 doi:10.20944/preprints202208.0461.v1

EFFICIENCY OF RICE-CUM-FISH CULTURE IN GHATAIL AREA OF TANGAIL DISTRICT

[1]Monuj Kumar Das, [2]Rony Roy, [3]Md. Lutfor Rahman Shimanta

[1]Department of Economics, National University, Bangladesh

[2]Department of Political Science, National University, Bangladesh

[3]Faculty of Agricultural economics and Business Studies, Sylhet Agricultural University, Bangladesh

Email: [1]monujdas42@gmail.com, [2]hello.ronyroy@gmail.com [3]lrshimanta@gmail.com

Abstract:

The efficiency of rice cum fish culture study was conducted in different areas of Tangail district with those farmers who cultivate rice and fish together at a time. The study was conducted along 60 farmers of different areas in Ghatail upazilla. The primary data were collected through face-to-face interviews and secondary data were collected through different reputed journals, newspapers, authentic portals and so on. Data collection was carried out during the period from November 2021 to May 2022. Both tabular and functional analyses were performed to achieve the specific objectives of the study. NPV, BCR and IRR method was used to estimate the profitability and a multiple regression model was used to find out the factors motivating farmers' decision on rice cum fish cultivation. SWOT analysis was done to find out the internal and external-positive and negative factors faced by the farmers in rice cum fish cultivation. About 40% of farmers are under the age of 30 and most of them got at least primary education. Agriculture was the main occupation of the respondents and fish cultivation was the secondary. The highest annual income among the sample growers came from the production of rice cum fish culture. The BCR of the production is upbeat and 2.09 which indicates that the cultivation is profitable.

Keyword: Rice, Fish, Culture, Efficiency, Environment, Rice-Fish Culture.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

Introduction:

Rice-fish culture means the continuous culture of rice and fish which is one of the best processes to increase food production from limited land and it is practiced in countries around the world. This system has received a great deal of attention in the recent past because the government focuses on sustainable rural development, food security, and poverty alleviation. De la Cruz et al. (1992) provided country overviews for Bangladesh, China, India, Indonesia, Korea, Malaysia, - Philippines, Thailand and Vietnam while Symons & Micha (1995) provided country reviews for Madagascar. Fernando (1993b) compiled an extensive bibliography on diverse aspects of fish culture in rice fields. The cost and return evaluation show that rice-fish culture can be a more profitable option than a monoculture of paddy.

Bangladesh is an agricultural country and the staple food of 135 million people of Bangladesh is rice. About 47.5% of the total manpower is involved in agriculture and 76% of the people live in rural areas. Agriculture contributes 19.3% of the gross domestic product (GDP) in Bangladesh. Among them, the rice sector provides one-half of the agricultural GDP and one-sixth of the national income. In the country, rice is grown by almost 13 million farm families on about 10.5 million hectares which has remained almost the same over the past three decades. Among the total cropping area, 75% of the area and 80% of the total irrigated area is planted with rice.

Bangladesh is considered one of the most suitable regions for fisheries in the world, as it has a unique position in the sub-tropical region, with the world's largest flooded wetland and the third largest aquatic biodiversity in Asia after China and India. The fisheries sector is currently providing 3.8 percent of the GDP. More than 2% of Bangladeshi export value comes from the inland fisheries sector. About 55% of animal protein is taken through fish in Bangladesh. Rice and fish culture is an innovative farming system in which rice is the main enterprise and fish fingerlings are taken as additional means to ensure extra income. Rice fish culture is not only improving the yields of paddy but also reducing the poverty of the farmers by creating employment opportunity and also increase nutrient intake which brings food security for them. Nowadays young farmers, have a large farm, with better industrial facility more interested in accepting new technology.

In areas where the land remains under water for 3 to 8 months in a year, rice cum fish culture can provide an additional supply of the fish crop. Even in this culture when rice is harvested, fish can be served as an offshore occupation for farmers. The predominant species are Crucian carp (*Carassius Carassius L.*), Silver carp (*Hypophthalmichthys molitrix V.*), Bighead carp (*Aristichthys Nobilis R.*), Grass carp (*Ctenopharyngodon Idella V.*), Catla (*Catla Catla V.*), Mrigal carp (*Cirrhina mrigalla H.),* Rohu (*Labeo Rohita H.*), Common carp, Grass carp etc. are commonly cultivated in rice-fish fields in India and Bangladesh (Frei & Becker, 2005; Sethi et al., 2005). In rice-fish culture, it is estimated that the requirement of water for rice culture was 1662mm while rice fish culture requires up to 2100mm which is 26% more than rice monoculture. To reduce the losses of puddling during land preparation, good maintenance of the dikes and proper sealing of inlets and outlets can be done.

