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Costs and Benefits of Collective Action: An Economic Inquiry into Canal Water Institutions in Kerala

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ABSTRACT

Policies of devolving management of resources from the state to user groups like water users' associations in India are premised upon the assumption that users will organise and take on the necessary management tasks. However, with the complex governance structure, these associations are expected to incur considerable transaction costs and affect significantly the performance of irrigation institutions. The present paper analyses the costs and benefits of household participation in canal irrigation management by taking 40 water users' associations in South India. The study reveals that search and information cost incurred is found to be very high followed by the contractual costs. The magnitude of the transaction costs incurred is less by the older groups, those in the middle and tail end, those with more infrastructural facilities and educated President. Introduction of cost sharing mechanism by farmers for canal maintenance would create responsibility among water management institutions. Further the coordination and interaction among farmers and officials, giving due importance to existing institutional practices and developing multi-stakeholders strategy would boost the successful functioning of water user association.

Keywords: Water user's associations, Transaction cost.

JEL: Q12, Q15, Q18

I

INTRODUCTION

Policies of devolving management of resources from the state to user groups like water users' associations in India are premised upon the assumption that users will organise and take on the necessary management tasks. However, with the complex governance structure, these associations are likely to incur considerable transaction costs and affect significantly the performance of irrigation institutions. Even though water user associations are excellent institutional arrangement the overall performance is rather in consistent. Often the formation, and successful functioning of the irrigation management institutions are limited by huge transaction costs involved (Suresh Kumar, 2010). The nature of this institutional development has a symbiotic relationship with transaction costs. Resource users in developing countries are more likely to have higher costs of obtaining, assessing, and sharing information about the resource. Often their effective functioning is limited by costs involved in collecting information, organising and executing planned efforts of managerial activities. Hence one of the major challenge is to quantify transaction costs and to

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find out how significant is the effect of these transaction cost on the performance of irrigation systems. Information on these costs and how important these transaction costs, would improve the likelihood of success of different policy reforms. Against this backdrop the present paper tries to quantify the costs and benefit of household participation in canal water user association (WUA).

Data

Palakkad district was purposively selected since the district has maximum number of canals and large number of water user associations. There are 29 major and medium, and about 5000 minor irrigation projects in Palakkad district. The Kanjirapuzha Irrigation Project (KPIP) has been purposively selected to study the functioning of WUAs because Command Area Development Authority (CADA) programme is being implemented in four projects out of which KPIP is one among them. This project has 23 distributaries in the Left bank Main canal (LBC) and 4 distributaries in the Right Bank Canal (RBC).

A list of all WUAs within the command area of KPIP project was obtained from the CADA. From the list, a sample of 40 WUAs (20 functioning and 20 non-functioning) were randomly selected to study in depth the performance of WUAs, the type and extent of household participation of the members in various canal maintenance activities (Table 1). Proportionate random sampling procedure was employed to study the farm households. As the size of WUA varies across the type of structures, 20 per cent of the WUA members were randomly selected and studied for the purpose. A sample of 142 farm households were selected in functioning WUAs and 131 farm households were selected in non- functioning WUAs. The structure, functioning and performance of WUA were studied to identify suitable policy options to enhance the effectiveness and improve its working. Thus a total sample of 273 farm households were selected and studied. In addition, village elders, local leaders and few knowledgeable persons in the concerned area, some beneficiary farmers and office bearers of WUAs for canal water management were interviewed. The information was also gathered through informal interviews with Command Area Development Authority (CADA) officials consisting of engineers, agricultural officers and co-operative personnel.

II

METHODOLOGY

Transaction Costs: Measurement

Following Suresh Kumar (2010) and Bhattarai (2011) the transaction cost incurred in canal irrigation can thus be grouped into information and decision making cost, contractual cost, enforcement cost and monitoring cost. Some of the indicators used in measuring the forms of transaction cost and the definitions of the different costs in the context of canal irrigation are presented in Table 1.

