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Physical and economic availability of 'Rich food for poor people': Trends and variability in fish prices in India

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Abstract

Fishes are the cheaper source of nutrition for poor people in the country. Among all the fish species; Rohu (*Labeo rohita*), Cat and Pomfret (*Brama brama*) fishes are the major fish species which are consumed by majority of fish consuming population in India. Thus, in the present study effort had been made to obtain insight into the rate of growth (compound monthly growth rate) and trends in price variations in fish prices of above mentioned three important fish species in India. The exponential function had been applied to study the growth in fish prices and a methodology suggested by the Bandyopadhyay had been used to study the variation in prices over time. The study revealed that the rate of growth in prices of Rohu, Cat and Pomfret fishes were positive and less than one% per month for all three types of fishes except Khozhikode and Udaipur cat fish markets in which cat fish prices were found increasing at the rate of more than one% per month. The variability in prices were found decreasing in all markets of these three types of fishes except Delhi, Dhanbad and Lucknow rohu fish markets, Panaji and Agartala cat fish markets and Panaji and Lucknow pomfret fish markets in which the price variability was increasing over the time.

Keywords: Cat fish, divergence, CMGR, convergence, pomfret fish, rohu fish

Introduction

India is a second largest fish producing country in the world accounting for 7.56% and contributes to 1.24% of the GDP and 7.28% of the agricultural GDP at factor cost (Economic Survey, 2021-22). The total fish production in India is about 145 lakh tons registering average annual growth of 10.87% since 2014-15. Fishery sector provides employment to 28 million people especially to the valunerable and marginalized people. Nearly 73.68% of total fish production comes from the inland sector and remaining from marine sector (Agricultural Statistics at a Glance, 2021) [5]. Indian fisheries and aquaculture is an important sector of food production. It provides nutritional security to the food basket, contributes around 18.44% to the total agricultural exports and engaging about fourteen million people in different activities (Agricultural Statistics at a Glance, 2021) [5].

Fish is especially important in the developing country like India. It is often referred to as "rich food for poor people," providing essential nourishment, especially quality proteins and fats (macronutrients), vitamins and minerals (micronutrients) to poor people involved in this business. Beside this, fishes are source of income which can be used to purchase other additional food items. The percentage share of expenditure on egg, fish and meat to total food expenditure is increasing over the time in both rural and urban areas while at the same time the share of expenditure on cereals is decreasing in both rural and urban area. Rohu, Cat and Pomfret fish are the major fish species which are consumed by majority of Indian population. Only about 35% of Indian population is fish eating. The annual per capita consumption of fish eating population would be about 16.6 kg by 2010, and 17.7 kg by 2015 (Kumar *et al*, 2005) [8]. Price of fish is the major determinants of the accessibility of people to fish, in general and the poor, in particular. Therefore, growth and fluctuations in prices of fish is an important aspect to study. As a trend the price fluctuations of different agricultural commodities were found decreasing over the time (Kumbhare *et al*, 1982; Bandyopadhyay, 1989; Agarwal and Sharma, 1990; Patel and Agarwal, 1993; Goswami, 1994) [9, 2, 1, 10, 6] which may be the case with fish. Therefore, the present study had been carried out to determine the rate of growth and trends in variability of fish prices of three important types- Rohu, Cat and Pomfret fish markets in India. Stability of prices with uniform growth also, exhibit maturity of the markets.

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Materials and Methods

The time series (monthly) data on retail prices of Rohu, Cat and Pomfret fish for important markets of India had been collected. Table 1 show the type of fish, markets and sources of data which were collected for the period of 2003-2010.

