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Studies on Growth Rate and instability of Fish Production in the Punjab

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Abstract

In the present study, data on total fish landing in different divisions of the Punjab during the period 1976-1991 have been utilized. Arithmetic as well as exponential growth rates of fish and the three instability indicators (straight line, exponential and power trend) based on time series model have been calculated division-wise as well as for the total Punjab. The data indicates that the fish growth rate could act as reliable measure of increase in production provided that it has less instability. It has been observed that Rawalpindi division has greatest growth rate as compare to other divisions of the Punjab but its growth was most instable. On the other hand, the Bahawalpur division has least growth rate and was least instable also. Bahawalpur division gives reliable growth rate as compared to the other divisions of the Punjab because this division has less instability.

Introduction

Human population in Pakistan is facing a serious shortage of animal proteins. It has become an actual problem for the health and welfare of human society in the country. In Pakistan, per capita per day protein intake is 69.63 grams which is 16.1 percent above the recommended dietary allowance (RDA) of 60 grams but the amount of animal protein available in Pakistan (21.87 gipersoniday) is for below the required quantity for sustainable health standards (Anonymous, 1997).

Fish play an important role in the diet of people. Although there are many sources of proteins for human consumption, however, fish offers nutritionally balanced food which is better than beef, mutton or chicken in its protein and fatty acid profiles (Javed, 1988). Fish meat is also high in essential minerals and has low undesirable saturated fats and thus, preferred as a food because of its digestibility (Watanabe, 1988).

The protein produced in the ponds is in-expensive as compared to the meat products of other farm animals. Pond fish culture provides an efficient way of converting low value protein stuffs into high quality fish proteins (Javed, 1988). The availability of suitable natural food for fish in pond ecosystem is one of the basic needs for securing high fish yields from limited area of land. Present studies deal with the data on growth rates and instability of fish production in different divisions of the Punjab.

Materials and Methods

The data on total fish landings in different divisions of the Punjab, during the period 1976-91, have been utilized for studying the fish growth rates as well as instability in fish landings. These data have been compiled on the basis of fish catches and marketing recorded by the field staff of Punjab Fisheries Department in various districts of the Province (Punjab Development Statistics 1990-1992). Growth rates and instability of fish landings were studied sdivision-wise as well as for total production of Punjab. Growth rates are obtained by using the following two important methods and instability indicators are obtained by fitting the following three regression equations, i.e. simple linear regression equation, exponential curve and power curve.

Growth rate: There are many techniques to calculate the growth rates, however, the following two techniques have been used in this work.

1) The arithmetic mean (A.M.) technique of the relatives of the consecutive empirical observations which can be defined as:

$$Q = \frac{1}{N}\sum_{t-1}^{N} P_t$$

where $P_{t-1} = Y_t/Y_{t-1}$, $t = 1,2,3,4,........N$

such that $P_1 = Y_1/Y_0 = P_2 = Y_2/Y_1$, $P_3 = Y_3/Y_2, ...P_N = Y_N/y_{N-1}$ are not constant. In percentage form, it can be defined as:

$$100(q)-100(Q\ 1)$$

2) Another approach is called the exponential trend technique which has been defined as:

$$Y_t = Ae^{bt} \qquad \text{where } e^b = Q$$

$$Y_t = AQ^1$$

where 'e' is the base of the natural logarithms in these theoretical models. The growth rates were assumed to be constant in this research work and now dropped this assumption and consider the time series, composed of sequence of statistical observations, such as $Y_0, Y_1, Y_2, Y_3, Y_4, Y_4, ...Y_n$ which are empirical realization of the geometric progression or of the exponential process "the time series", therefore, followed the model with random fluctuations and the individual (year to year) growth rate.

Instability: The measurement of instability is defined as "average year to year percentage change without regarding the sign in the irregular component of yearly or quarterly series remaining after removal of trend and seasonal variation". There are many instability indicators but only three have been used:

First instability indicator can be defined as the standard deviation of the relative deviations, i.e. V_t:

$$I_1 = \sqrt{\frac{1}{N}\sum (V_t - \overline{V_t})^2}, \quad \text{where} \quad V_t = \frac{Y_t - \hat{Y}_t}{\hat{Y}_t}$$

where $\overline{V_t}$ is the arithmetic mean of V_t over a period t = 1,2,3,4,..N. Second instability indicator is denoted by I_2 and is defined as the antilogy of the standard deviation of in U_1 minus one:

$$I_2 = \text{anti}\log\sqrt{\frac{1}{N}\sum (\text{In}U_t)^2 - 1}, \quad \text{where} \quad V_t = \frac{Y_t}{\hat{Y}_t}$$

Since the arithmetic mean of In U_t is zero. Third instability indicator is defined as the standard deviation of the observation C_t, Symbolically:

$$I_3 = \sqrt{\frac{1}{N-1}\sum (C_t - \overline{C_t})^2}$$

$$C_t = \frac{V_{t+1} - V_t}{1 + V_t} = \frac{U_{t+1}}{U_t} - 1$$

Where C_t is the arithmetic mean of the relative changes C_t. These three instability indicators were calculated on a family of the following trend fluctuations respectively:

$$Y_t = \alpha\ e\ \beta\ t \qquad (1)$$

Time series model, Generally known as straight line:

$$Y_t = \alpha\ e\ \beta^t \qquad (2)$$

This is called exponential time series model:

$$Y_t = \alpha\ e\ t^p \qquad (3)$$

This is known as power trend.

