To identify the community characteristics of successful common resource management: a case of shrimp farming in Bangladesh

Sadika Haque[1], Md. Nazmul Hoque[2] and Siegfried Bauer[3]

[1]Associate Professor, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Bangladesh, [2] & [3] are PhD student and Professor, Justus-Liebig University, Giessen, Germany.

Contact address: Sadika Haque

Associate Professor
Department of Agricultural Economics
Bangladesh Agricultural University
Mymensingh – 2202
Bangladesh

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Abstract

This paper examines the community characteristics of successful common resource management. As information base, data sets of 44 brackish water[1] shrimp farming communities in Bangladesh have been used. The result shows that common resource management is associated with resource scarcity, market distance from the resource, leadership structure in the community, group size, status of heterogeneity in the community, and involvement of other institutions. The results tell that while graduates and influential leaders facilitate collective action, political leaders and outsiders impede it. Unlike the findings from other sources, distance to market place has been found very important for common pool resource management in Bangladesh. Resource management could be more successful, when they can form users' association, receive coordination and help from other institutions and technical support from governmental institutions.

Keywords: common property, resource management, user's association, brackish water, shrimp farming.

1. Background of the Research

In common resource dependent rural areas of developing countries, resource management has especially been considered one of the most viable options for poverty reduction, enhancement of local level economic development, and biodiversity conservation (Adhikari, 2004). There is no general consent over whether privatization or state regulation promotes proper use of degraded common resource management. But there are many examples that villagers collectively managing resources for extended periods. Probably the reason is: less public money is likely to be needed in comparison to either privatization or state dictation. Local users, who live and work in the area, may have a comparative advantage over government agents in monitoring resource use, since their livelihoods depend on those resources. Therefore, they have the greatest incentives to maintain the resource base over time (Wade, 1987; Meinzen-Dick, et. al, 2000; Balland & Platteau, 1996; Ostrom, 1990).

The economy of coastal Bangladesh largely depends on shrimp farming that play very important role in the country's whole economy with regard to exports and employment. Shrimp farming is naturally dependent on the tidal flow of common property brackish water which flows from the rivers to the state owned main canals and sub-canals. The supply of water at farms that are far from the canals or sub-canals is usually done by using other farms private farmland (Haque, 2011). The water management is easier for the head-enders as their plots are adjacent to a canal, but tail-ender farmers face restricted water access, since they can exchange water only by using others private land. Due to this restricted access, the water quality degrades now and then, which affects shrimp production (Mazid, 2003). As a consequence, in many cases, the tail-enders lease out or sell their land to the head-enders, leave farming occupation and engage in other non-farm activities.

In the study area, BWDB (Bangladesh Water Development Board) is officially responsible for the management and maintenance of the sluice gates by which the tidal flow of brackish water is regulated. BWDB is also used to manage water user groups who are responsible for

[1] Brackish water is water that has more salinity than fresh water but not as much as sea water. Normally it is found in estuary point where river has connected to the sea.

distribution of water. But the management of BWDB has become problematic due to users' heterogeneity of demand for brackish water. To get rid of this problem, a considerable portion of farmers are trying to manage the canals collectively. Clearing weeds from canals, desilting the canal beds, repairing the bunds and roads along the side of the canals, are the most common forms of maintenance. Farmers contribute in terms of money and labour for collective work. Most of these units employ labour only for emergency repairs of canals, whereas some units employ for both, regular maintenance and emergency repairs.

This study seeks to answer: what are the characteristics of the resource using community that influence the users to manage the resource collectively? Furthermore, the paper may provide some guidelines for other important common resource management problems (like forest and inland water) in Bangladesh, as well as in other developing countries.

2. Research methodology

2.1 Study area and data

Khulna district is producing the highest amount of shrimp in Bangladesh. Data has been gathered from Paikgacha sub district of Khulna at which more than 90% of agricultural land is under shrimp farming, and it has severe water management problems. For collecting information on water user groups, we discussed with 48 canal user groups either through focus group discussion or rapid rural appraisal by following a semi-structured interview schedule. In many cases, we had to transect walk or mapping to follow the described situation. Due to problems in getting the required information from 4 groups, we finally considered 44 user groups. Questions related to the variables have not been asked directly to the group members. After every discussion meeting, the enumerator team measured those variables. Information have been collected on the number of water users in the group, distance from market to the canal, influential persons in the community, relationship with government institutions, existence of cooperative associations, social and economic similarity or heterogeneity etc. From the discussion, it was possible to draw information of approximately all canal users on the number of head and tail-enders for the same canal, as well as on the proportion of small, medium and large farmers.