Since the prices of fishes are greatly affected by the season on account of production and demand. The analysis was carried on depersonalized prices of fishes. In order to find out the growth rates, it was assumed that prices follow exponential trend.

$$P_t = a e^{bt + u_t}$$

Where, P_t = Price of relevant fish, t = Time, a = Constant parameter, b = Growth parameter and u_t = Random error term. The percentage growth was estimated by $(\text{antilog of } b-1) \times 100$. In order to find out the volatility of prices, coefficient of variation around the trend was calculated instead around mean in order to remove trend effect. The trend was assumed to be linear. Thus, CV was calculated by using the formula given below:

$$CV = \left[\frac{\sum (P_{ii} - P_{ij})^2}{P_{ij}} \right] \times 100$$

Where, P_{ii} and P_{ij} are the observed and estimated prices (deseasonalized) respectively of i^{th} product in j^{th} market.

In order to find out whether growth in prices of fish is with lower or higher variability, a method suggested by Bandyopadhyay (1989) [2] had been used. In this method, a linear trend was fitted to the prices of each fish market and deviation (positive and negative) of observed values from the trend value had been separated. A separate trends line had been fitted to the positive (P^+) and negative deviations (P^-) of following form:

$$P^+_t = a^+ + b^+ t \quad (1)$$

$$P^-_t = a^- + b^- t \quad (2)$$

For each of the trend line, all usual tests of significance and goodness of fit had been carried out. And in order to confirm that positive and negative deviation trend lines are not parallel; an F test of following form was conducted:

$$F = \frac{(R_{yy}^{**} - R_{yy}) / (v^{**} - v)}{R_{yy} / v}$$

Where, R_{yy}^{**} = Residual sum of square (RSS) due to linear fit on observed values.

R_{yy} = RSS from positive deviation trend line plus RSS from negative deviation trend line,

$v^{**} = n - k - 1$, $v = n - 2k$, where n = number of observations and k = number of parameters estimated.

If $F > F_{k-1, n-2k}(\alpha)$, then the hypothesis was rejected at the level of significance α indicating that positive and negative deviation trend lines are not parallel to each other. In such case, the inclination of these trend lines shows whether the variability in prices is divergent (increasing) or convergent (decreasing) by estimating the value of t^* at the point of intersection. The value of t^* at the point of intersection will determine the converging or diverging variability. The value

of t^* could be estimated using technical coefficients from the equation (1) and (2) in the following way:

$$t^* = \frac{(a^- - a^+)}{(b^+ - b^-)}$$

If $t^* > 0$, both the trend lines converge and hence the variation is decreasing and

if $t^* < 0$, both the trend lines diverge and hence the variation is increasing.

The rate of convergence or divergence per unit of time is calculated by:

$$|\tan(\theta^* - \theta)| = (b^+ - b^-) / (1 - b^+ \cdot b^-)$$

Results and Discussion

Fish Prices and Growth Rates

The Table 2 revealed compound growth rate in percentage per month of fish prices for all the markets and fish species separately for the period of 2003-2010. As the table indicates, the rate of growth in Rohu fish prices had been found to be the highest (0.94%) in Chittoor and Salem markets followed by Bhopal and Bhubneshwar (0.93%) markets during the study period i.e. 2003-2010. However, the Aizwal (0.12%) market had shown lowest rate of growth in Rohu fish prices during the same period. In case of cat fish, the highest rate of growth was observed in Udaipur (1.31%) market followed by Khozhikode (1.09%) market while the Portblair (0.36%) market had shown the lowest rate of growth during the period under study (2003-2010). The rate of growth in Pomfret fish prices had been found to be the highest in Lucknow (0.91%) market followed by Udaipur (0.84%) market. The lowest rate of growth in Pomfret fish price had been observed in Nasik (0.49%) market. The CMGR had also been found positive and below 1% per month in case of all the Rohu fish, cat fish and pomfret fish markets except Khozhikode and Udaipur cat fish markets.

Variation in fish prices

Coefficient of variation (CV) around the trend had been calculated to estimate variation of fish prices.

