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EXPLORING THE INFLUENCE OF ECONOMIC AND ENVIRONMENTAL KNOWLEDGE ON FISH PRODUCTION IN RURAL-BANGLADESH

Linda Bairagi
Sub Assistant Land Officer, Khulna
Khulna, Bangladesh
bairagilinda@gmail.com
https://orcid.org/0009-0009-2790-8776

Md. Harun-Ar-Rashid
Divisional Cooperative Office
Khulna, Bangladesh
haruncooperative41@gmail.com
https://orcid.org/0009-0004-9965-7578

Sk. Mahrufur Rahman
Department of Business Administration, North Western University
Khulna, Bangladesh
mahrufur89@gmail.com
https://orcid.org/0009-0005-0200-1933

Tanjila Sheikh
District Manager, BRAC
Satkhira District, Bangladesh
sheikhoaishi94@gmail.com
https://orcid.org/0009-0003-0379-3421

Tanbir Hossain
Department of Economics, North Western University
Khulna, Bangladesh
tanbir.nwustu@yahoo.com
https://orcid.org/0000-0003-1935-3001

Abstract *Aquaculture is a buzzword for rural economy as well as regional development. In this research, the author considers five individual villages where 200 farmers have been identified randomly. In this paper, the author divides this research into two segments. Firstly, most of the local farmers consider basic factors, where variable costs that is daily basis expenses affect fish production variables for farmers. Secondly, the authors try to identify the environmental knowledge index (EKI) for farmers affecting fish production, the EKI is measured by table 2. In Table 3, most of the expenses are calculated for human labor, fish feed and fingerlings purposes. Marginal farmers face higher variable costs compared to the other two categories of farmers. The authors run the Cobb-Douglas multiple regression model to investigate the effect of independent variables on fish production hectare-wise, while human labor cost, feed and manure cost, water supply, and Sustainability knowledge index have positive and significant relationships with fish production. To justify the 2nd research question, EKI has a significant connection with fish production for farmers,*

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because EKI helps farmers to lead production at a lower cost while maintaining a hygienic production system. The green economy is the upcoming challenge for the future, which leads to sustainable production and consumption behavior for producers and consumers. Moreover, sustainable and effective marketing channel creation are challenging factors for fish production and supply.

Keywords Aquaculture, Marginal-farmers, Environmental Knowledge, Green economy, Rural-Bangladesh.

1. INTRODUCTION

Bangladesh stands out as an effective and handy player in global fish production divided into three main categories inland capture, inland fish production culture and marine fisheries. In the fiscal year 2021-2022, fish production rises up to 47.59 Metric tons where aquaculture contributes almost 57.39% (DoF, 2022). In recent times, it has been observed that aquaculture practices are closely connected with paddy production which systematically transformed into an aquaculture system on a full-time basis in Bangladesh (Ahmed et al., 2011; Deb et al., 2013; Mondal, 2008). In the fiscal year 2021-2022, the fishery sector expanded to GDP growth of about 2.08% while agro-sectors stood at about 21.83% (BER, 2022) because about 12% population connects directly or indirectly with aquaculture sectors that reach our homeland as 3rd position for global overview. From the perspective of carp-fish production, Bangladesh stands as 3rd in Asia, furthermore, Bangladesh produces Hilsa fish (National Fish of Bangladesh) and holds 11.91% of total fish production (DoF, 2022).

Aquaculture plays a significant role in food security and poverty alleviation approaches worldwide because of its capacity to produce freshwater fish, which, while it consists of low-value species in consideration of market valuation, provides food items and increases nutritional variety all over the planet. Aquaculture could play a chief role in meeting the needs of people in terms of food now and in the future generations where freshwater fish farming or aquaculture plays an effective role in developing livelihood patterns of rural people in Bangladesh (Mazid, 2002). It develops various livelihood opportunities for several people all over the world who are living below the poverty level, in the figure of farmers, market operators, employees, fish traders, middlemen, daily labourers and transporters connected with fish-trading (Ahmed & Rahman, 2004). Moreover, Bangladesh has achieved its self-sufficiency for inland fish production taking the core support of government and non-governmental support, where Bangladesh is producing about 43.48 Lac metric tons of fish considering the demand of 40 Lac MT fishes, Likely 62.58 grams of fish consumed as nutrition against the daily consumption level of 60 grams fishes reported by (DoF, 2018).

