85 per cent in the tail-ends (Table 2). Interestingly, the shortages are severe in the tail-end locations when compared to the scarcity region. This is due to the uncertainty associated with public irrigation. In other words, in the command area large areas are entitled for irrigation though one is not sure whether water will reach the fields or not. In the scarcity region where the farmers use private irrigation, they are certain about getting or not getting water before the beginning of the season. On the contrary, tail-end farmers sow the *rabi* crops hoping that they would get water.

TABLE 2. EXTENT OF SHORTAGES IN IRRIGATION FOR WHEAT AND MUSTARD

Village (1)	Crop (2)	Requirement* (3)	Availability† (4)	Percetage of shortage (5)
Scarcity region				
(i) Anganwa	Wheat	5.88	3.13	47
(ii) Soorpura	Wheat	4.62	2.88	38
	Mustard	4.00	2.00	50
(iii) Bhacharna	Wheat	7.54	7.18	05
	Mustard	5.90	5.30	10
Endowed region				
(iv) Chaparda	Mustard	2.00	0.50	75
(v) Jakhana	Wheat	3.40	1.00	71
	Mustard	2.60	0.40	85
(vi) Rangapur	Wheat	3.00	2.00	33
	Mustard	2.00	1.00	50
(vii) Seentha	Wheat	2.85	2.70	05
	Mustard	1.67	1.67	0
(viii) Bandha	Wheat	3.50	1.50	57
(ix) Dharmapura	Wheat	3.63	1.75	52
	Mustard	2.00	1.67	19

Note: * Average number of waterings required; † Number of waterings available.

Water charges paid by the farmers differ according to the type of ownership/distribution of irrigation water. Three types of situations operate in the sample villages. In the command area locations it is purely public ownership, and distribution of irrigation water is carried out by the irrigation department. In the non-command areas and also in some of the villages in the scarcity region privately owned groundwater or lift irrigation systems are in operation and water markets are also prevalent. And in some of the villages private systems complement public systems. Water rates differ substantially among these three modes of irrigation. While standard water rates are fixed for each crop in the case of public irrigation systems, water rates are fixed arbitrarily on hourly basis in the case of water markets. For wheat and mustard the public irrigation rates are Rs. 75 and Rs. 57.50 per hectare respectively (Table 3). On the other hand, the private charges range from Rs. 438 to Rs. 2,331 per hectare. In Soorpura where public irrigation is supported by private irrigation the farmers spend about Rs. 250 per hectare. The variations in water charges are more striking in terms of irrigation charges as a proportion of value of output or cost per hectare. In the case of public irrigation systems the share of irrigation charges in the total value of output per hectare is less than 2 per cent and less than 5 per cent in terms of average cost per hectare. In the case of private irrigation systems the ratio varies from 7.52 per cent in Dharmapura to 48.12 per cent in Bhacharna for wheat and for mustard it varies from 9.38 in Dharmapura to 14.76

per cent in Bhacharna.[2] Irrigation charges as a proportion of average costs per hectare range from 24.16 per cent in Dharmapura to 62.30 per cent in Banda for wheat and from 37.88 per cent in Dharmapura to 41.69 per cent in Chaparda for mustard.

The high water charges, absolute as well as proportion, in private systems reflect the gains from irrigation and hence the ability of the farmers to pay for irrigation. Therefore, the question of low ability to pay does not arise while suggesting higher water rates in public irrigation systems. But it may be noted that private irrigation supplies higher quality service, hence the productivity gains are higher compared to public irrigation supplies. Therefore, the ability to pay differs between those getting irrigation from public sources alone and those getting from private sources. However, this does not seem to be the case in our sample villages. Even the evidence across size-classes from the three villages where private irrigation systems are prevalent, private irrigation systems are largely availed by the medium and large farmers (Reddy, 1996). This indicates even the access to water, let alone ability to pay, is skewed against small and marginal farmers in the case of private irrigation systems.