Rice and fish both are important grain and protein resource, rice cum fish culture promote a variety of beneficial interactions. In this culture when rice and fish both are cultivated in one field, the rice plants provide shade and insects for the fish, as well as organic matter that the fish can use. Fish oxygenate the water and help in moving the nutrients around, thereby it benefits the rice. The fish provide biological pest control and Azolla sp. also fix nitrogen for the rice. Rice fish culture is risk minimizing and suitable for poor farmers as it is culturally and economically preferred. Complex and diverse food webs of microbes, insects, predators and cultivated plants and livestock provide

 doi:10.20944/preprints202208.0461.v1

benefits to one or both of the components of the system. Rice fish culture provides long-term beneficial effects on the environment.

Objectives of the study:

The objectives of the study would be:

- To assess the profitability of rice-cum-fish farmers
- To estimate the contribution of key inputs to the production processes of rice-cum-fish culture.
- To measure the resource use efficiency of rice-cum-fish culture.
- To identify the major constraints faced by rice-cum-fish farmers.

Review of Literature:

Rice cum fish culture is practiced in different parts of the world and study is considered also. *Lucy et al.* **(**2020**)** have shown us that mainly rice-fish culture is done by involving paddy fields as the main crop and fingerlings to increase the economic, social, environmental and public health development in the selected area by Asian farmers. *Shingare et al. (2020)* mentioned that for the socio-economic development of the farming community, the rice cum fish culture should be in a scientific manner which may provide higher nutrition and much amount of protein. They represented that the productivity of paddy was improved by 14.28% before indicating the beneficial effects of stocking fish. *Sena et al. (2020***)** reported that rice cum fish culture is effective in China and Indian regions which include inland aquaculture with innovative changes. *Bounsong et al. (2018***)** concluded that most of the rice cum fish culture is conducted by indigenous fish like carp fishes, exotic species with wet rice variety. *Go*swami *et al.* **(**2020**)** conducted a study on different areas of Naogaon district in Bangladesh and reported that 53.3% of the fish farmers use medium offish farming, 42.4% had high use and only 4.3% had low use of fish farming. Ricce cum fish culture is an innovative process that helps to reduce poverty, increase income, create employment and increase nutrients. On this area, rice cum fish farming can be a way to influence the farmers. *DoF (2018)* reported that Bangladesh's is going further to lead the fish market in the world where they have achieved already the 3rd position in open water capture and 5th in aquaculture production. The scenario of rice cum fish culture in Bangladesh following the technology provided by the BFRI which was used as an alternative income source for poor families in the country. Generally, some common species of fish like Rajpunti, Mirror Carp, and Nile Tilapia can be used in rice cum fish culture where the ratio of production of rice and fish was 10:4.

Methodology:

The primary data of the study was collected from the Tangail district because rice cum fish culture is regularly practiced in the localized area. It was carried out through the survey of 60 rice cum fish farmers through a simple random sampling technique following a semi-structured interview

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

schedule aiming to collect more data from the farmers keeping a view of the objectives. The secondary data was collected through reputed journals, newspapers, authentic websites and so on. Tabular and statistical analysis was used for going through achieving the objectives.

Functional analysis:

Cobb-Doglus production function and profit function of the following algebraic form was used to analyse the data in the study.

$$\text{Profit } (\pi) = \sum_{i=1}^{n}(p_{yi}.Y_i) - \sum_{i=1}^{n}(P_{xi}X_i) - TFC$$

Where, π= Net Return,

Py_i= Price per unit of the ith produce

Y_i= Quantity of the ith produce.

Px_i= Price per unit of the ith inputs.

X_i = Quantity of the ith inputs.

TFC= Total Fixed Cost.

The Cobb- Douglus production function was selected for determining the effect of various inputs of rice-cum-fish production based on fittest significance result on output and in this model the dependable variable was considered yield per hectare. The functional form of the multiple regression equation is as follows:

$$Y=aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}X_8^{b8}X_9^{b9}e^{ui}$$

For the purpose of the present empirical exercise, the Cobb-Douglas production function was converted into the following logarithmic (Double log) form:

$$\ln Y = \ln a + b_1 lnX_1 + b_2 lnX_2 + \cdots + b_9 lnX_9 + u^i$$

Where,

Y = Gross return (Tk. /ha)

X_1 = Cost of human labor (Tk. / ha)

X_2 = Cost of seedlings (Tk. /ha)