The CV of Rohu, Cat and Pomfret fish prices had been presented in Table 3. As table reveals, the Karnal market had shown the highest price variability among all the Rohu fish markets while the least variability of prices was observed in Shillong market. The Hyderabad Cat fish market had shown least volatility in prices during the study period. In Pomfret fish markets, the highest variability in price had been observed in Udaipur (26.53) market and the lowest variability in price had been observed in Nasik market.

Trend in instability in fish prices

Rohu fish market

The estimated regression coefficients of overall (b), positive deviation (b^+) and negative deviation (b^-) trend lines and value of F-test for Rohu fish markets had been presented in Tables 4(A). The F-test confirms that positive and negative deviation trend lines were not parallel for all Rohu fish during 2003-2010 except in Bhopal market in which calculated F value was found lower than tabulated F value i.e. positive and negative deviation trend lines were parallel to each other.

The month to month price fluctuations were found converging in all the markets except in Delhi, Dhanbad and Lucknow markets [Table 4(B)]. This indicates that supply in these markets (showing convergence) commensurate with demand and there are better market linkage with respect to transportation and information. In Delhi, Dhanbad and Lucknow markets, the deviations in fish prices were diverging, which may be due to the reason that either supply does not match demand or the demand is uncertain. The rate of decrease in month to month price fluctuations was found to be the highest in Karnal (1.24) market while the rate of divergence in price fluctuations was found to be the highest in Dhanbad market.

Cat and Pomfret fish market

The estimated regression coefficients of overall (b), positive deviation (b⁺) and negative deviation (b⁻) trend lines and value of F-test for Cat and Pomfret fish markets had been presented in Tables 5(A). The F-test confirms that positive and negative deviation trend lines were not parallel in any of the fish market. Therefore, the convergence/divergence of positive and negative deviations had been studied for all markets during 2003-2010.

Table 5(B) reveal that in Hyderabad, Khozhikode, Udaipur and Portblair markets, the cat fish prices had tendencies to converge as indicated by positive t* value while in Panaji and Agartala fish markets, the deviations in fish prices were diverging during 2003-2010. In other words, the gap between positive and negative price deviations in the latter market had increased during 2003-2010. The rate of decrease in monthly price fluctuations was the highest in Udaipur (0.68) market among market where fluctuations were converging. However, the price fluctuations in Panaji (0.18) market were diverging at higher rate as compares to Agartala market.

For Pomfret fish prices, the t* value for Chittoor, Nasik, Udaipur and Portblair markets was found positive indicating convergence of the positive and negative deviations while the deviations were diverging in Panaji and Lucknow Pomfret markets. Putting differently, in the former markets, month to month price fluctuations had reduced while it was increased in Panaji and Lucknow markets. The month to month price fluctuations was found to be decreasing at the highest speed in Udaipur (0.88) market while the rate of increase in month to month price fluctuations was the highest in Panaji (0.19)

market.

In case of Rohu fish prices, the Chittoor and Salem market had shown the highest (0.94%) rate of growth in prices. The CV of fish prices around trend was the highest in Karnal market (18.5) followed by Chittoor market (18.02). On the basis of growth rate and CV, the markets that could be characterized as high-growth and high-fluctuations were Chittoor, Salem, Bhubneshwar and Dhanbad. Nevertheless, the deviations around the trend were converging in most of the high growth and high-fluctuations markets except in Dhanbad. The rate of convergence was slow in these markets. In case of Cat fish prices, the rate of growth was the highest in Udaipur (1.31%). The same was the market with higher CV. Thus, this market could be characterized as high-growth and high-fluctuations market. Panaji was another market with moderate growth but with high fluctuations in prices. In the former market, the month to month fluctuations had converging trend and rate of convergence was also highest. In latter market, the deviations in fish prices were diverging with growth which indicates at larger share of middlemen.

In case of Pomfret fish price, the Lucknow market had shown the highest rate of growth followed by Udaipur and Panaji. These were also the markets with higher CV where CV was exceptionally high for Udaipur market (26.53). Thus, markets like Udaipur, Lucknow and Panaji were the markets with high-growth and high-fluctuations. The Chittoor market was of moderate growth and fluctuation. However, the deviation of prices around trend was converging in Udaipur market while it was diverging in Lucknow and Panaji markets. The rate of convergence was the highest in Udaipur market.