TABLE 3. SHARE OF IRRIGATION CHARGES IN AGRICULTURAL COST AND OUTPUT

Village/Crop (1)	Value of output (Rs./ha) (2)	Cost of inputs (Rs./ha) (3)	Irrigation charges (Rs./ha) (4)	Percentage of col. (4) over col. (2) (4)	Percentage of col. (4) over col. (3) (6)
Scarcity region					
1. Anganwa					
Wheat	3,969	2,413	75	1.89	3.11
2. Soorpura					
Wheat	5,875	3,456	75	1.28	2.17
Mustard	11,669	7,000	250	2.14	3.57
3. Bhacharna					
Wheat	4,844	4,025	2,331	48.12	57.91
Mustard	11,275	3,994	1,665	14.76	41.69
Endowed region					
4. Chaparda					
Mustard	3,218	1,250	58	1.80	4.64
5. Jakhana					
Wheat	4,019	1,431	75	1.87	5.24
Mustard	6,900	1,850	58	0.84	3.13
6. Rangapur					
Wheat	9,850	2,131	75	0.76	3.52
Mustard	7,844	1,287	58	0.73	4.51
7. Seentha					
Wheat	8,913	2,869	75	0.84	2.61
Mustard	10,712	2,075	58	0.54	2.79
8. Bandha					
Wheat	6,506	1,825	1,137	17.48	62.30
9. Dharmapura					
Wheat	5,825	1,813	438	7.52	24.16
Mustard	5,000	1,238	469	9.38	37.88

Note: Variations in average value of output and cost per hectare across villages are mainly due to the reliability and quality of irrigation.

The preceding discussion indicates the desirability of public irrigation systems, especially in scarcity conditions (wherever feasible) in order to achieve the objective of equitable distribution. So far state intervention in providing irrigation facilities in scarcity regions has been limited. Even in the canal commands the state is not in a position to keep up the operation and maintenance of the distribution systems due to financial constraints. Of late, there has been a change at the policy level to move towards cost recovery principle in irrigation management. However, the effectiveness of the principle of cost recovery hinges on two important issues: (i) willingness of the farmers to pay for irrigation water, and (ii) the existing institutional set-up in collecting the water charges. In the absence of either of these aspects it would be difficult to operationalise the cost recovery principle.

Willingness to Pay for Irrigation Water

Contingent Valuation method (CVM) has been used to elicit information on willingness to pay for irrigation water by asking the farmers how much they are willing to pay for regular and assured (improved) water supply in the context of a hypothetical situation. This information is analysed for two important crops, wheat and mustard, in the sample villages in order to capture the variations across regions. Economic status is also expected to have a major influence on the willingness to pay and hence we have also looked into size-classwise variations in the willingness to pay for irrigation in both the regions.

The distribution of bids, *prima facie*, indicates that the majority of the farmers are willing to pay higher than the prevailing (administered) water rates provided the government supplies water in sufficient quantities and in a timely fashion. However, there are inter-regional, intra-regional and inter-crop variations in the willingness to pay for irrigation. It appears that the willingness to pay is linked more to the scarcity of water than the ability to pay. For, the bids are on the higher side in the scarcity region. In the case of wheat, the proportion of sample farmers bidding less than the prevailing water rates (public) is more or less the same in both the regions (Table 4). The proportion of farmers bidding in the higher ranges (above Rs. 125 per hectare) are substantially higher in the scarcity region (48 per cent) as compared to the endowed region (17 per cent) in the case of wheat. Within the regions also a larger proportion of the people from the villages with better access to water have opted for lower bids. For instance, 33 per cent of the sample farmers in Bhacharna (scarcity region) and 48 per cent in Seentha (endowed region, head-reach) bid for less than Rs. 75 per hectare despite the fact that water availability in these villages is much better when compared to the other villages in their respective regions. The case of Bhacharna needs specific mention because in this village there is no public irrigation at the moment. Private irrigation is expensive at an average rate of Rs. 1,166 per hectare. The market rate is reflected, to some extent, in 17 per cent of the sample farmers bidding above Rs. 175 per hectare. Nevertheless, the average bid[3] is substantially lower than the market price at Rs. 144 per hectare. This is true even in the case of villages in the endowed region where private irrigation/water markets are prevalent (Bandha and Dharmapura). On the contrary, average bids are substantially higher where public irrigation facilities exist with scarce water supply. But even in these villages the average bids are substantially lower when compared to private market rates prevailing in the vicinity. In the case of mustard the distribution seems to be somewhat different from that of wheat (see Table 4). The proportion of the farmers bidding less than the prevailing rate is substantially higher (27 per cent against 2 per cent) in the scarcity region for mustard crop. But the average bid is higher in the scarcity region. In all the cases the average bids are higher than the administered water rates and lower than the market rates with the exception of Soorpura, where public and private irrigation are used conjunctively. Here, the average bid is higher than the actual charges paid.