Aquaculture stands out as the most rapidly growing sector for fish production, it has proven a profitable and effective role in meeting the nutritional and livelihood needs of local people (Hasan & Jahan, 2022). It is reported that global aquaculture is producing 80 million total fish consisting of 47% world fisheries production and capture (DoF, 2016), where global fish production has surged by about 179 million tons of total capturing fish divided by capture fisheries (96.4 million tons) and aquaculture (82.1 million tons (FAO, 2020). Aquaculture contributes half a portion of total fish production and is proven as the swiftest growing sector for ensuring food security with proper nutritional balance (Singha & Chandan, 2023). In recent times, it has been noticed that Bangladesh, India, China, Myanmar, Indonesia, and Cambodia are trying to connect their inland for professional aquaculture production to accelerate economic wheels (FAO, 2020).

2. MATERIALS &METHODS

Bangladesh is well-known as a riverine country where rivers are being used as professional methods of communication, economic development and development of livelihood patterns from root level to top. Moreover, the northeastern region of Bangladesh, Hakaluki Haor and Tanguar Haor, is recognized as the heart of generating natural fish-breed that maintains fish ecology mostly (Kumar et al., 2022). These areas

cover 40,000 hectares of northeastern regions like (Sunamganj, Moulvibazar etc) and play effective roles in ecological and social spheres (Tamim et al., 2022). These regions are the most important part connecting to the aquaculture industry for livelihood earning, employment generation, irrigation systems, fodder and transportation. Basically, these regions help to maintain effective factor biodiversity and natural balance (Sarker & Alam, 2023). The regional benefits help to produce natural fish for Bangladesh and revitalize the fish industry at a large scale supporting national GDP (DoF, 2022). In recent report identifies that most parents discourage their children not to engaging in this traditional culture because of the generation gap, and send them to aboard for a glorious life (Ghose, 2017).

This culture breaks down the point of passion connecting with aquaculture which hampers continued fish production in the northern part of Bangladesh. Shamsuzzaman et al. (2017) highlighted that Bangladesh has been considered the most demandable and advanced land for flooded wetlands and large bio-diversified aquatic factors in the Asian belt after considering the giant China and India: Aquatic development has been possible due to the huge demand for protein, food efficiency, earning large volume of foreign-currency, improving life standard, declining poverty, local and regional development factors. Supporting these statements, paddy farming is converting to fish cultivation overdue time being the most profitable sector (Islam et al., 2002; Islam et al., 2017).

According to the report of FAO (2020), a prime portion of aquaculture fish production happens in Asian countries where these countries have been able to produce almost half portion of total fish exports, China, Indonesia, India, Viet Nam and Bangladesh are at the top five exporter countries in the world where aquaculture is proved as spinal-strength for local people. Bangladesh is now graded 5th in the world aquaculture production (FAOSTAT, 2016). Aquaculture practice has a high positivity to achieve self-sufficiency for ensuring food security and diminishing poverty from a Bangladeshi economic perspective (Al-Amin et al., 2012). A lot of factors are intentionally engaged with fish production, these are water supply, seasonal variation, fish-feed price, government and non-governmental supports, fish-fry supply at proper time etc. FAO (2013) mentioned that China is the leader for large volume fish-exporting which covers most of the protein sources for Chinese people. In economic review, Bangladesh is sanctified with inland water sources like ponds, haor, baor and lakes that cover about 5488 hectares, covers huge aquaculture sectors (DOF, 2015). Following this statement, it is observed that farming technology, species-generation, and fish breeding are the major sources of fish production that covers 41.34 lac MT, covering about 56.44% of total fish production (DoF, 2018). In a recent report, Bangladesh achieved 5th rank in world fish production, both Aquaculture and fisheries tackle almost 25.30% figure of the total GDP covering 3.57% national GDP (FAO, 2016). From Bangladesh's perspective, about 11% of the total population is connected with the fishery sector to survive their livelihood (DoF, 2018).

