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Modeling the Dynamicity of Data on all-India Prawn Production over the Years

Prasenjit Pal

Assistant Professor, College of Fisheries, CAU, Lembucherra, Tripura-799210
E-mail: prasenjit3agstat@gmail.com

Abstract—*The freshwater prawn is suitable for cultivation in tropical and subtropical climates and has high export potential. In the present study, an attempt has been made to model the dynamicity of the data on all-India prawn production and based on a model constructed on the above data-set (2000-01 to 2013-14). Some non-parametric model in combination with semi-parametric model have been compared with different parametric models in order to judge their precision level by measuring the proximity between the observed and the predicted values based on the data-sets on all-India prawn production. State wise production potentials over the years also have been compared to depict the real status of prawn production in India. The importance of such studies stems from the fact that the policy makers need the specialized scientific information in the form of advisory services in respect of the trend/pattern of production potential over the years in advance and identification of specific model helps to obtain such important information. This paper is devoted to generate such models. It is revealed that the precision levels are much higher when the non-parametric and semi parametric models are applied on the data-sets considered under the purview of the paper, in comparison to other methods exploited to obtaining the above-said information.*

Keywords*: Dynamicity, Parametric model, Non-parametric model, Semi- parametric model.*

1. INTRODUCTION

Fisheries sector in India is enriched with varied resources and economic potentials. Fisheries sector, however, has a strategic role in food security, international trade and employment generation. Only after the Indian Independence, has fisheries together with agriculture been recognized as an important sector. Aquaculture in India has evolved as a viable commercial farming practice from the level of traditionally backyard activity over the last three decades with considerable diversification in terms of species and systems, and has been showing an impressive annual growth rate of 6-7 percent. India is also an important country that produces fish through aquaculture in the world. As the second largest country in aquaculture production, the share of brackish-water sector [1] (Srinath 2003) includes culture of shrimp varieties mainly, the native giant tiger prawn, Penaeus monodon and exotic white-leg shrimp, Penaeus vannamei. Present status Brackish water aquaculture in India [2] (Handbook of Fisheries and Aquaculture, 2015) is restricted to shrimp farming utilizing semi-intensive culture practices mainly with giant tiger prawn at stocking densities of 0.1–0.3 million/ha. With the provision of a high protein diet, water exchange, aeration and improved health management, production levels of 4–6 tonnes/ha have been demonstrated in a production period of 4–5 months. The share of inland fisheries and aquaculture has gone up from 46 percent in the 1980s to over 85 percent in recent years in total fish production. Freshwater aquaculture showed an overwhelming ten-fold growth from 0.37 million tonnes in 1980 to 4.03 million tonnes in 2010; with a mean annual growth rate of over 6 percent. Freshwater aquaculture contributes [3] (FAO 2005) to over 95 percent of the total aquaculture production. The freshwater aquaculture comprises of the culture of carp fishes, culture of catfishes (air breathing and non-air breathing), culture of freshwater prawns, culture of pangasius, and culture of tilapia. In addition, in brackishwater sector, the aquaculture includes culture of shrimp varieties mainly, the native giant tiger prawn (*Penaeus monodon*) and exotic white leg shrimp (*Penaeus vannamei*).The freshwater prawn farming [4] (Rao and Ravichandran 2001) has received increased attention only in the last two decades due to its high consumer demand. The giant river prawn, *Macrobrachium rosenbergii*, the largest and fastest growing prawn species, is cultured either under monoculture or polyculture with major carps. Culture for mariculture species has been initiated in the country and is presently carried out to a limited extent for [5, 6] (Suri 1995) (Yogamoorthi, and Sivashankar 1994) seaweeds, and mussels as a commercial activity and some fish species like seabass and cobia on an experimental basis to standardize the technology.

2. MATERIALS AND METHODS

2.1 Data Description

In the present study an attempt has been made to explore the pattern of prawn production of India from 1999-00 to 2013-14. The present study considered the prawn production data collected from the Handbook on Fisheries Statistics, 2015 Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Govt. of India.

