SHRIMP FARMING IN THE NORTH EASTERN COASTAL PLAIN ZONE OF ODISHA: A MICRO-ECONOMIC ANALYSIS

ABSTARCT

The current experiment examines shrimp farming, including its return on investment, cost structure, and factors that affect yield in order to sustain it for future demands. Most new entrepreneurs selected it as their start up business since it is a lucrative one. The initial objectives of the investigation were established in advance. From the Balasore and Bahanaga blocks in the Balasore district in the Indian state of Odisha, 40 shrimp farmers have been selected for the present study. The information was gathered from the farmers using a well-planned schedule and questionnaire, together with a purposeful and random sampling method. The cultivation of shrimp requires 4 months, with 1 month required for pond preparation in between each cultivation. Therefore, shrimp are grown twice a year, from September to December and from February to May. As a result, the first year's shrimp cultivation has a one-season gestation time. The cost of feeds is highest followed by the rental value of land, according to the cultivation cost of various operations, manpower, and other variables. 30% of the overall production has been deducted for land rental costs. The shrimp business has been in operation for ten years on average since shrimp farming in the same pond year after year might lead to disease infestation, however the findings show that up to eight years can be successful in the chosen area. Pond construction costs were only incurred in the first year of shrimp farming. The other cost factor stays the same over the lifespan of the pond. The expense incurred in the first year exceeds the profit made in that year. The overall cost is more than it has ever been. It is estimated how productive and profitable shrimp farming is. The second year of pond age has the maximum yield, which is projected to be 8.1 tonnes per acre of land.The Cobb Douglas production function has been used in the current investigation to determine the link between yield and yield determining factors. To identify the important variables the Cob-Douglas production function has been used through step wise regression model where the cost of feed, amount of labour both for operation and management, and the duration of cultivation in a particular pond are highly significant and the model is also significant in the selected region. From the correlation matrix the degree of association has also presented in the discussion. The model is finally 96.8% significant with a 5% threshold of significance in the fifth stage. As a result, it is clear that this model is highly significant at the 5% level of significance, meaning that the independent variables can account for 96.8% of the dependent variable (productivity). Here the ANOVA which is calculated with the help of SPSS statistics shows whether the model is significant or not at each model where the different predictors are for different models. It is found that each of the models is highly significant at 5% level of significance.

Comment [Y1]: Authors need to concluded this long sentences.

Keywords: Shrimp farming, Balasore, C D production function, ANOVA, Regression through SPSS

INTRODUCTION

Aquaculture is increasingly recognized as a significant source of wholesome food for our people and a more effective means of earning money for farmers. One of them, among others, is the aquaculture of shrimp. It developed into an aquaculture industry that operates in either a freshwater or marine setting. Shrimp aquaculture has developed into a significant area of fish farming in recent years after undergoing a significant change from low input agriculture. It has evolved from localised,

small-scale companies in Southeast Asia into a global sector that is carried out anywhere that offers ideal shrimp cultivation conditions.Both are commonly referred to as shrimp in Australia and New Zealand. Both prawns and shrimp are referred to as "crevettes" in France. Both are referred to as "Cameron" in Spain. However, in India, smaller types are referred to as "shrimps" and somewhat larger ones as "prawns."

Shrimp culture in India dates back to 1970, when shrimp culture technology was first introduced at CMFRI (Cochin). This was followed in 1973 by the All India Coordinated Research Project on brackish water fish farming, and in 1975, research on shrimp breeding and seed production was conducted at Nirkkal (Kerala). In the years 1982–1983, Chilika Lake (Orissa) began a confined pond shrimp culture. Beginning in 1985, Andhra Pradesh's small farmers developed a widespread shrimp culture. At Sandeshkali (West Bengal), 3.5 tons/hectare/crop of semi-intensive shrimp culture was reported for the first time in 1987.

The first commercial shrimp hatcheries were then established in 1987 in Gopalpur (Orissa) and Visakhapatnam (Andhra Pradesh). At Tuticorin (Tamil Nadu), the first intensive shrimp culture with 8 tons/hectare/crop became a reality in 1989. At Nellore, the first example of semi-intensive farming with 4 tons/hectare/crop occurred in 1990. (Andhra Pradesh). Beginning with the 7th plan, the first Brackishwater Fish Farmers Development Agency (BFDA) was established (1985-90). The Marine Products Export Development Agency (MPEDA), a division of the Ministry of Commerce, then established its first prawn-farming division in 1979. In the 1980s, the Andhra Pradesh Shrimp Seed Production and Research Center (APSPARC) and Orissa Shrimp Seed Production and Research Centre (OSSPARC) were established.

