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Participation in Fishing Cooperatives and its Impact on Income: The Case of an Inland Fishing Cooperative in Madhya Pradesh, India

Jharna Pathak
Assistant Professor
Gujarat Institute of Development Research
Gota, Ahmedabad 380 060
*Email: **fmjharna@yahoo.com***
Phone (O): 91-2717-242 366, 367, 368
Phone (H) 91-79-2791 0589
Phone (Mobile) 099131 76607
Fax: 91-2717242 365

Abstract:

Community based fisheries management is important to conserve and sustainable use of fish resources. This paper examines the extent to which fishing cooperatives have been successful in meeting their primary goal of improving the lives of the rural poor depending on it. It analyses how fish resource in the reservoir and the environmental services they provide influence participation among members of the cooperative and the impact of participation on increasing income of households. The findings of this study might provide policy makers with important insights on management of degraded fish resources for poverty alleviation. If proved successful, this innovative experiment from an Indian state of Madhya Pradesh can provide valuable lessons to countries facing similar resource degradation and poverty problems.

1. Context

Fish production in India increased from 2444 thousand tonnes in 1981–82 to 8290 thousand tonnes in 2010–11. In 2010-11, inland fish constituted 61% of the total fish production while marine sources made up the balance. Over time, share of fish production from marine sources has declined from 59 per cent (1445 thousand tonnes of the total production of 2444 thousand tonnes) in 1981–82 to 39 per cent in 2010-11 (3220 thousand tonnes out of the total fish production of 8290 thousand tonnes) (provisional figures, Government of India, 2005). An upsurge in inland fishing in reservoirs, lakes, ponds, rivers and canals has been witnessed since 1999–00. Scholars argue that India's marine fisheries' production has reached a plateau and, at best, only a marginal increase can be predicted in the near future (Sinha and Katiha, 2002). They suggest that much of the increase in demand for fish will have to be met by increasing production from the inland sector. Reservoir fishing, along with riverine fishing and aquaculture, has been the main source of inland fish production. This multi-use common water bodies constitute an important component of community assets in India and have been used as traditional commons to meet the need of food and livelihood of the community (Marothia, 2012: 163). Governance structure holds certain potential to contribute towards reducing poverty.

In many states, efforts have been made to design efficient policies and governance regimes for sustaining inland fishing. As per the guidelines of the Government of India (2005), first preference has been given to fisheries cooperative society to lease large scale reservoir. The water body can only be leased out to fisher folk or individual fisher if FC do not bid for leasing in the reservoir. This was supposed to help its members in marketing the products, improving bargaining power of members leading to fetching better prices and fair services and preventing exploitative opportunism. Moreover, collective action is assumed to increase the overall economic efficiency and competitiveness of the marketplace by correcting market power imbalances and providing fair treatment (Torgerson et al.,1998).

However literature also has numerous incidents when Fishermen's Co-operative Societies do not avail any extra benefit other than the right of catching fish in the brackish water (Rahim et al., (1992). This discourages them from participating in fishing activities.In absence of well-defined property right over this common property resource, community-based interventions that are truly participatory in nature are being recognized for their ability to address poverty in a more efficient and equitable manner (Cernea, 1985). Koppen et al., (2002) shows that challenges of making CNRM participatory is not resolved. Ballabh et al., (1988) revealed that people participate in managing natural resources when private benefits from participation is higher than private costs of doing so. Experiences show that though there is strong theoretical and empirical evidence about conditions for the success and the failure of institutions in poverty reduction, designing policies to create local institutions for managing natural resources still remains a challenge (Heltberg 2001; Kumar 2007). Importantly, the effect of management of natural resource influencing the participation of the community is yet to be explored.

Dasgupta et al, (1991) believed that the nature of property-rights regimes and the pattern of distribution of access to natural resources not only affect the income but in the long run, it also affects the quantity and quality of the resource-base. Exclusion from crucial resources, following changes to property rights regimes, acts as the main catalyst for increasing vulnerability of poorer households. The process of decentralising fish resource management from central authority to the community involves a wide range of issues that go beyond the considerations of sectoral productivity and growth. The issue of participation by FC members in FC related activities is particularly crucial in areas where accesses to resources, in absence of alternative employment opportunities, play a major role in determining standard of living of the community.What is therefore questioned is the extent of dependence of community on fish resource and the impact of participation in FC on the household income of the community.