TABLE 4. DISTRIBUTION OF WILLINGNESS TO PAY BIDS FOR WHEAT AND MUSTARD CROPS ACROSS THE VILLAGES

(Rs./ha)

Region/ Village (1)	Percentage of farmers bidding (Rs./ha) <75 (2)	75-125 (3)	125-175 (4)	>175 (5)	Mean bid (6)	Median bid (7)	Actual charges paid (8)
Scarcity region				Wheat crop			
1. Anganwa	-	75	25	-	131	125	75
2. Soorpura	-	11	33	56	256	156	75
3. Bhacharna	33	33	17	17	144	125	1,166
All	14	38	24	24	177	135	-
Endowed region							
1. Rangapur	-	92	08	-	119	125	75
2. Seentha	48	52	-	-	88	94	75
3. Jakhana	-	40	20	40	188	188	75
4. Bandha	07	64	07	07	175	125	1,137
5. Dharmapura	-	62	-	38	238	125	438
All*	13	66	06	11	162	131	-
Scarcity region				Mustard crop			
1. Soorpura	-	-	-	100	281	-	250
2. Bhacharna	30	40	30	-	81	125	1,665
All	27	36	27	10	181	125	-
Endowed region							
1. Rangapur	14	72	14	-	125	125	58
2. Seentha	-	100	-	-	88	75	58
3. Jakhana	-	80	-	20	175	125	58
4. Chaparda	-	54	-	36	194	132	58
5. Bandha	-	100	-	-	125	125	-
6. Dharmapura	-	67	-	33	206	125	469
All	2	58	2	38	152	125	-

Note: * There are two no responses in Bandha and hence the total does not add up to 100.

On the whole, it suggests that the willingness to pay is two to three times higher than the prevailing water rates (public) in the case of both wheat and mustard. The average bids are relatively higher (in terms of water requirement, i.e., Rs. per unit of water) for mustard crop which may be due to its high remunerative nature. It may be noted here that the average bid (ranging from Rs. 152 to Rs. 181 per hectare) more than covers the operation and maintenance cost (Rs. 117 per hectare, as estimated by the Vaidyanathan Committee on Pricing of Irrigation Water - Government of India. 1992) in the Chambal command area. However, substantial difference between actual market price and average willingness to pay bids reflects the free rider attitude of the people towards public goods. The free rider attitude is more prominent in the villages where water is not so scarce. One more reason could be the lack of trust in public irrigation systems. This lack of trust arises out of people's experience with government officials belonging to irrigation as well as other departments. This aspect of trust as an important element in irrigation management has been very well recognised (Wade, 1988a). Though the willingness to pay for improved irrigation services is high, in actuality farmers may resist paying unless they are convinced of better service worth their money (Repetto, 1986).

Therefore, it may be argued that pricing of irrigation water to the extent of covering the operation and maintenance costs should not be a problem, especially in the Chambal command area. However, one needs to look at the size-classwise variations to see whether a blanket policy of increasing water rates commensurate with willingness to pay of various sections (size-classes) of the farming community. The average willingness to pay bids across size-classes indicate that in both the regions and in all classes, except one, the willingness to pay for irrigation is higher than the prevailing rate (Table 5). They also exceed the operation

TABLE 5. SIZE-CLASSWISE DISTRIBUTION OF WILLINGNESS TO PAY BIDS FOR WHEAT AND MUSTARD CROPS ACROSS THE VILLAGES

(Rs./ha)

