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The Differential Impact of User Heterogeneity in Resource Management: A Case Study from Kerala

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ABSTRACT

This paper analyses the heterogeneous users decision to participate in co-management, which is an institutional alternative proposed in the wake of state's failure in managing the Cochin estuarine fisheries in Kerala, India. Since a collective action under co-management require not only user's active participation in terms of their labor but also involve various types of organizational and managerial costs, the users were given the following choices on co-operation. Firstly, the users had the choice to contribute their labor in conservation activities, which would ensure sustainability of the fisheries. Secondly, they could make a voluntary contribution towards meeting the organizational costs of collective action. Thirdly, they could contribute in terms of labor as well as in monetary terms. Finally, they had the choice not to participate at all. Keeping in view the problems of free rider and adoption of stratagic behaviour by users some incentives were given for each of the above ways of co-operation. A multinomial logit analysis of the decision of about 369 sample fishermen to participate in co-management as defined above shows the differential impact of user heterogeneity in resource management. While heterogeneity in terms of the present legal status of the users motivate them for contributing their labor even in the absence of any additional economic incentives, heterogeneity in economic status and membership in formal organizations matters when it comes to making monetary payments. In addition to these, the overall optimism of the users' motivates them to both physically engage in conservation activities as well as make monetary payments. Adoption of strategic behaviors by at least some users cannot, however, be ruled out. On the whole it is seen that the heterogeneous fishermen's decision to participate depend upon their anticipation of the distribution of benefits from co-operation. However, one must be cautious that those who anticipate disproportionate benefit from co-operation are likely to take a lead role. Therefore, care must be taken to prevent them from deciding the rules of the game in such a manner that they are disproportionately in their favor

Key words: fisheries co-management; user heterogeneity; collective action

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I Introduction

Co-management, which visualizes relative roles for the state as well as users, is promoted in countries like India during the recent years in their effort to redress the problems due to state's failure in managing their natural resources. This approach while recognizes a crucial role for the state considers rural communities or user groups as the primary basis for resource management (Zuffrey, 1986). As far as the role of the users are concerned, it is argued that they are well informed about the local ecological, technical, economic and social conditions and as a result are in a better position to devise well-adapted rules, procedures, and sanction mechanisms that are capable of gaining broad support among resource users. The role of the state include providing economic incentives to users to induce them to shift from a shut-down path to a conservation path of resource exploitation, clarifying group territorial rights and providing legal framework to rural organizations to obtain legally enforceable recognition of their identity and rights, *etc.*, (Baland and Platteau, 1996).

Although conceptually appealing, a successful implementation of co-management will have to overcome a number obstacles and problems. In contexts where co-management is introduced as an institutional alternative to purely state based management of natural resources, the first and foremost thing is to institutionalize collaboration between the state and the users. Remember that coordination and information activities are initial aspects of building institutions (Ostrom, 1992). This means that the state has to take the resource users into confidence early on the design stages of co-management for which the co-operation and collective action of resource

users is inevitable. In fact, co-operation and collective action is a widely debated issue both at the theoretical and empirical levels (for instance, Wade, 1987; Ostrom, 1991; Bardhan, 1993; Baland and Platteau, 1996).

While sociologists and anthropologists look at social norms and codes of conduct in understanding cooperative behavior, economists usually emphasize incentives and penalties (Bardhan, 1993). According to some scholars, collective action have highest chance to occur and be effective when people belong to organized groups, when they are informed and consciously perceive that it is in their best interests to act purposively in a coordinated manner. Heterogeneity of group, which can be either ethnic, or even due to the differences in possession or access to some critical endowments have also, received considerable attention in literature.

Some studies have noted that heterogeneity of group facilitates collective action because it increases the likelihood that a 'critical mass' of highly motivated contributors will initiate action (Olson, 1965; Oliver and Marwell, 1985). However, there are also studies, which treat inequality synonymous to heterogeneity and argue that inequality has an ambiguous impact on the feasibility of the efficient outcome even though better-endowed agents contribute more to collective action (Baland and Platteau, 1999). Others like Heckathorn (1992) argue that under certain circumstances, heterogeneity of interests can impede collective action polarizing a group into opposing camps rather than coalescing members toward a unified collective action. In addition to this there is the problem of free rider. We know that in interdependent situations each individual takes into account the choices of others when assessing their personal choices (Ostrom, 1991) and if all participants choose to free ride the collective benefit will not be produced. There are also studies which have shown that although certain types of heterogeneities contribute towards the critical mass needed for a collective action, the distributional implications may still remain as a major problem. Under such circumstances, even if users initially get to agree to co-operate and share any rents from conservation, significant prisoner's dilemma will soon occur returning the resource to its current situation (Srinivasan, 2005).