2.2 Analytical approach: Logit model

The decision of a household to participate in collective water management takes the shape of a choice of options. When the dependent or response variable is qualitative and the outcome of the decision is a matter of probability, then the model is called qualitative response model or probability model or binary response model. Three approaches have been proposed in the literature, to develop a probability model. These include the linear probability model (LPM), the Logit, and the Probit model (Gujarati, 2003). In this study, the Logit model has been used which is very popular because of the fact that it is designed to describe a probability which is always a number that lies between *0* and *1*. Although the Probit model is also used when the dependant variable takes binary values, the logistic function is fairly accurate as a representation of the normal distribution. It is analytically convenient (Gujarati, 2003). Mathematically the Logit model is written as:

$$L_{i=}\left(\frac{P_i}{1-P_i}\right)=\beta_1+\beta_2 X_{1i}+\beta_3 X_{2i}+\text{----------}B_{k-1}X_{ki}+\mu_i$$

L is called the Logit. β_1 is the intercept term, and X_1, X_2, X_3……,X_k are the explanatory variables and the subscript *i* denotes the i^{th} observation in the sample. β_1, β_2, β_3…… β_k are the coefficients to be estimated in association with each of the explanatory variables. Finally, μ_i is the stochastic error term.

To estimate the equation, we have used the ordered Logit model. Traditionally, the model has been employed in applications such as surveys, where we find more than two response categories in terms of ordinal ranking. Examples of multiple ordered response categories include opinion surveys with responses ranging from "strongly agree" to "strongly disagree," levels of state spending on government programs (high, medium, or low) etc. (Torres-Reyna, undated). If we suppose, y^* is the exact but unobserved dependent variable, x is the vector of independent variables, and β is the vector of regression coefficients which we wish to estimate and ε is the error term, then the model will be, $y^* = x'\beta + \varepsilon$,

Instead of y^*, we can only observe the categories of response

$y = 1, \quad if \quad \mu_0 \leq y^* \leq \mu_1$
$y = 2, \quad if \quad \mu_1 \leq y^* \leq \mu_2$
$y = 3, \quad if \quad \mu_2 \leq y^* \leq \mu_3$
.
.
$y = n, \quad if \quad \mu_{n-1} \leq y^*$

The data analysis was carried out using STATA 8.2 software.

2.3 Defining the Variables

In the equation, the dependent variable is view of community about canal maintenance and defined as ‘‘3’’ for good, ‘‘2’’ for fair, or ‘‘1’’ for not good. All independent variables included in the model are social indicators which are as follows:

(1) Market access was measured by distance of nearest market from the canal in kilometres, in order to see its impact on the organization and on collective actions.

(2) Water scarcity is measured by the number of farmers facing scarcity. Normally, they are tail ender farmers. It should be mentioned here that water scarcity and group size – the two variables – are not correlated.

(3) Infrastructure is a dummy variable. It indicates average required time, group farmers need to travel to the nearest town from their farm. Towns are usually where the BWDB and local government offices are located. If groups of farmers can reach the town within 1 hour, it is considered as 1 and 0, if they need more time.

(4) Leaders (graduate/ influential/ political): Information on leadership was not asked directly. It was collected during the group interviews by asking about graduates, leaders of cooperatives, influential persons, politically active persons etc. and their role in the community. All these persons have been categorized as three types. Firstly, the graduates who have 14 years educational experience could be farmers themselves or their family members and engage in decision making in the family or in the community. Secondly, influential persons who are socially closely related with other group members and have the capacity to organize the community, like teachers, members of local government, religious persons. Normally, they are not formal leaders but friendly with others and people follow them. Thirdly, politically active persons, who have good relationships with major political parties and the government, can discuss with the responsible institutions and solve any social problem within very short periods.

(5) Gini-coefficient has been calculated to measure the heterogeneity or inequality in land ownership among the canal users. The highest Gini value has been found 0.81 and the lowest is 0.29.

(6) Group size refers to the number of water users for a canal.

(7) Relationship with government organization – a dummy variable and coded as 1 if group members maintain communication with Bangladesh Water Development Board.

(8) Resource user association is a binary variable. If a water user association exists in any community then it is coded as 1.

(9) Existence of an outsider is a dummy variable and coded as 1, if the outsider shows dominancy in the community.

(10) Existence of NGOs and other cooperative associations are measured as dummy variables and coded as 1, if those institutions exist in the user group.

3. Findings and Discussion

3.1 Descriptive Results

There is a wide variation among groups with respect to the characteristics of the resource as well as of the user groups and institutional arrangements. In addition, variations also exist in terms of recruitment of collective labour, collection of funds and methods of cost sharing. Some organizations were found to be very active for some years but after that period became inactive. A large proportion of the data is of a more qualitative type (with yes or no answers), because matters like cooperation and its determinants involve social and economic qualities of communities. Table 1 and 2 provides the descriptive information about the resource using community.