2.2 Description of Methodology

A series of observations of a random variable have been collected over some period of time. It helps to determine if their values generally increase or decrease. In statistical terms this is a determination of whether the probability distribution [7] (McCabe, and Tremayne 1995) from which they arise has changed over time [8] (Melard 1984) to describe the amount or rate of that change. The prawn production data of different states of India over time has been graphically presented to compare the production potential. Different Parametric Models like simple linear regression model, quadratic model, non-linear [9] (Prajneshu 1991) models like-Exponential model, Von Bertalanaffy model have been tried. Then different Non-Parametric method (LOESS-known as locally weighted polynomial regression model) is used to fit linear or quadratic functions of the predictors at the centers of neighborhoods. Semi parametric models (SPLINE), neural network model have also been tried. The spline procedure uses the penalized least squares method which provides a way to balance the fitting of the data closely and at the same time avoiding excessive roughness or rapid variation. A penalized least squares estimate is a surface that minimizes the penalized least squares over the class of all surfaces satisfying sufficient regularity conditions. It is used to fit a nonparametric regression model. It computes thin-plate smoothing splines to approximate smooth functions observed with noise. The spline procedure allows great flexibility in the possible form of the regression surface. The Artificial neural networks (ANNs) model are considered as a class of generalized nonlinear models that can catch different nonlinear structures present in the data set. For time series forecasting sigmoid activation function is utilized in hidden layer and identity activation function is utilized in the output layer for the appropriate trend equation. Different models have been compared with respect to AIC criteria. Lower values for the AIC imply a better fit, adjusted for the number of parameters.

Table 1: Forms of different parametric models

Model	Form
LINEAR	$b_0 + b_1t$
QUADRATIC	$b_0 + b_1t + b_2 t^2$
EXPONENTIAL	$b_0 e^{b_1 t}$
VON BERTALANAFFY	$Y = a (1-be^{-cx})$

Then using the forecasting technique (PROC FORECAST) the future production of prawn also had been derived. The production pattern helps to forecast the future production pattern enabling the better prospect in fisheries sector to maintain near self sufficiency in fish requirement. Determining the pattern of a time series data for forecasting the predicted value is commonly established through identifying the appropriate trend equation.

3. RESULTS AND DISCUSSION

The prawn production data of different states of India over time has been graphically presented in the following figure indicating the Maharashtra is the lead producer of prawn over the years. The states like Kerala, West Bengal, Gujarat and Andhra Pradesh also contributing an important role in prawn production of India over the years.

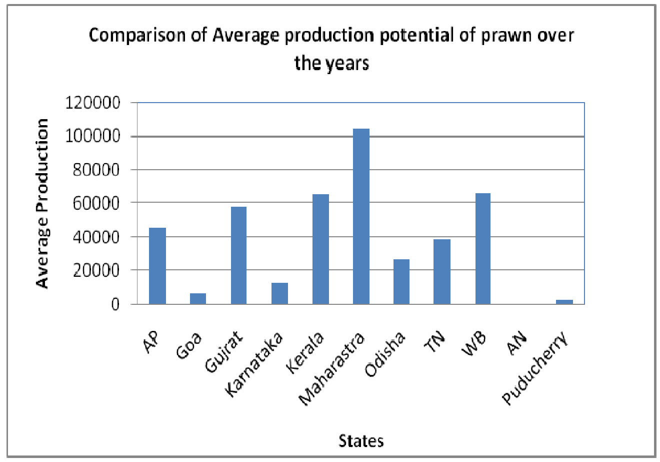

Fig. 1: Comparison of Average production potential of prawn over the years

The different parametric models have been fitted and graphically presented in the following diagrams. But the parametric models are not able to produce any satisfactorily precision level with the observed dataset.