X_3 = Cost of fingerlings (Tk. /ha)

X_4 = Cost of fertilizers (Tk. /ha)

X_5 = Cost of Insecticide (Tk. /ha)

X_6 = Cost of power tiller (Tk. /ha)

X_7 = Cost of irrigation (Tk. /ha)

X_8 = Cost of feed (Tk. /ha)

X_9 = Cost of pond preparation (Tk. /ha).

b_1, b_2, …, b_9= Coefficient of respective variables;

I = 1, 2, 3... N;

lna = Natural logarithm; and

U_i= Error term.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

Results and Discussion:

In every production, cost should be minimized, and profit should be maximized. Costs plays an important role for taking decision. Human labor cost for the production is the highest variable cost which is 33.49% of the total production cost which includes family labor also.

Table 1: Per Hectare Total Cost of Rice-cum-Fish Production

Cost items	Unit	Amount	Percent
(A) Variable Cost	**Tk.**	**108030**	**88.17**
Human labor cost	**Tk.**	**41033.33**	**33.49**
Family labor	Tk.	9166.67	7.40
Hired labor	Tk.	31866.66	25.21
Seedling cost	**Tk.**	**6916.67**	**5.59**
Fingerling cost	**Tk.**	**15016.67**	**12.20**
Fertilizer and manure cost	**Tk.**	**12373.33**	**10.10**
Urea	Tk.	3613.33	2.95
TSP	Tk.	3673.33	2.99
MP	Tk.	2580	2.11
Cow dung	Tk.	2506.67	2.05
Insecticide cost	**Tk.**	**1795**	**1.13**
Power tiller cost	**Tk.**	**7715**	**4.86**
Irrigation cost	**Tk.**	**1503.33**	**0.95**
Feed cost	**Tk.**	**13220**	**10.79**
Oilcake	Tk.	6458	5.27
Rice bran	Tk.	6762	5.52
Pond preparation cost	**Tk.**	**8456.67**	**6.83**
Digging ditch	Tk.	7286.67	5.89
Lime	Tk.	1170	0.94
Interest on operating capital	**Tk.**	**2583.33**	**1.63**
(B) Fixed Cost	**Tk.**	**14500**	**11.70**
Land use cost	Tk.	14500	11.70
Total Cost (A+B)	**Tk.**	**122530**	**100**

Source: Field Survey, 2021

The fingerling cost, fertilizer cost and feed cost play an important role in the variable cost which is 12.20%, 10.10% and 10.79% respectively of the total production. The land use cost for the

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

production is Tk. 14500 which is 11.70% of the total production cost. The total cost of the production is Tk. 122530 (Table:1).

Table 2: Per Hectare Gross Return from Rice-cum-fish Production

Particulars	**Unit**	**Amount in kg**	**Price per unit**	**Amount in (Tk.)**
Yield of rice	Tk.	5700	20	114000
Yield of fish	Tk.	1286.67	80	102933.33
Yield of Rice-fish	Tk.	6986.67		216933.3
By product	Tk.			40000
Gross Return	**Tk.**			**256933.3**

Source: Field Survey, 2021

In rice cum fish culture rice is the main crop and fish is used for secondary crop. Here, the yield of Rice is Tk. 11400 and fish is Tk. 102933.33. Here the by product from the field is Tk.40000 where the Gross return for the production is Tk.256933.33 (Table 2).

Table 3: Per Hectare Net Return and BCR for Rice-cum-Fish Production

Particulars	**Total value (Tk.)**
A. Gross Return	256933.3
B. Variable Cost	108030
C. Total Cost	122530
D. Gross Margin(A-B)	148903.3
E. Net return(A-C)	134403.3
F. BCR(Undiscounted) (A/C)	2.096901

Source: Field Survey, 2021

Table 3 shows that The BCR is 2.09 which is positive and it indicates that the production of rice cum fish culture is profitable and it is about to double from the production cost. The farmers get Tk. 2.09 by costing Tk.1 per unit which is the cause of happiness for the farmers.