2. Fishing Cooperative in Madhya Pradesh

Fish production in India increased from 2444 thousand tonnes in 1981–82 to 8290 thousand tonnes in 2010–11. In 2010-11, inland fish constituted 61% of the total fish production while marine sources made up the balance. Over time, share of fish production from marine sources has declined from 59 per cent (1445 thousand tonnes of the total production of 2444 thousand tonnes) in 1981–82 to 39 per cent in 2010-11 (3220 thousand tonnes out of the total fish production of 8290 thousand tonnes) (provisional figures, Government of India, 2005). An upsurge in inland fishing in reservoirs, lakes, ponds, rivers and canals has been witnessed since 1999–00. Scholars argue that India's marine fisheries' production has reached a plateau and, at

best, only a marginal increase can be predicted in the near future (Sinha and Katiha, 2002). They suggest that much of the increase in demand for fish will have to be met by increasing production from the inland sector. However, fish production from large reservoirs is lower than that from small inland water fishing sources. This can be attributed to poor management of fishing (Sugunan, 1995). Thus, a proper management system is necessary for enhancing the fish productivity of Indian reservoirs.

MP is cent per cent dependent on inland fishing (Government of India, 1994). Thus, the use of inland water bodies for the sole source of livelihood was common. Importance of fishing, physical condition of the reservoir, social and political system has led to the evolution of different management regimes like government control, community based fisheries management and so on. In the past, the state government was responsible for the fish harvest from the large and medium scale reservoirs in Madhya Pradesh. This responsibility later got transferred to Madhya Pradesh State Fisheries Development Corporation (MPFDC). MPFDC continued to manage fishing in the reservoir till 1994. Poor performance of reservoir under MPFDC regime (like an inconsistent level of stocking, irregularity in marketing, decrease in average number of fishing days, and the decline in the potential of the reservoir to generate income led to the formation of Madhya Pradesh State Fish Federation (MPFF) in 2005. The state government has made the functioning of MPFF and FCs mandatory by enacting a law. At present there are 19 FCs. As the villages are big, more than one groups of fishers from one village form a FC. MPFF is the apex organisation of FCs with each cooperative having its own committee headed by a president and a secretary. It has laid workable procedures for monitoring the behaviour of fishers by assigning role of monitoring and marketing to the contractor, enforcing against non-conforming behaviour through FCs. Thus, it would be interesting to understand how state's intervention in fishing activities impact on the livelihoods of the community dependent on them. We will be using an in-depth analysis of case-study of FCs formed in the Gandhisagar reservoirs and to show how and to what extent FCs have affected the income and livelihoods of fishers.

3. Objectives

This paper seeks to examine the process of decentralising fish resource management from central authority to end-users, and 2) critically understand the extent of participation in FC related activities and its impact on access to fish resource, income and inequality in income among fisher members.

These aims have been examined in the context of a case study in MP where different processes for forming FC in large scale reservoir fishing have been adopted.

4. Methodology and Data Collection

The analysis is based on primarily data collected by conducting survey of FCs formed in Gandhisagar reservoir, a large scale irrigation Project in Madhya Pradesh. Members of the fishing cooperative were mainly households who were displaced at the time of the construction

of reservoir and were later rehabilitated in the periphery of the reservoir. Members of Gandhisagar FCs also included refugees from Bangladesh who settled in India after 1971 war. These displaced communities got the rights to fish in the reservoir. Refugees from Bangladesh were originally landowners who also used to catch fish for home consumption. The group of fishers form the cooperative and these cooperatives constitute the fish federation that manages the fishing activity in the reservoir. FC is taken as a unit of analysis in this study. Given the specificity of fish resource, location of FCs is important in analysing the dependence on the resource. Keeping this in mind, primary survey was conducted in 90 households in each of the FCs located on the reservoir, i.e., the head, middle and tail portion of the reservoir, totalling to 270 households. The reference year for this study was 2009 and performance of fisheries management by community and its impact on poverty was compared with that in the year 2004 when fishing department was managing fishing activities.

