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Factors Influencing Production of Year-Round Bagda Shrimp in Satkhira District of Bangladesh

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Abstract

In Bangladesh, the brackish water shrimp, locally known as bagda, is a highly valued product for international markets. In order to increase the production of shrimp farming to the maximum possible extent, it is necessary to identify the factors that significantly affect bagda production so that policy interventions may be made accordingly. This paper was intended to investigate which factors play significant role in bagda shrimp production and its profitability. Sixty bagda farmers from Assasuni Upazila of Satkhira district were randomly selected for this study. Farmers were interviewed directly by using specific interview schedule during August to September 2009. Cobb-Douglas production function along with cost return analysis was used to achieve the objectives of the study. Six variable inputs viz., urea, triple super phosphate, manure, human labour, lime, and shrimp fry were found to have significant positive effect on income from bagda farming. Fin fish fingerling had negative effect on bagda production. The results also showed that the estimated production function revealed decreasing returns to scale. Undiscounted benefit-cost ratio

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was found 1.78. In order to reap the benefit of the international demand for shrimp, Bangladesh needs to utilize the potentiality of shrimp farming by adopting scientific method of bagda farming and ensuring quality shrimp fry and timely availability of easy credit to the farmers.

Keywords: *Bagda Shrimp, Cobb-Douglas production function, Profitability, BCR.*

1. Introduction

Bangladesh is an agro-based country but despite having a vast fertile plain land has not achieved a sustainable self-sufficiency in food production. Like other commodities, Bangladesh imports large quantity of foodgrains every year to meet her food shortage. However, a few agricultural, industrial and fisheries products are being exported, of which frozen shrimp is one of the major components (Paul 1996). In Bangladesh, fish provides 63 percent of animal protein consumption and about 1.2 million people are directly employed in this sector. Another 10.8 million people indirectly earn their livelihood out of activities related to fisheries (FFYP, 1997-2002). The fisheries sector contributes 4.73 percent of gross domestic product and about 4.04 percent to foreign exchange earnings through export (BER 2008 and FSYB 2007-08). This sector employs about 1.1 million labour force (BBS 2007). Besides, shrimp farming is one of the fastest growing components of the global aquaculture.

In Bangladesh, brackish water shrimp (*Penaeus monodon*) farming is currently one of the most important sectors of the national economy. Within the overall agro-based economy of the country, the contribution of shrimp production is considered to hold good promise for creating jobs and earning foreign exchange. The brackish water shrimp, locally known as bagda, is a highly valued product for international markets. Almost all shrimps are therefore exported, particularly to the USA, Japan and Europe. Brackish water shrimp farming is mostly concentrated in southern Bangladesh mainly Satkhira, Cox's Bazar, Khulna and Bagerhat districts. In southern Bangladesh, thousands of farmers have converted their paddy fields to 'gher' to accommodate a profitable shrimp culture practice. There are wide variations in the yield of shrimp under different cultural and management practices of shrimp farming. Variations in the time and method of cultural operations, level of input use, natural hazards, shrimp disease, water quality, salinity level etc., might be causing the yield differences. In order to increase the production of shrimp farming to the maximum possible extent, it is

necessary to identify the factors behind the yield variations so that policy interventions may be made accordingly. This study has been designed to fulfill the following specific objectives:

a. To determine the costs and returns of bagda farming;
b. To identify the factors affecting yield and economic returns;
c. To suggests some policy guidelines/ recommendations;

2. Methodology

Sixty year-round shrimp farmers were randomly selected from Assasuni Upazila of Satkhira district of Bangladesh. Direct interview method was followed and interview schedules were used to record the information so as to estimate the following Cobb-Douglas production function by Microsoft Excel software:

$$Y=a\ X_{1i}^{b1}\ X_{2i}^{b2}\ X_{3i}^{b3}\ X_{4i}^{b4}\ X_{5i}^{b5}\ X_{6i}^{b6}\ X_{7i}^{b7}\ e^{U}$$

The Cobb-Douglas production function was transformed into logarithmic form so that it could be solved by ordinary least squares (OLS) method. Thus,

$$\ln Y=\ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+b_5\ln X_5+b_6\ln X_6+b_7\ln X_7+U$$

