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Pond Fish Farming under NGO Support and Individual Management: A Comparative Socioeconomic Study

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Abstract

The study was conducted to compare the profitability of fish farming under NGO support and individual management and to evaluate the overall impact of NGO intervention on farmers' income. A total of 120 farmers (60 for own management and 60 for NGO support) were selected following random sampling technique for data collection from both Mymensingh and Tangail District. The data were collected through direct interview from the selected fish farmers. Data were analyzed with a combination of tabular and functional analysis. The BCR was 1.9 for own management and 2.4 for NGO supported pond fish farming which shows that the fish farming is more profitable under NGO support. The Ravallion test results showed that the income was increased by the amount of Tk. 32500 due to NGO's intervention. Cobb-Douglas production function analysis was done to determine the effects of variables on pond fish production. Out of six variables, three variables in case of own management and four variables in case of NGO support had significant impact on per acre output of fish production**.** The results of the efficiency computation indicated that labour, feed and lime and medicine were being underutilized and fingerlings and irrigation were being over utilized for own managed pond. Under NGO supported pond, labour, fingerlings and lime and medicine were being underutilized and feed and irrigation were being over utilized.

Keywords: Pond fish farming, Own management, NGO supported, BCR, efficiency

1. Introduction

As an agro-based country, it is often argued that the future development of Bangladesh depends particularly on the agriculture sector which includes crops, livestock, fisheries and forestry. Fisheries as one of the sub-sectors of agriculture has been playing very significant role in supplying nutrition, creation of rural employment, reduction of poverty, earning foreign exchange and more importantly socioeconomic stability in the rural areas of Bangladesh.

Most of the people in Bangladesh depend on fish for their animal protein and fish provides 60.0 percent of per capita protein intake (DoF, 2009-10). The fisheries sub-sector contributes 5.38 percent of Gross Domestic Product (BER, 2012). Bangladesh earns a significant amount of foreign currency, i.e. 2.75 percent of total export earnings from fisheries products (BBS, 2010).

Moreover, huge numbers of people are involved with marketing and processing of fisheries items. Bangladesh is considered one of the most suitable countries in the world for small-scale

fresh water rural aquaculture, because of its favorable resources and agro-climatic conditions. Fish catches and production are not keeping pace with growing need of population. Pond fish culture can also become a major income generating activity in rural development programs. As pond fish culture is very promising in Bangladesh, it should receive due attention to meet the growing demand for the increased population and to ensure higher returns. If the existing ponds are brought under semi-intensive fish culture, the present rate of pond fish production can easily be increased. Presently, government and several non-government organizations (NGOs) such as BRAC, PROSHIKA, ASA, SSS etc. have undertaken laudable programmes for pond fish culture through extending credit and technological support. The main goal of such programme is to upgrade farmers' socioeconomic conditions through income generating activity and improved nutrition availability.

Rahman *et al.* (2011) conducted a study on impact of fish farming on household income; Ahmed (2009) performed a study on the sustainable livelihoods approach to the development of fish farming in rural Bangladesh; Alam (2005) conducted a study to measure the productivity, profitability and efficiency of producing fish in Bangladesh. In the past, most of the studies dealt with cost, return, profitability and productivity of pond fish farming at the farmer's own management. Some studies determined the factors affecting the profitability of pond fish farming. Most of the studies were confined with the pond fish production at the farmer's own management. However, there is no study that may help to determine more profitable practices of pond fish farming and thereby improve socioeconomic conditions and livelihood patterns of farm households. To minimize this research gap this study was designed to generate valuable information on socioeconomic aspects of farmers involved with NGO assisted pond fish production in comparison with self managed pond fish culture.

It is essential to perform a socioeconomic study and make an investigation in respect of assessment of NGO supported pond fish culture with farmers' own management. The present study was expected to demonstrate how much better off the farmers have become through NGOs' credit and technical support. The objective of this study is to compare the profitability of fish farming under NGO support and individual management and to evaluate the average impact of the intervention of NGOs' on fish farming. The following specific objectives were addressed in the study:

1. To identify the socioeconomic characteristics of the NGO supported and self managed pond fish farm households;
2. To evaluate the impacts of pond fish culture program of NGO on employment creation and income generation;
3. To calculate the relative profitability between the farmers producing pond fish under NGO support and own management; and
4. To estimate the relative contribution of key variables to pond fish production under the NGO and individual management.