Region/Farm size (ha)	Percentage of farmers bidding (Rs./ha) <75	75-125	125-175	>175	Mean bid
(1)	(2)	(3)	(4)	(5)	(6)
			Wheat crop		
Scarcity region					
<1	-	-	-	-	-
1 - 2	25	75	-	-	69
2 - 4	-	71	-	29	875†
4 - 10	-	50	40	10	150
>10	-	76	12	12	156
Endowed region					
<1	05	90	05	-	106
1 - 2	-	78	11	11	131
2 - 4	-	50	-	50	175
4 - 10*	07	64	07	07	169
>10	-	57	-	43	250
			Mustard crop		
Scarcity region					
<1	-	-	-	-	-
1 - 2	-	-	-	-	-
2 - 4	-	67	-	33	994
4 - 10	-	33	-	67	1,188
>10	-	60	-	40	275‡
Endowed region					
<1	11	78	11	-	100
1 - 2	-	80	-	20	169
2 - 4	-	63	-	37	194
4 - 10	-	100	-	-	125
>10	-	67	-	33	188

Note: * Total does not add up to 100 as there are two no responses in this category. † Discrepancy in bids reflects the present mode of irrigation, i.e., bids tend to be higher if a farmer presently depending on private source, say well. ‡ Discrepancies in bids reflect the present mode of irrigation, i.e., bids tend to be lower if a farmer is presently availing public source say tank/canal.

and maintenance costs in Chambal command area in most of the cases for both wheat and mustard. In the endowed region there appears to be a systematic increase in the willingness to pay bids as the farm size increases reflecting a positive association between the willingness to pay and economic status. This also indicates the relation between the willingness to pay and ability to pay. Similarly, the proportion of the farmers bidding in the highest range (above Rs. 175/ha) also increases along with farm size. However, there is no such pattern in the scarcity region which may be attributed to limited access to water and low abilities to pay consequent to the prevailing economic conditions in these villages. For, in the absence of irrigation the ability to pay for water is very poor in scarcity conditions. Though the willingness to pay assumes that water would be available, at the moment the farmers are not sure how much they could afford to pay.

V

FACTORS INFLUENCING WILLINGNESS TO PAY FOR IRRIGATION WATER

In order to identify the factors affecting the willingness to pay for irrigation, the willingness to pay function is estimated with the help of ordinary least squares. The functional form used is:

$$WTP_{ijk} = (INC, FS, \%AIRR; SOURCE; MNSPT; SHORT; MRKT) + U$$

where

WTPijk = Maximum willingness to pay for irrigation water per hectare (in Rs) by i-th household in j-th village for k-th crop.

INC = Annual income of the household (Rs.). This includes agricultural and non-agricultural income.

FS = Average farm size of the household. This is defined as area owned by the household (ha).

% AIRR = Proportion of net area irrigated in the household.

SOURCE = Source of irrigation. For this, dummy variable is used, i.e., '1' in the case public irrigation; '0' in the case of private irrigation.

MNSPT = Money spent on irrigation (Rs./ha).

SHORT = Extent of shortage of irrigation water according to the farmer. Shortage is measured as percentage difference between number of irrigations required and available.

MRKT = Existence of water markets. Dummy variable is used to measure this aspect, i.e., '1' in the case of villages where water markets are prevalent; and '0' where they are not.

K ranges from 1 to 2 representing wheat and mustard crops.

These independent variables can be categorised as representing the economic status of the household (FS, INC and % AIRR); scarcity conditions of existing irrigation source (SHORT); value of water at present (MNSPT) and availability of alternative sources to the farmers (SOURCE and MRKT). Theoretically, the three variables representing economic status are expected to have a positive influence on the willingness to pay. Variables SHORT, reflecting the extent of water (irrigation) scarcity, and MNSPT are also expected to have a positive impact on the willingness to pay. SOURCE and MRKT variables are used as dummies. We have distinguished between public irrigation (canal/tank = 1) and private irrigation (others = 0). A positive association between WTP and SOURCE would indicate higher willingness to pay by the households which are presently availing public irrigation reflecting a positive attitude and trust in public irrigation systems and vice versa in the event of negative relation. Prevalence of markets (MRKT) is also expected to have a positive or negative impact depending on whether the present market value of water is higher or lower. Apart from these selected independent variables, we have also used village dummies to capture the variations across villages. The specifications are estimated for wheat and mustard crops separately as these crops are the major irrigated crops in the region. In the total sample we have 79 households growing wheat crop (spreading over 8 villages) and 53 households growing mustard crop.