According to the report of FAO (2018), Bangladesh has been covered with 260 freshwater sources where biodiversity is being maintained by different types of flora and fauna. To chase the SDG by 2030, it is high time to maintain green agriculture where it declines carbon emission levels at the maximum level. Within all fish items, Hilsa fish needs to maintain a high chain of biodiversity that covers approximately 12% of total inland fish production.

According to the report of Ferdoushi et al. (2019), Tilapia fish production has been proven most profitable business in the north-eastern part of Bangladesh, The average total cost per hectare is 0.33 million for tilapia monoculture compared to tilapia culture (0.241) million. So, the net margin is higher for tilapia monoculture which is 1.51 based on the cost-benefit ratio. Ebukiba et al. (2019) carried out a research study on the economic investigation of catfish production in the Karu local government area of Nasarawa State, Nigeria, that is proved a profitable business for the Nigerian economic perspective. Shawon et al. (2018) highlighted a paper on the socio-economic position and financial productivity of small-scale shrimp farming in coastal areas of Bangladesh, small scale farmers are economically profitable due to regional advantage.

Busari (2018) investigated an economic analysis of the farmstead aquaculture system in the Olorunda local government area, Osun State, Nigeria, which focuses on middle-aged, catfish farmers specially to focus the research. The researchers analyzed that the GM and RRI are 475,342.51 and 468,451.18 Nigerian currency (Naira) respectively supporting the return of 71.02% profit in the study area. Moreover, Bangladesh exports its fishery products to more than 55 countries, where the European Union is the major hub (Shamsuzzaman et al., 2017). However, Bangladesh is considered as still a trade-deficit country in terms of its fishery resources which is contradictory to the motion of the country. In Bangladesh, there is an apparent difference between the inland and marine fisheries production trend from FY'1984-85 to FY'2018-19 (Sunny et al., 2021). The trend of freshwater fisheries yields from 2007 to 2019 presents a production gap between freshwater capture and freshwater culture (Hasan et al., 2021).

The influence of the fisheries sector was 2.54% of the GDP of Bangladesh in 2021 (Manik, 2023). Either directly or indirectly, nearly 12% of the country's population depends on fisheries and aquaculture-related activities for their livelihood pattern (Department of Fisheries, 2020). The long-term Climate Risk Index expresses a 28.3 score that ranks Bangladesh seventh among the tenth most affected countries in the world due to climate change effect (Eckstein et al., 2021). About 90% of global aquaculture is supplied by developing countries which are measured global climate risk as hotspots (Islam et al., 2019). Overpopulation effect and climate change are the main difficulties in Bangladesh.

2.1 RESEARCH METHODOLOGY

This study is mainly based on primary survey which is based on simple random sampling. The author selects 5 villages where most farmers are engaged with aquaculture. The author selects five villages named *Chachibunia, Chokrakhali*, *Kochubunia, hatbati, Hogolbunia, taking 40 fish farms from every village for fish 200 farms.*

2.1.1 Cobb- Douglas Production Function

This function was used to estimate the effects of various inputs for the production of Koi fish. The functional form of the Cob-Douglas multiple regression equation was as follows.

Y = a+X1 b1 +X2 b2 +X3 b3+ X4 b4 + X5 b5+ X6 b6 +X7 b7 +X8 b8 +X9 b9+ X10 b10+ u.

The equation may be alternatively expressed in log-linear form:

lnY = lna + b1lnX1 + b2lnX2 + b3lnX3 + b4lnX4 + b5lnX5 + b6lnX6 + b7lnX7 + b8lnX8 + b9lnX9 + b10lnX9+ U

