Fish Production of Bangladesh, It's Pattern & Impact on GDP

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Abstract
Fisheries sector being one of the most productive and dynamic sectors is playing an increasingly significant role in the economy of Bangladesh. It contributes 3.50% to our national GDP and more than one-fourth (25.72%) to the agricultural GDP. This study uses data from 1996 to 2020 to analyze the relationships between fish production, its patterns and impact on GDP. This study splits the analysis into two parts; in the first part, the fish production pattern in Bangladesh is discussed and in the second part, empirical evaluation is made through using econometric tools. The study shows there is a positive cointregation between fish production and GDP, which indicates that an increase in fish production will lead to a rise in the GDP in the long-run. Despite the recent practice of fish production in Bangladesh, a further improvement in fish production pattern could increase both fish production and GDP in Bangladesh.

Key words: Fish production, Pattern of fish production, Lon-run relationship, impact on GDP.

1.1 Introduction

Now Bangladesh acquired 3rd position in open water fish harvesting, 5th position in inland water fisheries, 4th around the globe and 3rd within Asia in Tilapia production, and 1st in 11 vital Hilsha consuming countries (The state of world fisheries and aquaculture, FAO 2020). Fish is the second most contributor of agricultural GDP in Bangladesh. The production of fish contributes to the livelihood and employment of millions of people. The culture and consumption of fish has important involvement for national income and food security. The geographical position of Bangladesh comes with a large number of aquatic species and provide plenty of resources to support fisheries potential. In the national diet of Bangladesh, Fish is a popular complement to rice. People of Bangladeshi are popularly referred to as "Mache Bhate Bangali" or "fish and rice makes a Bengali" (Ghose,2014).

The fisheries can broadly be classified into three categories: inland capture fisheries, inland aquaculture and marine fisheries, of which the inland aquaculture sector is contributing more than 55% of the total production (DoF, 2016). In Bangladesh inland fisheries production is an integrated system in the rivers, floodplains and other natural depressions (beel and haor), all connected by khals (canals). The flood plains act as nutrient-rich nurseries for a large number of larval and juvenile fish species. Ponds are further classified as

a) Cultured ponds where fish fry are released
b) Cultured ponds where fish fry are not released, and
c) Derelict ponds that is not suitable for culturing fish.

Bangladesh has some 130 deep-sea fishing trawlers, 22000 mechanized fishing boats, and 25000 non-mechanized fishing boats. Currently there are 133 fish processing plants in Bangladesh which are mostly located in port cities (Khulna and Chittagong) of which 74 processing plants are EU approved. Though the country is endowed with enormous fishery resources which are vital to the livelihood of millions of people and national food and nutrition security, the sector is facing major constraints including climate change, poor fisheries infrastructure, resource mismanagement, water and environmental population, natural disasters such as recurrent flood and cyclones, and lack of knowledge among farmers. Bangladesh is working with close collaboration with Department for International Development (DfID), World Fish Center and other international organization to develop the sector by building research partnerships and increasing investment. Community based management of fisheries is proving its potential to avert the longstanding political challenges farmers have been facing. The country, however, faces urgent imperatives to strengthen environmental laws to curb pollution which is significantly compromising the performance of the fisheries sector.

1.2 Objective of the study

This study has three objectives: -

1.2.1 Discussing the general fish production pattern in Bangladesh.
1.2.2 To show the long-run integration between Fish Production and GDP in Bangladesh.
1.2.3 To find out causality between these variables.

2.1 Review of the Literatures

Shamsuzzaman et al (2020) found that Bangladesh has a big wetland area with a variety of fishery opportunities. Fish and fisheries are an important element of Bangladesh's economy, with significant export and revenue possibilities. Fish output in Bangladesh has tripled in the last two decades, going from 17.81 lakh metric tons in 2000–01 to 41.34 lakh metric tons in 2016–17, according to the data.

Das et al (2018) explained the prospect of fish farming of Gazipur Sadar upazila of Bangladesh. The complete fish creation of the Upazila in 2016-17 was 14492.7 MT, 27% of the Gazipur region. The researchers stated that the lake region produced the highest amount of fish, with 5436 MT and the semi-intensive system produced the most fish out of all the pond culture methods (2826 MT). Alongside further developing the lake fish cultivating, local area based fisheries the board and some hydroponics drives on private own occasional floodplains ought to be taken on a need premise to further develop and to prosper inland fish creation in the review region.