2. Methodology

Seven villages namely Chornikhola, Chorhosenpur, Chorshiari, Harua, Monohorpur, Kumrashashon, Ashrobpur under Ishwarganj Upazila of Mymensingh district were selected and eight villages namely Basudebbari, Maijbari, Kodimfosol, Chakondomul bari, Tholbari, Vottobari, Lokhipur, Jotabari were selected purposively under Madhupur Upazila of Tangail district. Random sampling technique was used to select two groups of fish farmers. A total of 120 farmers (60 for own management and 60 for NGO supported) were selected for data collection. The data and information were collected from the sample farmers from December 2012 to February 2013. The data were collected through direct interview with the help of predesigned questionnaire from the selected fish farmers. In addition to field level primary data, secondary data and information having relevance to this study were also collected and

discussed. For this research, the major sources were: different handouts, reports, published and unpublished documents of the Government of Bangladesh (GoB) and its different organizations and agencies such as Statistical Yearbook of Bangladesh, Bangladesh Economic Review, various journals, newspaper, notifications, etc. Data were analyzed with a combination of tabular and functional analysis. Both tabular and statistical techniques were used in this study. Descriptive statistics (i.e., sum, average, percentages, ratios, etc.) were employed to achieve the objectives.

Per acre profitability of fish production from the view point of individual farmers was measured in terms of gross return, gross margin, net return and benefit cost ratio.

Model Specification

In this study, several statistical inferences have been used to test the validity of the model which are described below:

(a) Outlier test

To find the outlier from the data set, normal probability plot of the residuals, residual versus fitted values and histogram of the residuals has been drown.

(b) Normality test

To perform the normality test, the residuals were plotted against the kernel density estimator in a graph to see whether there is normality in the residuals (Gujarati, 2003).

(c) Multicollinearity test

When multicollinearity exists in a model, there is very high standard error and low t-statistics, unexpected changes in coefficient magnitudes or signs, or non-significant coefficients despite a high R-square. The variance inflation factor (VIF) is used to measure the multicollinearity (Gujarati, 2003).

(d) Heteroscedasticity test

Heteroscedasticity does not destroy the unbisedness and consistency properties. In order to avoid the heteroscedasticity problem, the robust (White) standard error has been used (Gujarati, 2003).

(e) Autocorrelation test

As the data were collected from fish farmer for one year operation for both the own managed and NGO supported farm, there was no autocorrelation. Therefore, autocorrelation test is not relevant for this study.

All the test statistics and the results of test statistics for the data indicate that the data sets are appropriate for using Cobb-Douglas production function as follows:

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} e^{U}$$

This was linearised in the logarithmic form also as follows:

$$\text{In } Y = \ln a + b_1 \text{In} X_1 + b_2 \text{In} X_2 + b_3 \text{In} X_3 + b_4 \text{In} X_4 + b_5 \text{In} X_5 + b_6 \text{In} X_6 + U_i$$

Where,

Y = Output (kg/acre);
X_1 = Quantity of human labour (man-days/acre);
X_2 = Cost of fingerlings (Tk. /acre);
X_3 = Quantity of feed (kg /acre);
X_4 = Quantity of fertilizer (kg /acre);
X_5 = Quantity of lime and medicine (kg/ acre);
X_6 = Cost of irrigation (Tk. /acre);
a = Intercept;
$b_1 – b_6$ = Co-efficients of the relevant variables;
In = Natural logarithm; and
U_i = Disturbance term.

Allocative Efficiency Index (AEI) was used to calculate the resource use efficiency. The decision of whether a resource is used efficiently or not, that is dependent on the value of AEI_i (Nimoh, 2012). If AEI_i is equal to one (AEI_i = 1), the factor input is efficiently utlized, hence the farmer is considered allocative efficient. The factor input is over-utilized if AEI_i is less than 1 (AEI_i <1) and under-utilized if AEI_i is greater than unity (AEI_i >1).

3. Results and Discussion

3.1. Socioeconomic profile of fish farmers

The sample farmers were classified into three age groups such as 0-14 years 15-64 years and

above 64 years (HIES, 2010). Average family size was higher in NGO supported households for both areas. In Madhupur, average family size was lower than the national average for own management and for NGO supported pond, it is higher than the national average. Moreover, average family sizes were considerably higher than the national average for both groups in Ishwarganj Upazila (Table 1). The literacy rate for the family members of both fish farming groups in Madhupur and Ishwargonj upazila were even higher in the national context, where the statistics of literacy is claimed to be 57.9 percent (HIES, 2010). The average farm size was higher for NGO supported pond fish farmer than own managed pond owner and the area under pond was also larger in NGO supported pond than own managed pond in both the study areas (Table 2). NGO supported pond fish farmer got different types of facilities from their local NGO such as credit facilities, training, free fingerlings, monitoring, support for product selling etc. (Table 3). Distribution of sampled farmers on the basis of NGO intervention of the study areas is shown in Table 3.