Table 1: Estimation of Variables with Expected Sign for Fish Production

S.N	Variables Name	Variable Sign	Measurement Scale	Expected Sign	Literature References
1.	Human labor cost	*X1*	BDT/ Hectare	+	Ele et al. (2013); El-Naggar et al. (2008)
2.	Fingerling cost	*X2*	BDT/ Hectare	+	Ebukiba & Anthony (2019)
3.	Feed cost	*X3*	BDT/ Hectare	+ or -	Faruk (2003)
4.	Manure cost	*X4*	BDT/ Hectare	+	Faruk (2003)
5.	Fertilizer cost	*X5*	BDT/ Hectare	+ or -	Faruk (2003)
6.	Lime cost	*X6*	BDT/ Hectare	+ or -	Ferdoushi et al. (2019)
7.	Pesticide cost	*X7*	BDT/ Hectare	+	Islam (2002)
8.	Water supply cost	*X8*	BDT/ Hectare	+	Islam (2002); Islam (2008)
9.	Electricity cost	*X9*	BDT/ Hectare	-	Itam et al. (2014)
10.	Environmental Knowledge	*X10*	Index Score	+ or -	Author Own Compilation

Dependent Variable: Hectare wise Fish Production

Source: Authors Own compilation, 2025

2.2.2 Efficiency of Resource Allocation

In order to test the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input was computed and tested for its equality to 1.

$$\textbf{ERA}: \frac{\textbf{MVPx}}{\textbf{MFCx}} = \textbf{1}$$

From the above equation, it is seen that The marginal productivity of a particular resource represents if the owner increases 1 unit of input for fish-farming, how much he will get as output considering all others input as constant. The addition to gross returns in value term produced by an extra 1 unit of that resource, while other inputs are held constant. The most dependable, perhaps the most useful, estimate of MVP is achieved by taking fish-resources value as gross outcome at following geometric means (Islam, 2008). In terms of farming, Marginal Factor Cost (MFC) means the input valuation spent for fish-farming to gain effective outputs.

Table 2: Estimation of Environmental Knowledge Index (EKI)

Indicators	**Scoring Index**	**Required Score**
Knowledge about Greenhouse Effect	1 to 5	Very Low=1, Low=2, Moderate = 3, Good=4, Very Good=5 ***(Minimum Score=6 and Maximum Score =30)***
Knowledge about toxic creation from pond	1 to 5	
Awareness about Eco-friendly Fish-feed	1 to 5	
Responsible Knowledge of Carbon Emission from Pond	1 to 5	
Knowledge about Environmental-friendly Fertilizer usage	1 to 5	
Knowledge about Water Wastage Management	1 to 5	

Source: Authors Own compilation, 2025

3. RESEARCH RESULT

Profitability is the chief aim of any farmer. In order to earn a respectable economic return, production cost becomes an important factor and accordingly it contributes a dominant role for farmers. Costs and returns are valued on the basis of authentic market prices affected by the fish-farmers.

Table 3: Per Hectare Costing of Producing Different Categories of Fishes
(Hectare wise BDT Costing per Year)

Cost items	**Marginal farmers**	**Small farmers**	**Medium farmers**
Variable cost			
Human labor	4,67,130	4,25,228	3,83,450
	(20.36)	*(14.86)*	*(11.45)*
Feed	11,50,214	15,80,567	18,62,513
	(62.05)	*(70.45)*	*(74.45)*
Fingerlings	1,60,233	1,70,487	1,75,502
	(8.67)	*(6.97)*	*(6.36)*
Fertilizer	18,908	15,737	16304
	(0.94)	*(0.58)*	*(0.58)*
Manure	75	65	59
	(0.01)	*(0.01)*	*(0.01)*
Lime	13,041	7,277	9600
	(0.67)	*(0.38)*	*(0.34)*
Pesticide	8,200	4365	7534
	(0.40)	*(0.16)*	*(0.24)*
Electricity	10,660	12,500	13618
	(0.54)	*(0.44)*	*(0.51)*
Fixed cost			
Land use cost	40,290	42,014	39,627
	(1.68)	(1.46)	(1.36)
Interest on Operating Cost	94,373	1,05,725	1,22,252
	(4.68)	(4.69)	(4.70)
Total	**19,63,124**	**23,63,965**	**26,30,459**
(200)		(200)	(200)

Source: Author own compilation, 2025

From the above table, it is measure that the costing pattern is divided for two parts, fixed cost and variables cost. Most of the portion has covered by human-labor that varies from three categories of farmers. Marginal farmers spend most money for human labor purposes, and medium farmers' costs fewer below compared than marginal farmers. A big portion has been spent for feed-purchasing purchases for small and medium famers, which uplifts their costing pattern. The cost of fingerlings varies from farm size and fish quality, where marginal famers faces huge costing for fingerlings. The second portion denotes fixed cost, where land use and interest over operating cost are two parts, mostly marginal farmers bear most fixed cost as interest bearing factors.