TABLE 1. METHODS OF ESTIMATING TRANSACTION COSTS

Type of transaction (1)	Nature of transaction (2)	Nature of cost (3)	Approach (4)
Information and decision making cost	Meetings/dealing with agents for organisation of collective action and implementation of decisions	Time for meetings/ action	Value of time (Wage rate* time)
	Communication	Cost incurred for phone calls, stationary items	Monetary expenditure
	Dealing with stakeholders/ government offices	Cost incurred for the information of subsidy, repair of field channels etc.	Monetary expenditure
	Cost of organising and conducting WUA level meetings, seminars	Time for meetings / action	Value of time (Wage rate* time)
Contractual cost	Dealing with government offices	Cost to obtain external assistance for improvement of canal including lobbying, conflict resolution	Monetary expenditure
	Dealing with members of the association/farmers	Cost of obtaining contribution by farmers	Monetary expenditure
	Dealing with members of the association/farmers	Cost of renewal, registration	Monetary expenditure
	Dealing with members of the association/farmers	Cost involved for water tax	Monetary expenditure
	Opportunity cost of time in negotiating with officials for release of water	Cash payments/ time cost for watching	Wage cost/Value of time (Wage rate* time)
	Dealing with government officials	Cost incurred for negotiating with officials for release of water	Monetary expenditure
Monitoring and enforcement cost	Monitoring canal improvement activity and diversion of water by members of the WUA	Cash payments/ time cost for watching	Wage cost/Value of time (Wage rate* time)

Transaction cost estimation involves a direct monetary measurement as well as an imputed one. The direct measure included payments to hired labour for waiting while the imputed costs included contributions in terms of time by members for various activities. As there was no 'common irrigator' in the study area for effectively managing water distribution the members of WUA themselves kept a watch in regulating the flow of water to the fields. To measure the imputed cost of time spent by individuals in organisational work, the opportunity cost at the average wage rate was valued. It is possible to use the labour wage rate as a proxy to calculate the opportunity cost of time (Mburu *et al.*, 2003).

Factors Affecting Transaction Cost by Water User Associations

A number of studies explicitly discuss factors that influence transaction costs (Falconer *et al.*, 2001; Falconer and Saunders, 2002; Mburu *et al.*, 2003; Ducos and Dupraz, 2006; Rorstad *et al.*, 2007; Ducos *et al.*, 2009; Mettepenningen and Van Huylenbroeck, 2009; Nilsson, 2009; Mettepenningen *et al.*, 2011; McCann, 2013).

Based on the literature review and the conceptual framework, hypotheses are specified in terms of how different factors influence transaction cost.
The model specification is as follows:

$$TC = \beta_0 + \beta_1 AGEW + \beta_2 LOCATION + \beta_3 GSIZE + \beta_4 IINDEX + \beta_5 DFUNCT + \beta_6 MEETING + \beta_7 EDUCATION$$

where

TC	: Transaction cost incurred by WUA (Rs./yr/ha)
AGEW	: Age of the water user association in years
LOCATION	: Location of the association within the system (Head=1, Middle=2, Tail=3)
GSIZE	: Number of farmers in the association in numbers
INFINDEX	: Infrastructure index[1]
FUNCT	: Dummy for the functioning of WUA (1= functioning, 0=otherwise)
CONTACT	: Number of times water user association meet irrigation department per year
EDUCATION	: Education level of the WUA President (1=illiterate, 2= primary, 3= secondary, 4=higher secondary, 5=collegiate)

Benefit of Collective Action

The benefit of collective action is measured in terms of revenue from agricultural production. The yield from each of the crops cultivated by members and nonmembers was calculated. Since mixed cropping was practiced in some farms the return from each crop was added or the gross returns were taken up for the further analysis (McCarthy and Essam, 2009). It is assumed that the net benefits from this collective action are more than the costs of collective action.

It is assumed that there are 'm' household members and 'n' number of crops being cultivated by the farm households in the command area. Then the benefit from the collective action is written as

$$\text{Benefit from collective action} = \sum_{i=1}^{n} \sum_{j=1}^{m} P_{x_{ij}} Y_{ij}$$

where, $P_{x_{ij}}$ is the price of the 'n' number of crops being cultivated by 'm' number of farm households in the study area and Y_{ij} is the yield of 'n' number of crops being cultivated by 'm' number of farm households. The cost incurred by different members of WUA is the transaction cost for various canal maintenance activities. It can be represented as

$$\text{Transaction cost incurred} = \sum_{j=1}^{m} \text{TC}_{x_i j}$$

where, $\sum_{j=1}^{m} \text{TC}_{x_i j}$ is the transaction cost incurred by 'm' number of farm households.

