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Research Article

Relationship between Fish Seed Production and Inland Fish Production of West Bengal, India

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Abstract

West Bengal is rich in Inland Fishery Resources. Ponds and tanks dominate with 90.62 percent water resources that are brought under culture. Overall 87.56% of total potential water resource is utilized for culture leaving another12.44% for yet to bring under culture. Fishermen constitute about 3.3 percent of total population of 91.3 million in West Bengal. Fisheries are next to agriculture in terms of providing employment and food supply. Fish is an important source of quality protein and cheaper in cost compared to other sources of animal protein. The government is continuously expanding areas under aquaculture. Therefore, there is a steady demand of fish seed for aquaculture. Fish seed is reported to be a constraint for expanding aquaculture in the state. In this communication, it is attempted to examine each of the trends of water area expansion for aquaculture, fish seed and inland fish production as well as demand and supply of fish based on secondary government statistics. The following trend lines were developed. (i) Prediction models on growth of pond fishery $(est)=1823.76X+1000,000;$ $R^2 = 0.97$ (where Y is estimated pond fishery in ha and X is year. (ii)Demand of fish: Y(est.) $=15+0.2118X$; $R^2 = 0.9967$ (where Y is demand of fish in lakh ton and X is time in years). (iii) Supply of fish as Y(est.) $=14.528+0.032X$; $R^2=0.0606$ (iv)*Prediction Model for Fish Seed Production:* $Y_{est}=8000+470.8X$; $R^2=0.864$. v) *Established relationship between inland fish production and fish seed production of* the form $Y_{est}=1.9173+0.0007X$; $R^2=0.6785$, (where Y is Inland Fish Production and X is fish seed production). Finally, based on trend, appropriate strategy of water area expansion, fish seed production and supply & demand can be explored for sustainable aquaculture growth.

Introduction

Fishery is the oldest and most important livelihood option for the inhabitants of West Bengal since times immemorial. Fisheries are next to agriculture in terms of providing employment and food supply. Fish is an important source of quality protein and cheaper in cost compared to another source of animal protein. Majority of west Bengal's population is fish eaters and the per capita consumption is 9.8 kg whereas the recommended intake is 13 kg. The surging demand for fish and fishery products will mainly be met by growth in supply from aquaculture production. Aquaculture remains one of the fastest-growing sectors for animal food production. One of the main constraints is the availability of quality fish seeds. Seed is the primary input in any culture systems; its production has been accorded highest priority in terms of bloodstock management, establishment of hatcheries, and refinement of induced breeding techniques, rearing and production of quality seed across the state [1].

It is well known that a good statistical system is essential for decision making and forming viable public policies. Secondary data is available from statistical hand books published by fisheries departments of West Bengal and Govt. of India covering various aspects of fishery resources, production, consumption, resource utilization etc. [2,3]. Trend studies and modeling is of crucial importance to fishery science and management. Till date few reports are available on modeling in fisheries and aquaculture [4,5,6,7], but statistical analysis to unearth hidden facts is rare in case of for West Bengal. Therefore, for the first time, it is attempted to examine each of the trend of water area expansion for aquaculture, fish seed and inland fish production as well as demand and supply of fish as based on secondary authentic statistics. This will also pave the way for identification and optimum utilization of various resources with appropriate measures for fisheries development of the state of West Bengal.

Methodology

This study is based on secondary data available so far on various aspects of fishery statistics mainly published in Hand Book of Fishery Statistics by Government of West Bengal, and Govt. of India [2,3]. The secondary data is considered for analysis followed by. Interpreted and presented in the form of tables, graphs, and charts for easy visualization and comprehension. Various statistical techniques like, correlation, regression, and trend line fitting were performed using MS Excel. Trend

lines with time series data on fish seed production, and inland fish production, demand, and supply are also fitted for model building and forecasting purposes.

Results and Discussion

Secondary data collected from authentic and reliable Government sources are tabulated, analyzed and presented in the most convenient way for comprehension for decision making by policy planners responsible for management of this sector [1,3,4].

Marine fisheries resources of west bengal

West Bengal is having a vast coast line of 158 km. Continental shelf is vast to the extent of 17049 sq.km. Offshore area is 1813 sq.km. and inshore area up to 10 fathom depth is 777sq.km. Marine fisheries is an important sector of West Bengals economy supporting the livelihood of the millions of fisher-folks inhabiting the long coastline those who are engaged in the related activities. The marine fisheries sector of India's maritime state of West Bengal has witnessed a phenomenal growth during the last five decades both quantitatively and qualitatively with a slower growth rate presently. Therefore, attention is given for development of Inland fishery resources for aquaculture [3].

Distribution of Inland Fishery Resources of West Bengal: Total area under of River, Canal / Khal and Beal / Boars of West Bengal is 279569.31ha. River occupies 58% of total area followed by canal / Khal (27%) and Beal / boar (15%). Inland fisheries enjoy prime of place in West Bengal's economy. It provides employment and livelihood for fishers who solely depend on it [2].