Table 4: Multiple Regression Model to measure the Impact of Independent Variables

Variables Name	Variable Sign	Coefficient Value	t Value
Constant	2.698	1.890	0.872
Human labor cost (X_1)	0.214 **	0.097	2.201
Fingerlings cost (X_2)	0.009	0.105	0.086
Feed cost (X_3)	0.651 ***	0.149	9.987
Manure cost (X_4)	0.081 *	0.040	1.775
Fertilizer cost (X_5)	-0.056	0.082	-0.919
Lime cost (X_6)	0.079	0.049	1.674
Pesticide cost (X_7)	0.009	0.032	0.281
Water supply cost (X_8)	0.135 **	0.065	2.077
Electricity cost (X_9)	0.086	0.082	1.049
Environmental Knowledge (X_{10})	*0.045**	0.033	1.85
F-value (N = 60)	*27.20*		
R2	*0.94*		
Returns to scale	*1.72*		

Source: Author own compilation, 2025

4. DISCUSSION

From the above table, it is known that Labor Costing, Manure Costs, fish food, and water supply costs have a significant relation with fish production per hectare. If the human capital is more utilized for pond-processing, fish production will be increased will be increased significantly. Secondly, Feed cost has a positive connection with fish production, increasing feed cost helps to enhance fish production by nearly 65 per cent, which is statically significant at a 1 per cent level. Thirdly, manure cost has a positive connection with the production, when farmers start farming the waste of hen ducks is mixed with water, which is a natural source of protein and vitamins for fishes. Fourthly, water supply has a positive and significant connection with production, proper water supply leads to enhanced fish production per hectare. Fifthly, most farmers have no idea about environmentally friendly fish-feed supply, which is called green feed for fish, environmental knowledge is one of the emerging issues for fish production, it is highly connected with basic environmental knowledge which is depicted in Table no 2 in this research. When all over the world is trying to achieve sustainable goals by 2030, it is our core duty to establish the practice of eco fish-feed production and consumption. It is noticed that environmental knowledge also helps to ensure the growth of fish production per hectare. It is also statistically significant.

5. CONCLUSIONS

Sustainable fish production is one of the challenging issues for rural farmers, but fish marketing and supply are two well connected factors that help to ensure profit margin at the maximum level. In most cases, local fish farmers do not grab the fragrance of profit properly which it grabs by middlemen who control farmers

and final consumers badly. By studying the fish marketing channel and their cost and profit margins some recommendations are drawn which are given below. Fish is a highly perishable product that needs proper preservation facilities for marketing. It is needed to move fish distance places for marketing. So transportation and shipment facilities should be improved. It is the basic requirement of the establishment of a sufficient ice factory adjacent to the cultural ground. It is necessary to introduce modern wholesaling and retailing facilities. To improve the hygienic conditions of landing centres and markets. Keep the constant price of fish by the government. Avoiding middlemen during fish marketing is a key factor in improving the market share of farmers. Local, National and International NGOs and also Government should provide technical knowledge and credit sources for the agents of fish marketing. Ensure better marketing and distribution of fish. With the increasing of middlemen, the market share of fishermen decreases and the consumer price increases. The result shows that there is a huge gap between the farmed price and the consumer-level price. This indicates the longer the marketing channel, the lesser the share of the fisherman and the higher the marketing margins. Alternatively, the shorter the marketing channel, the higher the share of the fisherman and the lower the marketing margins. To develop and improve the fish marketing channel, the unnecessary and exploitative middleman should be eliminated. In future, some research may be conducted with sustainable fish-farming and environmental knowledge where green economy and eco cultivation should be prioritized. So, government and public-private relationships are essential to improve the existing fish marketing system.

REFERENCES

Ahmed, N., & Rahman, M. M. (2004). A study on fish marketing system in Gazipur, Bangladesh. *Pakistan Journal of Biological Sciences, 8*(2), 287–292.

