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*FACTORS AFFECTING POND FISH PRODUCTION IN NORTH-WEST BANGLADESH**

M. Serajul Islam**

ABSTRACT

Cobb-Douglas production function has been used to measure the effect of various factors on pond fish output. The chosen factors were stocking of fish seed, fertilizer and artificial feed, human labour, farm size, age of pond, depth of pond water, and number of pond owner. Considering the aggregate production for all locations, it was found that, except the depth of pond water, all of her factors were statistically significant in explaining the variation of pond fish output but the results varied in different locations.

I. INTRODUCTION

Fish is one of the most important food in our country. More than 80 percent of total production of fish comes from inland source and of this, 39 percent is contributed by ponds. In Bangladesh, total area under ponds and tanks is 915425 hectares and the number of ponds is about 1.8 million (BBS 1984, p. 16). Among the total ponds, 18.37 percent are derelict and in most of the remaining ponds fishes are cultured by traditional means. However, only 2 to 5 percent of total production comes from scientifically managed ponds and tanks (Ali et al. 1982 p. 103). There is big difference of yield between managed and unmanaged ponds. It is recognised that use of supplementary inputs such as feed and fertilizer are very much important to increase production.. Generally, a fertilized pond produces 2725 kg/ha/year while in, unfertilized pond, yield does not exceed more than 500 kg/ha/year (MPO 1984, p. 2.37). Therefore, the yield of fish pond can be increased at least 5 to 6 times by using fertilizer and it can be further increased through intensive cultivation employing other necessary inputs and management.

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**Assistant Professor, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

In this study, important inputs and other related factors that affect the output of pond fish production have been assessed. The analysis is based on data for the year 1985 of a sample of 70 stocking ponds selected from four different areas in North-Wast Bangladesh, namely, Natore, Naogaon, Bogra and Santahar. Farmers who used either fertilizer or feed, or both of them, were selected purposively.

II. METHODOLOGY OF THE STUDY

Cobb-Douglas form of production function was chosen on the basis of best fit and significant result on output. Seven inputs or explanatory variables were hypothesized to explain the pond fish production in the study areas. The choosen variables were not multicollinear. The effect of inputs on pond fish output was estimated and quantified with the help of regression analysis of the form :

$$Y=ax_1^{b_1} x_2^{b_2} \ldots\ldots\ldots\ldots x_7^{b_7}$$

or $\log y=\log a+b_1 \log x_1+b_2\log x_2+ \ldots\ldots+b_7\log x_7$

where Y=gross income (Taka) ; x_1=fish seed stocked (Taka) ; x_2=fertilizer and artificial feed (Taka) ; x_3=human labour (Taka) ; x_4=farm size (land in ha); x_5=age of pond (years) ; x_6=depth of pond water (metre) ; x_7=number of pond owner (person) ; and b_i=regression coefficients (parameters) to be estimated. The production coefficients (b_i) or exponents in the Cobb-Douglas form are the elasticities of production. The b_i terms are actually transformation ratios of the various inputs used in pond fish production of different quantities.

A brief discussion is presented here about the explanatory variables i .cluded in the model.

Pond fish production in the sample areas was mainly based on stocking of fish seeds, use of fertilizer and feed, and human labour for different operations and pond management. These three factors or inputs covered about 90 percent of total cost. Besides these, there are some inherent characteristics or factors in pond fish production that affect its environment and production such as age of pond, depth of pond water, size and ownership of pond. Therefore, both used and inherent inputs have been included in this study to explain the variation of pond fish output.

Stocking of fish seed, and use of fertilizer and artificial feed are the main items of material input and covered 41 percent and 28 percent of the total cost respectively. Generally, per unit production of pond is higher with proper fertilization and feeding than without. Therefore, it is quite logical to hypothesize that these two elements of material cost will have significant effect on pond fish output.

Labour is used in different operation of pond fish culture and pond management and it covered 18 percent of total cost. It was assumed that production of well managed pond will be higher than that of poorly managed one.

Among the inherent inputs, farm size is an important factor that can affect pond output. An optimum size of pond is required to maximise production and to minimise cost. Of course, pond size may vary in different areas depending on socio economic and environmental condition.

Age of pond has been included as one of the explanatory variables to explain the productivity of fish pond because it is commonly observed that newly excavated pond is less productive than older one.

Required water level available in the pond is the prerequisite factor for scientific fish culture. In the dry season, many of the ponds suffer from lack of sufficient water and this condition hampers the normal growth of fish and decreases yield.