Here, Y = Gross income from year-round bagda shrimp (Tk/farm)

X_1 = Cost of Urea (Tk/ha)
X_2 = Cost of TSP (Tk/ha)
X_3 = Cost of manure (Tk/ha)
X_4 = Human labor cost (Tk/ha)
X_5 = Cost of lime (Tk/ha)
X_6 = Cost of bagda fry (PL) (Tk/ha)
X_7 = Fin fish fingerlings cost (Tk/ha)
a = Intercept
b_i = Production coefficient
i = 1,2,3,…..n

Besides, the following conventional profit equation was applied to examine farmers' profitability level of the shrimp producing farms in the study areas.
Where, Per hectare net return from year-round bagda farming.

$$\pi=\sum_{i=1}^{n}Psb\theta.sb+\sum_{i=1}^{n}Pof.\theta of-\sum_{i=1}^{n}Pxi.Xi-TFC$$

Psb = Per unit price (Tk/kg) of bagda shrimp
.sb = Total quantity of bagda shrimp (kg/ha)
Pof = Per unit price (Tk/kg) of other relevant fish
.of = Total quantity (kg/ha) of other relevant fish
Pxi = Per unit price of ith inputs
Xi = Total quantity of ith input
i = 1,2,3,…..n; and (number of input)
TFC = Fixed cost involve in per hectare of bagda shrimp.

3. Results and Discussion

Bagda shrimp production is the result of various combinations of inputs in the production process. Inputs used in this study are shrimp fry (PL), fertilizer, human labor, manure, lime and fin fish fingerlings. All these inputs have been included as explanatory variables in the production function. Cobb-Douglas production function was chosen on the basis of best fit. Seven inputs or explanatory variables were hypothesized to explain the year-round bagda shrimp farming in the study areas. Management factor was not included in the model because specification and measurement of management factor is almost impossible particularly in the present study, where a farm operator is both a labor and manager. Other independent variables like water quality, soil condition, time, etc., which might have affected production of farm enterprises, were excluded from the model. It is hypothesized that, using all the inputs discussed above, will have no effect on production and income of bagda shrimp farm.

3.1 Results of the regression analysis

Estimated values of the coefficients and related statistics of Cobb-Douglas production function for the selected sample farmers producing bagda shrimp are presented in Table 1.

The usual fashion of interpreting the estimated coefficients of Cobb-Douglas production function is that, keeping other things unchanged if 1% change occurs in the independent variable then the dependent variable would change by the percentage of estimated coefficient. From Table, it can be seen that all the explanatory variables except fin fish fingerling (X_7) have significant positive effect on income from bagda shrimp.

Table 1: Estimated coefficients of Cobb-Douglas production function for bagda farming

Explanatory variables	Coefficients	Standard error
Intercept	***4.259	0.420
Urea (X_1)	**0.109	0.081
TSP (X_2)	*0.045	0.045
Manure (X_3)	***0.218	0.054
Human labor (X_4)	***0.220	0.061
Lime (X_5)	*0.016	0.042
Shrimp fry (X_6)	***0.355	0.107
Fin fish fingerlings (X_7)	*-0.007	0.042
R^2	0.978	-
Adjusted R^2	0.975	-
Returns to scale	0.956	-
F-statistic	***317.048	_

* 10% level, ** 5% evel, *** 1% level

3.2 Returns to Scale

The summation of all the production coefficients of bagda shrimp farming is equal to 0.956. This means that production function for bagda shrimp farming exhibits diminishing returns to scale (Table 1). However, returns to scale indicates that farm income can be increased if more improved technologies are introduced.

3.3 Coefficient of multiple determination (R^2)

The coefficient of multiple determination R^2 for shrimp farming was 0.978 which indicates that 97.8 percent of the total variation of output of respective farming system is explained by independent variables included in the model.