The issue becomes even more complex in situations where the failure of the state in resource management has effectively created a set of users who are not only heterogeneous but also unorganized and geographically

scattered. The only common position they have among themselves is that they are direct users of the resource. So the question is whether these users can be motivated to co-operate and engage in a collective action which is a prerequisite for bringing about co-management. In this paper, we argue that in some cases like that of the Cochin estuarine fisheries in India, it may still be possible to motivate the unorganized, heterogeneous and geographically scattered users to co-operate and engage in a collective action provided some information regarding the likely distribution of benefits from various forms of cooperation are made clear to the users in the early stage itself. If this information is not provided, as noted earlier, after an initial cooperation, significant prisoner's dilemma is likely to occur thus returning the resource into its current situation. However, heterogeneity under these circumstances can have a differential impact and depends upon the users anticipation of benefits from each form of co-operation.

Area descriptions, methods and techniques

The Cochin estuary, also known as the Cochin backwater, which is about 90 kms in length and 250 kms^2 in area is the largest of its kind in the southwest coast of India. The existence of estuarine passages and bar mouths makes possible the constant mixing of freshwater with seawater through tidal exchange giving it the characteristics of a tropical estuary. The Cochin estuary provides a nursery ground for some species of penaied prawns (marine) of the southwest coast of India and fishing (although juvenile fishery[1]) has been an important source of livelihood for the people living along the estuary.

The fisheries have been managed by the Department of Fisheries of the state government as per the Travancore-Cochin Fisheries Act of 1950[2]. This Act empowers the government for making rules to protect fish and its habitat and thereby perform the basic resource management functions. The rules can be classified into 'access' and 'conservation rules' using the

[1] The penaied prawns are migratory species which migrate to the estuary during the post larvae stage and returns to the sea after attaining full growth.

[2] Travancore and Cochin were two princely states ruled by independent Kings before Indian independence and which continued as princely states until the formation of the State of Kerala on 1st November 1956. Following the formation of the state, the Act was extended to cover the whole of the state of Kerala. For the details of Travancore-Cochin Fisheries Act 1950, refer Ramakumar (1994).

typology of Baland and Platteau (1996). Access rules are those restricting free access to fishing in the estuary mainly through the issue of licenses and the conservation rules are those prohibiting destructive fishing practices, such as, the adoption of fishing nets with small mesh size, fishing during high tide, especially, near estuarine bar mouth, etc. For fishing in the estuary a licence was to be obtained from the Department of fisheries after paying a nominal amount as licence fee, which varied according to the type of equipment used for fishing. The important equipments used in estuarine fishing are the fixed engines such as Chinese and Stake nets, and free nets of different types and shapes. The traditional fishing community, the *Dheevara* mostly operates stake nets.

In spite of having well defined rules and regulations, the recent evidence shows that the state regulation has been a failure. Ghosh (1987 cited in Nair 1989) reports that out of 4,823 chinese dip nets operated, 3,131 (65 per cent) are unlicensed. In the case of 12,900 stake nets the unlicensed are about 3,887 (30 per cent). Substantiating the lack of adherence to both access and conservation rules, Nair (1989) reports that even though the operation of fixed engines are prohibited by law during high tide, especially, near the estuarine bar mouth, it is neither observed by fishermen nor effectively implemented by the Fisheries Department. Apart from these industrial pollution is also a major threat to fisheries. There are reports that around 250 industries on the banks of the river Periyar in the Eloor and Edayar industrial belt discharge about 260 million litres of untreated water which contains phosphates, sulphides, amonical nitrogen, fluoride, mercury, chromium, lead, zinc etc., per day into the Periyar which drains into the estuary. Under these circumstances the resource users are tempted to ignore the relationship that exists between estuarine fisheries and their own harvest practices. A web of interdependent common property, open access issues, prisoner's dilemma, adverse selection problem and regulatory failures have been identified as the causes for the ineffectiveness of state regulation (Srinivasan, 2005). It is under these circumstances that efforts are taken to involve resource users in the management of the Cochin estuarine fisheries.