3.2. Impact on employment creation

The impact of NGO intervention on employment was measured by using the simple mean difference of both areas. The level of significance of the result was tested by P-value from two sample t-test. The differences were 23.0 for male and 5.7 for female labor employed which were significant at 5 percent probability level (Table 4). It was found that NGO supported pond owner expanded their fish farming and thus, they created greater opportunity for employment of both male and female members than own managed pond fish farmers. These findings represented that the pond fish culture program of NGO had a good impact on employment creation.

3.3. Impact on income generation

Average annual income from own managed and NGO supported pond fish farming were estimated at Tk. 234,233 and 236,517, respectively. Because of the NGO intervention, the annual average fish farming income per acre increases from Tk. 181,467 to Tk. 213,967 (Table 5). The Ravallion test results showed the income was increased by the amount of Tk. 325,00 in the study areas due to NGO intervention (Ravallion, 2008). The impact of intervention on income in both areas was statistically significant which was verified by the value of t- statistic.

3.4. Costs and returns of fish farming estimation of cost items

Production costs were calculated for all the family supplied and purchased inputs used for producing fish. Total cost was calculated by adding up total variable costs and total fixed costs. In pond fish farming, per acre total cost was Tk. 272,266 and Tk. 277,179 for own managed and NGO supported pond, respectively (Table 6). In case of own managed pond, total fixed cost and total variable cost covered 8.6 and 91.4 percent, respectively. For NGO supported pond fish farming, total fixed cost covered 9.2 percent and total variable cost covered 90.8 percent of total cost.

3.5. Gross return (GR)

Gross return was calculated by multiplying the total amount of production by their respective market prices (Dillon and Hardakar, 1993). Here, gross return is found based on monetary value of net change in inventory. The net change in inventory was estimated by using the following formula:

Net change in inventory = (Closing stock + Consumed / gifted + Sold + Died) - (Opening stock + Bought)

Annual gross returns from pond fish farming were estimated at Tk. 520,699 and Tk. 652,109 per acre for own managed and NGO supported pond, respectively (Table 6). The benefit cost ratio (BCR) of pond fish farming were 1.9 and 2.4 for own management and NGO supported pond, respectively.

Table 1. Family size, age, sex distribution and educational status of sample farmers

Particulars	Madhupur						Ishwarganj					
	Own Management			NGO Supported			Own Management			NGO Supported		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Age Groups												
0-14	15	20	35 (26.3)	20	28	48 (34.3)	27	25	52 (35.6)	27	25	52 (35.4)
15-64	48	48	96 (72.1)	44	46	90 (64.3)	46	46	92 (63.0)	46	49	95 (64.6)
Above 64	2	0	2 (1.6)	2	0	2 (1.4)	2	0	2 (1.4)	0	0	0 (0.0)
Total	65	68	133 (100.0)	66	74	140 (100.0)	75	71	146 (100.0)	73	74	147 (100.0)
Average	2.2	2.3	4.4	2.2	2.5	4.6	2.5	2.4	4.8	2.4	2.5	4.9
Literacy level												
Illiterate	1	4	5 (3.9)	8	8	16 (11.9)	7	3	10 (7.1)	6	10	16 (10.9)
Primary	21	26	47 (37.0)	18	30	48 (35.8)	25	29	54 (38.3)	24	27	51 (34.9)
Secondary	24	28	52 (40.9)	29	30	59 (44.1)	25	34	59 (41.8)	29	32	61 (41.9)
Higher Secondary	9	7	16 (12.6)	10	1	11 (8.2)	15	1	16 (11.4)	12	4	16 (10.9)
Graduation and above	7	0	7 (5.6)	0	0	0 (0.0)	2	0	2 (1.4)	2	0	2 (1.4)
Total	62	65	127 (100.0)	65	69	134 (100.0)	74	67	141 (100.0)	73	73	146 (100.0)

Source: Field survey, 2013. Note: Figures within the parentheses indicate percentages of total.