As our objective is to assess the participation in group activities and its impacts on poverty, simple comparison of key indicators is done. Following Kumar (2009), we first compared mean income levels. On the lines of the above discussion for estimating the impact of participation of fishers in FC activities on the poverty indicator namely the income (MPCE), we controlled for the observed heterogeneity across households and estimated the following multivariate Ordinary Least Squares (OLS) regression model:

$$Y = \alpha + \beta X + \gamma P + U1 \quad \text{.................................(1)}$$

where, Y refers to monthly per capita expenditure (MPCE) which is taken as a proxy of income variable of the household. The variable 'X' is the vector of household specific and contextual factors which affect the household income. These variables include age (Age), educational level of head of the household (Education), number of workers (totalworkers), size of the household (members), major activity in which households are involved (MJSIoccupation), households with more than two children (children>2), index of benefits received from FC (benefitindex), index for the condition of reservoir (conditionreservoir), measured in terms of over exploitation, population pressure, illegal fishing, etc, location dummy with village in the middle reach of the reservoir (locmiddle), location dummy with village in the tail reach of the reservoir (loctail) and participation of members in the FC (participation). Index of benefit of the FC is the percentage of actual score by maximum score of variables like more fish catch, more expenditure on education, more expenditure on health, more loan and deferred wages, availability of loans, deferred wages and increase in saving. These variables are admittedly rather narrow and partially capture the notion of benefit of the household. But this limitation is mainly due to data availability in the survey. Similar index of condition of the reservoir include index of variables like level of overexploitation, population pressure, illegal fishing, political influence, deforestation in the catchment area and so on.

It is assumed that the participation in FC would explain the resource harvest and its sustainability. As per the programme evaluation literature, the variable participation cannot be treated as exogenous[1] i.e., household dependent on fishing is more likely to participate. To

[1] Exogeneity means that the right-hand side variables are determined independently of income and so they are uncorrelated with the error term in the income regression. Because fishers of FC activities are selected by the programme officials, FC participation is not exogenous.

control for such possible endogenous selection of fishers in the FC activities, we employ instrumental variable approach. This requires identification of a valid instrument variable i.e. one which is highly correlated with participation but not correlated with income. In this case, the variable named partdummy 'working closely and helping the President of the FC in FC related activity'. Here, the variable P is replaced with its predicted value derived from a probit regression of the following model.

$$P = \alpha_0 + \alpha_i H_i + ß_i C_i + U2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where, P is a binary variable, takes the value 1, if the household is a participant in FC activity; 0, if does not participate. H_i is the vector of household specific variables influencing education of head of the household (education), age of the head of the household (age), number of dependents, size of household (members), children more than two in number, major activity in which households are involved, totalworkers, income from non fishing activity (incomenonfish), and C_i is the contextual factors like index for the condition of the reservoir, benefit index, location dummy of village in the middle reach of the reservoir, location dummy of the village in the tail reach of the reservoir.

To implement the instrumental variable estimation, we need instruments that do not affect the outcome variable viz., income directly but which affect fishers' participation in activities of FC. The model is estimated by two stage least squares method (2SLS).

It is hypothesised that the favourable environments of FC would facilitate the smooth functioning of the groups, reduce social tension and enhance cohesion between members of FCs. The error term U1 is assumed to follow independently identical distributions. The above model of instrumental variable method may some time be restrictive, in that it ignores the fact that FC members who are more likely to benefit from FC participation are in turn more likely to be the observed members. To allow for such self-selection, we estimate the following Heckman's two step procedure *(Coadyet al. 2001 as referred in Kumar, 2009)*. To understand the impact of members' participation in FC activities, following equations were solved:

Participation=Bo+B1age+B2education+ B3members+ B4mjsioccupation+ B5 children>2 + B6 totalworkers +B7 dependents+ B8nonfishincome + B9 benefitindex +B10conditionreservoir + B11locmiddle +B12loctail.