Inland fishery resource utilisation by type of fishery of west bengal

There are two important sectors in Fisheries namely, Marine Fishery and Inland Fishery. Both sectors play an important role in West Bengal's economy.

West Bengal is rich in Inland Fishery Resources. Ponds / tanks dominate with 90.62 parent of water resources under culture. Overall 87.56% of total potential water resource is utilized for culture while another 12.44% is yet to be brought under fish culture. West Bengal is rich in open

water system like reservoirs, rivers, canals and estuaries. Blue colored space is the area that can further be utilized for fish culture (Figure 1).
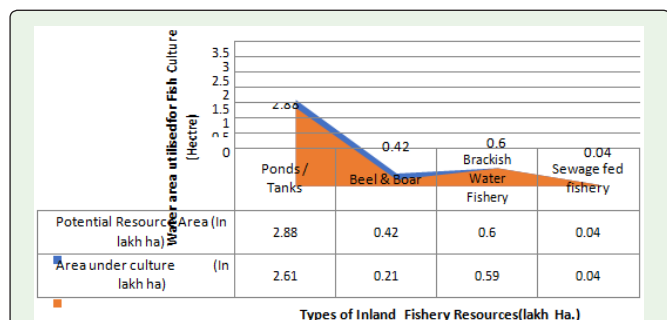
Trends in growth of pond fisheries in west bengal

The scenario of fish production from marine sector is declining during successive years in west Bengal and this trend is not different from the global trend. 'The State of World Fisheries and Aquaculture ' concludes that capture fisheries production is stagnating and aquaculture output is expanding faster than any other animal-based food sector(. There are growing concerns with regard to safeguarding the livelihoods of fishers as well as the sustainability of both commercial catches and the aquatic ecosystem from which they are extracted. To combat the scenario, the Govt. of West Bengal has taken steps to develop pond fishery as shown in the figure 2.

One of the most important reasons for doing time series analysis is to try to forecast future values of the series. The ability to make such predictions successfully is obviously important to any scientific field. In the present case, the fitted equation is $Y(est)=1678.8X+101698$ where Y is estimated pond fishery(ha) and X is year. The R^2 value (0.9888) is indicative of good fit of the equation. This prediction equation may give picture for future development of pond fishery development initiated by Govt. of West Bengal.

Demand-supply scenario

Trend of Fish Demand and Supply Scenario during 2007-08 to 2012-13 is presented in figure 3.

It is evident that the demand of fish is increasing steadily over the years (Figure 3). The fitted equation for demand of fish is as follows $Y(est.) =14.951+0.2231X$; $R^2 =0.9999$ (where Y is demand of fish in lakh ton and X is time in years). The R^2 value is an indicator of goodness of fit of the data (Figure 3). This equation will facilitate precise estimation of demand of fish for future years. This model is first of its kind with fisheries sector at West Bengal that in turn may help resource management and future planning of fisheries / aquaculture sector to fill the gap of demand and supply. Similarly, attempted to fit the fish supply data and the fitted linear equation is $Y(est.) =14.528+0.032X$; $R^2=0.0606$ and second degree polynomial equation as $Y(est.) =15+0.2231X$; $R^2 =0.0741$(where Y is production of fish in lakh ton and X is time in years). Interestingly, neither linear nor polynomial curve was found suitable for fish supply data as can
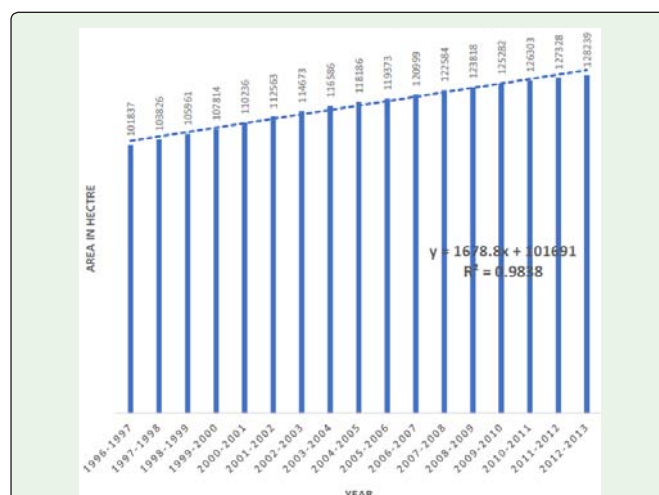

Figure 1: Inland fishery resources utilisation in west bengal.

Figure 2: Treng of growth of pond fishery in west bengal (Hectere).