With seven coastal districts and a 480 km long coastline, Odisha is a maritime state in India (Excluding Chilika with 790 ha of water spread area). The state was regarded as the nation's least developed (Economic survey, 2003-04). Agriculture and fishing are two primary sector industries that are important to the state's economy. The state has severe unemployment and poverty. Despite this, the state has great potential for developing its fisheries. Orissa had the highest rate of pond fish stocking (579/ha), according to records. According to data from 1980–1981, it was also the top supplier of fish seed, providing 226 Lakh fingerlings to the other states. In light of this, the state government launched the brackish water shrimp culture project under the BFDA plan with the stated goals of reducing rural poverty and fostering employment possibilities.

In the current experiment, we analyze shrimp farming, its return on investment, cost structure, and factors that affect yield in order to sustain shrimp farming for future demands.

Comment [Y2]: What is study purposes? It's benefit for whom?

MATERIALS AND METHODS

The goal of the current study is to evaluate the socioeconomic status of the household of shrimp farmers, aspects of shrimp cultivation, and the cost and return structures of shrimp farming. Through random selection, farmers from two distinct Balasore district blocks have been purposefully chosen for the study. Additionally, information on various costs and return streams from 40 farmers,

twenty (20) from each block, has been gathered. The information was gathered from chosen farmers with the goal of examining the cost and return structure of shrimp farming. Step-by-step regression analysis was used to identify the elements that affect shrimp farming yield when compared to seasonal paddy cultivation.

The several approaches for figuring out the return and cost structure of shrimp farming have been used. These approaches include returns at constant pricing and returns on discounts. Using project appraisal approaches such as NPW (185068.36 rupees), BC ratio (1.10) at a 10% opportunity cost of capital, and Financial Rate of Return, the economic viability of the shrimp farm has been calculated (over 50 per cent). Regression analysis has been used to determine the elements that determine yield, and the results show that the duration of cultivation, feed costs, and labour costs for both daily operations and pond management are highly significant. The correlation matrix has been used to examine the degree of relationship between the variables. Here, the variables that affect yield have been identified.

Comment [Y3]: Need to showed the map of locations? 40 farmers from how many farmers?

RESULTS AND DISSCUSSIONS

DEMOGRAPHICS OF THE RESPONDENTS

The socioeconomic circumstances of the respondents are significant for the social sciences since some social and economic factors also directly or indirectly support the production system. The respondent's age and educational background have been taken into account in the analysis in this first section in order to capture their overall production and marketing experiences. In addition to these, the total number of household members, including their age distribution, is crucial because, in developing nations, the availability of labour in the production and management of agriculture and related industries improves the utilisation of excess labour, leading to the generation of additional family incomes.

One of the most important economic assets that drive all agricultural-based activity is operational holdings, which is also covered in this section using tabular approaches.It is a key component of the farm household system that represents how they accept new technology, make decisions, and eventually manage the entire farm enterprise. The sample in this instance is broken down into three age groups: young (18-35), medium (36-50), and old (>50).

Table 1:Age distribution of survey respondents

Sl. No.	Age (in years)	No. of Respondents	Total in %
1	Young (18-35)	17	42.50
2	Middle (36-50)	15	37.50
3	Old(>50)	8	20.00

One of the key criteria in determining the potential productive human resources is knowledge of the shrimp farmers' ages (Hussain, et al., 2009). Here, it is found that 42.5% of respondents, or the maximum age range of the sample, are fewer than 20. This demonstrates that the majorities of farmers

are still in their prime and may be able to get more cutting-edge technologies and take prudent risks. Chaudhari (2007) in Maharashtra, Koteswari et al. (2014) in Andhra Pradesh, and Sahuet al. (2014) in the Balasore and Puri district of Odisha all reported making similar types of observations. Previous research revealed that this occupation attracted the biggest percentage of people (18–35) (45%). (Das et al., 2015). The age distribution of shrimp producers offers important insights into their capacity for making decisions and conducting effective farming operations (Paul et al., 2018). It is crucial to note that the younger generations showed no interest in shrimp fishing (Paul et al., 2018), which suggests that if the scenario persists, difficulties are about to come.

The level of education a person has determines where they fall in the social hierarchy. Education generally has an impact on attitude, creativity, and decision-making. The goal of the current study was to evaluate the respondents' educational backgrounds.

