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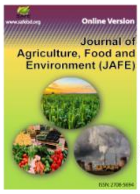

Original Article

An Economic study on Vietnam *Koi* farming in some selected areas of Muktagacha Upazila in Mymensingh district

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A B S T R A C T

Vietnam *Koi* has opened up a new horizon of pond culture in Bangladesh. In Bangladesh, the importance of this fish in meeting the protein needs of the growing population is enormous.

Farmers prefer it as a business because of its strong growth and productivity. It was necessary to do an economic analysis on Vietnam *Koi* aquaculture in order to do so. The cost, returns, and profitability of Vietnam *Koi* production were estimated in this study, as well as the major variables influencing the gross return on Vietnam *Koi* farming. For this, 40 farmers were selected randomly from three villages namely Polsha, Sayedgram and Baniakazi at Muktagacha *Upazila* under Mymensingh district. Both tabular and functional analyses were done to address the objectives of the study. The average total cost of Vietnam *Koi* production per hectare was calculated Tk.12,90,498.19. The total return of Vietnam *Koi* per hectare was estimated as Tk.19,92,413.50. Gross margin and net return per hectare were estimated as Tk.7,84,238.11 and Tk.7,01,915.31 respectively. In the research area, the production of Vietnam *Koi* was determined to be profitable. Cobb-Douglas production function was used to estimate the specific effect of factors on gross return. Most of the factors included in the model were considerably effective on the production of Vietnam *Koi*, according to the Cobb-Douglas production function model. So there is a positive effect of key factors in the gross return of Vietnam *Koi*. Out of nine variables, five of them (human labor, fingerling, feed, fertilizer and pesticide) had significant effect on returns of Vietnam *Koi* production. In conclusion, the study found that Vietnam *Koi* fish farming was profitable in the research area.

Introduction

Bangladesh is predominantly an agricultural country. Agriculture sector is comprised of crops, livestock, fisheries and forestry (BBS, 2018). A total of 62.6 percent of the population lives in rural areas and is involved in agriculture in some way (BBS, 2020). The contribution of GDP from Agriculture in Bangladesh was BDT 8,820.6 million in fiscal year 2010-11 and it had been increasing on a regular basis. In 2019 it was BDT 10,799.1 million which had increased to BDT 11,023.2 million in 2020 (BBS, 2020). So undoubtedly it can be said that the contribution of agriculture has been immense from time immemorial. Now Bangladesh agriculture is not only self-sufficient in food but also fisheries sector is becoming notable day by day. "Mache-Bhate Bengali," as we call ourselves, is a familiar term among us. Its meaning is "Bengali is made up of fish and rice" (Hasan *et al.*, 2010). As a result, we may say that fish plays a significant role in our lives. Agriculture relies heavily on fish and fisheries. In Bangladesh, fisheries sector is separated into two categories: inland and marine fisheries (DoF, 2016). The inland fishery is further divided into two subsectors; inland capture fishery and inland culture fishery. Inland culture fishery is further divided into fresh water aquaculture and coastal aquaculture. With a total production of 4.384 million MT in FY2018-19, Bangladesh is one of the world's major fish producers (DoF, 2019). Last 10 years average growth performance of this sector is 5.26% which seems encouraging. This sector plays an essential role in Bangladesh's socioeconomic development and has tremendous potential for future growth in the rural economy. This country is endowed with vast open water resources that support a diverse spectrum of aquatic life (Haque *et al.*, 2017). It is one of the world's leading fish producing countries with a total production of 43.84 lakh MT in FY 2018-19, where aquaculture production is 24.89lakh which contributes 56.76 percent of the total fish production. The majority of farmers in Bangladesh employ conventional methods for fish farming, which is a major impediment to boosting output. To increase fish production, environment friendly new technology and scientific methods should be applied (Islam *et al.*, 2017). In this case, *Koi* farming is a new degree of scientific culture for the farmer. Few years ago, farmers could not think to cultivate *Koi* in their pond in large scale. But now this practice is familiar to many fish producer. This is really a matter of hope. In 2002, the journey of *Koi* fish farming started with the help of Thai *Koi* (DoF, 2002). It was introduced from Thailand. This carp came from Eastern Asia and has traveled a long way. It is not possible to say about the specific origin *Koi* fish. Many thinks that it is originated from China as like all the carp fish and some think its origin in Japan as an ornamental fish. The scientific name of *Koi* is *Anabas testudineus* (family-Anabantidae, order-Perciformes). Since the introduction of induced breeding and bulk seed production, *Koi* culture has grown it's popularity in Bangladesh (Zafar *et al*. 2017). *Koi* is a relatively new aquaculture species in Bangladesh compared to other aquatic species. Production of *Koi* has increased in our country at a continuous basis (FAO, 2020). Production of *Koi* was 38,007 metric ton in FY 2011-12, it increased to 63,103 metric ton in FY 2017-18. In Bangladesh, this is a ray of hope for *Koi* fish farming. Among all the fish, *Koi* is a widely accepted healthy food owing to its richness in essential amino acids, minerals and trace elements (Faruk *et al*, 2018). Vietnam *Koi* is a popular fish in India and Bangladesh due to its high nutritional value (Dey *et al.*, 2010). The particular goals of this study were to assess the cost, return, and profitability of Vietnam *Koi* farming in Muktagacha Upazila, Mymensingh district, as well as to determine the primary determinants impacting gross return on Vietnam *Koi* farming.