Income = Bo+B1age+B2education+ B3members+ B4mjsioccupation+ B5 children>2 + B6 totalworkers +B7 benefitindex +B8conditionreservoir + B9locmiddle +B10loctail +B11partdummy + B12 λ +ui

This method can simultaneously handle consistency and computational efficiency. This procedure involves two separate steps. First, estimate the participation probability by applying a binary probit model. Probit model would reveal factors affecting participation of members in FCs. This would help us to calculate inverse mill ratio (IVMR)[2]or household specific selective

[2] The IMR is used as an additional regressor. It is calculated for each observation of the selected sample from the first stage of Probit estimation. If the coefficient of the IMR is found to be significant, sample selection bias is really exists and including IMR as an additional regressor is relevant and increases efficiency. Contrarily, insignificant effect of the IMR indicates no such sample selection bias is detected (Dutta and Magableh, 2004 as referred in Kumar, 2009).

variable. The IVMR which measures probability of household being a participator would help us in addressing self selection bias using Heckman two step approach. Following Kumar, (2000), we have estimated IVMR using probit model:

Prob (partdummy = 1) = β ' K + ei

From which $\lambda = \varphi (\beta ' K) / 1 - \Phi (\beta ' K)$;

where, partdummy is working with and helping the President in FC activities, K is a set of variables explaining the participation decisions, φ and Φ are the probability density and cumulative distribution of the error term respectively. In the second step, apply OLS on the income equation, while using λ as another explanatory variable in the income equation. This would help in getting rid of the omitted variable problem that would emerge otherwise and the estimator of the parameter vector 'ß' becomes consistent. The additional regressor controls for the part of the error term in the outcome equation that is correlated with the dummy variable for participation. Sample selection bias has been corrected by the selection equation, which determines whether an observation makes it into the non-random sample.

5. Results and discussion

5.1. Household Characteristics

Table 1 presents characteristics of the sample households. It shows that 52% of the total population are engaged in various economic activities. Nearly 64% of households were dependent on fishing while another 26% were dependent on income from causal labour in non agricultural activities. Nearly 57 households (21%) reported income from supplementary sources too, such as income from causal labour in non agriculture activities. Richness of the reservoir in fish resource, lack of ownership of agricultural land, problems associated with cultivating forest land, lack of alternative employment opportunities and remoteness from nearby urban centres explain greater dependence of the community on fishing. However, location wise analysis shows that out of total households, nearly 76% in tail end of the reservoir are dependent on fishing for their livelihood as against 93% of households in head and middle reach of the reservoir (For detail see Pathak (). Perhaps, the inherent characteristics of the reservoir might be the reason for this trend. The geographical distance between the head reach village and the tail end village (nearly 80-120 kms) confines fishers to fish in a limited area of the reservoir. As a result, tail end fishers supplemented their income by taking up secondary employment by working as a casual labour in non agricultural activity (61%). There appears a clear relationship between locational advantage and dependence on fishing activity as the major source of income of the householdsFor detail see Pathak (). This is believed to have its implication on income earned from fishing as well.

Table 1: Characteristics of sample households, Gandhisagar Reservoir

Details	After FC	Before FC
Total households covered (N)	270	270
Number of fisher households owning land	15	15
Total population (N)	1712	1566
Average family size (number)	6.3	5.8
Total Workers (N)	**889**	**576**
Workers (%)	51.9	50.2
Occupation status: Primary Source of Income (% to hhs)		
Agriculture and Animal Husbandry	2.6	
Fisheries	64.1	99.2
Casual agricultural labour	4.8	
Casual non agricultural labour	26.3	
Self employment	2.1	0.8
Secondary Source of Income (% to hhs)		
Fisheries	1.7	
Total (% to total hhs)	21.1(57)	8.9 (24)
Total income of the household (Rs/month)	4288	3082
Total income from fishing activity (Rs/month)	3127	3050
MPCE (Rs/month/capita)	686.7	526.8
Poverty Gap**	278.2	199.02
Percentage of poor	11.1 (30)	19.3 (50)

Note: * It was a forest village. Its since three months from the date of the survey that the village was declared a revenue village.

** The poverty gap is defined as the poverty line less actual income for poor individuals; the gap is considered to be zero for everyone else.

Figures in parenthesis indicate number of observations.

Source: Field Survey (2009)

Table 2 shows that fishing contributes (Rs. 30, 010 per year) significantly to the income of the fishers when compared with income from non fishing activity (Rs. 22803). Income from fishing has increased over time. This reflects the greater contribution of fishing to the income of the household.

As stated, monthly per capita consumer expenditure (MPCE) is considered in this paper as a proxy for income to mean distribution of income among community. It is observed that MPCE may not reflect income but is closely related to person's wellbeing and is not affected by seasonal fluctuations in income. It may also factor in earnings from assets, debt and dissavings. Table 1 also shows that before participating in the FCs, nearly 19% of households were below poverty line which declined to 11% after joining FCs. Notably, the poverty ratio as observed in the study area has been well below the state average. For instance, according to 61st round of NSS, nearly

48% of people live below the official poverty line in MP during 2004-05. Perhaps, the productive fish resources as available in the reservoir and the greater dependence on it, might explain the lower incidence of poverty in the study area during both the periods.