Mostofa et al (2017) found that Bangladesh is one of the world's most fisheries-friendly countries, with the world's largest flooded wetland and Asia's third-largest aquatic biodiversity after China and India. The researchers discussed that the expansion in hydroponics creation has been made conceivable with the execution of logical and mechanical modernization. According to the researchers, the hydroponics production increased from 712,640 to 2,060,408 metric tons between 2000 and 2016, a far larger quantity than wild catch production (1.023 million t) in 2016. Whereas Islam et al (2017) discussed that the average harvesting weight of Tilapia fish in Rangpur district was 122g before the IAPP-BFRI project, but it grew to 194g after applying IAPP-BFRI germplasm. In the case of Thai Koi, the increase in harvesting weight was 26% in the Rangpur district, which was statistically significant at the 1% level.

Rahman et al (2017) attempted to survey the productivity of fish culturing in paddy fields in the town of Kunia and Chandora, under Gacha union in Gazipur sadar upazila in Gazipur area. They collected the primary data from 15 fish farmers for the study during the period from June to November, 2016.That study found that fish productions in paddy fields are profitable business. According to a Cobb-Douglas production function study, fish fingerlings, fertilizer, fish feed, and lime had a positive impact on overall income and farm productivity, where as human labor and the bank interest rate had a negative impact. Fish farming on rice fields is financially viable, environmentally friendly, and profitable.

Bhaskar et al (2016) explained in their paper that the maximum annual fish output in flood plains was 8,79,513 MT, while the lowest annual fish production was around 4,49,150 MT in 2001-02. Jahan and Ali (2015) illustrated that Bangladesh is the fifth largest aquaculture producer in the world. Over the last three decades, aquaculture in Bangladesh has grown at a quick rate of 10.2 percent per year, and it contributes considerably to the country's rural economy through farm revenues and on and off-farm jobs. According to Fernandes et al (2016), the fisheries industry is extremely important to the Bangladeshi economy, which accounted 4.4 percent of GDP and 22.8 percent of agriculture sector production, as well as providing 60 percent of the country's animal protein intake.

This study discusses the overall fish production pattern in Bangladesh and the impact of overall fish production on the GDP of Bangladesh.

3. Methodology

3.1 Unit Root Test

Unit root test need to run in order to know whether GDP (GDP which is termed here as a dependent variable) and fish production (FP which is independent variable) are stationary or not. This is done by the augmented- Dickey-Fuller test. The following equation represents the augmented D-F test with a constant and a trend as:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p} \left(\delta_j \Delta Y_{t-j} \right) + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $\Delta Yt = Y_t - Y_{t-1}$ and p represents lag of dependent variable with the Akaike Information Criterion and e_t represents stochastic error term. In case of unit root the null hypothesis requires that $\gamma=0$.

3.2.2. Cointegration Test

Performing Cointegration test requires that variables in the time series analysis should have the characteristic that they must be integrated in the same order. For this purpose, we can use a special method called Engle-Granger two-steps method (Engle-Granger,1987). The cointegration between LNGDP and LNFP was made through the Johansen-Juselius

cointegration technique. Two types of test statistics are used to justify the cointegrated vectors, as Trace test and Maximum Eigen value test statistic. These are given below:

$$\lambda trace = T \sum_{i=r-1}^{n} \ln(1 - \lambda i) \quad \ldots\ldots\ldots\ldots \quad (2)$$

$$\lambda max = -T \ln (1-\lambda r+1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In the max statistic alternative roots which are *r, r+1*should be tested. Where *r+1* will be tested to verify it is rejected or not in favor of *r* root. Johansen (1988) argued these two tests have non- standard distribution under the null hypothesis which provide approximate critical values for the statistic represented by Monte Carlo methods. The alternative hypothesis of trace test requires that the cointegrating vector is either equal or less than *r+1*, whereas *r+1* is hold for the maximum Eigen value test. Replacing GDP with LNGDP and FP with LNFP it carries out the Johansen's maximum likelihood procedure.