Methodology

Study area

Muktagacha is the *Upazila* of Mymensingh district which is 314.71 sq km, located in between 24°36' and 24°52' north latitudes and in between 90°04' and 90°20' east longitudes (Rana *et al.*, 2022). The majority of the individuals in this area are interested in Vietnam *Koi* farming. The area has some identical characteristics like homogenous soil type, topographical condition and climate. Previously no study of this type was done in the area. The research area was easily accessible and the respondents were expected to cooperate. As a result, it was predicted that credible data would be gathered. We have chosen this area based on these characteristics, and the study area included three villages in the Muktagacha *Upazila* of Mymensingh district: Polsha, Syedgram, and Baniakazi.

Sampling procedure and sample size

AEO provided a list of Vietnamese *Koi* farmers. The 40 farmers were then chosen with random sampling from the mentioned three villages described above, based on the criterion of having the most Vietnam *Koi* producers in the research area. For collecting data through survey method, we prepared an interview schedule. It is the most important and first tool for starting a research project. The interview schedule was used to gather information on the cost items and revenue of Vietnam *Koi* farming.

Data collection and processing

A draft interview schedule was constructed before the final interview schedule keeping the study's objectives in mind. The suggested schedule was then pre-tested in the research area, and special attention was devoted to the inclusion of a new question that was not included in the original survey (Shamsuzzaman *et al.*, 2020). The draft schedule was then improved, rearranged and modified in the light of the actual and practical experience of field observations. Data were gathered from June to July 2021 through face to face interview method.

Processing, tabulation and analysis of data

The information gathered were edited and coded. After that, all of the data were compiled and thoroughly examined. Initially for convenience, information were collected in local units. After that it has been converted into international standard units. Data entry and analysis were done by using Microsoft Excel and STATA software in computer. On the light of the objectives of the study, a list of tables was created.

Analytical techniques used

The following techniques were used to analyze the data.

Tabular analysis

Calculation of gross return

Gross return was calculated by multiplying the total volume of output by the average price in the harvesting period. The following equation was used to estimate the gross return (GR):

$$GR = Q_m P_m$$

Where,

GR=Gross return of the product (Tk./ha);

Q_m= Quantity of the product (Kg/ha);

P_m = Average price of the product (Tk./Kg);

Calculation of gross margin

The gap between gross return and variable costs is known as gross margin. Farmers, in general, prefer a high rate of return over a variable cost of production. The farmers' motivation for applying the gross margin analysis is to maximize profits over variable costs (Haque and Chakbarty, 2014) Total variable costs were subtracted from gross return to obtain per hectare gross margin. That is,

$$GM = GR - TVC$$

Where,

GM = Gross margin;

GR= Gross return;

TVC = Total variable cost

Calculation of net return

Fixed costs, such as land use charges, interest on operating costs, and depreciation costs, were addressed in the net return analysis. All costs (variable and fixed) were subtracted from the gross return to obtain the net return.

$$\text{Net return} = GR - TC$$

Where, TC = Total fixed cost + Total variable cost

Undiscounted Benefit Cost Ratio (BCR)

A key measure for determining profitability is the return on each taka spent on production. Undiscounted BCR was estimated as the ratio of total return to total cost:
BCR (Undiscounted) = Total Return/ Total Cost

Econometric model

To identify the main variables and determine the contributions of the most essential variables in the production process of Vietnam *Koi*, the statistical technique of Cobb-Douglas type production function model was employed in this study.