This is based on the assumption that the state have the ability to deal with the exogenous factors affecting estuarine fisheries and protect the habitat while users would be in a position to organize, make suitable harvest decisions to prevent over exploitation, help in the enforcement of rules and

regulations and bargain for their rights over the estuarine fisheries. Thus a co-management where there are relative roles for both the state as well as the users is proposed as an alternative to purely state management of estuarine fisheries. It has been argued that the control of resources from within the fishing community as well as from above by the state are two complementary and mutually reinforcing channels that constitute a viable system of the administration and management of coastal fisheries (Ruddle, 1987). It should however, be noted that the user communities who are unorganized and geographically scattered are heterogeneous in terms of the community to which they belong, legal status, educational levels, type of equipment used for fishing, awareness regarding the ecological aspects of estuarine fishery and the various rules and regulations imposed for fisheries management under the fisheries Act, *etc*.

It is against this background that the users' willingness to co-operate and engage in collective action under co-management of the estuarine fisheries been examined in this paper. It may be pointed out that a collective action under co-management on the one hand requires active physical participation of users and on the other hand has to incur various types of managerial and organizational costs for bringing users together. Therefore, keeping in view the problem of free rider and strategic interactions there were several considerations while seeking co-operation of users. Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint-effort but to free ride on the effort of others. As observed earlier, if all the participants choose to free ride, the collective benefit will not be produced (Ostrom, 1991:6). Then there are strategic interactions which are conditional cooperation that says, 'if you cooperate, then I will too' (Olson, 1965). Gould (1993) argue that in the absence of incentives *strategic interactions* arising out of interdependent decision-making play an important role in motivating individuals to participate in collective action. Since the fishermen depend on the Cochin estuary as a source of their livelihood, they are jointly affected by almost everything they do. In the absence of any coherent user groups, individual fishermen are likely to adopt a strategic behavior if they are simply asked to co-operate. Therefore, we tried to provide some incentives to the users for their co-operation, which is targeted to meet the labor as well as monetary requirements of a collective action.

Specifically, the users had the following choices to make. Firstly, the users can co-operate and engage in collective action by contributing their labor for various conservation activities. The active physical participation of the fishermen include their labor towards formulation and implementation of various rules and regulations for the use and management of estuarine fisheries, disseminate information on the need to adhere to the rules and regulations among other fishermen *etc*. The incentive here is that those engaging in conservation activities will be included as members of *kayal samrakshana samitis* (Association of Backwater Protection) and will be having a say in decision making without regard to any other considerations related to fishing. Secondly, instead of contributing labor, the fishermen can cooperate by making a voluntary contribution towards meeting the organizational costs of collective action. In order to avoid strategic behavior, a question whether they are ready to make a contribution of certain amount of money annually, which would in turn give them a legal entitlement to fishing was posed to the fishermen. Grant of a licence was considered as an incentive to prevent the fishermen from adopting strategic behavior because of the reason that it not only gives legal entitlement to fishing but also is important in giving awareness regarding various conservation rules and is also used by the government to identify eligible fishermen for the purpose of bringing them under various welfare schemes (Srinivasan, 2005). Thirdly, the fishermen were allowed to contribute in terms of their labor as well as money for which the incentive in addition to the grant of licence is the insurance coverage for their fishing equipment and life in the eventuality of any natural calamity. Lastly, the fishermen had the choice not to participate at all.

Specification of the multinomial logit model

From the above discussion it is seen that the choices that the fishermen have are unordered and mutually exclusive. Therefore, a multinomial logit model specified below has been used to analyze the data.

$$\Pr(Y_i = j) = e^{\beta_j' X_i} / \sum_{k=0}^{3} e^{\beta_k' X_i} \qquad j = 0,1..\ 3 \quad (1)$$

Where j denotes the specific one of the $J + 1$ possible unordered choices of fishermen's co-operation, Y_i is the indicator variable of choices, X_i denotes the vector of the independent variables, and β_j is the corresponding

coefficient vector. As a standard practice of multinomial logit estimation, the vector of coefficients for one of the alternatives in the individual's choice set needs to be normalized to zero (see Greene, 2000) so that the dependent variable is the loglikelihood ratio of one alternative over the benchmark alternative. In this paper, the fishermen's decision to abstain from both physical participation and voluntary payment has been chosen as the benchmark (reference) category. In short, let X_i denote the vector of independent variables, then the estimation function for the fishermen's decision on co-operation can be formulated as:

$$\ln(P_{ij}/P_{ik}) = X_i^{'}(\beta_j - \beta_k) = X_i\beta_j \text{ if } k=0. \qquad (2)$$