Table 1 Descriptive statistics of quantitative variables

Variables	Description		
Leadership (GRADUATE/ INFLUENTIAL/ POLITICAL)			
Types of leaders	No leader	1- 5 leader	>5 leaders
Graduates (number)	18	15	11
Influential persons (number)	12	24	8
Politically active persons (number)	27	14	3
Group size			
Number of members	Less than 15	15-30	More than 30
Number of groups	10 (23%)	15 (34%)	19 (43%)
Water scarcity			
Mean	Standard deviation	Maximum	Minimum
0.64	0.42	0.85	0.32

Source: Rapid rural appraisal and focus group discussion, 2008

Table 2 Descriptive statistics for dummy variables

Variables and number of communities	NGO	Cooper-atives	formal user groups	Infra-structure	Relation with BWDB	Outsider
Exist (1)	21	23	32	25	16	15
Do not exist (0)	23	21	12	19	28	29

Source: Rapid rural appraisal and focus group discussion, 2008

Mainly three NGOs (named *Shushilon*, *Uttaran* and *Nijera Kor*i) have been found in the study area to be working for the promotion of collective water management. In some communities, there are cooperative associations. The members sit together weekly/ monthly and raise

limited funds equally. Normally, their motive is to save some money to cope with adverse situations, like getting loans to start small businesses at the time of unemployment, or to buy food and necessary items after a cyclone or any other natural disaster. In the study area, the resource-poor farmers are mostly engaged in this kind of cooperatives; very few rich farmers cooperate with them. The communities which do not have written or semi-written documents, never arrange meetings.

3.2 Analytical results

Although successful resource management is always related to well build up organizations to work collectively, its quality mainly depends on farmers' willingness to be a part of such an organization. Nevertheless, the formation of the organization is only a starting point of any management. To achieve the goals of the organization, activities are required. There are two types of work normally performed in collective actions: collective maintenance and collective bargaining or negotiating. In the study area, 32 groups have been founding formal organizations. But only some of them are satisfied with their collective activities and some are not. If farmers' maintenance of canals and sub-canals is a way to manage water timely, we wanted to find out, what accounts for whether or not farmers are willing to take over the maintenance of the system and what the social characteristics of different groups are that influence farmers to execute well.

Using the theoretical factors suggested in the literature, ordered logit model has been employed to measure the determinants of success in common resource management as a function of physical and technical characteristics of the resource, institutional arrangements and characteristics of the user groups. The regression results are presented in Table 3. The analytical results are being described in the following sections.

3.2.1 Physical and technical characteristics of the resource

In this section, we describe, how the physical characteristics of resources like distance from the resource to the market, resource scarcity, infrastructure etc., affect common resource management. The findings show that market distance negatively affects resource management. Bangladesh is a country where the role of the market place is very interesting and important. On the one hand, the market place (*Bazaar*) does not only create commercial opportunities, it also serves as an important avenue for social interactions that helps to form organization, especially in the small tea stalls. On the other hand, it is true that people, who live near the market, become less attentive to farming and are more inclined to pursue non-farm income activities. Furthermore, farmers discuss personal as well as social problems on the market place with a view to find solutions. So, those who are farming near the market are more likely to be organized to work for collective resource management. Our explanation differs from Gebermedhin, et. al, (2004) and Ostrom & Gardner (1993) who found that collective action is more beneficial for areas far away from the market. This could also be true in Bangladesh. But in the study area, market is shrimp business oriented because of its backward and forward linkages.

It is observed from the results that if more members of the group face scarcity, they are less likely to go for collective resource management due to the fact that conflicts arise among group members, and they receive lower returns, compared to their contributions. In this way, the location of the resource influences the users to join in a collective effort. The reasons are highly consistent with various opinions expressed in the empirical literature, for example Bardhan (1993), Dayton-Johnson and Bardhan (1999), Agarwal (2001) and Araral (2009). They found that cooperation is more difficult when water is either very scarce (due to

potential conflict on water allocation) or is plentiful (because of little incentive to cooperate, since water is abundant).