Table 2:Distribution of responders by educational backgrounds

Sl. No.	Education level	No of respondents	Total in %
1	Secondary education	23	57.50
2	Higher secondary	15	37.50
3	Graduation	2	0.05

According to the table, 57.7% of the respondents have completed secondary education, while 37.5% have completed upper level education. There are 5% graduates among farmers. This demonstrates the producers' commitment to educational advancement in shrimp culture. The fact that only 8% of farmers have a university degree is concerning. According to Das et al. (2015), 75% of the fishing community was illiterate. However, our study showed a distinct pattern that is thought to be improving as a result of the increase in the socioeconomic status of the communities who practise shrimp farming. According to Rahman (1994), the fishermen are socially, economically, and educationally disadvantaged and do not have enough money to devote to their schooling. Low or no education was found to be a defining aspect of rural life in several communities by Karim (1978) and Bangladesh Agricultural Research Council (BARC, 1980). Similar findings were made by Patil et al. (2018) in their study in the Palghar region of Maharashtra, where they noted that the biggest percentage of shrimp farmers (50.91%) had graduate degrees, followed by shrimp farmers (29.09%) with higher secondary education. The findings of the present study and those of Hossain &Pingali (1998) and Shahjahan et al. are comparable in this regard (2001).

FAMILY SIZE AND MEMBERS' ENGAGEMENT IN SHRIMP FARMING

Table 3:Distribution of responders based on the number of family members

Comment [Y4]: Meaning up to 5 is <5?

Sl. No.	No of family member	No of respondents	Total in %
1	Up to 5	19	47.50
2	>5	21	52.50

In rural Odisha, family members frequently work in agriculture in addition to the family head. Family members must participate in numerous agricultural operations and keep an eye on the

activities because shrimp farming is a specialist commercial farming activity.In their study in the Palghar area of Maharashtra, Patil et al. (2018) found that more shrimp farmers (54.55%) had experience between six and 10 years. Similar findings were found by Kumaran et al. (2017) who noted that 94.65% of East Coast of India farmers had more than five years of experience.

Table 4:Distribution of responders by member engaged in shrimp farming

Sl. No.	No of family member involved in shrimp farming	No of respondents	Total in %
1	Up to 1	18	45
2	>1	22	55

According to the two tables above, 47.5% of respondents had families with less than five members, while 55% of respondents had more than one member of their family work in the shrimp industry.Due to the higher subsistence level, the seasonal and sometimes professional fishers are engaged in multiple earning activities on a part-time basis, especially during the low season for fishing (Paul et al., 2018a). Many fishers were also involved in agricultural activities (Goswami et al., 2002; Rahman et al., 2016; Hossain and Hasan, 2017; Islam et al., 2017). The increasing percentages of executive involvement are noticeable in the study area, a promising sign for the shrimp farming community.Akber et al. (2017) have reported similar findings in previous studies targeting the same locality. The substantial economic benefit is the primary reason for the increased commercial saline-water BagdashSrimp farming (Hossain et al., 2009; Saha, 2017). The saltwater ascension worked as a double-edged sword. It resulted in a decline in rice production while acting as a more profitable farming source for the coastal communities. The saline water intrusion was the prime cause that forced the study area people to shrimp farming instead of rice cultivation (Saha, 2017).

Table5:Distribution of responders according on their operating holdings size

Sl. No.	Holding size	Total operational holding		Area under shrimp farming	
		Frequency	%	Frequency	%
1	Less than 2.5 acre	14	35.00	34	85.00
2	2.5- 5 acre	22	55.00	6	15.00
3	More than 5 acre	4	10.00	0	0.00

The table clearly shows that the majority of farmers (55%) are small farmers. Only shrimp farming is done on less than 2.5 acres for 85% of farmers. No farmer uses more than 5 acres for shrimp aquaculture.According to Mohite's 2007 research, 65.79% of shrimp farmers had farms that were smaller than two hectares. The findings from this study concur with those from Salunkhe (2018), Srinivas and Vankatraylu (2016), Randive (2008), and Gawade (2006). In their study conducted in the Palghar district of Maharashtra, Patil et al. (2018) found that the majority of shrimp farmers (40.00%) had farms with an area of between 2 and 5 hectares.

COST OF PRODUCTION

Shrimp aquaculture is carried out commercially in the research region. They operate the business on their own land. However, because it is strictly commercial, the rental value of the land is set at 30% of the entire yield for the establishment of agriculture as a business strategy. Major farm equipment like aerators and water motors are in the hands of the growers. Farm equipment depreciation and maintenance costs are also included in the assessment. Other farming expenses are covered by adhering to the CACP rules, even if this is primarily an investment strategy for the long term as opposed to the growing of seasonal food grains. The cost of labour is calculated at Rs. 300 per man-day.

According to the project analysis approach, the flow of financial costs and returns at 2018–19 prices has been estimated for this study. Based on the facts gathered during data collection, the enterprise's lifespan is likewise fixed. Table 5 details the price of farming.