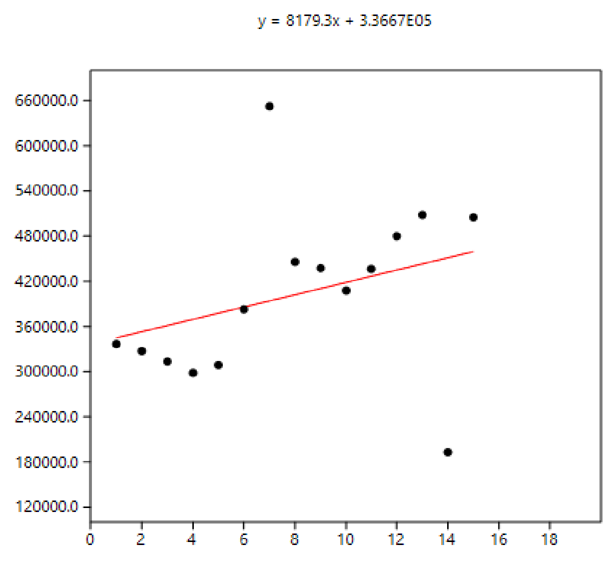

Fig. 2: Linear model

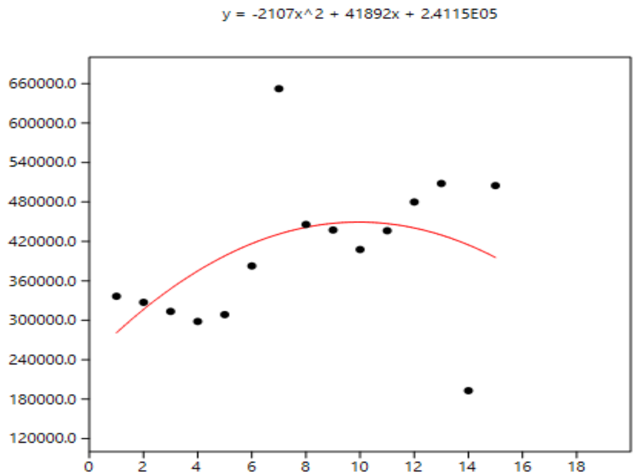

Fig. 3: Quadratic model

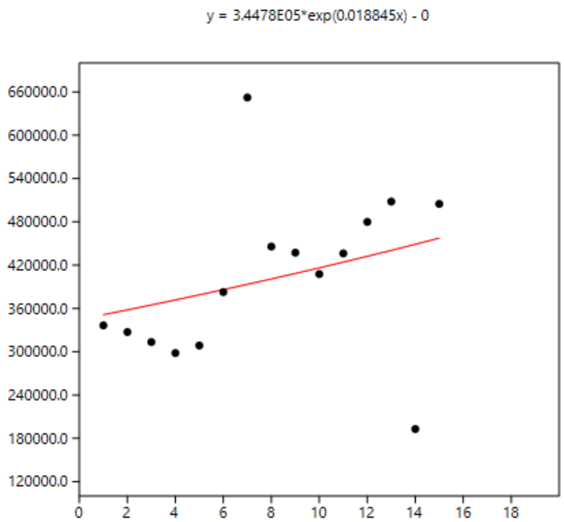

Fig. 4: Exponential model

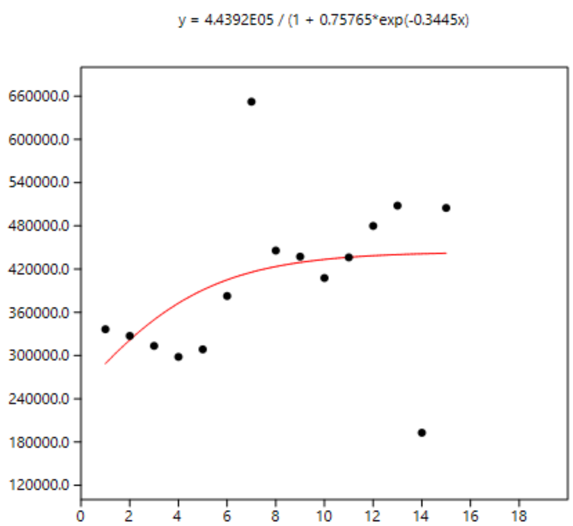

Fig. 5: Von Bertalanaffy model

Then times series data of prawn production was fitted utilizing ANN approach. As there are no settled theories open for the decision of p, q, learning rate and momentum. Hence, the distinctive combination of lag and hidden unit has been attempted.10 distinctive combination of learning rate and momentums have been endeavored. The ANN with 1 lag and 1 hidden layer was performing superior to other combination. Learning rate 0.04 with momentum 0.02 gives best outcome. Total number of iterations was 1500 and R^2 value was 0.94 indicating a very good precision level of the data set. In this paper, along with the parametric models, one non-parametric and one semi-parametric model have been tried.

The best fit for the above mentioned marine data is offered by non parametric regression methods called LOESS (locally weighted scatter plot smoothing) or semi-parametric methods called spline which computationally very intensive program calculates the best fit polynomials from subsets of data set in order to eventually find out the best fit curve for the overall data set. The data are fitted to a smoothing spline, which is a sequence of third-order polynomials continuous up to the second derivative. The graphs of LOWESS (Fig. 6) and Semi-parametric models (Fig.7) precisely depict the dynamics of the Prawn production data over parametric models. The graphs of the different models are also given below.