Method of estimation: There are several methods of estimation, i.e. Method of least square, Method of moment, method of maximum likelyhood etc. But in this paper parameters were estimated by the method of least squares. Alon-linear exponential time series models were converted first to linear regression equations by means of the logarithmic transformation then estimate the parameters.

Results and Discussion

Growth rates of fish landings in different divisions: Different growth rates of fish landings for the period (1976-91) division-wise as well as on the total Punjab basis are presented in Table 1. This table reveals that the arithmetic and exponential growth rates were maximum for Rawalpindi division and minimum for Bahawalpur division.

Table 1: Division-wise growth rate of fish landing for the period (1976-1991)

Landings	Estimated Growth rate(%) by	
	Arithmetic mean	Exponential trend
Rawalpindi	22.50	20.80
Sargodha	13.50	12.90
Faisalabad	15.20	14.60
Bahawalpur	12.60	10.60
Multan	19.50	13.30
Gujranwala	15.20	12.97
Lahore	14.34	13.90
D.G.Khan	13.41	14.11
Punjab	14.20	13.70

Table 2 represents the three instability indicators calculated by simple linear curve method on division-wise as well as for the whole Punjab. These three instability indicators were maximum for Rawalpindi division,i.e. 90.63, 46.04 and 80.85 percent and minimum for Bahawalpur division, i.e. 5.76, 5.91 and 5.6 percent respectively. Table 2 indicates the exponential instability indicators. Indicators. viz. I_1 and 1_3 showed that the maximum instability for Rawalpindi division and minimum for D.G.Khan division. However, according to the second instability indicator, i.e. I_2 minimum instability occurs in Faisalabad division. Similarly, The power trend instability indicators are presented in Table 2. These instability indicators show that the maximum instability occur in Rawalpindi division and minimum in Bahawalpur division. In the present study, generally we have seen that the increase or decrease in growth rate was associated with increase or decrease in instability. The present investigation reveals that fish growth rate could act as reliable measure of increase in production provided that it has less instability. It has been observed that Rawalpindi division has greatest growth rate as compare to other divisions of the Punjab but its growth was most instable. On the other hand, the Bahawalpur division has least growth rate with least instability. Kathuria *et al.* (1990) studied the growth rates in marine fisheries in India, on the basis of different states and species-wise for the period 1966-81. They estimated that the production of marine fish in India was 1.42 million tones (maximum value) in 1975

Table 2: Division-wise instability of fish landing for the period (1976-1991)

Landings	a	b	I_1 (%)	I_2 (%)	I_3 (%)
	Instability based on the equation Y = a+bt				
Rawalpindi	-4990	3107	90.63	46.04	80.85
Sargodha	4162	4021	15.48	13.52	7.92
Faisalabad	-571	2521	55.42	41.68	17.20
Bahawalpur	6590	2093	5.76	6.91	5.60
Multan	2057	2618	16.24	15.61	9.07
Gujranwala	914	2736	31.09	31.53	15.27
Lahore	95	3596	36.31	31.53	19.07
D.G.Khan	324	4193	16.72	33.47	14.44
Punjab	7648	25061	28.38	24.56	10.82
	Instability based on the equation Y_t = a e^{bt}				
Rawalpindi	3229.23	0.189	15.01	16.35	16.74
Sargodha	12088.40	0.121	7.94	8.20	19.65
Faisalabad	5541.39	0.136	7.96	1.00	9.89
Bahawalpur	9509.06	0.101	11.87	12.76	8.23
Multan	7331.97	0.12	7.63	8.03	8.60
Gujranwala	7405.66	0.122	8.88	10.02	6.88
Lahore	8787.97	0.13	7.58.	7.46	6.93
D.G. Khan	9996.60	0.132	4.60	5.24	6.32
Punjab	66171.20	0.13	2.94	7.58	4.59
	Instability based on the equation Y_t = a t^b				
Rawalpindi	1422.26	1.060	31.54	52.09	19.60
Sargodha	9045.29	0.667	14.31	14.39	9.48
Faisalabad	4188.09	0.737	22.25	23.04	13.92
Bahawalpur	7044.48	0.593	6.82	6.95	7.17
Multan	5431.66	0.699	14.48	14.96	9.85
Gujranwala	5825.50	0.657	20.90	22.57	11.63
Lahore	6836.29	0.692	21.61	23.73	12.24
D.G.Khan	7707.89	0.710	20.65	22.68	12.60
Punjab	49020.00	0.712	17.09	18.19	9.90

and 1.38 million tones in 1981, with maximum contribution of Kerala State. i.e. 0.36 million tones (30.49% of the total landings).

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