The Net benefit (NB) due to collective action can be represented as

$$\sum_{j=1}^{m} \text{NB}_{M_j} = \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_i j} Y_{ij} - \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_{ij}} X_{ij} - \sum_{j=1}^{m} \text{TC}_{x_j}$$

where, $\sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_i j} Y_{ij} - \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_{ij}} X_{ij}$ is the total revenue from 'n' number of crops being cultivated by 'm' number of members in WUA of the study area. $\sum_{j=1}^{m} \text{NB}_{M_j}$ is the net benefit accrued to 'm' number of farm households. $\sum_{j=1}^{m} \text{TC}_{x_j}$ is the transaction cost incurred by the members of WUA.

The Net benefit for the non-members can be represented as

$$\sum_{j=1}^{m} \text{NB}_{NM_j} = \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_i j} Y_{ij} - \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_{ij}} X_{ij}$$

where, $\sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_i j} Y_{ij} - \sum_{i=1}^{n}\sum_{j=1}^{m} P_{x_{ij}} X_{ij}$ is the total revenue from 'n' number of crops being cultivated by 'm' number of non-members in WUA of the study area.

Hence, the total net benefit due to collective action is calculated as

$$TNB = \sum_{j=1}^{m} \text{NB}_{M_j} - \sum_{j=1}^{m} \text{NB}_{NM_j}$$

where, $\sum_{j=1}^{m} \text{NB}_{M_j}$ is the net benefit due to collective action by members of WUA and $\sum_{j=1}^{m} \text{NB}_{NM_j}$ is the net benefit by non-members of WUA.

III

RESULTS

An understanding of the household characteristics is important to contextualise the farmers' behaviour in irrigation management. Descriptive statistics of the variables used in the study are presented in Table 2.

TABLE 2. DESCRIPTIVE STATISTICS OF THE VARIABLES STUDIED

Variables (1)	Description (2)	Number of observations (3)	Mean (4)	SD (5)	Min. (6)	Max. (7)
Functioning						
AGEW	Age of the water user association in years	20	8.70	2.10	3.00	11.00
LOCATION	Location of the association within the system (1=Head, 2=Middle, 3=Tail)	20	1.85	0.73	1.00	3.00
GSIZE	Numbers of farmers in the WUA (number)	20	47.65	15.76	22.00	79.00
INFINDEX	Infrastructure index	20	5.60	1.85	1.19	8.52
FUNCT	Dummy for the functioning of WUA (1=if functioning, 0=otherwise)	20	1.00	0.00	1.00	1.00
MEETING	Number of times WUA meet irrigation department /yr	20	2.95	1.16	1.00	5.00
EDUCATION	Education level of the WUA President (1=illiterate, 2= primary, 3= secondary, 4=higher secondary, 5=collegiate)	20	2.90	1.41	1.00	5.00
Non Functioning						
AGEW	Age of the water user association in years	20	6.80	1.44	4.00	9.00
LOCATION	Location of the association within the system (1=Head, 2=Middle, 3=Tail)	20	1.95	0.74	1.00	3.00
GSIZE	Numbers of farmers in the WUA (number)	20	42.35	15.74	15.00	70.00
INFINDEX	Infrastructure index	20	4.46	2.26	1.78	11.29
FUNCT	Dummy for the functioning of WUA (1=if functioning, 0=otherwise)	20	0.00	0.00	0.00	0.00
MEETING	Number of times WUA meet irrigation department /yr	20	2.00	0.77	1.00	3.00
EDUCATION	Education level of the WUA President (1=illiterate, 2= primary, 3= secondary, 4=higher secondary, 5=collegiate)	20	2.35	0.79	1.00	3.00

The average age of the WUA is 8 years as reckoned from the date of their in corporation with the CADA. Meinzen-Dick *et al*. (1997) suggested that the older

group members are experienced as they are familiar with already established patterns of understanding and this will reduce the cost. Most of the WUAs (on an average 1.85) are located at least in the middle from the head works of the canal. A WUA on an average has 47 members with a standard deviation of 15.76 when compared with non-functioning association. The infrastructure of a functioning WUA on an average is worked out to be 5.60 against 4.46 of non-functioning WUA. It is assumed that as infrastructure increases transaction costs increases. On an average two meetings are conducted by the associations in a year. Finally the educated Presidents of WUA deal with the different formal organisations.