The above discussion shows that fishing contributes significantly to the income of the households. For a better understanding of the standard of living of fishing households, it is important to compare their income level with those of households in other sectors of the rural economy. For this purpose, comprehensive socio-economic data for the other sectors were required and these data were comparable over time. MPCE data were used to generate the distribution of household over major sources of income earned by the household. It is clear from Table 4 that income earned from non agricultural labour is higher followed by income from fishing activity.

Table 2: Average (median) Household Income, Contribution of and Difference in Income after FC Formation, by MJSI: Gandhisagar Reservoir, MP

Fishing cooperatives	Sources of income (in Rs/year)					
	Cultivation	Fishing	Agri-cultural labour	Non-agricultural labour	Other*	Total
Before FC formation (constant terms at 2009 prices)						
Gandhisagar	7695 (1)	29,818(90)		8978(2)	27,702(1)	31,614(90)
Rampuriya		26,535(90)	9234(1)	7695(6)		26,663(90)
Sanjit		32,742(90)		12,825(1)		32,743(90)
Total	7695 (1)	28,407(270)	9234(1)	7695 (9)	27,702(1)	30,742(270)
After FC formation						
Gandhisagar		46,000(90)		17,825(34)	18,400(9)	56,925(90)
Rampuriya		39,100(90)	26,450(2)	17,825(46)	27,600 (3)	55,085 (90)
Sanjit	18630 (9)	26,910(90)	14,720(22)	20,700(47)	23,000(5)	49,680(90)
Total	18630 (9)	38,870(270)	14,720(24)	18,400(127)	23,000(17)	53,360(270)
Share to total Income Before FC (%)						
Gandhisagar	0.15	98.96		0.4	0.5	100.0
Rampuriya		98.25	0.2	1.6		100.0
Sanjit		99.75		0.3		100.0
Total	0.05	98.99	0.1	0.7	0.2	100.0

After FC						
Gandhisagar		85.6		11.6	2.8	100.0
Rampuriya		80.5	0.8	17.4	1.4	100.0
Sanjit	5.8	58.0	10.0	24.5	1.8	100.0
Total	1.6	76.0	3.1	17.3	2.0	100.0
Average (median) difference in income after FC formation (Rs/year)						
Gandhisagar	-7695	16182		8848	-9302	25311
Rampuriya		12565	17216	10130	27600	28422
Sanjit		-5832	14720	7875	23000	16938
Total	-7695	10463	5486	10705	-4702	22619
% change after FC formation						
Gandhisagar	-100.0	54.3		98.6	-33.6	80.1
Rampuriya		47.4	186.4	131.6		106.6
Sanjit		-17.8		61.4		51.7
Total	-100.0	36.8	59.4	139.1	-17.0	73.6

Note: *Other includes shopkeeper, carpenter, plumber etc.

2. Figures in parentheses indicate number of observations.

Source: Field Survey (2009).

5.2. Factors Influencing Participation of Members in Activities of Fish Cooperative

The participation in FC takes place: (i) when there is a greater dependence on the fishing activity, and (ii) when the resource dependence (?) has contributed to an improvement in income. Given this, we try to understand what factors contribute to participation in FC activities which in turn improve income of the household. Since the initial number of poor is low and majority of households are dependent on fishing, we consider MPCE, as a proxy of income of the household as the dependent variable rather than change in income after FC to study the impact of participation on income. The definition of variables and their descriptive statistics are presented in Table 3.