Table 4: Model Summary of Cobb-Douglus production Function

Model Summary				
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.710[a]	.505	.448	5627.5048
a. Predictors: (Constant), feed, irrigation, insecticide, power tiller, fertilizer, human labor				

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

Table 5: Coefficients and significance level of the study

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	167408.113	41614.749		4.023	.000**
	Human labor	.873	.394	.278	2.214	.031*
	fertilizer	1.558	.712	.261	2.188	.033*
	insecticide	-2.325	3.293	-.073	-.706	.483
	Power tiller	2.316	3.962	.061	.584	.561
	irrigation	-7.795	10.243	-.085	-.761	.450
	feed	2.454	1.000	.293	2.453	.017*
a. Dependent Variable: gross return						
F= 6.4025*						

Source: Field Survey, 2021

*(** denotes Significant at 1 percent level; * denotes Significant at 5 percent level).*

Table 4 showed us that our R^2 value of the model was 0.505 which means on the total variations 50.5% variables can be explained by dependent variable (Gross Return) of the model. On table 5, the regression co-efficient for human labor was 0.031 which was positive and significant at 5% level of significance. It concludes, in human labor cost if we increase 1% cost, then, the gross return will increase by 0.031% other thing remain constant. On the other hand, the coefficients for fertilizer, insecticides and power tiller are 0.03, 0.483 and 0.561 respectively where 0.03 is significant at 5% level of significance that means if we increase 1% then, the fertilizer and manure cost will be increased by 0.03% other things remains constant.

Table 6: Constraints in Rice-Cum-Fish Culture

Problems and Constraints	**No. of respondent**	**Percent (%)**
(a)Economic problems		
i. Lack of sufficient fund	12	20
ii. High price of input	8	13.33
iii. Low price of output	6	10
(b) Technical problems		

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 26 August 2022 doi:10.20944/preprints202208.0461.v1

i. Lack of scientific knowledge and technology	10	16.67
ii. Lack of good quality seeds and fingerlings	12	20
iii. Lack of extension services	5	8 .33
iv. Attack of disease and pests	6	10
(c)Social problems		
i. Problems of theft	1	1.67
Total	**60**	**100**

Source: Field Survey, 2021

On rice cum fish culture, the farmers reported that that the input price are high and they hardly had the sufficient fund to manage the production. Due to lack of scientific knowledge and technology, they couldn't get the actual expected yield from the production also. On the same way, lack of good quality seeds and fingerlings also the cause of lower production.

Conclusion:

From ancient times agriculture and fisheries have been a part of the life of Bangladeshi people. Fish alone supplies about 60% of animal protein and rice alone provide 70% of calorie. Though an integrated farming system can play an important role increase food production as it is better than rice monoculture in terms of utilization, diversity, and productivity, rice monoculture remains the main farming system. The research suggests that immediate measures need to be implemented like buying and stocking seed formation, feeds and fertilizer, increasing training programs, upgrading the knowledge on scientific fish culture, proper use of scientific chemical ensuring, and increasing the social consciousness through public and private institutes to return the farmer's fate. The price of the production per unit should be ensured by the government as the farmers can get their reasonable price at the proper time by ensuring the available inputs. As the BCR is positive, we can conclude that the production of rice cum fish culture is profitable. For improving the social condition of the rural farmers and developing their economic condition rice cum fish production can be an efficient way which will also ensure the nutritional condition. The availability of some modern inputs and technology can help to get a better result from the production. To establish the present and future potential market at a national level, it should be gone on a comprehensive study where it should have a well-planned production program.

Recommendations

For improving the rice cum fish culture, to formulate a sustainable strategy, the following suggestions are recommended for developing the intensified rice cum fish culture in Tangail district. The recommendations are forwarded:

- Proper scientific knowledge and technology should be ensured in rice cum fish farming.

 doi:10.20944/preprints202208.0461.v1

- Proper scientific method of production should be applied.
- Increasing the extension and training program in the area.
- High yielding and soil adaptable variety should be available for the production of rice cum fish culture.
- Establishing the strong market demand and supply of inputs and outputs and making a strong network among the farmers-retailers and consumers.

Authors' contributions:

The study was carried out through the collaboration of all authors. MD made the first draft of the study, then RR made the design of the study and MD, RR and MLRS all together made the literature review, data collection, analysis and created an interpretation of the study. All authors read and approved the final manuscript.

References:

Amulya Kumar Saikia, Santosh Kumar Abujam, Debangshu Narayan Das, Biswas Shyama Prasad (2015). Economics of paddy cum fish culture: A case study in Sivsagar, Assam. International Journal of Fisheries and Aquatic Studies; 2(5): 198-203 ISSN: 2347-5129 IJFAS 2015; 2(5): 198-203 © 2015 IJFAS.

Banglapedia (2019). National Encyclopedia of Bangladesh. Asiatic Society of Bangladesh. Dhaka, Bangladesh.