Table 2. Average land utilization of sample farm households of Madhupur and Ishwarganj Upazila

Types of land	Madhupur				Ishwarganj			
	Own management		NGO supported		Own management		NGO supported	
	Area (Acre)	Percentage (%)	Area (Acre)	Percentage (%)	Area (Acre)	Percentage (%)	Area (Acre)	Percentage (%)
Homestead area	0.25	15.6	0.25	14.9	0.29	18.3	0.25	15.6
Owned cultivable land	1.1	68.8	1.1	65.7	0.95	63.0	0.99	61.7
Leased /Mortgaged-in	0.04	2.5	0.04	2.6	0.06	4.0	0.05	3.1
Leased/Mortgaged-out	0.02	1.3	0.05	2.6	0.02	1.3	0.04	2.5
Area under pond	0.25	15.6	0.33	19.4	0.26	16.0	0.37	22.1
Total	1.62	100.0	1.67	100.0	1.54	100.0	1.62	100.0

Source: Field survey, 2013.

Table 3. Distribution of Sampled Farmers on the Basis of NGO Intervention

Types of NGO Intervention	Madhupur		Ishwarganj	
	No.	%	No.	%
Credit	6	20.0	5	16.6
Training	20	66.6	28	93.3
Fingerlings	8	26.6	10	33.3
Monitoring	30	100.0	30	100.0
Product selling	9	30.0	17	56.6
Credit + Training + Monitoring	3	10.0	4	13.3
Training + Monitoring+ Fingerlings	7	23.3	9	30.0
Training+ Monitoring+ Product selling	7	23.3	15	50.0
Fingerlings+ Monitoring+ Product selling	4	13.3	8	26.6

Source: Field survey, 2013

Table 4. Impact on Employment

Average employment	NGO supported	Own managed	Difference	P-value
Male (Man-days)	119.5	96.5	23.0	0.10**
Female (Man-days)	29.8	24.1	5.7	0.08**

Source: Author's estimation, 2013. Note: ** Significant at 5 percent level.

Table 5. Average annual income of sample fish farmers

Sources of income	Own Management		NGO Supported	
	Amount (Tk.)	%	Amount (Tk.)	%
Pond fish farming	85533.3	36.5	108600.0	45.9
Crop cultivation	57300.0	24.5	52716.7	22.3
Livestock rearing	22233.3	9.5	27066.7	11.4
Service	21033.3	8.9	22033.3	9.3
Others	48133.3	20.6	26100.0	11.1
Total	234233.3	100.0	236516.7	100.0
Ravallion test result				
Annual income	181466.8		213967.3	
Impact of intervention on income (Tk.)	32500.5			
t-value	3.78***			

Source: Field survey, 2013 and author's estimation, 2013. Note: *** Significant at 1 percent level.

Table 6. Per acre cost and returns of pond fish farming

Cost Items	Own management		NGO Supported	
	Cost (Tk.)	%	Cost (Tk.)	%
Human labour	78755.6	28.9	79155.8	28.6
Fingerlings	28542.7	10.5	28667.1	10.3
Feed	118798.2	43.6	120811.1	43.6
Fertilizer	2318.6	0.9	2341.1	0.9
Salt	1493.3	0.6	1501.2	0.5
Lime and medicine	3072.7	1.1	3152.9	1.1
Irrigation	6811.5	2.5	6880.3	2.5
Electricity	104.2	0.1	105.2	0.1
Cost of harvesting	8151.9	2.9	8158.5	2.9
Miscellaneous	850.3	0.3	858.5	0.3
Total variable cost (TVC)	248899.0	91.4	251631.7	90.8
Lease value	2812.5	1.0	4827.1	1.7
Depreciation on tools and equipments	5620.5	2.2	5621.9	2.1
Interest on operating cost	14933.9	5.4	15097.9	5.4
Total fixed cost (TFC)	23366.9	8.6	25546.9	9.2
Total cost (TC)	272265.9	100.0	277178.6	100.0
Gross returns (GR)	520699.2		652109.3	
Gross margin (GM) = (GR-TVC)	271800.2		400477.6	
Net return (NR)=(GR-TC)	248433.3		374930.7	
BCR (Undiscounted) (GR/TC)	1.9		2.4	

Source: Field survey, 2013

Table 7. Estimated values of coefficients and related statistics of multiple regression function for pond fish farming under own management and NGO support