where P_{ij} denotes the probability of ith fishermen choosing anyone of the option j and P_{ik} denotes the probability of choosing the reference category, that is, abstaining from both active participation and voluntary payment. Green (2000) points out that the coefficients in this model are difficult to interpret. The coefficients represent the effect of a change in each independent variable on the probability of selecting any of the other categories relative to the probability of abstaining from both. Since the coefficient estimates of the multinomial logit model represent only the effects of independent variables on the relative probability of choices, we cannot compare absolute values of the coefficients across different choices available to the fishermen. Therefore, in order to properly determine the direct effect of an independent variable on the probability of choosing an alternative option we compute the partial derivative of the probability of choosing an alternative with respect to the explanatory variable of interest, evaluated at the means of those independent variables (Greene, 2000). We can obtain the marginal effects by differentiating equation 1 as

$$\delta_j = \partial P_j/\partial X_i = P_j[\beta_j - \sum_{k=0}^{J} P_k\beta_k] = P_j[\beta_j - \bar{\beta}] \qquad (3)$$

Equation (3) shows that every subvector of β enters every marginal effect, both through the probabilities and through the weighted average that appears in δ_j. These values can be computed from the parameter estimates and the equation suggests that for any particular x_k, $\partial P_j/\partial x_k$ need not have the same sign as β_{jk} . The marginal effect estimates represent the change in the

choice probability of each alternative with respect to a change in the independent variables.

Drawing insights from the literature, the variables such as AGE, EDU, CASTE, TYPNET, LICENCE, MEMSHIP, RULES, OPTIMISM, LIFECYCL have been included in the multinomial logit model. These variables represents the socio-economic characteristics of the fishermen and the variables related to their fishing in the estuary and reflects various types of heterogeneities. The explanation of the variables is given below. Care was taken in defining dummy variables in order to avoid dummy variable trap[3].

Table 1. Explanation of the variables included in the multinomial logit model

Variables	Explanation
AGE	Age of the fishermen in years (quadratic form)
EDU	Education of the fishermen in schooling years
CASTE	Caste of the fishermen 1 if Dheevara and 0 Otherwise
TYPNET	Type of the fishing net used for fishing; 1 if fixed engines such as Chinese and Stake net; Otherwise 0
LICENCE	Legal status of the fishermen based on the possession of a fishing licence; 1 if possess a fishing licence; otherwise 0
MEMSHIP	Membership of the fishermen in their welfare organizations; 1 if they are members; otherwise 0
RULES	Fishermen's awareness of the access and conservation rules 1 if aware of the rules; otherwise 0
OPTIMISM	Optimism of the fishermen regarding the likely success of co-management 1 if optimistic; otherwise 0
LIFECYCL	Awareness of the fishermen regarding the lifecycle of the penaeid prawn, a proxy variable used to assess their knowledge of the ecological aspects of fishery, 1 if they are aware, 0 otherwise.

[3] The general rule is that if a qualitative variable has m categories, one must introduce only m-1 dummy variables. If this rule is not followed one might fall into a dummy variable trap which is a situation of perfect mutlicollinearity (Gujarati, 1988).

The coefficient and marginal effects estimates of the variable AGE is expected to be negative across all three forms of co-operation. According to theory, the fishermen's decision to come forward for a collective action has to be determined by their net expected gains from doing so. Here it should be noted that the costs to conserve the resource are incurred in the current period whereas the benefits only come in a later period. The present value of the net expected benefits, in turn, depends on the structure of users' time preference. Those with shorter time horizon disregard longer-term considerations in resource conservation (Baland and Platteau, 1999). Hence it is argued that the older fishermen discount the future at a high discount rate and therefore, are interested in maximizing their current incomes. However, the estimates of the variable EDUC which measures the number of schooling years completed is expected to be positive assuming that formal education can create greater awareness regarding the resource conservation needs and about one's own roles in achieving that.

Johnson and Libecap (1982) observe that differential yields that result from heterogeneity can affect the willingness of the fishermen to organize with others for specific regulations. Taking a cue from the above argument it was assumed that heterogeneity of the fishermen in terms of the technology adopted for fishing, that is whether they operate fixed engines or not can be a major factor influencing the fishermen's decision to co-operate. Therefore, TYPNET that indicates whether fishermen use fixed engines or not was introduced in the model. Since fixed engine users are immobile in nature they are the worst sufferers of the problems faced by the estuary. Their equipment is also more vulnerable to destruction in the event of any natural calamity. This also means that they are likely benefit more out of the resource conservation measures as envisaged in co-management. Due to this reason the estimates of the coefficient and marginal effects of the variable is expected to be positive in all the three forms of co-operation.