Measuring Transaction Costs

The transaction cost involved in canal management were decomposed into three categories, viz., information and decision making costs, contractual costs and monitoring and enforcement costs. The total transaction costs incurred by the water user association are worked out to Rs. 223/ha/yr. Of this total transaction cost, the information cost accounts for 70.8 per cent, contractual cost 26.82 per cent and monitoring and enforcement cost 2.4 per cent. Among different components of transaction cost, the information costs account for a major share. It is interesting to note that for the WUA, the search for information cost assumes critical importance. The cost for searching and gathering of information is relatively high due to several reasons. Firstly, members of the association do not possess substantial knowledge on working of WUA, CADA and the contracting parties who impose the participatory approach of irrigation management on the farmers. Secondly, for acquiring technical know-how, farmers have to spend time in gathering information and participate in awareness- and training-programmes conducted by CADA. Thirdly, farmers have certain apprehension about the CADA officials in not disseminating the concepts and requirements of the programmes with a clear social dimension (Chackecherry, 2014).

The contractual cost accounts for 26.82 per cent which reveals that lobbying by farmers for water is prominent in the study area. Disputes are also common among the farmers about the distribution and use of water which they themselves find it difficult to resolve. In the release and distribution of water neither the critical phases of growth of plants nor the differing water requirements of the plants is considered. Distortion of water distribution schedule in order to confer undue advantage to the powerful farmers by lobbying the government officials was predominant in the area. Crase *et al.* (2013) argued that the consultation process in the Murray-Darling Basin enabled lobbying by irrigators which ultimately resulted in poor policy decisions.

Enforcement and monitoring costs basically imply the cost of watching to prevent poaching measured in terms of the imputed value of labour and/or actual payments made for the task. Poaching used to be the most important problem faced by WUA in many villages. Since there was no ‘common irrigator’ to watch over, members of the association themselves spent their time near the sluices to prevent the diversion of

water to other fields. Moreover they had to negotiate with the irrigation officials for the release of water. Nearly 2.4 per cent of the cost was incurred for this activity.

What Affects Transaction Costs?

The regression results show how various factors affect the transaction cost among WUAs. The results summarised show that the age of the WUA, location of the association, infrastructure index, dummy variable for functioning and educational level of the president are statistically significant. However, group size and contact with the irrigation officials of the WUA were not statistically significant. The results are robust to assumptions underlying the OLS model.

The findings on age of water user association indicate that it has a positive, strong, and statistically significant effect on the levels of transaction cost. Members of older group are more experienced and thereby they are able to develop a shared understanding among the fellow farmers regarding irrigation issues like poaching. Therefore the monitoring and enforcement cost incurred by the association will be less.

As expected, water scarcity represented by the proxy measure location of the association within the system has an inverted U shape relation with the transaction cost and the result is statistically significant. This finding is highly consistent with the consensus in the empirical literature (Agrawal, 2002 and Ternstrom,2003). The farmers at the tail and middle end incur high transaction cost because they receive less water as compared to the head end farmers. In addition they have to negotiate with other farmers and officials to get more water for their fields.

The supra household factor like infrastructure index influences the transaction costs significantly. Farmers in the study area highly relied on buses and mobile phones to communicate with each other regarding meetings, visit to various departments and conflicts if, any. This variable is a social capital indicator which establishes the members and office bearers to actively participate in WUA, willing to invest more time and resource in canal management activity and hence incur high transaction cost.

The dummy variable FUNCT is expected to have a positive influence on transaction cost. The result shows that this variable significantly influences the transaction cost. It appears that the functioning WUA conduct meetings and receives the subsidy for various inputs and functional grant for operation and maintenance of canals in time. Moreover these WUAs renew their membership every year in order to avail the subsidy.

As the table shows educational level of the President significantly influences the transaction costs. This is because of the fact that education improves awareness about WUA, CADA and meetings held by them. However, in times of need, an educated President can organise meetings to discuss specific issues. He can give apt opinion which will enable him to deal with all members of association and other associations

regarding irrigation disputes. He spent a lot of their working time on WUA activities. He also raised finances through donations from among the members. He participated actively in WUA so as to influence the members and motivate them to work together. Hence he incurred high transaction costs.