EARNINGS AND RETURN

The gross return, total cost, and net return are estimated as per acre of cultivation of L. vannameifor during the survey year from the sample holding and are shown in table 6. The output from each pond is multiplied by the prawn price per kg. The average price for the survey year in that locality was determined to be Rs. 280/Kg despite the fact that prices there vary slightly. Local farmers are becoming more and more interested in shrimp growing as it promotes job creation and are profitable.Estimated returns from shrimp farming are: (I) Fixed price (II) Reduced price.

Comment [Y5]: italic

(I) Fixed pricing

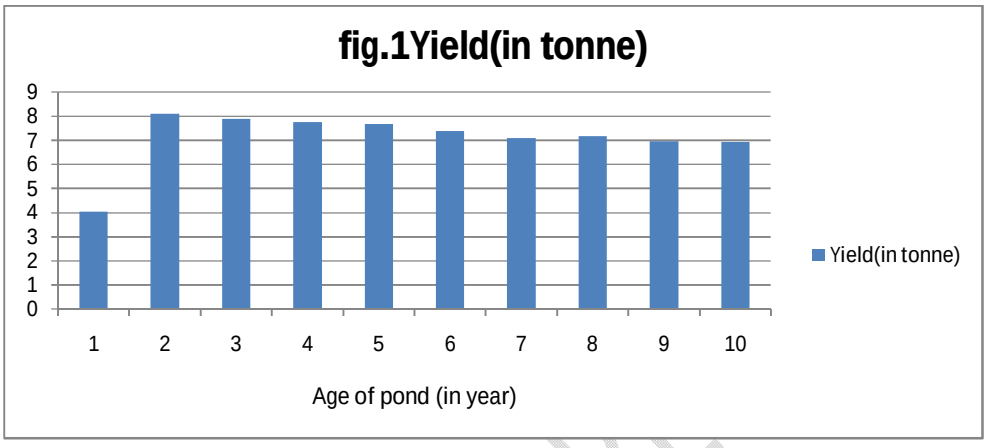
Table 6 provides the return per acre of shrimp according to pond age. By using the formula of the weighted average of the acquired data for the respective age of the pond, the per-acre cost and return at constant price are determined. The difference between the entire return and the total expenditure incurred is the net return.

Twice a crop year is dedicated to shrimp cultivation. Since shrimp farming has a gestation period of only one season out of a lifespan of ten, the net return was negative only for the first year of cultivation. The net return then showed a positive return from the second to the eighth year. Shrimp farming generates a maximum net return of Rs. 168508.00/- in the second year. The net return then gradually dropped, showing a negative value in the ninth and tenth years. The pond is currently in its second year of cultivation, with maximum cost, return, and net return estimates.

Table 6: Shrimp farming's per-acre output and cash flow stream (in Rupees)

Age of pond (in years)	Yield (in tonne)	Gross return (inRs)	Total cost (in Rs)	Net return (in Rs)
1	4.03	1129333.00	1348646.00	-219313.00
2	8.10	2268000.00	2099492.00	168508.00
3	7.87	2205000.00	2077133.00	127867.00
4	7.74	2168000.00	2075179.00	92821.00
5	7.67	2146667.00	2056241.00	90426.00
6	7.38	2067333.00	2008006.00	59327.00

7	7.10	1988000.00	1959131.00	28869.00
8	7.15	2002000.00	1997826.00	4174.00
9	6.94	1943200.00	1970173.00	-26973.00
10	6.92	1939000.00	1962635.00	-23635.00



Discounted price

The return at discounted pricing is determined using the project appraisal technique. In this manner, the discounted factor for each year is multiplied by the gross return, total cost, and net return, respectively. Table 5 displays the discounted values of gross return, total cost, and net return.

Net present worth

It is the simplest discounted cash flow measurement of project value. The opportunity cost of capital is assumed to be 10% for the purpose of calculating net present worth. Net return at various ages is multiplied by the 10% discount factor for that specific year. In table 5, the net return for ponds of various ages is shown. The net present worth, which is projected to be Rs. 185068.36/- when discounted net return is added up, demonstrates the investment potential of this enterprise.