TABLE 6. ESTIMATED WTP REGRESSION COEFFICIENTS FOR WHEAT AND MUSTARD

	Wheat		Mustard†	
Variable (1)	Specification I (2)	Specification II (3)	Specification I (4)	Specification II (5)
1. Constant	162.139	126.208	206.935**	313.833*
	(148.60)	(149.35)	(95.26)	(91.85)
2. SOURCE	52.402	-76.899**	172.861	-197.733
	(117.90)	(44.99)	(71.34)	(72.22)
3. FS	1.367	0.449	2.103	2.109
	(3.37)	(2.99)	(2.64)	(2.41)
4. % AIRRI	1.358**	0.624	1.050**	0.868
	(0.66)	(0.55)	(0.53)	(0.44)
5. MNSPT	0.005	0.009	-0.007	-
	(0.03)	(0.02)	(0.02)	
6. SHORT	0.528	1.021***	0.716***	0.129
	(0.79)	(0.59)	(0.39)	(0.44)
7. MRKT	-	-	-124.285	-204.44*
			(78.19)	(85.79)
8. INC	-	-	0.001	-
			(0.001)	
Village dummies	Yes	No	No	Yes
R^2	0.19	0.09	0.19	0.32
N	77	77	51	51
DF	64	71	45	41

Note: Figures in parentheses are standard errors. *, ** and *** indicate levels of significance at 1, 5 and 10 per cent respectively.

† For mustard we included three village dummies only as the number of observations in other villages is very less.

The estimated equations are consistent with the theoretical expectations though their explanatory power is on the lower side (Table 6). Except the variable SOURCE, all the independent variables are consistent in their signs with and without village dummies (not presented). Specifications with village dummies have revealed theoretically expected sign for SOURCE variable also. Apart from this, there could be a multicollinearity problem between FS and % AIRRI, but it does not appear to be serious as the variables show consistently expected signs. Of the selected variables, SOURCE, SHORT and % AIRRI turned out significant in the case of wheat as well as mustard crops. The SOURCE variable, which is expected to reflect the farmers' attitude towards public irrigation, has a negative relation with WTP. This indicates that households availing low-priced public irrigation presently are willing to pay less when compared to others depending on private irrigation. This may be due to the fact that the farmers who have been using public irrigation over the years are used to subsidised water rates and their attitudes towards public irrigation is of free rider type. In fact, the farmers in command areas (especially head-reaches) feel that water should be provided free of cost by the government. Besides, the farmers who are used to public irrigation are aware of its poor reliability and hence lack trust. The free rider attitude of the farmers is also reflected in the low recovery rates in the command areas. This indicates that in the existing canal systems increasing water price alone may not serve the purpose of improving the financial viability of the system. It is also unlikely that the recovery rate would improve with an increase in water rates. On the other hand, the scarcity of water (SHORT) leads to higher willingness to pay for obvious reasons. When this is analysed in the context of negative relation between SOURCE and WTP, it indicates that the low willingness to pay is prevalent in public canal distribution systems. Public irrigation seems to be most unreliable in the sample villages. Only one of the four command area villages gets adequate water supply (Seentha in the head-reaches). Moreover, two of the scarcity region villages depend on tank (public) irrigation which is barely enough to protect even a single crop. In fact, water scarcity is more severe in the tail-end villages of canal commands when compared to other villages (as noted earlier). Even the average bids (WTP) are somewhat lower in the scarcity villages with public irrigation systems when compared to other scarcity villages and higher when compared to head reaches of canal command. Therefore, it is the unreliability of public irrigation that prompt low willingness to pay of the households and resulting in a negative attitude towards public good.