Ownership of pond is a social factor which affect the production decision of the farming unit. Researchers observed that, generally, single owner pond is well managed and more productive than multiple owner pond.

III. RESULTS AND DISCUSSION

The results of the estimation of production function for individual area and all locations are shown in Table 1. The R^2 value ranged between 0.78 in Santahar to 0.94 in Bogra, but for all locations, it was 0.65. However, the choosen variables have explained the variation of farm income from 65 to 94 percent.

From Table 1 it can be seen that, among the regression equations, there are, in total, 34 input coefficients and of these, only 8 coefficients have improper(negative)sign and the remaining coefficients show positive impact on farm output. Out of 34 coefficients 16 are significant at less than or equal to 10 percent level of significance and for most of the remaining coefficients standard error of estimates are higher than the estimated values of input coefficients.

The returns to scale were obtained as the sum of co-efficients of inputs used. It may be increasing, decreasing or constant depending on the ratios of inputs to output The return to scale was about constant in Naogaon. For other individual areas and all locations, increasing returns to scale were found which indicate that doubling all fish inputs would more than double output in these areas.

Table 1 shows the impact of independent variables on pond fish output for different locations and as a whole. First, if we consider the aggregate production function for all locations, it is evident from the table that, except the coefficient of depth of pond water

all other variables were statistically significant in explaining the variation of pond fish output. Among all the inputs, farm size had greater influence on farm income and it contributed 0.73 percent to total output for each 1 percent increase in land area. Similar results were found by other researchers (Chong *et al.* 1982, p. 41)

TABLE 1. ESTIMATED VALUES OF COEFFICIENTS AND RELATED STATISTICS OF COBB-DOUGLAS PRODUCTION FUNCTION MODEL

Explanatory variables		Natore	Naogaon	Bogra	Santahar	All locations
Intercept		8.903	1.046	4.012	7.173	9.324
Quantity of fish seed stocked	(x_1)	0.910*	0.115	0.284***	0.192	0.422*
Fertilizer and feeding	(x_2)	0.148**	0.281***	0.160*	0.193	0.185*
Human labour	(x_3)	0.127	0.313	0.3537***	0.343	0.548*
Farm size	(x_4)	0.835*	0.943***	0.122	0.327	0.726*
Age of pond	(x_5)	-0.296**	0.713	0.123	0.104	-0.227*
Depth of pond water	(x_6)	-0.194	-0.745	0.516	0.301	0.130
Number of pond owner	(x_7)	—	-0.610	-0.244***	-0.101	-0.233***
R_2		0.887	0.918	0.944	0.786	0.654
F		19.783*	9.597*	19.402	5.274*	16.785*
Returns to scale		1.53	1.010	1.318	1.359	1.551

*Significant at 1 percent level.
**Significant at 5 percent level.
***Significant at 10 percent level.
— Absence of multiple owner.

The inherent variables such as age of pond and number of owner of pond showed significant negative impact on pond fish output. These results are quite reasonable in the present context of fish pond. For instance, 25 percent fish ponds in the survey areas are

under multiple ownership. It has been studied and observed by other researchers (Gill and Motahar, 1982 p. 10) that multiple ownership is one of the basic constraints to improve the pond condition. Therefore, this type of pond is less productive than that of the single owner pond.

Generally it is known that older ponds are more productive than newly excavated ponds. But in the sample areas most of the ponds are very much old and they are not reexcavated and cleaned up for long. As a result, poisonous gas and carbondioxide, there formed and grew excess organic matter, harmful insects and parasites which affected the healthy growth of fish and reduced yield.

Because of difierences in input doses and other related factors, the value of regression conefficients and their significance are also difierent in different location. The elements of material costs i.e. stocking of fish seeds, and use of fertilizer and artificial feeding had significant impact in Natore and Bogra but in Noagaon only the second variable was significant. None of the included variables was found significant at Santahar. On the other hand, cost of human labour was siginificant only in Bogra. It can be seen from the Table that most of the inputs in individual area showed insignificant result but almost all of them turned highly significant in case of aggregate production function for all locations. This might be due to insufficient number of sample ponds for different individual location.

In addition to regression analysis, tabular method is used here to show how yield varies with the application of supplementary inputs to different sizes of pond (Table 2). For the purpose of this study, size of farm is specified as follows : a small farm has an area less than 0.15 ha, a medium farm has from 0.16 to 0.30 ha and a large farm is more than 0.30 ha. Most of the fish farms are in medium size category and represent 71 percent of total ponds. The number of small and large size ponds are almost same in the sample areas and they represent 16 and 13 percent respectively.