Regressors	Own management			NGO supported		
	Co-efficient	Robust Standard error	t-value	Co-efficient	Robust Standard error	t-value
Constant	3.044**	1.410	2.160	-0.107	0.818	-0.130
Quantity of labour (X_1)	0.200*	0.109	1.830	0.302***	0.103	2.930
Cost of fingerlings (X_2)	0.054	0.119	0.450	0.25***	0.066	3.800
Quantity of feed (X_3)	0.195*	0.106	1.840	0.052	0.094	0.550
Quantity of fertilizer (X_4)	-0.036	0.035	-1.040	-0.034	0.044	-0.770
Quantity of lime and medicine (X_5)	0.365***	0.121	3.010	0.696***	0.123	5.650
Cost of irrigation (X_6)	0.011	0.014	0.790	0.50**	0.200	2.500
F-value		5.480			36.970	
R^2		0.506			0.714	
Returns to scale		0.790			1.315	

Source: Authors' estimation, 2013. Note: *** = 1% level of significance, ** = 5% level of significance; and * = 10% level of significance.

Table 8. Allocative Efficiency Index (AEI) for two groups

Variable	Groups	Co-efficient	MPP	MVP	MFC	AEI
Labour	Own managed	0.200	3.348	535.68	267.5	2.00
	NGO supported	0.302	5.35	856.0	273.67	3.13
Fingerlings	Own managed	0.054	0.018	3.02	3.60	0.84
	NGO supported	0.25	0.11	17.60	2.14	8.22
Feed	Own managed	0.195	0.26	41.80	40.0	1.05
	NGO supported	0.052	0.096	15.36	40.0	0.38
Fertilizer	Own managed	-0.036	-1.988	-318.08	26.0	-12.23
	NGO supported	-0.034	-1.93	-308.8	26.0	-11.88
Lime and	Own managed	0.365	1.57	251.20	12.0	20.93
medicine	NGO supported	0.696	2.07	331.20	12.0	27.60
Irrigation	Own managed	0.011	0.005	0.88	3556.6	0.001
	NGO supported	0.500	0.40	64.0	2736.6	0.023

Source: Authors' estimation, 2013.

These results are close to the findings of Uddin and Takeya (2005) who found the highest benefit cost ratio (2.15) for the pond fish enterprise among all agricultural enterprises such as crop, cattle, poultry and pond fish farming. Thus, pond fish farming was profitable in the study areas under both managements, although NGO supported fish farming was more profitable than own managed pond fish farming. As NGOs provided technical support before and during fish production period, the NGO supported pond fish farmers were more benefited than own managed pond fish farmers.

3.5. Functional analysis

To determine the effect of the variable inputs, Cobb-Douglas production function was estimated. Six independent variables namely, quantity of labour, cost of fingerlings, quantity of feed, quantity of fertilizer, quantity of lime and medicine and cost of irrigation were considered to explain the production of fish farming. In case of own managed pond fish farming, three variables out of six namely, quantity of labour, quantity of feed and quantity of lime and medicine had significant impact on per acre output of fish production**.** In case of NGO supported pond fish farming four variables namely, quantity of labour, cost of fingerlings, quantity of lime and medicine and cost of irrigation had significant impact on per acre output of fish production (Table 7).

3.6. Allocative efficiency index (AEI)

Table 8 represents the result of allocative efficiency index (AEI) for the study areas on the basis of the result of the multiple linear regression model. The results of the efficiency computation indicated that labour, feed and lime and medicine were being underutilized and fingerlings and irrigation were being over utilized in the study area for own managed pond fish farming. On the other hand, computation indicated that labour, fingerlings and lime and medicine were being underutilized, and feed and irrigation were being over utilized under NGO supported pond fish farming in the study areas.

It can also be summarized from allocative efficiency index that farmers could increase output and income through better use of available resources. The achievement of efficiency in all the inputs and for that matter, their totality will very much depend on increasing all the inputs that need to be increased, and reducing all those that need to be decreased.

4. Conclusions

The study shows that the pond fish farming is profitable. Bangladesh has a great potentiality to increase its growth through expanding the fisheries sub-sector with proper scientific method. There is a great impact of NGO intervention on pond fish production, employment creation and income generation. Therefore, it can be concluded that there is great scope to improve the overall economic condition of the fish farmers in terms of higher income and more employment generation through the intervention of NGO. The NGOs should improve and deliver high quality extension service to farmers in time so that the farmers gradually learn and adopt aquaculture technology that sustains their increasing productivity and income in the long-run. The NGOs should strengthen its technology dissemination capacity through more careful recruitment of field staff, adequate provision of training, logistic supports and more intensive efforts towards human resource development.

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