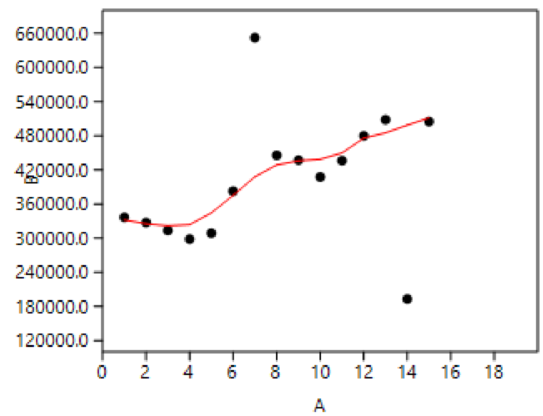

Fig.6: LOESS model

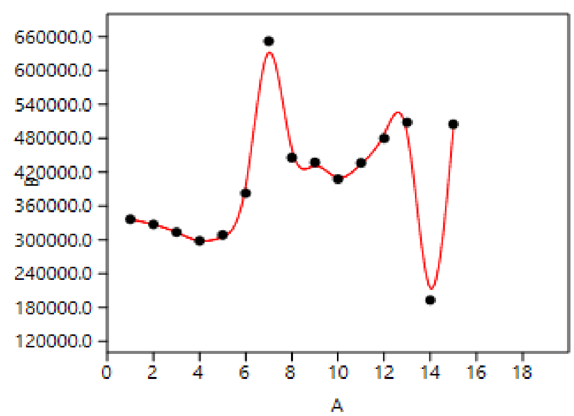

Fig.7: SPLINE model

The *AIC* values which are presented in the Table 1 indubitably confirm the superiority of the representative power (in terms of higher precision or less AIC values) of the non-parametric and semi-parametric modeling in comparison to parametric modeling, when called for, in situations to depict the pattern of Prawn production. The forecasted values of prawn production also presented in the Table 2.

Table 2: AIC criteria of different fitted model

Model	AIC
Linear	1.5743 E11
Quadratic	1.39E+11
Exponential	1.588 E11
Von Bertalanaffy	1.4556 E11
LOESS	1.51 E 03
SPLINE	1.22 E 02

Table 3: Forecasting of ten years of prawn production

Future year	Forecasted production
1	467538.3
2	475717.6
3	483896.9
4	492076.19
5	500255.49
6	508434.79
7	516614.08
8	524793.38
9	532972.68
10	541151.97

4. CONCLUSION

The performance of semi-parametric model (spline) as compared to other prametric modeling is most accurate to produce exact dynamics at any time space so as to support accurate advisory services to fisheries sector. Also, it is reassuring to observe the forecasted values of production data, an advance knowledge of which is of utmost importance to the sector for better export potential. It is no denying that to model the dynamics evidenced in temporal real-life data situations, the semi-parametric models offer better representations almost often.

5. ACKNOWLEDGMENTS

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REFERENCES

[1] Srinath, M (2003) *Appraisal of the Exploited Marine Fishery Resources of India.* In: Status of Exploited Marine Fishery Resources of India. CMFRI, Cochin, pp. 1-17.

[2] Handbook of Fisheries and Aquaculture, 2015, Indian Council of Agriculture Research publication (ICAR), India.

[3] FAO. 2005. Aquaculture production, 2003. Yearbook of Fishery Statistics - Vol.96/2. Food and Agriculture organization of the United Nations, Rome, Italy.

[4] Rao, G.R.M. & Ravichandran, P. 2001: Sustainable Brackishwater Aquaculture. In: Pandian, T.J. (Eds.), Sustainable Indian Fisheries, National Academy of Agricultural Science, New Delhi, pp. 134–151.

[5] Suri, K. (1995) World Trade Research and Information Report. NVIRDC World Trade Centre, Bombay 1(3): 9-11.

[6] Yogamoorthi, A., Sivashankar, A. (1994) India's seafood export trends and its future prospects by 2000 A.D. Seafood Export Jour. 26: 19-34.

[7] McCabe, B. P. M., Tremayne, A. R. (1995) Testing a time - series for difference stationarity. Annals of Statistics 23(3): 1015-1028.

[8] Melard, G. (1984) A fast algorithm for the exact likelihood moving average models. Applied Statistics 33: 104-114.

[9] Prajneshu (1991) Cautionary note about nonlinear models in fisheries. Indian J. Fish 38: 231-233.