3.4 Profitability of year round bagda shrimp production

Profitability of year-round bagda shrimp production in the study area has been calculated per hectare basis. The profit equation stated in the preceding section was used to find the per hectare profit of year round bagda production. First, total variable costs were computed and then these ware added to the fixed costs to form total costs. Finally total costs were deducted from total revenue which was computed by multiplying total production with their price. Variable inputs, their quantity and prices are presented in Table 2 Items of different fixed costs with value are presented in Table 3 In the study areas, per hectare average yield of

shrimp was 433.84 kg and its money value was Tk. 157977.60. Apart from this, few species of shrimps and fishes were also grown in shrimp farms. Therefore, the gross income for year round bagda shrimp farming was Tk 190814.80 (Table 4).

Table 2 : Per hectare variable cost of year round bagda shrimp farming

Variable cost items	Units	Quantity	Price/Unit (Tk.)	Cost (Tk.)	% of total
Human labor	Man-days	150	110	16500	28.86
Shrimp fry (PL)	Numbers	59840	0.40	23936	41.87
Lime	kg	100	10	1000	1.75
Urea	kg	150	12	1800	3.15
TSP	kg	80	35	2800	4.90
Manure (cow dung)	kg	1000	0.50	500	0.87
Fin fish fingerlings	kg	40	110	4400	7.70
Miscellaneous cost	-	-	-	2000	3.50
Interest on operating capital (OC)	-	-	-	4235	7.41
Total Variable Costs	-	-	-	57171	100

Field survey 2009

Table 3: Per hectare fixed costs of bagda shrimp production

Cost items	Cost (Tk)
Land use cost	44880
Construction of water supplying canal, guard room, office and other housing cost	2244
Canal digging and dyke	1496
Miscellaneous	1000
Total Fixed Costs	49620

Field survey 2009

Net return is the differences between gross return and the total cost of production. Per hectare total cost, gross income and net return were Tk 106791.00, 190814.80 and 84023.80 respectively (Table 4).

Table 4 : Per hectare economic return of year-round bagda shrimp farming

Items	Yield (kg/ha)	Price Tk/kg	Gross income (Tk/ha)	% of gross income
Gross Income				
(i) Bagda shrimp				
A-grade	44.88	560	25132.80	13.17
B-grade	149.60	440	65824.00	34.50
C-grade	239.36	280	67020.80	35.12
(ii) Tilapia	127.16	40	5086.40	2.67
(iii) Pershey	37.40	180	6732.00	3.52
(iv) Horina	29.92	200	5984.00	3.14
(v) Chali	22.44	130	2917.20	1.53
(vi) Tangra	52.36	160	8377.60	4.59
(vii) Vetki	14.96	250	3740.00	1.96
Gross Return	-	-	190814.80	100
Total cost (TVC+TFC)	-	-	106791.00	
Net income or profit	-	-	84023.80	
BCR (undiscounted)			1.78	

4. Conclusion and Recommendation

From the Cobb-Douglas production function model, the included key variables of the model were significantly effective on production. So, there is a positive effect of key factors in the production process of year round bagda shrimp farming. It should be noted here that the major international markets for Bangladesh's shrimp (frozen) are Japan, the USA and European Union (EU). Unfortunately, Bangladesh exports have now substantially declined. Despite the fact, Japan external trade organization (JETRO) argued that there is a great demand for Bangladeshi shrimp in the Japanese market. If Bangladesh wants to retain the existing opportunities of shrimp markets as well as to enjoy the supremacy in the competitive world market, the performance of local shrimp farms (in terms of quality and volume) must be increased quite substantially without further delay. As the demand as well as the price for bagda shrimp in the international as well

as in the domestic markets has increased, extensive culture of bagda shrimp has also increased but productivity is still low compared to other shrimp exporting countries. So there is an ample opportunity to improve per hectare yield of year round bagda shrimp. For this to achieve, the following policy recommendations are made:

- Scientific method of cultivation should be introduced to increase the production. The farmers should be provided with training, information and necessary facilities to cope with new and changed situation.
- Bank loan and institutional credit should be made available on easy terms and conditions to the shrimp farmers.
- Availability of quality shrimp fry should be ensured at proper time for bagda shrimp farming.
- Field level agronomic research is suggested to be carried out for studying the impact of salinity on the yield of various crops including vegetables and fruits.
- Finally, if more areas could be brought under shrimp cultivation, the country could probably have earned a huge amount of foreign exchange by exporting shrimp.

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