Cobb-Douglas production function

To estimate the influence of important variables on the gross return of Vietnam *Koi* production, the Cobb-Douglas production function was utilized. The Cobb Douglas production function employed in this research is as follows.
Y = aX1bl X2b2 X3b3 X4b4 X5b5 X6b6 X7b7 X8b8 X9b9eu
The Cobb-Douglas production function was transformed into the logarithmic version shown below:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + U$$

Where,
Y = Gross return (Tk./ha)
X_1=Human labor cost (Tk./ha);
X_2= Fingerling cost (Tk./ha);
X_3= Feed cost (Tk./ha)
X_4=Chemical cost (Tk./ha);
X_5= Fertilizer cost (Tk./ha);
X_6= Manure cost (Tk./ha);
X_7= Pesticide cost (Tk./ha);
X_8= Electricity and water supply cost (Tk./ha); X_9= Communication cost (Tk./ha); a = Constant or intercept term; ln= Natural logarithm;
b_l to b_9 = Coefficients of the variables that need to be estimated; and U = Disturbance term.

Results and Discussion

The profitability of Vietnam *Koi* farming was one of the most important aspects of this study. Calculating net return and gross margin was a quick approach to analyze profitability (Sarker *et al.*, 2016). Table 1 depicts the cost and return analysis.

Table 1. Cost and return of Vietnam *Koi* cultivation (Tk./ha).

Items	Quantity per hectare	Unit price (Tk.)	Cost (Tk.)	% of Total cost
Variable cost				
Human labor(Man-days)	412	500	2,06,055.94	15.79
Fingerling(Kg)	37.08	3,175.18	1,17,535.26	9.01
Feed(Kg)	12,193.20	62.18	7,56,906.15	58
Chemicals				
-Lime(Kg)	569.86	20.15	11,459.66	0.88
-Zeolite(Kg)	245.45	79.8	19,586.39	1.50
-Salt(Kg)	425.37	15.03	6,393.45	0.49
Fertilizers				
-Urea (Kg)	34.74	19.88	690.76	0.05
-TSP (Kg)	19.26	25.75	495.84	0.04
Manures (Kg)	125.99	5	628.90	0.05
Pesticides (Piece)	352	3.18	1,109.83	0.09
Electricity and water supply (Kilowatt-hour)	5,188.72	8.75	45,325.53	3.51
Communication (Tk.)	-	-	1,270.77	0.10
Interest on operating capital(Tk.)	-	-	35,189.57	2.72
A. Total variable cost (Tk.)			12,08,175.39	93.52
Fixed cost				
Land use cost (Tk.)	-	-	82,322.80	6.37
B. Total fixed cost (Tk.)			82,322.80	6.37
C. Total cost (Tk.)= A+B			12,90,498.19	100
D. Yield of Vietnam *Koi*(Kg/ha)	18,026.24			
E. Price (Tk./Kg)		110.53		
F. Gross Return (Tk./ha)=D*E			19,92,413.50	
G. Gross Margin (Tk./ha)= GR-TVC			7,84,238.11	
H. Net Return (Tk./ha)=GR-TC			7,01,915.31	
I. BCR (Undiscounted)		1.53		

Source: Author's calculation based on field survey (2021)

Estimation of cost, return and profitability

Cost is important in every production process since it helps farmers make the best decisions.

Total expenses were calculated by adding total variable and fixed costs together (Kohinoor *et al.*, 2016). The entire cost of producing Vietnam *Koi* farming was assessed at Tk. 12,90,498.19 per hectare in this study.

The whole volume of production was multiplied by their individual market price to arrive at the gross return. Table 1 shows that average yield of Vietnam *Koi* fish was 18,026.24Kg per hectare and its estimated value was Tk.19,92,413.50. The gross margin of Vietnam *Koi* production was evaluated at Tk.7,84,238.11 in the current study, indicating the difference between gross return and total variable cost. Total cost was subtracted from total return to arrive at Tk.7,01,915.31 per hectare net return from Vietnam *Koi* fish farming. Total cost is the sum of total variable and fixed costs. The Benefit Cost Ratio (BCR) compares benefits to expense per unit of cost. This is calculated as a ratio of total return to total cost in this case. The total BCR (Undiscounted) for Vietnam *Koi* fish farming was 1.53, indicating that Vietnam *Koi* production was lucrative.