B: C Ratio

One indicator of a project's economic viability is the benefit-cost ratio. The benefit-cost ratio is not frequently employed in developing nations, despite the fact that the ratio's value will vary based on where the netting out of cost and return streams takes place.The opportunity cost of capital was set at 10% in this study to determine the benefit cost ratio. The value of the gross benefit stream at 10% is currently worth Rs. 12062840.00, whereas the value of the gross incremental cost stream at 10% is currently worth Rs. 11877771.63.Dividing the present worth of gross benefit stream by the present worth of the gross cost stream, the benefit cost is estimated to be 12062840.00 / 11877771.63 = 1.01

FINANCIAL RATE OF RETURN (FRR)

Table 7: Computation of Financial rate of return

Age of pond	Net return	Discounted @ 50%	Discounted net return at 50%	Discounted factor at 53%	Discounted net return at 53%

1	-219313	0.660	-144745.92	0.6530	-143210.931
2	168508	0.440	74140.97	0.4270	71953.001
3	127867	0.296	37848.63	0.2790	35674.893
4	92821	0.197	18332.08	0.1820	16893.367
5	90426	0.131	11909.05	0.1190	10778.730
6	59327	0.087	5161.45	0.0770	4568.179
7	28869	0.058	1674.40	0.0500	1443.450
8	4174	0.039	162.79	0.0330	137.742
9	-26973	0.026	-701.31	0.0210	-566.440
10	-23635	0.017	-401.79	0.0140	-330.883
Total			**3380.35**		**-2658.892**

$$\textbf{\textit{Financial rate of return}} = 50 + (53 - 50) \times \left(\frac{3380.353}{6039.245}\right) = 50 + 1.679 = 51.67\%$$

This section analyses the financial viability of shrimp farming by calculating the maximum annual interest rate that the industry would be required to pay for the resource utilized throughout the course of its ten-year life cycle in order to recover its recurring and non-recurring prime costs. The financial rate of return's calculation details are presented in table 7 under the heading "Self-Perpetuating Rate of Return." Using the interpolation method, it is discovered. Calculated are the two interest rates that have produced the fewest positive and negative results. The previously indicated formula is then used to calculate these values.

$$\textbf{\textit{Financial rate of return}} = 50 + (53 - 50) \times \left(\frac{3380.353}{6039.245}\right) = 50 + 1.679 = 51.67\%$$

Hence, the financial rate of return thus calculated is found to be 51.67%.

According to our research, it is true that shrimp farming has replaced rice cultivation as a lucrative new industry for the residents of the southwest coastal regions (Akber et al., 2017; Hossain and Hasan, 2017).

DETERMINANTS OF YIELD

Correlation matrix

The correlation between sets of variables is displayed in the correlation matrix. The values of each random variable in the tables are correlated with one another. This makes it easier to identify the pairs with the highest correlation.From the table, it can be seen that the correlation between labour costs and stocking costs has a value of 0.930, indicating that the two costs are very closely tied to one another. If one of the variables in this pair increases in value, the other variable will almost certainly increase at the same rate, and vice versa if one variable decreases.

From the table8, it can be seen that there is a bad association between the expense of managing ponds and their location. Location was used here as dummy variables 1 and 2. where block 1 represents Balasore and block 2 represents Bahanaga. This suggests that pond management is

expensive for the shrimp producers in the Balasore block based on the table's findings that cost of management has a positive association with Balasore block.

Comment [Y6]: Where is the location? What for authors clustered in two location? Table 8, it is not clear enough.

Cobb – Douglas production function

The Cobb Douglas production function has been used in the current investigation to determine the link between yield and yield determining factors. So, using SPSS, the actual input and output data are converted to log values, which are then regressed stepwise. The dummy variables 1 and 2 are used for location. When there are a total of 10 variables, the stepwise regression is finished in 5 steps. One dependent variable (productivity) and nine independent variables were among them. When only feeding costs are used as the predictor in the first model, the model is 88.7% significant at the 5% level of significance. The model's significance grows over time in little steps. The model is finally 96.8% significant with a 5% threshold of significance in the fifth stage. As a result, it is clear that this model is highly significant at the 5% level of significance, meaning that the independent variables can account for 96.8% of the dependent variable (productivity).

Comment [Y7]: SPSS? Mention it only in materials and methods.

Table 8: Model Summary of stepwise regression through SPSS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.943[a]	0.890	0.887	0.05855
2	0.969[b]	0.940	0.936	0.04399
3	0.980[c]	0.960	0.957	0.03619
4	0.983[d]	0.967	0.963	0.03350
5	0.986[e]	0.972	0.968	0.03117

a. Predictors: (Constant), feeding cost
b. Predictors: (Constant), feeding cost, age of pond
c. Predictors: (Constant), feeding cost, age of pond, labor cost
d. Predictors: (Constant), feeding cost, age of pond, labor cost, cost of pond management
e. Predictors: (Constant), feeding cost, age of pond, labor cost, cost of pond management, cost of disease prevention.