The proportion of area under irrigation (% AIRRI) showed a positive association with WTP. If % AIRRI is considered as a proxy for ability to pay, the positive sign indicates that the farmers with higher ability to pay would be willing to pay more for irrigation water. However, other indicators of ability to pay such as farm size (FS) and annual income (INC) did not turn out significant. The market variable turned out to be significant only in the case of mustard. In the case of mustard the prevalence of water markets seems to have a negative impact on WTP. This may be due to two reasons: (i) the existing market water rates may be perceived as high by the farmers and (ii) the attitude towards public good. For, these farmers are aware of the water rates and the reliability of public irrigation systems. Though the market rates for water are higher when compared to public irrigation, the demand for water at these high prices in these villages reflects the fact that price elasticity of water is low and farmers are willing and able to buy water from these markets. This once again emphasises the earlier argument that the attitude of the people towards public goods like irrigation plays an important role in determining the willingness to pay for irrigation water. As long as these attitudes are negative, pricing of water alone may not be a useful policy instrument. Change in attitudes may be possible through inculcating credibility and trust in state managed irrigation systems. Moreover, the existing institutional structure needs to be strengthened and should be made more powerful so that people cannot take them for granted. This calls for revamping of the institutional structure of the irrigation department fostered with institutional arrangements at the local level such as water user associations, pani panchayats, etc. Here the experience of Taiwan where joint efforts of irrigation departments and farmers have led to successful and sustainable irrigation management would come in handy (Lam, 1996).

VI

RATIONALE FOR COPRODUCTION INSTITUTIONAL ARRANGEMENTS

Based on a rapid appraisal as well as survey methods, this study brings out clearly the problems associated with pricing of irrigation water in large systems in India. Some of the important conclusions are: (i) Pricing of irrigation water on cost basis (at least to cover the operation and maintenance costs) is a feasible proposition both in terms of willingness and ability of the farmers to pay for it. (ii) But under the existing institutional arrangements pricing on cost basis alone may not lead to sustainability of the irrigation systems in terms of efficient allocation of water and financial viability. For, in the given institutional set-up the recovery rates are quite low (ranging from 27 per cent to 70 per cent across the states) and it is unlikely that higher water rates would lead to better recovery (a good example in this regard is income tax). Therefore, pricing policies need to be fostered with institutional changes at all levels in order to make the former more effective. And the primary target in this regard would be the irrigation department. In the present conditions where irrigation departments lack any authority and autonomy in recovering irrigation charges, free rider attitudes are widely prevalent. Efficient allocation can be achieved only through volumetric pricing which is possible by technically upgrading the distributary systems. (iii) Water markets in the present form (selling of water by private people) may not necessarily result in equitable distribution of water in all the situations. Especially in the conditions of scarcity access to water becomes highly skewed in favour of large farmers and water markets fail to improve the distribution due to non-availability of water *per se*. In the scarcity regions policies of intervention (state), wherever possible, become mandatory to ensure equitable distribution of water.

It is argued that institutional mechanisms such as user associations, farmers' participation in irrigation management, turning over the irrigation systems to the farmers' groups are essential for improving the performance of irrigation systems in India. Though India had a long history of community participation in irrigation management, these systems no longer exist consequent to the irrigation policies, bureaucratic control over irrigation systems, of colonial as well as Indian governments. Moreover, these institutions were functioning in a different socio-political set-up where production relations were of feudal or semi-feudal nature. Expecting such institutional mechanisms in the present day system of decentralised democracy would be unreasonable. Effective community involvement is observed only when there are substantial economic gains expected from group action or when they are promoted and supported by external organisations like non-governmental organisations (NGOs). In the absence of sincere efforts from the government to promote community participation the spread has been limited. Despite the possibility of substantial economic gains associated with water, community-based institutions have not made any inroads into the large irrigation systems in India. In fact, community managed irrigation systems cover less than 1 per cent of the total irrigated area (Government of India, 1992). This is mainly due to the fact that in large systems inter-village co-operation is a necessary condition consequent upon the interdependence between upstream and downstream villages. Unless upstream canals are maintained properly, maintenance of downstream distributary systems may not yield any gains (water). Given the myopic nature of individuals and heterogeneity across villages organising all the villages along the distributary is proving to be a difficult task. This is the case with our sample villages in the Chambal command area. Though the farmers in the tail-end reaches had contributed, both in kind and cash for the maintenance of the distributary systems, they found it futile without the co-operation of the upstream villagers. Upstream villagers are not keen in such activities as they are happy with their water supplies at present. After a long wait (about 10 years) the tail-end farmers are looking for alternative sources of irrigation (lift schemes) and lobbying with government. The transaction costs involved (for the tail-end villagers) in organising inter-village communities (for canal management) are much higher than organising intra-village community.

