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Research Paper

Indian Fisheries and Aquaculture Growthtrend: An Economics Analysis

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ABSTRACT: *This study examines India's fisheries and aquaculture sector's growth trajectory. To arrive at the conclusion, a multiple variate regression model has been applied. Analysis reveals that the population of vegetarians has decreased, and government investment has increased leads to growth in productivity. However, research also demonstrates that the currentadministration has no influence because growth has been constant over the last two decade.*

KEYWORD*: Aquaculture,Agricultureand Allied Industries,Fisheries, Blue revolution.*

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I. INTRODUCTION

Since horticulture and vegetation have existed for 10,000 years not longer than human history (500 000 years), our common ancestors were most likely not vegetarians. Hunting was the main source of food accumulation up until our ancestors discovered the right gardening technique. As cultivation was accidentally introduced to our ancestors, a paradigm change occurred. Due to the fact that it is outside the scope of the research issue, we will not be discussing this accident. As our ancestors got more skilled at agriculture, the entire civilization moved into a new zone of comfort, and domesticating animals for their milk, meat, and other products became standard practise during that time. The system is still in use. However, in the modern era, food security has become a major concern for the global society. Growing population and climate change are the two main causes of the growing danger to food security. Whereas the problem of a growing population has been extensively addressed over the past 300 years, Sir Thomas Malthus was the first to express worry in 1798. According to Malthus, population growth follows a geometric trend while food follows an arithmetic progression. In other words, population growth will outpace food growth. It is well documented that the Industrial Revolution helped Europe overcome this threat, but because the globe has become a global village, the threat has changed as a result of globalisation. Second, agricultural productivity is under more pressure due to climate change. Because of the nonlinear relationship between climate and agricultural productivity, crop productivity and climate variables unquestionably form an inverted U shape curve. Due of this issue, the globe is turning to aquaculture as a potential remedy. Considering that aquaculture includes both farmed and wild fish, a new era of animal domestication has begun. Fish farming alone, or aquaculture, has some advantages over agriculture. First, there is the obvious larger resource available due to the earth's distribution of water and land, which is 71 percent and 29 percent, respectively. The global village is currently just using a small portion of the resource. Second, compared to crop cultivation, it is less vulnerable to climate change. Thirdly, it offers a chance for growth without a lot of industrialization. Fourth, it respects the environment. Fifth, adopting fish as a primary food can help the population's nutritional deficiencies. The last step is to maintain clean water.

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Understanding the effects of different factors on the growth pattern of the aquaculture sector in India is essential given that aquaculture is regarded by the global economy as a key tool in the fight against food security and climate change. In this essay, we shall attempt to investigate the impact of socioeconomic factors on fisheries and aquaculture productivity.

1.1 OVERVIEW OF INDUSTRY

Fisheries and aquaculture are included in the category of associated industries to agriculture and forestry. Fishing and aquaculture make up the majority of this sector's activities. We must thoroughly analyse both their collective and individual contributions to India's GDP in order to comprehend the expansion of this industry. As a whole, the basket's contribution decreased from 51.9 percent in 1951 to 13.7 percent in 2014; but, when fisheries and aquaculture are considered separately, each sector's contribution increased from 0.40 percent in 1951 to 0.92 percent in 2014. Evidently, basket contribution is also reaching new heights. We can gain a deeper understanding of the industry's development by analysing production levels over time, as the above figures may not accurately depict the situation given how sensitively they respond to contributions from other sectors of the economy.

Therefore, from 0.75 MT in 1951 to 14.16 MT in 2020, production increased by 1892 percent. It's interesting to see that industry growth varies by subset. Between 1980 and 2020, inland output had grown by 1172 percent, and marine production had recently demonstrated growth of 241 percent. Aquaculture is a major factor in unequal growth, as shown in figure 1.