Ahmed, N., Zander, K. K., & Garnett, S. T. (2011). Socioeconomic aspects of rice-fish farming in Bangladesh: Opportunities, challenges and production efficiency. *Australian Journal of Agricultural and Resource Economics, 55*(2), 199–219.

Al-Amin, A. Q., Alam, G. M., & Hassan, C. H. (2012). Analysis of inshore economic benefit and growth through the proper uses of the utility and scope of fisheries and livestock: A guideline to the MOFL in Bangladesh. *Asian Journal of Animal and Veterinary, 7*, 477–488.

Bangladesh Economic Review. (2022, June). Economic Advisers Wing, Finance Division, Ministry of Finance.

Busari, A. O. (2018). Economic analysis of homestead fish farming in Olorunda local government area, Osun State, Nigeria. *Nigerian Journal of Fisheries and Aquaculture, 6*(2), 19–26.

Deb, A., Chandan, C. S. S., Roy, P., Hossain, M. I., & Bari, S. M. (2021). Inland aquaculture and fish health management: A case study of Sylhet district in Bangladesh. *Aquaculture Studies, 21*(3), 129–137.

Department of Fisheries (DoF). (2015). *Fishery statistical yearbook of Bangladesh*. Ministry of Fisheries and Livestock, Bangladesh.

Department of Fisheries (DoF). (2016). *National Fish Week Compendium* (In Bengali). Ministry of Fisheries and Livestock, Bangladesh.

Department of Fisheries (DoF). (2018). *Fishery statistical yearbook of Bangladesh*. Ministry of Fisheries and Livestock, Bangladesh.

Department of Fisheries (DoF). (2022). *Yearbook of fisheries statistics of Bangladesh, 2021–2022*. Fisheries Resources Survey System (FRSS), Ministry of Fisheries and Livestock, Bangladesh.

Ebukiba, S. E., & Anthony, L. (2019). Economic analysis of catfish production in Karu Local Government Area, Nassarawa State, Nigeria. *IOSR Journal of Agriculture and Veterinary Sciences, 12*(3), 41–48.

Eckstein, D., Kunzel, V., & Schafer, L. (2021). *Global climate risk index 2021* (pp. 10–15). Germanwatch. https://www.germanwatch.org/en/cri

Ele, E. I., Out, I., Obong, E. A., Iniobong, O., Okon, E., & Udoh, E. (2013). Economic analysis of fish farming in Calabar, Cross River State, Nigeria. *Greener Journal of Agricultural Sciences, 3*, 542–549.

El-Naggar, G. O., Nasr-allah, A. M., & Rasaki, K. (2008). Economic analysis of fish farming in Behera Governorate of Egypt. *International Symposium on Tilapia in Aquaculture, 10*, 4794–4803.

Food and Agriculture Organization (FAO). (2012). *The state of world fisheries and aquaculture 2012*. FAO Fisheries and Aquaculture Department.

FAO. (2013). *Software for fishery and aquaculture statistical time series*. http://www.fao.org/fishery/statistics/software/fishstatj/en

FAO. (2016). *Food and agriculture—Key to achieving the 2030 agenda for sustainable development*.

FAO. (2020). *The state of world fisheries and aquaculture 2020: Sustainability in action*. https://doi.org/10.4060/ca9229en

FAOSTAT. (2016). *Statistical database*. Food and Agriculture Organization of the United Nations.

Faruk, M. A. R. (2003). *A comparative economic analysis of carp and pangus culture in some selected areas of Mymensingh district* (Unpublished master's thesis). Bangladesh Agricultural University, Mymensingh.

Ferdoushi, Z., Patwary, Z. P., Ara, Y., & Rana, M. (2019). Economic analysis of tilapia farming in some selected areas of Dinajpur District: A comparison between monoculture and polyculture. *Journal of Bangladesh Agricultural University, 17*(1), 117–121.

Ghose, B. (2017). *Fisheries and aquaculture in Bangladesh: Challenges and opportunities*.