In the 5thstep of regression the predictors are constant, feeding cost, age of pond, labor cost, cost of pond management and cost of disease prevention

Table 9: Significance of models (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Significance
1	Regression	1.055	1.00	1.055	307.833	0.000[b]
	Residual	0.130	38.00	0.003		
	Total	1.185	39.00			
2	Regression	1.114	2.00	0.557	287.848	0.000[c]
	Residual	0.072	37.00	0.002		
	Total	1.185	39.00			

3	Regression	1.138	3.00	0.379	289.645	0.000[d]
	Residual	0.047	36.00	0.001		
	Total	1.185	39.00			
4	Regression	1.146	4.00	0.287	255.337	0.000[e]
	Residual	0.039	35.00	0.001		
	Total	1.185	39.00			
5	Regression	1.152	5.00	0.230	237.195	0.000[f]
	Residual	0.033	34.00	0.001		
	Total	1.185	39.00			

df : degree of freedom

a. Dependent Variable: productivity (yield/acre)
b. Predictors: (Constant), feeding cost
c. Predictors: (Constant), feeding cost, ageofpond
d. Predictors: (Constant), feeding cost, ageof pond, labor cost
e. Predictors: (Constant), feeding cost, ageof pond, labor cost, pond management
f. Predictors: (Constant), feeding cost, age of pond, labor cost, cost of pondmanagement, cost of disease prevention

Here the ANOVA table (Table 9) which is calculated with the help of SPSS statistics shows whether the model is significant or notat each model where the different predictors are for different models.Here the ANOVA table shows that each of the models is highly significant at 5% level of significance.

Comment [Y8]: Why authors always mention and over confidence about anova? Showed your results and discuss. Give reader there own judgement.

Table 10: Significance of Coefficients

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	-9.950	0.679		-14.653	0.000
	Feeding cost	0.878	0.050	0.943	17.545	0.000
2	(Constant)	-11.865	0.617		-19.217	0.000
	Feeding cost	1.027	0.046	1.104	22.172	0.000
	Age of pond	-0.071	0.013	-0.274	-5.507	0.000
3	(Constant)	-10.861	0.559		-19.439	0.000
	Feeding cost	0.396	0.151	0.426	2.622	0.013
	Age of pond	-0.090	0.011	-0.345	-7.816	0.000
	Labor cost	0.659	0.153	0.736	4.318	0.000
4	(Constant)	-10.627	0.525		-20.256	0.000
	Feeding cost	0.355	0.141	0.382	2.526	0.016
	Age of pond	-0.090	0.011	-0.344	-8.439	0.000
	Labor cost	0.567	0.146	0.633	3.899	0.000
	Cost of Pond management	0.129	0.049	0.167	2.650	0.012
5	(Constant)	-10.160	0.522		-19.470	0.000
	Feeding cost	0.285	0.134	0.307	2.134	0.040
	Age of pond	-0.083	0.010	-0.317	-8.048	0.000
	Labor cost	0.482	0.140	0.538	3.458	0.001
	Cost Pond	0.116	0.046	0.150	2.541	0.016

	management					
	Cost of Disease prevention	0.138	0.054	0.184	2.534	0.016
a. Dependent Variable: productivity(yield/acre)						

Excluded variables: Stocking density, stocking cost, location and experience of the entrepreneur.It is clear from the coefficient table whether each coefficient is significant at each level of the model. As can be seen in the table, all five independent variables are significant at the 5% level of significance because their respective significance values for each predictor are less than 0.05. It can be claimed that the age of the pond coefficient is significantly more important than other coefficients. Similar to this, after pond age, the labour cost coefficient is higher than other coefficients.

In this case, the coefficient table reveals that the beta value for pond age is negative, indicating that the relationship between production and pond age is inverse. The output of a pond decreases as its age rises and vice versa. The other coefficients have positive values, indicating that productivity will rise as costs for various independent variables rise and vice versa.

The income level of the stakeholders has significantly changed as a result of shrimp farming (Matin et al., 2016). Prior to this, each responder had previously declared how satisfied they were with rice cultivation versus shrimp farming (Islam et al., 2002; Saha, 2017; Akber et al., 2017). The farmers' opinions were stated in light of their current socioeconomic situation and lifestyle choices that might have an adverse impact on the environment (Akber et al., 2017). Since many respondents expressed satisfaction, we can therefore draw the conclusion that shrimp farming has benefited the research area. Compared to rice farming, the respondents' income level has significantly increased as a result of shrimp farming (Mitro et al., 2014). The income from shrimp farming could therefore be unpredictable, which is consistent with earlier results (Matin et al., 2016; Primavera, 1997). This also offers a plausible explanation for why some shrimp growers are unhappy. These results showed that shrimp farming raised people's income in a way that was acceptable and could be attributed to the coastal towns' improved socioeconomic condition (Rahman et al., 2008).