Another important variable included in the model is LICENCE which reveals the current legal status of the fishermen. Due to the widespread illegal fishing in the estuary, the legal fishermen are forced to share the fishing space and location with other users and are therefore in a disadvantageous position. Since illegal fishing is the result of the lapses in restricting access to fishing any measure taken under co-management to restrict entry would

be beneficial for the legal fishermen. On these grounds the estimates of the variable is expected to be positive and statistically significant in the first and last forms of co-operation. Since the grant of a license is the incentive for making a voluntary payment, the coefficient of this variable is expected to have a negative sign in this case as those fishermen who already possess a fishing licence do not perceive any additional benefits for the payments that they make. For example, Libecap (1989) noted that although the aggregate gains from reducing common pool problems by defining or redefining property rights are unlikely to be controversial, the distribution of wealth and political power that are part of the transition to the proposed rights structure will be a source of dispute. Since a grant of licence is the incentive for making voluntary contribution, it is natural that the present legal users would not be willing to pay. Firstly, they are already paying a nominal amount as licence fee. Secondly, since redistribution, that is the sanction of licences for those who are willing to make the voluntary contribution irrespective of current legal status would affect their status quo, they would be more inclined to oppose such a move. But when they perceive some additional benefits the present licenced users are willing to contribute money as well as labor and therefore, a positive sign for the coefficient is expected in the last case.

The estuarine fishermen are heterogeneous in terms of the community to which they belong. It is expected that the traditional fishermen community, that is, the *Dheevaras* are likely to show more interest for resource conservation. Belonging to traditional fishing community means greater interest for them in resource conservation, which in turn, might influence their decision for collective action positively. Therefore, the coefficient and marginal effects of the variable CASTE was expected to be statistically significant with a positive sign in all three forms of co-operation.

It is said that individuals with common interests would voluntarily act so as to try to further their interest (Bentley (1949); Truman (1958) cited in Ostrom (1991)). Assuming that the fishermen in their associations are individuals with common interest, the coefficient and marginal effects of the variable MEMSHIP was expected to be positive and statistically significant. Seabright (1993) in his model of ‘habit forming’ co-operation points out that people’s expectation about how cooperative others are may fluctuate randomly. If the

people's moods are correlated, then any one person's expectation about the cooperativeness of others will amount to an expectation about how likely others are to be sufficiently optimistic about the prospects for cooperation to be willing to cooperate among themselves. Cooperation is then induced by 'optimism about the level of optimism'. Therefore, OPTIMISM, which reflects the individual resource user's optimism about other's co-operation and the likely success of co-management, was expected to be positive and statistically significant in all the three forms of co-operation. Other than the above variables LIFECYCL and RULES were also included as explanatory variables. This is based on the assumption that when the resource users are more aware of the specificities of the resource, they would be in a better position to understand the factors working against its sustainable use. Penaeid prawns being the major stay of Cochin estuarine fisheries, the knowledge of the life-cycle of the penaeid prawns have been taken as a proxy variable to assess the fishermen's knowledge of the ecological aspects of estuarine fisheries. Since many of the fishermen are aware that pollution, fishing during high tide and the use of small mesh nets act as problems in fishing, it was expected that those who are aware of the life cycle were more likely to come forward. Similarly, the awareness of the fishermen regarding the rules and regulations was also assumed to influence collective action by the fishermen positively.

Data and sample selection

This paper is based on the data collected by conducting a primary survey among the Cochin estuarine fishermen during January – March 2000. Data has been collected after classifying the inland fishing villages in the Cochin estuary on the basis of the dominant type of fixed equipment such as Chinese and stake nets used for fishing. After dividing the 15 inland fishing villages into two, a sample size of about 360 was determined using the formula $n=1/\alpha^2*Q/P$, where p is the proportion of the cases having the characteristics under study in the population, Q=1-P and α is the per cent margin (IIPS, 1996). In this study, α was taken as 5 per cent. Further the villages were randomly selected and the estimated sample size was allocated between these sample villages. Since the fishermen live in clusters one active fisherman from each fishermen household of the purposively selected clusters was surveyed. In the final stage, the surveyed fishermen were classified on the basis of Chinese, stake and free net users. Out of the 369

sample fishermen, 55 (14.9 per cent) used Chinese nets, 195 (52.8 per cent) used stake nets and the rest 119 (32.3 per cent) were free net users. A structured interview schedule has been used for data collection.