Table 3 Determinants of successful common resource management

Variables	Coefficient (S. E.)
Dependent variable	Probability of collective maintenance of canals (1 or 0)
Constant	.236** (.091)
a. Physical and technical characteristics of the resource	
Distance from market	-.825** (.293)
Water scarcity	-.579** (.270)
Infrastructure	0.005 (0.049)
b. Characteristics of the user groups	
No. of graduates	.290* (.107)
No. of influentials	1.265** (0.023)
No. of political leaders in the community	-.245** (.082)
No. of outsiders	-3.528* (1.569)
Gini coefficient	-1.194* (.0381)
Group size	-1. 452* (.702)
c. Institutional arrangements for water management	
Relationship with government organization	.0589** (.0220)
Existence of NGOs	.002** (.0009)
Existence of cooperatives	2.634* (1.208)
Existence of water users' association	1.126** (.0332)
Number of observations	34/ 44
LR chi^2	55.29
Prob > chi^2	0.0000
Pseudo R^2	0.29
Log likelihood	-417.94

Source: Author's calculation is based on rapid rural appraisal data, 2008.
** Significant at 1% level and *significant at 5% level. standard errors are robust.

3.2.2 Characteristics of the user groups

Common resource management is not only affected by the characteristics of the resource, but also by the socio-economic characters of the community, using the resource. The model results tell that the presence of graduates and influential persons in the resource using community plays a significant role in resource management. The technical knowledge of graduates could be helpful for canal maintenance and the influential persons have strong

social relationships with the community and they enjoy high acceptability in the society. At the same time, they know the networks and the way that could draw official attention to the area, which would be useful in starting an organization for resource management. In a similar way, they also play a role in collective lobbying. For start-up meetings with high officials, as well as for demonstration, procession and other lobbying, strong leadership is a basic prerequisite.

Although political persons are recognized as leaders in the society and can play a significant role in solving many problems, in case of common resource management, their role differs from the role of other leaders. If they find any issue against their self interest, then it is very difficult to find a solution for the community. Even the whole society cannot raise its voice against 1 or 2 persons. In the context of the study area, the role of politically active persons seems to be that of "musclemen".

Like them, outsiders' presence in the community usually discourages collective resource management. In most cases, outsider farmers are relatively wealthy. They are mostly residents of urban areas, want to control the common resource and try to disorganize the local people. In some cases, outsiders offer bribes to some locals in order to dissuade other locals from participating in collective work. So, their dominancy disheartens local people to work together in organizational activities. It is a sensitive issue for collective lobbying in the area. Some farmers are willing to contribute for lobbying, but due to fear of outsiders, they fail to participate. It was found that outsider farmers have spies (confidential informers) in the community. They report to the outsiders about the people who are going to arrange lobbying. As a result, the locals, even influential farmers, face harassment by the outsiders.

The outsiders and politically active persons are very powerful and have good relationships with law and order forces. Sometimes, they file false cases against the locals and police forces create problems for the victims. Even many murder cases, happening in the study area, do not receive fair justice. If the entrance of outsiders could be discouraged through the implementation of appropriate policy measures, the law and order situation around shrimp farms might improve. The scenario is very common in many other developing countries.

Our results suggest that group size plays a controversial role in group formation and common resource management. It was found that relatively large numbers of canal users significantly influence the success in organizing a group. Most of the literature suggests that cooperation works better in small groups. Result shows that farmers in a large group are not satisfied or are not getting their expected return. It seems that after being organized, members of large groups face conflicts with each other over time. The social cohesion among members of large groups may not be sustainable over longer time periods. Frohlich and Oppenheimer (1970) reported that the effects of group size on cooperation are conditional on how other variables are affected by changes in the size of a group. So, future tests would have to be done, in order to determine how the group size is related to other variables, like heterogeneity or inequality among the common resource users, and the benefits of the collective action.

The impact of the GINI-coefficient of land distribution is negative and significant which tells that greater resource inequality may reduce the level of collective effort. It seems that if few farmers have large resource stocks in a common resource using community, while many of them are poor, then poor users face problems. After analyzing the previous literature, Araral (2009) mentioned three dimensions that wealth affects collective maintenance of the common pool resource: (i) wealth provides incentive for the rich to contribute for the maintenance of the resource despite there are some free riders (the same as in Olson's hypotheses); (ii) wealth can create exit options for large land owners, making collective action less likely and, (iii) heterogeneity in wealth creates problems regarding agreements on distributive rules, which

makes enforcement difficult and lessens the likelihood of collective action. The second and third dimensions may have influence on the resource using communities in the study area.

3.2.3 Institutional arrangements for water management

The set up of institutional arrangements also influence the success of collective action. For instance, involvement of government institutions leads water users to organize a group for collective work. Farmers believe that BWDB could solve crucial problems which are difficult to solve for individuals, especially the timely maintenance of sluice gates. The same reason may also bring success for water user associations. But this result differs from the findings of Byrnes (1992), who concluded that collective efforts for Pakistani watercourses declined due to government intervention.