On the other hand, upstream villagers do not expect any additional gain in the short run to incur these transaction costs of organising the community. At the moment the balance between transaction costs and additional gains is tilted against the former due to the artificially low price of water. An added dimension in this regard is that without strengthening the recovery system there is no gain in increasing the water prices. This calls for revamping, reorganising and strengthening the institutional structure of the irrigation departments. Besides, volumetric pricing is a necessary condition for efficient use of irrigation water. This calls for the adoption of water control and measurement technologies.

Irrigation departments need to be decentralised to the local level and assigned with authority, responsibility and flexibility within a local area. Irrigation officials should be given the authority to collect the irrigation fee from the user groups (on volumetric basis) rather than from individual farmers. These user groups should be given the responsibility of distribution of water between users and pay the irrigation fee collectively to the irrigation officials. Adopting of volumetric delivery systems at the community (user association) level would be more cost effective than at the individual level. Irrigation officials, in turn, are responsible for delivering the water to the user groups and are answerable to the higher officials and farmers as well if they fail to do so. It may be noted that involvement of local NGOs would be vital for promoting water users' associations (Reddy, 1998b). They should be provided with (dis)incentives to manage the system (in)efficiently. Effectively, they will be selling the water to user groups on volumetric basis rather than to individual farmers. Their responsibility of maintaining the system ends at the point of delivering the water to the user group, but they are answerable in case of any problems there in. That is, irrigation officials are responsible and hence instrumental in promoting and sustaining user groups at the distributary level. They should be in a position to control water supplies in case user groups fail to pay water fees. That is technology to control water supplies below distributary levels and to measure water quantities should be provided in order to check free riding on the part of user groups and facilitate volumetric pricing. This authority to control free riding coupled with the responsibility of efficient allocation and distribution of water within the user groups creates incentives for coproduction activities between officials and farmers. This prompts the promotion of local level institutional arrangements and provides the necessary environment for their sustenance. This is somewhat closer to Taiwan's model of irrigation management, where the state assumes the role of a facilitator in promoting institutional arrangements for irrigation management (Lam, 1996). However, the difference is that irrigation water in Taiwan is highly subsidised, whereas in India we are concerned with financial viability of irrigation projects through reducing the irrigation subsidy and also efficient allocation of water. When fostered with institutional reforms at the administrative level user societies are expected to bring in efficient and equal distribution of water as evident from most of the Asian countries (Postel, 1992; Sengupta, 1991; Raby, 1991;

Mitra, 1992; Bruns, 1993). In fact, the experience in the Philippines shows that fee recovery and system viability are much higher where participatory institutional arrangements exist (Sengupta, 1991, p. 47).

Therefore, we argue that in order to arrive at any meaningful solutions to irrigation management in India, it is essential to bring in institutional changes at grassroots as well as at administrative level and fostered simultaneously with market mechanisms (pricing). On the other hand, either the 'bottoms up' approach or 'top down' approach alone may not help in achieving the goal of sustainable irrigation management. While the problems associated with 'top down' approach are well established, the main problem with 'bottoms up' approach is impracticability in the given socio-political conditions. The transaction costs involved in organising inter- and intra-village unity would be very high apart from the manpower and resources required for mobilising the groups. However, inter- and intra-village unity can be facilitated with the involvement of local NGOs to a large extent. Therefore, the replicability of some of the successful East Asian cases is possible only through decentralisation of irrigation departments and assigning them with authority and responsibility at the local level coupled with sharing the responsibility of maintenance with user groups and even NGOs.

NOTES

1. *Nadi* is a traditional drinking water system and *khadin* is a traditional irrigation system.
2. In the case of private systems irrigation charges are taken as the total amount paid by the water buyer to the owner of the water lifting mechanism. In the case of pure owners the operation and maintenance costs are taken into account for calculating the per hectare irrigation charges.
3. We have also presented the median bids which are often preferred to average bids for estimating the total money available from pricing.

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