Table 3: Descriptive Statistics: Gandhisagar Reservoir, Madhya Pradesh

(N=270)

Variables	Definition of variables	Minimum	Maximum	Mean	Std. Deviation
Income	Yearly household expenditure (Rs/year/household)	13500	103908	46740	11480
Age	Age of the head of the household (in years)	16.0	62.0	39.9	12.9
Education	Educational level of head of the household (in years)	0	17	9	2.4
Totalworkers	Number of workers in the household	1.0	10.0	2.7	1.6
Members	Family size	1.0	17.0	6.3	2.8
MJSIoccupation	Binary variable: 1, if major source of income is from fishing; 0, otherwise	1.0	1.0	1.0	0.0
Children>2	Number of children more than 2	1.0	2.0	1.5	0.5
Participation	Binary variable: 1, if the household participates; 0, otherwise	0.0	1.0	0.9	0.2
Partdummy	Help president in FC activities Binary variable: 1, if the household participates; 0, otherwise	0.0	1.0	0.7	0.2
Conditionreservoir	Condition of the reservoir in index	32.1	90.6	50.1	8.4
Benefitindex	Benefits accrued from FC in index	13.6	68.2	41.2	10.4
Loctail	Binary variable: 1, if the Village is located in tailreach of reservoir; 0, otherwise	0.0	1.0	0.3	0.5
Locmiddle	Binary variable: 1, if the Village is located in middle reach of the reservoir; 0, otherwise	0.0	1.0	0.3	0.5
Dependents	Number of dependents in the family (adults aged above 60 years and children below five years)	0.0	13.0	4.6	2.3
Nonfishincome	Income of the household in non fishing activity in Rs/year/household	800	60000	12885	11358

Source: Field Survey (2009)

The participation of fishers in FC activities is influenced by various household specific factors like age and educational level of head of the household, average size of the household, children more than two, total number of workers, number of dependents, income from sources other than fishing activities, dummy signifying household's main occupation, dummy signifying village located in middle reach of the reservoir, dummy signifying village located in tail end of the reservoir, condition of the reservoir, index of benefits received from FC and index of condition of the reservoir, (Col.3 of Table 4).

Coming to the role of number of children more than 2 and the number of other dependents, we find that both these variables are insignificant related to participation of members in FC activities. There are two competing effects of increase in number of children and other dependents on the participation in FC activities. On the one hand, fisher households with a large number of children and dependents have greater economic pressure that pushes them in search of more income sources. On the other hand, an increase in number of children or dependents results in a high level of dependence on economic activity which may sometimes be at the cost of meeting the rules of the FC. Our result suggests that although economic pressure to participate in the labour force is somewhat dominant, the net effect of the two does not have any significant effect on participation in FC activities.

Education of the head of the household can have two different types of effects on participation in the activities of fishers and resultant participation in FCs. Education some times offers exit options and this is likely to reduce participation (Lise, 2000). However, educated members can be influential in the household and can participate in the group activities. In the study area, education shows a significant influence on participation.

Table 4: Participation in FC activities and its Impact on Household Income: Gandhisagar Reservoir, Madhya Pradesh

Particulars	Log (Income)	Member Participation	Marginal effect	Log (Income)	Log (Income)
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Intercept	5.747*** (20.340)	-2.443 (-0.97)		5.360*** (12.240)	-4.556*** (7.650)
Age	0.052 (1.43)	0.232 (0.720)	0.035	0.037 (0.860)	-0.087 (-1.410)
Education	0.107** (4.610)	0.373* (1.790)	0.051*	0.011 (0.820)	0.320*** (2.59)
Members	-0.488*** (-12.88)	-0.448 (-1.17)	-0.068	-0.454*** (-9.04)	-0.308*** (-3.02)
MJSIoccupation	0.013 (0.600)	0.529** (3.03)	0.081	0.037 (1.230)	-0.451** (-2.490)
Children>2	-0.047** (-2.160)	0.049 (0.260)	0.007	-0.044** (-1.73)	-0.071*** (-2.990)
Totalworkers	-0.008 (-0.340)	0.932*** (3.290)	0.142***	-0.010 (-0.330)	-0.512** (-2.390)
Dependents		0.085 (1.150)	0.013		-0.031* (-1.700)
Nonfishincome		-0.067** (-1.840)	-0.010		0.031** (2.080)

Benefitindex	0.132*** (4.41)	0.371* (1.630)	0.057*	0.046 (0.690)	-0.124 (-1.12)
Conditionreservoir	0.148** (2.580)	0.059 (0.120)	0.009	0.211*** (2.730)	0.336*** (3.61)
Locmiddle	0.019 (0.840)	0.404** (1.870)	0.062**	0.047* (1.490)	0.195** (2.230)
Loctail	-0.057** (-2.420)	-0.256 (-1.40)	-0.039	0.009 (0.170)	-0.152* (-1.800)
Participation	0.002* (1.9)			0.016** (1.710)	
Partdummy					0.003* (1.6)
IVMR λ					4.773* (1.800)
Model	OLS	Probit	Probit	2SLS	Heckman 2step
F stat	56.97***		41.9***	50.16**	
R^2	0.5861		0.4381	0.5913	
Adjusted R^2	0.5758		0.4241	0.5796	
Loq likelihood		-171.176			
Chi square		91.62***			
No of Observations	270	270	270	270	

Note: 1. *** Significance at 1%; ** significance at 5% and * significant at 10%.