Table 2 shows the interrelation between the average quantities of supplementary inputs and yield/ha according to farm size. This table reveals that, small and medium farmers applied more fertilizer and artificial feed per hectare than that of large farmers. As a result, there is inverse relationship between farm size and yield/ha. Considering all locations, the small, medium and large farms obtained respectively 1257, 1087 and 920 kg of yield/ha. If we consider individual location, the result is the same in all the areas except Naogaon where rates of supplementary inputs were different than that of other areas in respect to farm size. However, from the regression analysis it was found that farm size had greater impact than feed on yield but the yield depeded more on the combined effect of size and feed than on the individual effect of any of them.

TABLE 2. INTERRELATION BETWEEN THE USE OF SUPPLEMENTARY INPUTS AND YIELD/HA ACCORDING TO FARM SIZE

Partizulars of farm size	Location				
	Natore	Noagaon	Bogra	Santahar	All locations
Small Farms					
Fertilizer (Kg):					
Organic	1375	417	3626	3750	3356
Inorganic	285	48	69	141	139
Artific,al feed (Kg) :					
Oil cake	560	64	279	317	310
Rice bran	172	—	1077	920	521
Medium Farms					
Medium Farms					
Fertilizer (Kg) :					
Organic	1244	868	2916	1381	1256
Inorganic	464	176	—	—	207
Artificial feed (Kg) :					
Oil cake	518	315	89	11	293
Rice bran	450	—	476	450	323
Large Farms					
Fertilizer (Kg):					
Organic	1200	622	230	1331	817
Inorganic	400	175	—	106	105
Artificial feed (Kg) :					
Oil cake	583	136	—	324	190
Rice bran	166	—	418	290	271
Yield (Kg) :					
Small Farms	920	752	1864	1582	1257
Medium Farms	1065	834	1706	970	1089
Large Farms	1217	824	886	939	920

Small farms =0.01–0.15 ha.
Medium farms=0.16–0.30 ha.
Large farms = >0.30 ha.

IV. CONCLUSIONS

The result of this study indicate that pond fish production can be increased either by increasing the size of pond or improving the production technology in existing ponds. Based on aggregate production function it was found that, increasing farm size by 1 percent would induce an increase in farm income of 0.73 percent which is more than 4 times larger in comprison to the application of fertilizer and feed. The size of the coefficient of fertilizer and feed can be increased with its further application because most of the sample farmers used this input at below the standard dose. This result indicates that there are two different ways to increase the production but considering the scarcity of land in our country, fish production should be increased through intensification rather than by increasing farm size. In the study areas, the survey data have shown that the average yield of sample ponds is only 1025 kg/ha/year and it can be increased easily more than 4 times by using proper dozes of fertilizer and artificial feeding. Therefore, there is enough possibilities to increase yield/ha through intensive method of fish culture. On the other hand, all culturable and derelict ponds should be brought under scientific fish culture to extend the farming area and to increase production.

REFERENCES

Ali, M.H.; and M.A. Akbar, and M.H.Rahman, (1982) : "Utilization of Fish Ponds in Mymensingh District". *Bangladesh Journal of Agricultural Economics,* 5, 1-2.

Bangladesh Bureau of Statistics, (1984) : *The Survey of Ponds*-1982, Dhaka : Bangladesh Government.

Chong, K.C. ; M.S. Lizarondo, ; V.F. Holazo, ; and I.R. Smith, (1982) : *Input as Related to Output in Milk Fish Production in Philippine,* ICLARM Technical Report 3, Makati, Manila.

Frederick, L. J. and S. Nair, (1985) : "Production Technology of Small-scale Fisheries in Peninsular Malaysia." *Small-Scale Fisheries in Asia : Socioeconomic Analysis and Policy.* Edited by Theodore Panayotou. Ottawa, International Development Research Centre, Canda.

Gill, G. J. and S. A. Motahar, (1982) : "Social Factors Affecting Prospects for Intensified Fish Farming in Bangladesh". *Bangladesh Journal of Agricultural Economics,* 5, 1-2.

Master Plan Organization, (1984) : Water Development and Flood Control, *National Water Plan Project, Second Interim* Report, (VII Fishes) Ministry of Irrigation.