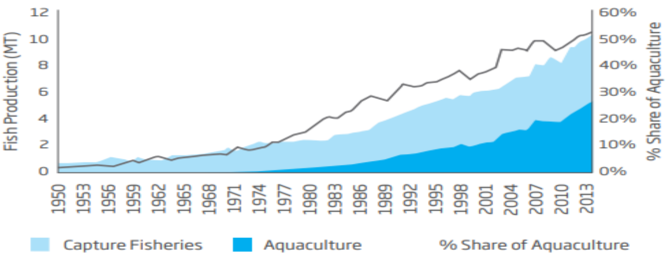

Figure 1; Share of Aquaculture; courtesy FOA 2016

Aquaculture has replaced catch fisheries as the dominant form of inland production, increasing its share from 34% to 80%. Due to this significant transition, China currently holds the top spot in terms of aquaculture production, with India coming in second. When it comes to 88 percent of fish and 10 percent of crustaceans, aquaculture is equivalent to fresh water cultivation. Asopen water sources are seldom being utilised to their maximum potential, chain aquacultureproduction is only 10 times that of India, leaving market share available for grabs.

Fish are caught in marine fisheries from the ocean floor. The depth of the sea floor, together with technology and capital, are the two factors that have an impact on production under this clause. Beyond 200 metres of depth, considerable technological and financial utilisation are needed. Currently, just 8% of sources are deeper than 200 metres, making up 86% of all sources. To boast production under this part, a proper infrastructure, such as a fishing harbour, landing facilities, and coastal, is required.

India has a legitimate chance to become a major supplier thanks to brackish water aquaculture. Shrimp, a product with a high export value, is the main output of this sector. Shrimp in a frozen state makes up over 40% of India's exports. assisting India in expanding its position in the world's seafood market.

II. OBJECTIVE

The goal of this study is to establish a relationship between one dependent variable, namely production, and four explanatory variables: the population of vegetables, harbour investments, the conversion of brackish soil into brackish fish farming, and finally the government regime of the previous 21 years, which has been used as a dummy variable.

Understanding the impact of demographic change and government policies on aquaculture is fundamental to picking this variable. It is clear that any organised sector, including the oil industry, is most concerned with the demographic shift. For the sake of future planning, many high-level brands analyse demographic change. In layman's terms, a demographic shift can be defined as a change in the population's basic makeup, such as an increase or decrease in the average age, income, or taste. And over the past 20 years, there has been a change in the foods that Indians prefer. Understanding the effects of this demographic change on the expansion of the aquaculture industry in India is crucial.

Similar to how aquaculture is growing, there are many jobs and opportunities for self-employment in India. The primary production, transportation, storage, and processing are available employment options (Ayyappan and Krishnan 2004). Therefore, it is crucial to understand how the government feels about this newly discovered employment opportunity and whether or not the government is doing enough to profit as much as possible from this expanding sector. We used two variables, namely the conversion of brackish soil into potential brackish fish farming and investment in harbour over the previous 21 years, to understand the government's strategy to aquaculture.

The rationale behind the conversion of brackish soil is that aquaculture is a highly significant export sector for India. Global shrimp output has increased significantly during the past two decades in both value and volume (Krishnan et al 2020). Being the dominant species in this branch of aquaculture, shrimp farming is synonymous with brackish water aquaculture. Figure 1 depicts the Indian export situation precisely; 39 percent of exports consist of frozen shrimp. Therefore, including BSC in the model will significantly aid in the sector's growth pattern. India can make significant strides in the global fish industry with further expansion of this segment.

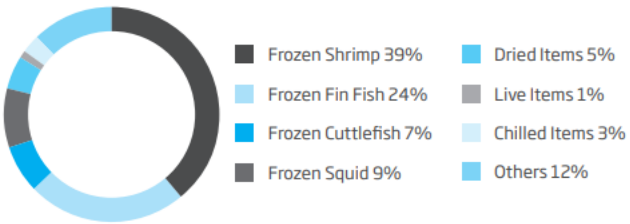

Figure 2; Major fisheries and aquaculture export by India; courtesy: NABARD

While farming and freshwater fishing are part of the inland sector, marine fisheries focus on catching sea food. Figure 3 makes it abundantly clear that the world places more emphasis on the maritime sector, accounting for 66% of global production, while India trails behind with 36%. In contrast to other subsector, even growth rate is not that outstanding.

The government's improvement of the harbour is a significant step in improving the infrastructure and facilitating marine fisheries. Building harbours, jetties, and landing areas increased the amount of fish that could be caught (Kumar et al 2010). It offers fishermen and women landing facilities and fishing opportunities. The coastal aquaculture cage culture in India, where fish are raised in cages on the sea floor, will be driven by a major benefit of well-designed harbours. Another benefit is that it provides our fish producers with an entirely new supply. Therefore, it is crucial to comprehend the effects of the government's approach to aquaculture.