NGOs could to some extent play a role in resource management, though it does not influence significantly the founding of an organization due to the fact that resource users regard them as outsiders. But it could enhance the management activities of user associations by providing financial facilities, like the provision of credit, through which shrimp producers can get input supply timely. Sometimes, they also try to manage conflicts between water users, in case, they are engaged in the same NGO.

Cooperative associations significantly increase the likelihood to successfully form an organization. The underlying fact could be that cooperatives provide some motives to increase social ties. Members, who are already cooperating in other areas; are assumed to be more inclined towards collective actions. Thus, having a "cooperative mind" is very important for the common resource users. This may not evolve automatically, rather the cooperative may be asked for support. Karl Marx also argued in this way: "Employees who are in regular contact with one another, develop a 'habit of cooperation' and be more likely to act collectively than employees who work in isolation" (Bennis, 1967).

The existence of water user associations has significant effects on collective maintenance and lobbying. This indicates that organizations facilitate collective action. The formal recognition of registered organizations may empower farmers to undertake maintenance which requires coordination, like scheduling work days, determining labour and cash contributions, monitoring and supervising those who do not participate etc. In particular, regular maintenance is possible when there is an organization that makes these issues routine. Farmers' involvement can also improve the sustainability of the organizations themselves. Usually the association arranges general meetings, where farmers can interact with each other and exchange information. This may also increase social ties. Therefore, regular general meetings could also be one factor which may lead to successful collective maintenance.

On the other hand, associations facilitate farmers to come forward for lobbying and collective bargaining, as well as for creating opportunities to discuss problems in local decision making forums. Ramanathan and Ghose (1994) explain that without local decision-making forums, people eventually mobilize mass political movements against the government. While these protests happen sporadically, collective efforts of demonstrations can be a warning for formal movements. Ultimately, organized farmers gain a stronger voice and, at the same time, the presence of water users associations gives farmers more trustworthiness in communicating with the authorities (Meinzen-Dick, et. al, 1997). There are many formal and informal organizations for water management in different countries, but due to the lack of managerial guidance, they in most cases tend to become worthless. Therefore, attention should be given to ensure that organizations remain active after they have been founded.

4. Conclusion and implications

The intention of this paper was to identify the basic social characters that are necessary, where the community needs to manage non exclusive common pooled resources. Ordered logit model have been employed on a data set of 44 brackish water canal user groups, located in the south west coastal areas of Bangladesh. Consistent with the empirical literature, our findings imply that collective actions in common resource management are being influenced by the characteristics of the resource, as well as the characteristics of the resource users, and the institutional structure of the community. In particular, scarcity of the resource, relations with governmental authorities, leadership, resource inequality, existence of user associations, cooperatives and outsider's dominance in the community etc. are influencing the performance of collective resource management.

User associations strongly influence resource management. But, resource scarcity and group size play an opposite role in collective management. If users face resource scarcity, or the group size is very large, collective action slows down, although an association exists in the community. It seems how users start the organization, the bond does not continue may be due to facing conflict. So, further study could be conducted on how the number of conflicts could be successfully decreased.

The existence of a market plays an important role in the formation of an organization, as well as in conducting successful collective lobbying. It was found that in some places markets existed in the past. However, due to scarcity of drinking water and fuel, because of the expansion of the saline water, people started to move to different localities. Eventually, only very poor people with low purchasing power remained in the area. In the end, the market place was shifted to another locality. The distance between the farms and the market place increased, causing fewer possibilities for the farmers to meet with each other, which, as a consequence, impeded collective action. Through this finding, we may discover an important clue that environmental degradation negatively influences collective action.

While influential persons and graduates play an important role in collective action, presence of politically active persons as well as of outsiders and economic inequality restrict resource users to form an organization. In developing countries, if any farming or business is profitable, outsiders and wealthy people always try to enter and control the business sector. At the same time, they create difficulties for the locals and the poor. In many cases, the locals get out of the business. In the study area, we have found that they move to cities to seek employment. After movement, very few men get hard working jobs like rickshaw pulling, and the females get 'maid' jobs and sometimes low end positions in the shrimp industry. Most of the men remain unemployed or engage with theft, hijacking and many other illegal activities. This is one example for poor developing countries on how locals are driven away by the outsiders in resource-rich communities. So, before implementing any other policy measures, it should be made sure that local people can keep control over their resources. Under present circumstances, appropriate steps should be taken to discourage outsiders from entering to the shrimp farming business. It certainly would be useful to further study what kind of affirmative action is required to empower local farmers. Policy measures should also be taken to reduce the economic inequality.

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