2. Figures in parentheses indicate estimated‘t-ratio’

Source: Field survey (2009-10)

Similarly, presence of non-fishing income negatively influences the participation of members in group activities. As income from other sources like agriculture labour increases, the interest of members to participate in the FC activities diminishes. This shows that contribution of fish resource to the income encourages members to take active interest in the functioning and activities of FCs.

Similarly, the presence of direct and indirect benefits of FC, less interference of the reservoir from outside agents increase social interactions and the possibility of enforcing an agreement. Increase in dependents will have negative interaction with participation in FC activities. Gandhisagar has laid down proper framework for managing the resource. If this is true, benefits accrued to fishers would get translated in the positive interaction with the participation in FC activities.

5.3. Impact of Participation on Household Income

To examine the relationship between participation of fishers in FC activities and its impact on household income, participation is used as an independent variable in the income regression. The result of the OLS in Column 2 of Table 4 shows that participation of household in FC activities is positively and significantly related to the household income.

The household specific characteristics such as family size of the household and number of children more than two are the significant factors influencing household income negatively. The

conditions of reservoir, benefits from FC are significantly and positively related to income. Since most of the households depend on fishing for their livelihood, the significance of the condition of the reservoir and benefit from reservoir opens up scope for improving the benefits from FC and maintaining the condition of the reservoir.

Since the programme is expected to generate benefits, it is possible that households with a higher average income tend to be better informed and have stronger bargaining power. Considering this issue of endogeneity in programme participation, we employed instrumental variable (IV) technique and estimated two equations of income and participation by two stageleast squares method (2SLS) (Kumar, 2009). In the first stage, a probit model of participation of fishers in FC activities is estimated and then the predicted value of participation [in the form of an Inverse Mills Ratio (IVMR)] is included as an explanatory variable in the income equation. IVMR is the standard normal probability density function (evaluated at some point, usually the sample mean values) divided by the standard normal cumulative density function (again, evaluated at the sample mean values). The coefficient in probit equation have no direct interpretation (being simply the values that maximize the likelihood function), but the marginal effects = $\varphi(Z\gamma)\ \gamma j$ signify that one extra worker raises the probability of helping the president of FC in FC's activity by 14 percentage points.

To implement IV estimation, we need instruments that do not affect income directly but will affect participation in the FC activities. As an instrument, we chose variable named partdummy 'working with and helping the President of the FC in FC activity'. Column 1 and 2 reveals results of the impact of programme on income. Our OLS (col. 2) of the income impact of the programme shows that the presence of the programme increases income by 0.2%. But if income of fishers and participation of fishers have to influence each other, then our OLS estimate of the programme effect is biased. Using IV estimation, we get a consistent estimate of the direct and a significant impact of participation in FC activity to lead to a 1.6% increase in income. To control for self-selection issues, a Heckman two step procedure is employed. The results (col.6) from Table 4 revealed that the income is negatively influenced by size of the household, major source of income from fishing activities, number of children greater than 2, villages located in tail end, total number of dependents, total number of workers and total land owned. Location in middle reach, condition of the reservoir, income from non fishing activity is positively and significantly related to income.

The estimate of the inverse Mills' ratio (IVMR) in the regression model is statistically significant and has positive sign, signifying that helping the president in FC activities and household income are positively correlated. Inclusion of IVMR (λ) in the specification corrects for the selection bias and the significance of the other regressor (Pattanayak, et al., 1998 as referred in Kumar, 2009). The positive and significant IVMR implies that there exists sample selection bias and the estimation of Heckman two step procedures is a relevant one. The positive sign indicates that unobserved factors that make participation in the FC activities likely in stage one tends to be associated with higher income. Notice also that the estimated coefficient on education, condition of reservoir index, is now significantly larger than before, indicating the selection is biasing down the income returns to education and condition of reservoir index.