BBS. (2019), Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BER. (2018), Bangladesh Economic Review, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

BER. (2016), Bangladesh Economic Review, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Billah, M. (2012). An Economic Analysis of Rice-cum-Fish Farming in Some Selected Areas of Shyamnagar Upazila Under Satkhira District. An Unpublished M.S. Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Bounsong V, Shinsuke M, Kensuke K and Atsushi M.(2018). Factors Influencing Fish Productivity in Rice Paddy Aquaculture: A Case Study in Vientiane Province. Central Laos JARQ 52 (4), 359 – 366. (https://www.jircas.go.jp)

Dewan, S. (2004). A desk study report on rice-fish culture in Bangladesh. The Land/water Interface Programme, Floodplain Production Systems.p. 62-64.

Dhawan, K.C and Bansal, P.K (1977). Rationally of the Use of Various Factors of Production on Different Sizes of Farm in the Punjab, Indian Journal of Agricultural Economics, 32(3): pp 121-130.

DoF, 2018. Yearbook of Fisheries Statistics of Bangladesh 2017-18. Fisheries Resources Survey System (FRSS), Department of Fisheries. Bangladesh.

DoF, (2017). Fish Week Publication. Department of Fisheries, Government of the People's Republic of Bangladesh, Dhaka.

DoF, (2011). Fish Catch Statistics. Various issues. Department of Fisheries, Government of the People's Republic of Bangladesh, Dhaka.

Dr. Debasis S, Dr. Sanjit M.,Dr. Binod.,Dutta B., Dr. Santosh K., Dr. Debasish B. (2015). TRAINING MANUAL ON Rice cum fish and duck culture ICAR- NRC ON YAK Dirang,

W. Kameng District In collaboration with KRISHI VIGYAN KENDRA, LOHIT, Arunachal Pradesh Year – 2015.

Fernando, C.H. (1996). Ecology of Rice Fields and its Bearing on Fisheries and Fish Culture., in Perspectives in Asian Fisheries, pp 217-237.

Goswami P., M. R. A. F. Noman, M. S. Islam and S. Huda, 2020. Use of fish farming practices bythe fish farmers. Res. Agric. Livest. Fish., 7 (3): 565-576. Available from: https://www.researchgate.net/publication/348551685_Use_of_Fish_Farming_Practices_by_the_Fish_Farmers

Hossain, S.M. Altaf, Ali, M.M., Dewan, S. and Islam, M.S. (2011). Rice-Fish Culture.An Adaptable Technology for Bangladesh. Journal of Extension Education 134 (1):pp 40-62.

Lucy A. Onoh, Charles C. Onoh, Christiana I. Agomuo, Theresa C. Ogu, Evajoy O. Onwuma (2020) . Adoption of Integrated Rice-Fish Farming Technology in Ebonyi State Nigeria: Perceived Effects and Constraints. EJFOOD, European Journal of Agriculture and Food Sciences Vol. 2, No. 5, September 2020. DOI: http://dx.doi.org/10.24018/ejfood.2020.2.5.99

M. A. Rahman, S. Hoque and P. K. Sharma (2012). Socioeconomic impact of rice-cum-fish culture in a selected area of Bangladesh J. Bangladesh Agril. Univ. 10(1): 119–123, 2012 ISSN 1810-3030. Bangladesh Agricultural University, Mymensingh-2202, Bangladesh (https://www.researchgate.net/publication/317095585)

Mazid, M.A. and Hossain, (2010). Rice-fish farming technology- a popular practice in Bangladesh, Biological Science and Living Resources 27(9).

Mazid, M.A. and Hossain, (2010). Rice-fish farming technology- a popular practice in Bangladesh, Biological Science and Living Resources 27(9).

P. E. Shingare, K. J. Chaudhari, A. U. Pagarkar, H. S. Dhaker, S. D. Naik, S. P. Shingare, N. H. Sawant and R. L. Kunkerkar (2020). Role of Rice Cum Fish Culture as An Additional Source of Income in Konkan Region of Maharashtr. J. Exp. Zool. India Vol. 23, Supplement 1, pp. 961-963. (www.connectjournals.com/jez ISSN 0972-0030).

Rashed MAR, (2018). Use of Best Management Practices (BMPs) by the Farmers of Savar Upazila of Bangladesh. M.S. (AEIS) Thesis, Department of Agricultural Extension and Information System, Sher-E-Bangla Agricultural University, Dhaka. *(PDF) Use of Fish Farming Practices by the Fish Farmers*. Available from:https://www.researchgate.net/publication/348551685_Use_of_Fish_Farming_Practices_by_the_Fish_Farmers.

Sena S. De Silva, F. Brian Davy (2020). Success Stories in Asian Aquaculture. ISBN 978-90-481-3085-6 e-ISBN 978-90-481-3087-0 DOI 10.1007/978-90-481-3087-0