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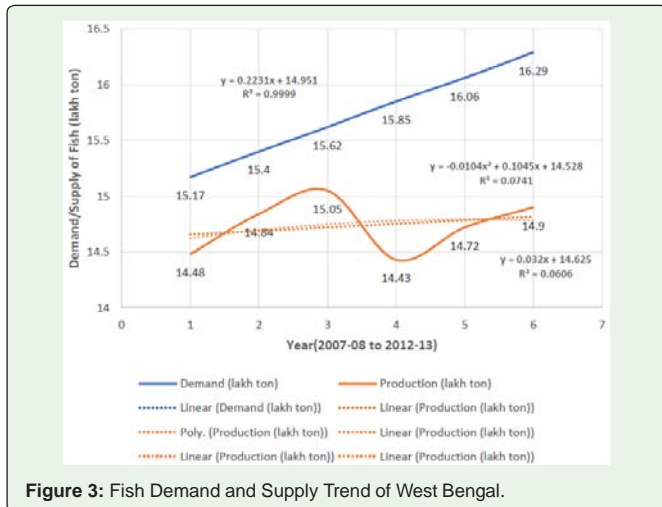
Figure 3: Fish Demand and Supply Trend of West Bengal.

Figure 5: Relationship between inland fish production and inland fish seed production.

be evidenced from R^2 values. The present fitted equation is capable of forecasting future demand of fish for West Bengal.

Forecasting of fish seed production data

Fish seed is a very important component for successful implementation of fisheries and aquaculture development. From 1998-99 to 2012-13 there is an up-word growth of fish seed to the extent of about two times from an initial of 8610 million. Therefore, it was attempted to estimate statistically the rate of growth in the form of a prediction equation to enable future forecasting of fish seed production for West Bengal. We fitted trend lines for Fish Seed Production (million seed) of West Bengal for the years 1998-99 to 2012-2013 as follows.

Prediction model for fish seed production

$$Yest = 8000 + 470.8X; R^2 = 0.864$$

Where Yest is the estimated values of fish seed production (dependent variable) and X is time in years (independent variable). The fitted model developed for Fish Seed Production explains 86.4% of variability of production as can be evidenced by R^2 value of 0. 894. This indicates that fish seed production is increasing at the rate of 470.8 million fish seed per year.

Relationship between Inland Fish Production and fish seed production

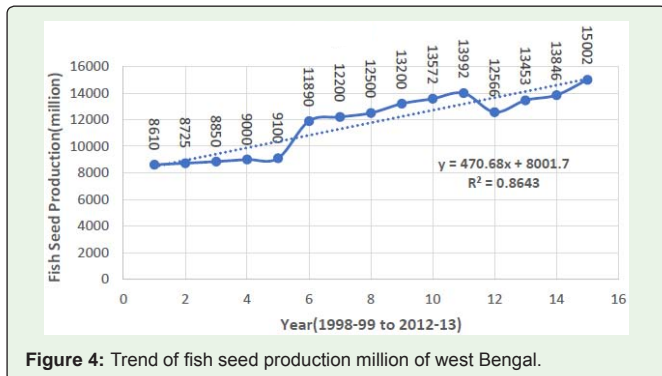It is well known that fish seed is an important input for successful

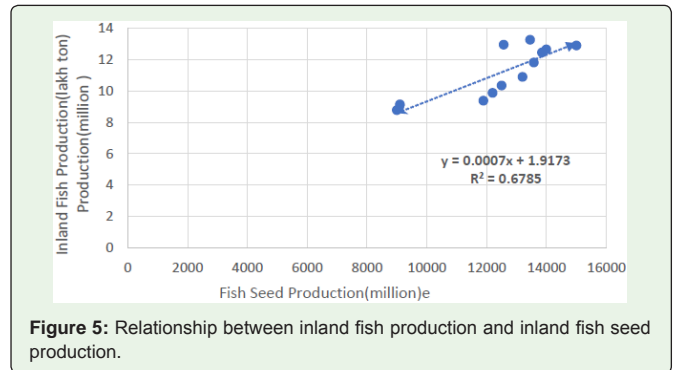**Figure 4:** Trend of fish seed production million of west Bengal.

aquaculture. The government of West Bengal has taken lot of steps to enhance fish seed production resulting 15002 million fish seed in 2012-2013 an increase of 1.7 times of seed production from 2000-2001 and the corresponding figure for of Inland Fish production jumped 1.52 times to 13.38 lakh ton. Regression analysis of Inland fish production and fish seed production showed a significant positive relationship between the two variables of the form Yest =1.9173+0.0007X; R^2 =0.6785, where Y is Inland Fish Production and X is fish seed production (Figure 5). This proves that inland fish production is dependent on fish seed production. Similar relationship is reported in case of North Eastern States [9].

Conclusion and Recommendation

Established trend lines and regression equations on each of water area expansion for aquaculture, fish seed and inland fish production as well as demand and supply of fish are likely to pave the way for identification and optimum utilization of various resources with appropriate measures for fisheries development of the state of West Bengal. Projections indicate a continuous rise in demand for fish seed. Therefore, attention for long-term effective management of resources as well to boost aquaculture production in West Bengal State of India where fisheries and aquaculture it is an important sector of employment as well as nutrition for low-income rural fishers besides steady of fish being an important source of quality protein at a cheaper cost compared to other sources of animal protein.

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