3.2.3. Granger Causality Test

Finally, the Granger Causality test is carried out for checking the causal relationship between two variables such as *X* (representing LNGDP) and *Y* (representing LNFP). It is a prediction based econometrical concept. If a single value of *X* Causes *Y*, then it is assumed that the previous values of *X* must have some information that assists predict *Y* before and after the information contained in the previous values of *Y* alone assuming both variables are stationary. This test is solely based on the time series data:

$$Y_t = \delta + \sum_{i=1}^{m} \alpha i \; Yt - 1 + \sum_{i=1}^{n} \gamma i \;\; Xt\text{-}1 + vi \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$X_t = \kappa + \sum_{i=1}^{m} \mu i \;\; Xt\text{-}1 \quad + \sum_{i=1}^{n} \varphi i \;\; Y\,t\text{-}1 + \eta i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

v_i and η_i are the white noise disturbance terms which are assumed stationary where *m* and *n* are lags. Both equations represent Present Values of any one of the variables are related to the past values of itself and another variable. *X* will Granger Cause *Y* if the calculated F-statistics is significant at conventional level and similar will occur in case of *Y* to *X*. The lag length should be taken on the basis of Akaike information criterion.

4. Discussion, Data, Result, and Analysis

This part has been distinguished into two parts. In the first part the discussion on fish production pattern is given. The second part analyses the empirical calculation of the study.

4.1 Fish Production Patterns in Bangladesh

On the basis of habitat fish production in Bangladesh are two types as below:

- ✓ Freshwater aquaculture
- ✓ Coastal aquaculture

Fish production pattern in Bangladesh are mainly divided by 5 types

(a) Pond Culture

Pond culture represents the main source of aquaculture in Bangladesh, which accounted 85.8% of total recorded production and 57.7% of the area under culture (DOF, 2010). Unlike gher culture and seasonal floodplain aquaculture which are limited to a few key districts, pond culture is commonly practiced in nearly every district of the country. For the purposes of this review we differentiate between two main forms of pond aquaculture which are:

i. Homestead Pond Culture

Broadly speaking, homestead pond culture occurs as a small component of the larger household farming system. Homestead ponds are used for multiple purposes including bathing, washing and watering livestock. As a result, many households in rural Bangladesh possess a small pond close to their homestead.

ii. Entrepreneurial Pond Culture

The emergence of 'entrepreneurial' pond culture in Bangladesh is relatively recent. We use the term entrepreneurial pond culture to indicate a form of aquaculture distinct from homestead pond culture. Entrepreneurial pond culture is usually deliberately initiated as a stand-alone enterprise involving significant capital investment.

(b) Seasonal Floodplain Aquaculture

Seasonal floodplain aquaculture (FPA) involves the enclosure of areas of privately owned floodplain through the construction of an embankment which creates a water body during the monsoon season. During the dry season a crop of irrigated rice is grown. The water body is managed through the stocking of indigenous and exotic fish species, feeding,

fertilizing, and then the complete harvesting of the stock. The areas enclosed are typically in the range of 50-100 ha in size.

(c) Rice-fish Culture

Rice-fish culture has been promoted in Bangladesh by a number of projects. Although not adopted on anything like the scale of pond-based forms of culture, it does occur in numerous locations throughout the country, most notably in parts of the northwest. However, there is a fairly fine line between this type of rice-fish culture and the production of rice and prawns/shrimp/fish in ghers, which is widely practiced in southern districts, particularly given current trends for many farmers in the sea as to stock only fish in preference to crustaceans. Country wide data on rice-fish farming in Bangladesh are not available (Nabi, 2008).

(d) Cage Culture

This type of culture in Bangladesh remains limited at present. A major DFID funded project, Cage Aquaculture for Greater Economic Security (CAGES), operated by the NGO CARE worked with more than 10,000 extreme-and moderate-poor participants, of whom 63% were women, between 1997 and 2001 (Hambrey and Roy, 2002). The project's rationale was that landless participants otherwise excluded from participation in aquaculture by a lack of principle production factors would be able to practice aquaculture using very small (1m3) cages located either in open access or privately owned water bodies, with modest investment costs of between Tk450 and Tk800 per crop, and using readily available inputs. Net incomes derived by participants averaged Tk444 to Tk1,027 per cage (Hambrey and Roy, 2002).