5.4. Effect of Participation in FC on Improving Income of the Household

It is expected that participation in FC activities enable the households to earn more income to the household. The percentage increase in income is nearly 9.7% over households not participating in FC related activities.

Analysis of pattern of consumption expenditure of the households revealed that MPCE is worked out to Rs.3719 per household per month and Rs. 3389 per household per month for the participating and non participating households respectively (Table 5). The expenditures towards food and non-food items (Rs 1129 per household per month) for participating households are higher compared to expenditure by non participating households. Increased benefit emanating from fishing positively affects interest of fishers in activities of FCs. Data reveals that the expenditure on food items like fish, cereals, pulses and oil and non food items like clothes and medical seems to be higher among the member households when compared to households not participating in FC activities. This indicates that for households dependent on fishing, access to cash flow, additional income generated and social interactions through participation in FC activities not only help the households to acquire adequate nutrients, but also in uplifting the status of household.

Table 5: Participating in FC Activities and Its Impact on Household Income

Rs/household/month

Particulars	Participating household		Not participating household		Total	
	Mean	%	Mean	%	Mean	%
Food Expenditure						
Cereals	1008	27.1	857	25.3	999	27.0
Pulses	228	6.1	202	6.0	226	6.1
Milk	347	9.3	383	11.3	349	9.4
Oil	275	7.4	252	7.4	274	7.4
Vegetables	278	7.5	330	9.7	281	7.6
Fish	455	12.2	256	7.5	444	12.0
Total	2591(13.7)	69.7	2279	67.2	2573	69.5
Non Food Expenditure						
Clothes	341	9.2	335	9.9	341	9.2
Medicines	345	9.3	295	8.7	342	9.2
Education	146	3.9	185	5.4	149	4.0
Transport	238	6.4	240	7.1	238	6.4
Fuels for domestic purposes	59	1.6	56	1.7	59	1.6
Non food expense	1129 (1.7)	30.3	1110	32.8	1128	30.5
Total	**3719 (9.7)**	**100**	**3389**	**100**	**3701**	**100**

Note: Figures in parenthesis indicate % increase in income of households

Source: Field Survey (2009)

It is often being concluded from various researches that a community based and decentralised system of management is the best form of managing natural resources. However, the scale, nature of the resource and other socio-economic factors play a vital role in the effectiveness of any management system, which makes replicability of management system difficult. However, it is also clear that FC in Madhya Pradesh led to an improvement in the access to fish and increase in income of the fishers depending on it. Much of these early gains reported by the respondents could be due to inherent characteristics of the reservoir, initial low poverty rates and monitoring by the contractor. There is still a strong hold of the government in managing the federation. It is clear that such an institution is forced onto the community and lack the true nature of being participatory. However, besides attending the meetings, helping FC in monitoring the reservoir, informing other members about deferred wages, bonus, availability of loan, members are required to select contractor on their own or carry out functions like collecting and selling fishes, monitoring the fishing ground on their own. How far FC would be successful in performing these tasks is still an open question to be explored.

6. Conclusions

Although the co-operative is the best model available for management of inland fish resources and has the potential for reducing poverty, there are internal and external issues which need to be understood to ensure equity, efficiency and sustainability of the co-operative. Initial size of the resource in Gandhisagar is sufficient to generate participation among members of FCs. As the level of dependence and benefits accrued from fishing is high, fishers took active interest in activities of FCs.

A newly formed FCs elsewhere would require motivation and involvement of members in activities of FCs, training and skill formation in activities related to fishing, selling, managing accounts, information provision and inclusion of all fishers need strong attention from the start onwards. However, long-term benefits of fishers would enhance participation which will have positive impact on income. Better inclusion of the fishers in information and decision-making flows for long term sustainability of resource requires, in any case, systematic monitoring of key scheme variables and participatory variables by location of FCs. Though, the observations from this study are difficult to generalise, they suggest some pointers. It has been observed that

- The initial processes for FCs become important in managing the resource use. Awareness about the potential benefits of FCs, capacity building and training in activities of FCs would generate an interest of members in managing the resource.
- Efforts made to monitor the members of FCs and exploring new marketing avenues of fish and better prices would encourage members to participate in FC activities.

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