Results and discussion

Before presenting the results of the multinomial logit analysis, a brief over view of some of the important user characteristics is useful. The average age of the fishermen surveyed is about 42 years and have about 24 years of fishing experience. Their educations levels are also fairly high reporting an average of 7 years of schooling and about 37 per cent of the fishermen having education levels of high school and above. The average size of the fishermen household is about 5. Almost 67 per cent (246) of the sample fishermen belonged to the traditional fishing community. Others are mostly Latin Christians and Hindus belonging to other backward and scheduled castes. Almost 60 per cent of the sample fishermen did not possess the required licence for fishing. Out of 369 fishermen surveyed, only 216 (58.5 per cent) acknowledged their awareness of the lifecycle and 171 (46.3 per cent) about the rules and regulations.

Among 369 respondents about 57 (15.45 per cent) respondents were willing to participate in co-management by merely contributing their labor in conservation activities. About 80 (21.67 per cent) respondents were ready to participate by making a voluntary contribution only. What is more striking to observe is that almost 160 (43.36 per cent) respondents were ready to co-operate by contributing their own labor while at the same time making a voluntary contribution as well. The rest 72 (19.51 per cent) were not interested in any of above.

Table 2 presents the estimated coefficients and marginal effects of the multinomial logit model. As is known, since marginal effects are easier to interpret and more informative than coefficients, we prefer to discuss marginal effects concurrently with those of the coefficients.

As per our expectation, the coefficient of the variable AGE is negative and statistically significant across all the three forms of co-operation. This tempts one to conclude that being an older fisherman negatively affects the probability of either co-operating in labor terms alone, or in monetary terms alone or in terms of both labor and money in relation to the probability of

abstaining from both. However, the estimates of marginal effects turned out to be not statistically significant.

Table 2 Estimated Coefficients and Marginal Effects of the Multinomial Logit Model.

Independent variables	Co-operation in labor terms only		Co-operation in terms of monetary payment only		Co-operation in terms of labor as well as in monetary payment	
	(I)		(II)		(III)	
	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
AGE	-0.0003***	-0.000	-0.0003***	0.0000	-0.0004**	-0.0000
	(0.0021)	(0.000)	(0.0002)	(0.0000)	(0.0002)	(0.0000)
EDU	-0.0067	0.0075	0.0254	0.0183**	-0.1357**	-0.0355*
	(0.0774)	(0.0081)	(0.0702)	(0.0094)	(0.0657)	(0.0118)
TYPNET	0.4533	-0.0612	0.7448**	-0.0199	1.4904*	0.2513*
	(0.3972)	(0.0462)	(0.3644)	(0.0504)	(0.3482)	(0.0571)
LICENCE	1.1657**	0.0903	-0.0191	-0.1331**	0.9330**	0.1428**
	(0.5294)	(0.0599)	(0.4749)	(0.0575)	(0.4292)	(0.0748)
MEMSHIP	0.2549	-0.0917	1.2181**	0.0894***	1.2314*	0.1754*
	(0.4592)	(0.0641)	(0.4693)	(0.0548)	(0.4238)	(0.0729)
OPTIMISM	0.5318	-0.0250	0.4449	-0.0593	1.3859*	0.2396*
	(0.5356)	(0.0667)	(0.4452)	(0.0732)	(0.4647)	(0.0738)
CASTE	0.6652	0.0937**	-0.2652	-0.0633	-0.0679	-0.0303
	(0.4541)	(0.0406)	(0.3850)	(0.0544)	(0.3584)	(0.0642)
LIFECYCL	0.27091	0.0188	0.0804	-0.0158	0.2034	0.0237
	(0.4089)	(0.0423)	(0.3677)	(0.0503)	(0.3415)	(0.0611)
RULES	-1.0653**	-0.1032**	-0.3619	0.0066	-0.3290	0.0269
	(0.5071)	(0.0533)	(0.4173)	(0.0589)	(0.3997)	(0.074)
Constant	-0.9665	----	1.0177	----	-0.8628	----
	(1.0810)	----	(0.9765)	----	(0.9185)	----

Number of Observations = 369
LR Chi2(27)=97.42; Prob>chi2=0.00
Pseudo R2 = 0.1015Log-likelihood = -431.40975
*, **, *** denotes 1, 5, and 10 per cent levels of significance

Another important result to note is with respect to the variable EDUC. Here the coefficient shows negative and positive signs respectively in the first and second forms of co-operation but are not statistically significant. However,

in the third case of co-operation, that is, both by way of active participation in terms of labor as well as by making voluntary payment, the coefficient showed negative sign, which was statistically significant at 5 per cent significance level. When we look at the estimates of marginal effects, it can be seen that the estimates are statistically significant in the second and third cases with positive and negative estimates respectively. Apparently what makes them behave positively in the second case is the presence of a licence as an incentive. The negative and statistically significant estimates of the coefficient and marginal effect in the third form of co-operation could be due to the adoption of strategic behavior which may be due to their apprehensions about the practicability of giving the incentives in the third case as compared to the second one.