Empirical results of the factors influencing the Gross return of Vietnam *Koi* farming

Cobb-Douglas production function was chosen as the best fit for estimating the influence of variable factors on gross return of Vietnam *Koi* production. In this analysis, nine independent variables such as costs of using human labor, fingerlings, feed, chemicals, fertilizers, manures, pesticides, electricity and water supply cost and communication cost of the farmers were taken into considerations. The gross return on Vietnam *Koi* production is affected by all of the variables.

Table 2. Coefficient and related statistics of Cobb-Douglas production function of Vietnam *Koi*.

Explanatory variables	Estimated coefficient	Standard errors	t-value	p-value
Constant	-1.446	5.238	0.28	0.784
Human labor cost (X_1)	0.134***	0.029	4.61	0.000
Fingerling cost (X_2)	0.149**	0.056	2.68	0.014
Feed cost (X_3)	0.970***	0.294	3.29	0.003
Chemical cost (X_4)	0.029	0.069	0.41	0.681
Fertilizer cost (X_5)	-0.104*	0.054	-1.94	0.071
Manure cost (X_6)	0.071	0.104	0.68	0.502
Pesticide cost (X_7)	0.102 *	0.053	1.93	0.063
Electricity and water supply cost (X_8)	0.242	0.191	1.26	0.216
Communication cost (X_9)	-0.019	0.024	-0.81	0.426
R^2		0.670		
F-value		6.76***		
Returns to scale		1.57		

Source: Author's calculation based on field survey (2021)
*** indicates 1% level of significance
** indicates 5% level of significance
* indicates 10% level of significance

The estimated Cobb-Douglas production function for Vietnam *Koi* can be shown through the following formula

$$\ln\hat{Y} = -1.446 + 0.134 \ln X_1 + 0.149 \ln X_2 + 0.970 \ln X_3 + 0.029 \ln X_4 - 0.104 \ln X_5 + 0.071 \ln X_6 + 0.102 \ln X_7 + 0.242 \ln X_8 - 0.019 \ln X_9$$

The coefficient of human labor was 0.134, which was statistically significant at the 1% level.. It indicates that keeping other factors constant, 1 percent increase in money spent on human labor would result in increase of total return by 0.134 percent. The regression coefficient of fingerling, feed cost, chemical cost, fertilizer cost, manure cost, pesticide cost, electricity and water supply cost were positive which implies that 1 percent increase of each item would increase the profitability of Vietnam *Koi* by their respective percentage. Only the communication cost regression coefficient was negative, implying that if all other parameters remained fixed, a 1% rise in communication cost would reduce the gross return of Vietnam *Koi* by 0.019 percent. The coefficient of multiple determinations, for Vietnam *Koi* was 0.670, indicating that the explanatory variables included in the model explained around 67 percent of the variation in the gross return from Vietnam *Koi*. The model's F-value was 6.76, and it was significant at the 1% level of significance, showing that the explanatory variables in the model were the primary determinants of Vietnam *Koi* production. The total of all input coefficients (Returns to scale) for Vietnam *Koi* production was 1.57 in this study. This means that the production function has growing returns to scale in the sense that if all of the production function's inputs were increased by 1%, the gross return on Vietnam *Koi* would increase by 1.57 percent. Most of the model's included factors were considerably effective on the production of Vietnam *Koi*, according to the Cobb-Douglas production function model. As a result, crucial factors have a beneficial impact on the gross return of Vietnam *Koi*.

Conclusion

Since time immemorial, Bangladesh's fisheries sector has played a critical part in the country's economy (Ahamed *et al*. 2018). The overall outcomes of this study demonstrated that *Koi* farming in Vietnam is quite profitable. Yield and production could be increased if current agricultural inputs and production technology are made available to farmers in a timely manner. It can help farmers to increase income and improve their livelihood standards. It can help in improving the nutritional status of rural people. Despite the better returns, many farmers are wary about the Vietnam *Koi* culture because of the high production costs compared to other fish. However, it can be claimed that the study region has a lot of room to improve its production and thereby to increase income and employment of the farmers. As a result, there is a lot of scope to increase the efficiency of Vietnam *Koi* farming.

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