Conclusion

Comment [Y9]: Conclusion need to short, point from research results. No need to write down amount of samples etc.

The current experiment examines shrimp farming, including its return on investment, cost structure, and factors that affect yield in order to sustain it for future demands. The study's initial goals were set forward in advance. From the Balasore and Bahanaga blocks of the Balasore district, 40 shrimp farmers have been taken. The information was gathered from the farmers using a well-planned schedule and questionnaire, together with a purposeful and random sampling method. The cultivation of shrimp requires 4 months, with 1 month required for pond preparation in between each cultivation. Therefore, shrimp are grown twice a year, from September to December and from February to May. As a result, the first year's shrimp cultivation has a one-season gestation time. The cost of feeds is highest followed by the rental value of land, according to the cultivation cost of various operations, manpower, and other variables. 30% of the overall production has been deducted for land rental costs. The shrimp business has been in operation for ten years on average since shrimp farming in the same

pond year after year might lead to disease infestation, however the findings show that up to eight years can be successful in the chosen area. Pond construction costs were only incurred in the first year of shrimp farming. The other cost factor stays the same over the lifespan of the pond. The expense incurred in the first year exceeds the profit made in that year. The overall cost is more than it has ever been. It is estimated how productive and profitable shrimp farming is. The second year of pond age has the maximum yield, which is projected to be 8.1 tonnes per acre of land.

From the comparison of employment generation between seasonal paddy cultivation and shrimp farming in the study area it is found that the shrimp farming in one acre provides 5times more employment than one season paddy cultivation in a year. The number of man days employed in one acre of land is around 350 in average in shrimp farming per year in that study area. To identify the important variables the Cob-Douglas production function has been used through step wise regression model where the cost of feed, amount of labour both for operation and management, and the duration of cultivation in a particular pond are highly significant and the model is also significant in the selected region. From the correlation matrix the degree of association has also presented in the discussion. The model is finally 96.8% significant with a 5% threshold of significance in the fifth stage. As a result, it is clear that this model is highly significant at the 5% level of significance, meaning that the independent variables can account for 96.8% of the dependent variable (productivity). Here the ANOVA which is calculated with the help of SPSS statistics shows whether the model is significant or not at each model where the different predictors are for different models. It is found that each of the models is highly significant at 5% level of significance.

REFERENCES

Akber, M.A., Islam, M.A., Ahmed, M., Rahman, M.M., Rahman, M.R., 2017. Changes of shrimp farming in southwest coastal Bangladesh. Aquac. Int. 25 (5), 1883–1899.

BARC, 1980. National Survey of Rural Bangladesh 197-199. Public Shed in ESCAP Country Monograph Series No. 8.

Chaudhari K J. 2007. Economic and marketing analysis of shrimp farming in some district of Konkan coast, Maharashtra. Ph.D. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, India. 208 p.

Das, M.R., Ray, S., Kumar, U., Begum, S., Tarafdar, S.R., 2015. Livelihood assessment of the fishermen community in the South West region of Bangladesh. J. Exp. Biol. Agric. Sci. 3, 353–361.

Das, M.R., Ray, S., Kumar, U., Begum, S., Tarafdar, S.R., 2015. Livelihood assessment of the fishermen community in the South West region of Bangladesh. J. Exp. Biol. Agric. Sci. 3, 353–361.

Gawde M M, Chandge M S and Shirdhankar M M. 2006. Adoption of improved aquaculture practices by shrimp farmers in South Konkan region of Maharashtra, India. *Journal of Agriculture and Social Research*, 6(2): 1-8.

Goswami, M., Sathiadhas, R., Goswami, U.C., Ojha, S.N., 2002. Socio-economic dimension of fish farming in Assam. J. Indian Fish Assoc. 29, 103–110.

Hossain M, Pingali PL (1998) Rice research, technological progress and impact on productivity and poverty: an overview. In: Pingali P, Hossain M (Eds.) Impact of Rice Research. Proceedings of the International Conference on the Impact of Rice Research, 3-5 June 1996, Bangkok. Thailand: Thailand Development Research Institute and Los Benos (Philippines) and IRRI, Pp 1-2, 5.

Hossain, M.A.R., Hasan, M.R., 2017. An Assessment of Impacts from Shrimp Aquaculture in Bangladesh and Prospects for Improvement, 618. FAO Fisheries and Aquaculture Technical Paper No, p. 96.

Hossain, M.I., Siwar, C., Mokhtar, M.B., Dey, M.M., Jaafar, A.H., 2009. Socio-economic condition of fishermen in seasonal floodplain beels in Rajshahi District, Bangladesh. Res. J. Soc. Sci. 4, 74–81.