Benefits of Collective Action

It is assumed that a household decision to participate in collective action depends on the expected the benefits of such participation. This in turn is determined by the expected cost of participation and expected benefits of participation in collective action (Table 3).

TABLE 3. BENEFITS OF COLLECTIVE ACTION

Particulars (1)	Members (2)	Non-members (3)
Cost of cultivation (Rs./ha)	43,834.28	47855.5
Gross returns (Rs./ha)	64,605.93	58260.2
Transaction cost (Rs./ha)	1472.47	-
Net benefit (Rs./ha)	19,299.18	10,404.70
Total net benefit due to collective action (Rs./ha)	8,894.48	

Source : Primary household survey (2014-2015) .

In irrigation, two considerations influence the calculations of net-gains leading to the choice of institution; cost minimisation and benefit maximisation. Benefit is more or less a function of crops grown. It is reasonable to assume that, given the cropping pattern, the benefit calculations would not arise in the institutional choice of irrigation. For a defined crop pattern, returns from farming remain almost the same for all the plots, and also the level and costs of other inputs such as fertilisers, seeds are also given. Under this condition, the net-gain maximisation behaviour of the farmers could be reduced to a strategy of minimising the cost of acquiring irrigation (Neetha, 2003).

With this theoretical background, the benefits of different crops grown on the farm were calculated and transaction cost incurred by the different individuals were analysed. Since mixed farming was practiced in most fields, gross returns were calculated for the different crops (McCarthy and Essam, 2009). The table revealed that transaction cost incurred by the member households totalled to Rs.1472.47/ha. It could be revealed that there was significant difference in net returns between the members (Rs.19,299.18/ha) and non-members (Rs.10,404.70) of the WUAs. Even though the net returns of the members of the WUA was higher, the cost incurred for the collective action was significantly high (Rs.1472.47 /ha). It could also be concluded that the net benefit due to collective action by members of WUA was Rs. 8,894/ha. It could thus be interpreted that even though members of WUA incurred transaction cost it was compensated by the increase in net returns. Since the members received seeds and fertilisers as incentives, the cost of cultivation was reduced as

compared to the non-members. It was deduced from the survey that members received adequate and timely water as compared to the non-members.

IV

CONCLUSION AND POLICY IMPLICATIONS

As devolutionary policies through institution building become widely adopted across the world, it becomes important to understand the circumstances under which these policies are successfully implemented.

It is found that on an average, the total transaction cost incurred by a WUA is worked out to be around Rs. 223.31/ha. The decomposition of transaction cost indicates that the information and decision making costs account for 70.8 per cent and contractual costs account for 15.5. per cent of the total transaction cost involved in canal irrigation management. It is observed that farmers had to spent time in gathering information regarding various programmes under CADA and its role in canal irrigation management. The members of WUA also had to negotiate with the irrigation officials and other WUA for water.

An analysis of factors influencing transaction cost indicates that age of the WUA, location of the association, infrastructure index, dummy variable for functioning and educational level of the president were statistically significant.

The functioning WUA incurs a substantial amount of Rs. 223.31/ha in addition as transaction cost for its different activities compared to non-functioning WUA. It could be seen that funds allocated were inadequate for the maintenance of the canal and field channels. Many of WUAs have become defunct in later years. It could also be concluded that the net benefit due to collective action by members of WUA was Rs. 8,894/ha. It was deduced from the survey that members received adequate and timely water as compared to the non-members. Hence it is suggested that cost sharing mechanism by farmers for canal maintenance if introduced, would enhance the responsibility so that all the WUAs would function effectively. Furthermore, WUAs contact with the CADA and irrigation officials was lacking in the study area. Many of the farmers were unaware of the different activities of CADA. The coordination and interaction between farmers and officials regarding existing institutional practices and developing multi-stakeholders strategy to reduce transaction costs would pave the way for successful functioning of WUA.

NOTE

1. Infrastructure Index was constructed based on different indicators like length of roads, number of post offices, number of telephone exchanges and number of buses operating in the area. Iyengar and Sudarshan method was used to work out the composite index of infrastructure.

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