(e) Gher Culture

Shrimp and prawn production in Bangladesh takes place mainly in converted rice fields known as ghers. Shrimp has undergone more rapid expansion in volume and value terms than any other agro- export commodity in Bangladesh. The contribution of black tiger shrimp (Penaeus monodon) to the Bangladesh national economy is significant and shrimp exports are now the second highest foreign income earner in the country (DOF, 2010). The shrimp sector of Bangladesh grew rapidly from the 1970s until the mid-1990s. In 2008–2009, Bangladesh produced 97,746 t of tiger shrimp and giant fresh water prawn, of which the prawn's share was around a quarter, with a total export value of approximately $380million (DOF,2010).

(f) Coastal Aquaculture

Raising fish, mollusks or crustaceans under controlled conditions in polders, tanks, *gher*s (ponds), or specially constructed polders in the coastal regions. Shrimp culture expanded rapidly in the mangrove and polder areas during early seventies when price of shrimp became very high due to unanticipated rise in demand globally. The culture operation in 51,812 ha (in 1983-84) was expanded to about 1,42,110 ha (in 1993-94) of which bagda shrimp culture (in about 1,33,670 ha) dominates over the culture of *golda* shrimp, *Macrobrachium rosenbergii* (in 8,439 ha). Coastal aquaculture farms are mostly located in Bagerhat (29%), Satkhira (19%), Khulna (19%), and Cox's Bazar (33%). In addition, there are about 422 ha in Keshabpur (Jessore), 43 ha in Kalapara (Patuakhali), and 87 ha in Anwara and Banskhali (Chittagong).

4.2. Empirical Analysis

4.2.1 Data Source

In this study, the annual data on Total fish production and Gross Domestic Production (GDP) have been drawn for the year 1996 to 2020. The data was used to find out the fish production patterns in Bangladesh and its impact on GDP. The main sources of data are World Development Indicators and Bangladesh Economic Review. The fish production is independent variable and GDP is the dependent variable. Taking Natural Logarithms of GDP as LNGDP and FP as LNFP we tried to examine the data empirically by using econometric software Eviews version 9.

4.2.2 Result of unit root test

Table-1: Unit Root Test (ADF)

Unit Root test without trend and intercept				Unit Root test with trend and intercept		
Variable name	Level	First Difference	Second difference	Level	First Difference	Second difference
LNFP	11.94356	-1.533075	-4.94653	-2.463027	-4.272010	-4.913290
LNGDP	2.255419	-0.854609	-5.541819	-2.336670	-2.905887	-5.074480

Note. *, ** and *** represents the level of significance in critical value for 10%, 5% and 1% respectively.

The result of the ADF unit root test states that the presence of unit roots in the original series of LNGDP and LNFP are not stationary in the levels and their first differences. But in their second differences they are stationary as the second differences remove the unit roots. So, both variables are integrated at their second differences [denoted as I (2)], as a result, it is necessary to run the cointegration test to determine whether there is any long-run relationship between these two variables.

4.2.3 Results of Cointegration test

Table-2: Johansen Cointegration Test for LNGDP and LNFP

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.527702	15.88232	15.49471	0.0437
At most 1	0.006138	0.129287	3.841466	0.7192

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.527702	15.75303	14.26460	0.0289
At most 1	0.006138	0.129287	3.841466	0.7192

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The Johansen and Juselius (1990) test has been done here by taking one lag length. Here the *p* value is less than 5% at both trace and maximum eigen value at none. It shows the cointegration relationship between the variables. We can say that there has a long-run relationship between GDP and the fish production.

Normalized cointegrating coefficients (standard error in parentheses):

LNGDP	LNFP
1.000000	-2.96938
	(0.37038)

According to the normalized cointegration coefficients, GDP has a positive relationship with the Fish production of Bangladesh. The coefficients value 2.96 (≈3) indicates that if fish production increases by 1%, the GDP will increase by 3%. It means, an increase in fish production will lead to a rise in the GDP in the long-run.