Islam, M.S., Wahab, M., Miah, A.A., 2002. Socio-economic and environmental impacts of alternate shrimp-crop farming in Bangladesh. Bangladesh J. Agric. Res. 25 (1), 63–76.

Islam, S., Reza, M.S., Roknuzzaman, M., Razzaq, A., Joadder, M., et al., 2017. Socio-economic status of fishermen of the Padma river in Chapai Nawabganj district, Bangladesh. Int. J. Fish Aquat. Stud. 5, 101–104.

Karim, A., 1978. Socio-economic Survey of Village Sahapur. A Project Work Submitted in the Department of Sociology. Rajshahi University, Bangladesh, pp: 48.

Koteswari N, Immanuel S, Cyril A L and Viswanatha B S. 2014. Impact of Aqua Societies on shrimp farming in Andhra Pradesh, India. Fishery Technology, 51(2): 130-135.

Kumaran M, Ravisankar T, Anand P R, Vimala D D and Balasubramanian C P. 2017. Knowledge level of shrimp farmers on better management practices (BMPs) of Litopenaeusvannamei farming: A comparative assessment of East and West coast of India. Indian Journal of Fisheries, 64(3): 93-99.

Matin, M.A., Chakraborty, C., Amin, M.A., Ghosh, A., 2016. An assessment of shrimp aquaculture in selected coastal areas of Bangladesh. J. Noami 33 (1&2), 103–116.

Mitro, S., Khatun, R., Baten, M., 2014. Socio-economic and environmental impacts of shrimp culture in some selected areas of Bagerhat District. J. Environ. Sci. Nat. Resour. 7 (1), 265–269.

Mohite Y T. 2007. Efficacy and constraints in adoption of improved aquaculture practices by shrimp farmers in Raigad district of Maharashtra. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, India. 58 p.

Patil S, Sharma A, Ojha SN, Shirdhankar MM and Dhaker HS. 2018 Emergence of shrimp farming and profile of shrimp farmers in Palghar district, Maharashtra. *Contemporary Research in India*, 9 (1): 37-42.

Paul, A.K., Bashak, S.K., Islam, M.S., Hussain, M.A., 2018a. Comparative Socio-economic Study with a Review on Fisherman's Livelihood Around Tulsiganga River, Joypurhat, Bangladesh. J. Fish. Aquat. Sci. 13, 29–38.

Primavera, J.H., 1997. Socio-economic impacts of shrimp culture. Aquac. Res. 28 (10), 815–827.

Rahman, A.K.A., 1994. The small scale marine fisheries of Bangladesh and socio-economic issues in coastal fisheries management. In: Proceedings of the IPFC Symposium. Bangkok, Thailand, pp. 170–175. November 23-26, 1993.

Rahman, M.M., Chowdhury, P., Islam, M.S., 2016. Socio-economic status of fish farmers in DhumkiUpazila under Patuakhali district, Bangladesh. Int. J. Fish Aquat. Stud. 4, 288-29.

Rahman, M.M., Flitner, M., Krause, G., Maniruzzaman, M., 2008. Socio-economic assessment of shrimp farming in relation to local livelihoods in the southwest coastal Bangladesh. Bangladesh J. Fish Res. 12 (1), 109–120.

Randive P C. 2008. Adoption of Shrimp health management practices in the South Konkan Region of Maharashtra. M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, India. 116 p.

Saha, S.K., 2017. Socio-economic and environmental impacts of shrimp farming in the south-western coastal region of Bangladesh. Int. J. Res. Land-use Sustain. 3, 128–137.

Sahu R, Swadesh P, Kumar N R and Krishnan M. 2014. Adoption of better management practices and constraints in shrimp farming in selected district of Odisha. Indian Journal of Fisheries, 61(2): 151-155.

Salunke A B. 2018. Efficacy and constraints in adoption of Penaeus (*Litopenaeusvannamei*(Boone, 1931) culture practices by the farmers of North Konkan region of Maharashtra M.F.Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, India. 206 -208p.

Shahjahan M, Miah MI, Haque MM (2001) Present Status of Fisheries in the Jamuna River. Pakistan Journal of Biological Sciences, 4: 1173-1176 DOI: 10.3923/pjbs.2001.1173.1176.

Srinivas D and Venkatrayalu C H. 2016. Studies on present problems and prospects of shrimp farming in West Godavari district of Andhra Pradesh, India. *Advances in Applied Science Research*, 7(2): 49-54.

Comment [Y10]: Red color, three different format of journals? Which one is correct?