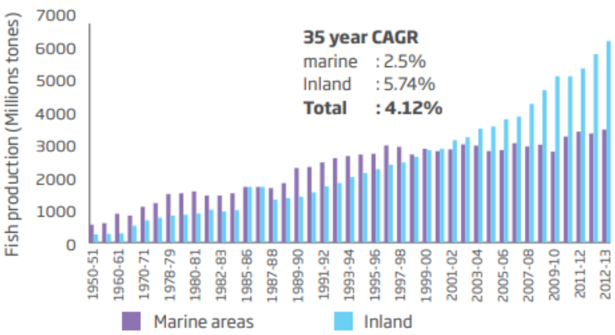

Figure 3; CAGR by Subsector; courtesy: NABARD

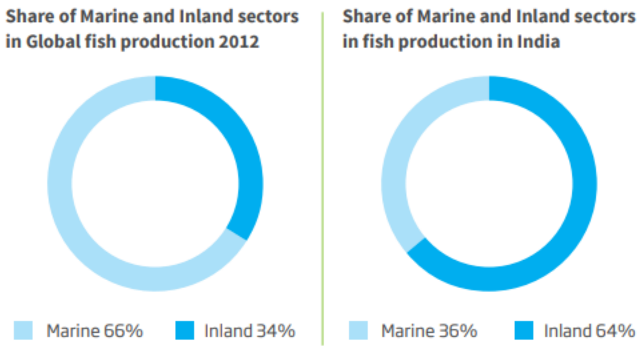

Figure 4; Share of marine and inland sector (Globally and India); courtesy: NABARD

In order to determine whether the rise of aquaculture has been consistent throughout the past 21 years or may be attributed to a certain government, we have also included a political regime as a dummy variable.
Therefore, we are evaluating four null hypotheses.
H01: Demographic changes have no bearing on the aquaculture industry's expansion.
H02: There is no correlation between the expansion of the aquaculture business and the conversion of brackish soil into potential brackish water fish farming.
H03: The expansion of the aquaculture industry has nothing to do with developing harbours.
H04: The growth of the aquaculture industry is unrelated to the current political climate.

III. MATERIAL AND METHOD

The paper relied on secondary data to arrive at its predetermined result. One dependent variable and four explanatory variables make up the data set. Production is the dependent variable, whereas government policy and demographic changes are the explanatory variables. The conversion of brackish soil (BSC) into a prospective brackish fish production centre and investments in harbours have been taken into consideration by the government. The socioeconomic variable includes the population's percentage of vegetarians. Finally, the influence of the change in government has been demonstrated using a dummy variable. To account for data variability, data from twenty-one years, from 2000 to 2020, have been collected. The Ministry of Fisheries, Husbandry, and Dairying's guidebook on fisheries statistics was used to compile the production data. While information on brackish soil availability and harbour investment is taken from a sectoral paper on fisheries and aquaculture published by NABARD. The Hindu survey from 2006 and other recent surveys are used to calculate the percentage of vegetarians in society. And using the compound annual growth rate, missing data was filled in.

Before selecting the best fit model, we had performed a number of diagnostic tests. First, the Kolmogorov-Smirnov test of normalcy was used, and the results are shown in the table1; whichindicate that all of the variables have very high P values. As a result, we lack sufficient data to reject the null hypothesis. Therefore, it is safe to state that variables are statistically equivalent to those with a normal distribution.

Variables	**Test**	**P value**
Production	Kolmogorov Smirnov	0.8154
Veg	Kolmogorov Smirnov	0.9797
Brackish Soil	Kolmogorov Smirnov	0.2769
Investment on harbours	Kolmogorov Smirnov	0.5903

Table 1; Test of Normality

Second, we conducted a cointegration test first before moving on to the unit root test. To make inference more reliable, the AEG (Augmented Engle and Granger) and Johansen test were applied.
The results of two tests are shown in Table 2, and the low P value indicates that the data are significantly cointegrated.