When we consider the sign of the coefficient of TYPNET it is seen that in all the three cases, it is positive and is statistically significant in the last two cases. Since they are immobile with respect to fishing location, they suffer more from both endogenous and exogenous problems faced by the estuary. Even though being a fixed engine user is not a condition sufficient enough to motivate them to co-operate in terms of contributing their labor, as is evident from the table, it certainly is a determinant in the other two cases. While being a fixed engine user positively affects the probability of making a monetary payment, as is seen from the marginal effects, that alone does not significantly influence the fishermen to choose the second form of co-operation. However, the estimates of both coefficient and marginal effects are statistically significant at higher levels of significance in the last form of co-operation indicating the significance of the variable in explaining cooperation in terms of labor as well as money. This is not surprising as the fixed engine users are the ones who will benefit more from the incentives that accompany the last form of co-operation.

As per our expectation the coefficient of the variable LICENCE is positive and statistically significant in the first and last forms of co-operation. Regarding the second form of co-operation, that is, making only voluntary payment, unlike the coefficient which had a negative sign that was not statistically significant, the marginal effects had a statistically significant negative sign. It is interesting to observe that both the coefficient as well as marginal effect estimates was positive and statistically significant in explaining the last form of co-operation.

There are also some other factors that exercise considerable influence on the users decision to co-operate. For example, MEMSHIP that indeed was not an important variable explaining the first form of co-operation as is evident from both coefficient and marginal effects estimates turns out to be a major determinant in the other two forms. This is clear from both coefficients and marginal effects estimates, which are statistically significant. Although it is true that when fishermen are members of an identifiable collective identity they are bound by a norm of fairness at least with respect to specific collective good in question, that alone cannot be taken as a major determinant. The first case clearly reflects the attitude of the fishermen who do not perceive any additional benefits out of conservation measures. In the other two cases, which also accompany some additional incentives, one finds that the fishermen are interested in co-operating in collective action. This implies that in the absence of coherent user groups, users belonging to any organization which are not necessarily user groups but in one way or the other related to their livelihood activity can be motivated to co-operate in resource management activities provided that they derive some economic reward for their co-operation.

RULES is yet another variable which has to be paid proper attention. Here both marginal effects and coefficient estimates have negative signs which are statistically significant in the first case which could be a reflection of their strategic behaviors. As some of the respondent fishermen themselves could be rule violators, in an event of strict resource use regulation they are likely to suffer. The estimates of both coefficient and marginal estimates were not significant in the other two cases.

Another important variable to be noted is OPTIMISM. While optimism is not so important in engaging only in active labor participation or only making voluntary payment, the variable is very important in the third form of co-operation where the coefficient of the variable is positive and statistically significant. This means that if the individual users are sufficiently optimistic about the likely success of co-management then they are ready to invest both money and time for the conservation activities. This is an important result to observe since co-operation and collective action is not a question of either labor participation or merely monetary contribution from the individual users but requires their full commitment in terms of both.

Lastly, CASTE and LIFECYCL variables were not statistically significant in explaining the co-operation of the fishermen. This is against the widely held argument that people belonging to the traditional communities and those who are aware of the ecological specificities are more likely to come forward for resource conservation activities. In other words, the results indicate that these conditions are not enough for the users to engage in resource conservation activities in the present context.

Summary and Conclusions

This paper presents an analysis of the fishermen's decision to co-operate and engage in collective action in co-management, which is proposed as an alternative to the failure of the state in managing the Cochin estuarine fisheries in India. The estuarine fisheries have been managed by the State according to the Travancore-Cochin fisheries Act of 1950. However, the recent evidence point to the fact that state management have been a failure and the fisheries have been adversely affected by both exogenous as well as endogenous factors. It is under these circumstances that co-management where there are relative roles both for the users as well as the state have been proposed. However, it should be noted that the estuarine fishermen are not only heterogeneous but also are unorganized and geographically scattered.