4.4 Granger Test

Table-3: Pair wise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGDP does not Granger Cause LNFP	21	1.88147	0.1846
LNFP does not Granger Cause LNGDP		2.28029	0.1345

Here, any of the null hypotheses could not be rejected, as the probability values are greater than 0.05, and the F-Statistics are not in the rejection area. So, according to this test there is no unidirectional or bidirectional causality between these two variables.

5. Conclusion

Fisheries sector of Bangladesh is important for both providing protein and boosting up the GDP of our country. This paper found that fish production has significant positive influence on GDP of our country. So, now it is very essential to amend the existing laws and legislation of the country to save the fisheries resources. Although much of the damage to the habitat and biodiversity of the inland water of Bangladesh over recent decades is likely to be irreversible. All concerned bodies both in government and nongovernmental level should raise social and technical environment to improve fisheries sector in Bangladesh in order to meet the present and future need of the country and also contribute in future development. Improvement of fish production patterns is also an important way to increase fish production in Bangladesh.

Reference

1. Shamsuzzaman M, Mojumder M and Bhuyian S (2020) The economic contribution of fish and fish trade in Bangladesh https://doi.org/10.1016/j.aaf.2020.01.001
2. Biswas J ,Hauque M,Kabir W (2019) Extreme Climate Events and Fish Production in Bangladesh January 2019 :10.5539/enrr.v9n1p1
3. *Coastal aquaculture*. Banglapedia. (n.d.). Retrieved May 12, 2022, from https://en.banglapedia.org/index.php/Coastal_Aquaculture
4. *Department of Fisheries Bangladesh Ministry of Fisheries and Livestock ...* (2018). Retrieved May 12, 2022, from https://fisheries.portal.gov.bd/sites/default/files/files/fisheries.portal.gov.bd/page/4cfbb3cc_c0c4_4f25_be21_b91f84bdc45c/2020-10-20-11-57-8df0b0e26d7d0134ea2c92ac6129702b.pdf
5. Das, M., Islam, M., Akter, T., Kawser, A., & Mondal, M. (2018). Present status, problems and prospect of fish farming at Gazipur Sadar upazila in Bangladesh. https://doi.org/10.3329/pa.v29i1.37480

6. Islam M,Tania N, Barman P (2017) Fisheries resources of Bangladesh: Present status and future direction https://doi.org/10.1016/j.aaf.2017.03.006
7. Islam A ,Kohinoor M, Rahaman M(2017) Impact of genetically improved fish species and technology on selected hatchery and fish production in Bangladesh July 2017 10.3329/ijarit.v7i1.33323
8. Fernandes, J. A., Kay, S., Hossain, M. A. R., Ahmed, M., Cheung, W. W. L., Lazar, A. N., and Barange, M. Projecting marine fish production and catch potential in Bangladesh in the 21st century under long-term environmental change and management scenarios *–ICES Journal of Marine Science (2016)*, 73(5), 1357–1369. https://doi.org/10.1093/icesjms/fsv217
9. Ghose, B.2014. "Fisheries and Aquaculture in Bangladesh: Challenges and Opportunities". *Ann Aquac Res* 1(1): 1001.
10. Hambrey, J. and Roy, M. 2002. *Final Project Review of the 1 year extension of the CAGES project.* Nautilus Consultants
11. Jahan, K., and Ali, H. (2015) AQUACULTURE TECHNOLOGIES IN BANGLADESH: AN ASSESSMENT OF TECHNICAL AND ECONOMIC PERFORMANCE ANDPRODUCERBEHAVIOR Penang, Malaysia: *WorldFish. Program Report*: 2015-52
12. Nabi, R. 2008. Constraints to the Adoption of Rice-Fish Farming by Smallholders in Bangladesh: A Farming Systems Analysis. *Aquaculture Economics & Management.* 12(2):145–153.
13. Yearbook of Fisheries Statistics of Bangladesh 2019-20. (n.d.). http://fisheries.gov.bd/sites/default/files/files/fisheries.portal.gov.bd/publications/f9e3f9f4_e728_4442_a60c_f409f01ee497/2021-09-15-09-08-6403c5da6be3f3d0250c5dcb170c5e1a.pdf