TEST	**P value**
AEG	0.0005
Johansen	0.000

Table 2; Test of Cointegration

We conclude that ECM (Error Correction Model) will be the best fit for our analysis after running all diagnostic tests. The regression equation shown below was examined;

$$PROD = \alpha + \beta_1 VEG + \beta_2 BRAC + \beta_3 HAR + \beta_4 GOVT + \varepsilon$$

Where PROD stands for production, is the intercept, VEG stands for the vegetarian population, BRAC stands for brackish soil suitable for brackish fish, HAR stands for harbour expense, GOVT stands for government regime, and, and are the corresponding coefficients. Is the regression model's representation of the standard error. This formula is used for long-term forecasting.

$$PROD_{D1} = \alpha + \beta_1 VEG_{D1} + \beta_2 BRAC_{D1} + \beta_3 HARD_{D1} + \beta_4 GOVT + \beta_5 \omega_{t-1} + \varepsilon$$

The first equation and the second equation (first difference) are similar with the inclusion of the first lagged value residual (t-1) produced by the first equation. This equation evaluates if the stated equilibrium was attained or not. The equilibrium has not been reached if the residual is significant, and vice versa.

IV. RESULT AND DISCUSSION

The model's R squared and adjusted R squared values are, respectively,.9977 and 0.9972. proving good model fit, thus. Government is statistically non-significant, while the variables veg population, brackish soil conversion, and investment in harbours are all statistically significant. As a result, we have enough data to rule out hypotheses H01, H02, and H03, while accepting H04. At a 5% level, the F statistic of the model, which is 0.00%, is also statistically significant. A cutoff level of 10 is used when measuring the association between explanatory variables using variance inflation factors (VIF) (Myers 1990). The related VIFs for veg population, brackish soil conversion, harbour investment, and government spending are 6.51, 7.29, 2.41, and 3.98. The model's autocorrelation, as measured by Durbin Watson, is 1.45, with a limit of 0.634 to 1.712 denoting inconclusiveness. Breusch Godfrey's test of serial correlation, which was used to determine whether the autocorrelation in our model was viable, returned a P value of 0.505; as a result, the null hypothesis that there was no serial correlation was accepted, making our model workable. The Jarque Bera test was used to examine the normality residual, and the resultant p value of 0.96 indicated that the series was normally distributed. Heteroskedasticity was tested using the Breusch Pagan Godfrey test, and the p value of 0.91 indicated that there is no heteroskedasticity.

Vegetable population and production are inversely correlated; one unit change in one measure causes the opposite change in the other. Fish farm production is positively correlated with brackish soil conversion because one unit change in a variable result in a.0000018 unit change in production. A unit change in the variable results in a change production of.000257, and investment in harbours is likewise positively correlated. Last but not least, the government's role in determining aquaculture productivity is statistically insignificant. Same can be observe from Table 3.

Model	Coefficient	Std Error	T statistic	Significant	VIF
Constant	127.34	4.66	27.31	0.0000	NA
Veg population	–162.90	10.12	–16.09	0.0000	6.51
Brackish soil conversion	0.0000018	.000000127	14.69	0.0000	7.29
Investment in harbour	0.000264	.0000075	3.50	0.0029	2.41
Government	1.10	1.29	0.86	0.4030	3.98

Table 3; Result of Regression

Further, first lag of residual term obtain from first regression was used as an equilibrium error to understand short term relation. The mean value of the lagged value was -0.11235 and its coefficient was -0.85 indicting that production going to rise in t period.

$$\Delta PROD = -1.409 - 268.9\Delta VEG + 1.90E\text{-}05\Delta BSC + 0.000292\Delta INVEST + 0.24GOVT$$
$$-0.85\omega_{t-1} + \varepsilon_t$$

V. CONCLUSION

Since, this study employs the ECM model to examine India's fisheries and aquaculture industry's growth pattern. The main focus is to understand production is going to behave in in coming t period using short term relationship, even though first regression model provided desired result (three variable out of four was statistically significant).The mean of first lagged order of residual series is negative (-0.11235) indicating production below than equilibrium point and $\beta_5$is also -0.85 (statistically significant). Thus, negative relationship exists between equilibrium error and production, so it can be interpreted that it is going to increase further. Thus, the future is very bright and this industry is truly a sunrising industry (NABARD 2018).

VI. LIMITATION

When it comes to including technological advancement, this research has significant limitations. From bio floc to recirculating aquaculture systems, numerous innovative technologies have been incorporated into the production process during the past years. These factors can strengthen analysis, however statistics on them are scarcely available on any reliable platform.

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