Since co-management involves co-operation not only in terms of labor contribution but also in terms of monetary contribution for meeting various organizational and managerial costs, the co-operation of the fishermen have been addressed in the following manner in this study. The fishermen had different choices for co-operation with different incentives associated with them keeping in view the problems of free rider and adoption of strategic behavior. Firstly, they could participate in conservation activities in terms of their own labor. This will give them membership in Kayal samrakshana samitis and a say in decision making irrespective of their status related to fishing. Secondly, they could make a voluntary contribution in terms of money towards meeting the organizational costs of collective action for which the incentive was the grant of a fishing licence. Thirdly, they could engage in physical participation as well as make a voluntary payment for which besides the grant of a fishing licence, insurance coverage for the fishing equipment and life was the additional incentive. Finally, they could

abstain from both. It was found that out of 369 sample fishermen, 57 (15.45 per cent) were willing to participate in terms of their labor only and another 80 (21.67 per cent) were willing to make a voluntary contribution in terms of money. Another 160 (43.36 per cent) were willing to participate in terms of labor as well as in monetary terms. The rest 72 (19.51 per cent) were not interested in any of above. A multinomial logit model has been used to analyze the data.

The estimates of the coefficient and marginal effects of the multinomial model offer interesting results and are by and large consistent with few exceptions. Although the sign and significance of the coefficient of the variable AGE was according to our expectation that being an older fishermen negatively affects the probability of co-operation, that alone is not enough for us to conclude that they are less likely to co-operate as is seen from the marginal estimates. Strategic behavior by educated fishermen which could be due to their apprehensions about the practicability of giving incentives in third form of co-operation as compared to second one have been observed. The variable TYPNET, which in fact is a reflection of the economic heterogeneity of the fishermen, also have interesting results to offer. Unlike in the first case where TYPNET is not all that important, it certainly is important in the other two cases. This is not surprising as the fixed engine users are the ones who will benefit more from the incentives that accompany the second and third forms of co-operation. Similarly, the variable LICENCE, which indicates the heterogeneity in terms of the current legal status of the users, also offers interesting results. In conformity with our expectation, the coefficient of the variable is positive and statistically significant in the first and last forms of co-operation. Regarding making only voluntary payment, unlike the coefficient which had a negative sign that was not statistically significant, the marginal effects had a statistically significant negative sign. This is understandable, as the current legal users do not anticipate any additional benefits from contributing money, as grant of a fishing licence is the incentive given for monetary contribution. When it comes to the question of making contribution in terms of labor as well as money, the coefficient as well as marginal effect estimates was positive and statistically significant. Other variables that were found to be important in explaining co-operation are MEMSHIP, OPTIMISM etc, especially when it comes to the last form of co-operation. However, here also one can observe

the difference in the behavior of the fishermen who perceive some additional benefits or economic incentives from co-operation. It is significant to note that if the individual users are sufficiently optimistic about the likely success of co-management then they are ready to invest both money and time for the conservation activities. RULES, although is not significant in explaining second and third forms of co-operation is important in the first case. This could be due to some strategic behavior, as at least some of the respondent fishermen themselves could be rule violators and therefore, if strict resource use regulations are implemented they are likely to suffer. Lastly, as against the widely held argument that people belonging to the traditional communities and those who are aware of the ecological specificities are more likely to come forward for resource conservation activities, CASTE and LIFECYCL variables were not statistically significant in explaining the co-operation of the fishermen.

To sum up, while heterogeneity in terms of legal status positively affects the decision to co-operate in labor terms, when it comes to the more pertinent question of making monetary payment, economic heterogeneity and membership in formal organizations matters and the decision depends on the anticipated benefits from conservation. Apart from these, optimism about other users co-operation and success of an institutional change are found to be very important. However, even in this case where some information about the likely distribution of benefits is provided to the users, one cannot rule out the adoption of strategic behaviors at least by some users. Therefore, it is important to note and recognize that for a given a set of users', similar kinds of heterogeneities can have strikingly differential impacts on various forms of co-operation. In situations like that of the Cochin estuarine fisheries, where heterogeneity of unorganized users is a matter of fact, it would be better to design policies that seek users involvement in resource management in such a way that users are given more than a single choice on co-operation. In other words, if at all co-management has to be introduced in such situations, instead of debating whether heterogeneity is good or bad for co-management, policies should be designed to make best use of the heterogeneous users interest in resource management. However, one must be cautious that those who anticipate disproportionate benefit from collective action are likely to take a lead role. Therefore, care should be taken to prevent them from deciding the rules of the game in such a manner that they are disproportionately in their favor.

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