Hasan, J., Lima, R. A., & Shaha, D. C. (2021). Fisheries resources of Bangladesh: A review. *International Journal of Fisheries and Aquatic Studies, 9*, 131–138. https://doi.org/10.22271/fish.2021.v9.i4b.2532

Hasan, M. R., & Ahmed, G. U. (2002). Issues in carp hatcheries and nurseries in Bangladesh, with special reference to health management. *FAO Fisheries Technical Paper, 406*, 147–164.

Islam, M. M., Barman, A., Kundu, G. K., Kabir, M. A., & Paul, B. (2019). Vulnerability of inland and coastal aquaculture to climate change: Evidence from a developing country. *Aquaculture and Fisheries, 4*(5), 183–189. https://doi.org/10.1016/j.aaf.2019.02.007

Islam, M. R., Haque, M. M., & Rahman, M. M. (2017). Strength and weakness of existing traceability system of seafood production in Bangladesh. *Program of Agriculture, 28*, 160–162.

Islam, M. S., Murshed, S. M. M., Moniruzzaman, M., & Baree, M. A. (2002). Rice-cum fish farming in selected areas of Mymensingh district. *Online Journal of Biological Sciences, 2*, 715–718.

Islam, N., Haque, E., & Mohsin, A. B. M. (2008). Carp culture: Cost-return and profit analysis of Rajshahi district. *Bangladesh Journal of Fisheries, 3*(3), 52–55.

Itam, K. O., Etuk, E. A., & Ukpong, I. G. (2014). Analysis of resource use efficiency among small-scale fish farms in Cross River State, Nigeria. *International Journal of Fisheries and Aquaculture, 6*(7), 80–86.

Kumar, B., Sharma, R., Lakra, W. S., Sharma, A., Prakesh, S., & Sharma, M. M. (2022). Economic assessment of shrimp farming (*Litopenaeus vannamei*) in Gujarat—A profitable venture. *International Journal of Innovative Research in Science Engineering and Technology, 5*(8), 15334–15342.

Manik, M. H. (2023). Movement of the economy of Bangladesh with its sector-wise contribution and growth rate. *Journal of Production, Operations Management and Economics, 3*(2), 1–8. https://doi.org/10.55529/jpome.32.1.8

Mazid, M. A. (2002). *Development of fisheries in Bangladesh: Plan and strategies for income generation and poverty alleviation*. Dhaka: Nasima Mazid.

Mondal, G. (2008). *Effects of land use changes on livelihood pattern of small farmers*.

Sarker, F. C., Rahman, M. K., Sadat, M. A., Shahriar, A., & Nowsad Alam, A. K. M. (2022). Haor-based floodplain-rich freshwater ichthyofauna in Sylhet Division, Bangladesh: Species availability, diversity, and conservation perspectives. *2*(4), 639–661.

Shamsuzzaman, M. M., Islam, M. M., Tania, N. J., Al-Mamun, M. A., Barman, P. P., & Xu, X. (2017). Fisheries resources of Bangladesh: Present status and future direction. *Aquaculture and Fisheries, 2*(4), 145–156.

Shawon, N. A. A., Prodhan, M. M. H., Khan, M. A., & Mitra, S. (2018). Financial profitability of small-scale shrimp farming in a coastal area of Bangladesh. *Journal of Bangladesh Agricultural University, 16*(1), 104–110.

Singha, C., & Chandan, S. (2023). Aquaculture practices in Bangladesh: A synopsis on prospects, productivity and problems. *December*. https://doi.org/10.1111/jwas.13045

Sunny, A. R., Mithun, M. H., Prodhan, S. H., Ashrafuzzaman, M., Rahman, S. M. A., Billah, M. M., & Hossain, M. (2021). Fisheries in the context of attaining sustainable development goals (SDGs) in Bangladesh: COVID-19 impacts and future prospects. *Sustainability, 13*(17), 9912. https://doi.org/10.3390/su13179912

Tamim, A. T., Begum, H., Shachcho, S. A., Khan, M. M., Yeboah-Akowuah, B., Masud, M., & Al-Amri, J. F. (2022). Development of IoT based fish monitoring system for aquaculture. *Intelligent Automation & Soft Computing, 32*(1).

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