The convergence of monthly price fluctuations over time in fish markets was the results of improved infrastructure for fish marketing, dissemination of market information to buyer and seller, regular supply, availability of storage facility etc. However, the increase in monthly price fluctuations may occur due to the shortfall in supply, sudden increase in demand during festival period, lack of storage facility, unavailability of market information to buyer and seller etc. in the markets. Attention need to be drawn to high growth and high-fluctuations markets namely Chittoor for rohu fish, Udaipur for cat fish and Lucknow for pomfret fish to control the month to month deviations of prices by improving the marketing of fishes in these markets. The stable price will encourage the production and consumption and at the same time this will decrease the speculative middlemen.

Table 1: Markets and Sources of data as per types of fish

| Name of Fish | Markets | Sources of data |
|-------------------------------------|---|---|
| Cat Fish | Hyderabad, Panaji, Khozhikode, Udaipur, Agartala and Portblair | Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India. |
| Pomfret Fish (<i>Brama brama</i>) | Chittoor, Panaji, Nasik, Udaipur, Portblair and Lucknow | Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India. |
| Rohu Fish (<i>Labeo rohita</i>) | Kolkata, Delhi, Chittoor, Hyderabad, Patna, Karnal, Dhanbad, Bhopal, Shillong, Aizwal, Bhubneswar, Salem, Agartala, Allahabad and Lucknow | Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India. |

Table 2: CMGR of selected Rohu, Cat and Pomfret fish retail price

| Rohu Fish | | | | Cat Fish | | Pomfret Fish | |
|-----------|------|-------------|------|------------|------|--------------|------|
| Markets | CMGR | Markets | CMGR | Markets | CMGR | Markets | CMGR |
| Delhi | 0.34 | Shillong | 0.87 | Hyderabad# | 0.90 | Chittoor | 0.59 |
| Kolkata | 0.44 | Aizwal | 0.12 | Panaji | 0.59 | Panaji | 0.83 |
| Chittoor | 0.94 | Bhubneshwar | 0.93 | Khozhikode | 1.09 | Nasik# | 0.49 |
| Hyderabad | 0.83 | Salem | 0.94 | Udaipur | 1.31 | Udaipur | 0.84 |
| Patna | 0.66 | Agartala | 0.62 | Agartala | 0.56 | Portblair | 0.79 |
| Karnal | 0.54 | Allahabad | 0.51 | Portblair | 0.36 | Lucknow | 0.91 |
| Dhanbad | 0.72 | Lucknow | 0.44 | | | | |
| Bhopal | 0.93 | | | | | | |

for the period 2003-2009

Table 3: CV for selected Rohu, Cat & Pomfret fish markets

| Rohu Fish | | | | Cat Fish | | Pomfret Fish | |
|-----------|-------|-------------|-------|------------|-------|--------------|-------|
| Markets | CV | Markets | CV | Markets | CV | Markets | CV |
| Delhi | 8.46 | Shillong | 7.79 | Hyderabad# | 6.18 | Chittoor | 12.76 |
| Kolkata | 16.82 | Aizwal | 9.04 | Panaji | 13.65 | Panaji | 17.62 |
| Chittoor | 18.02 | Bhubneshwar | 12.47 | Khozhikode | 12.24 | Nasik# | 10.14 |
| Hyderabad | 9.35 | Salem | 12.56 | Udaipur | 28.43 | Udaipur | 26.53 |
| Patna | 13.40 | Agartala | 15.48 | Agartala | 8.25 | Portblair | 11.88 |
| Karnal | 18.50 | Allahabad | 8.42 | Portblair | 7.13 | Lucknow | 16.27 |
| Dhanbad | 16.70 | Lucknow | 11.8 | | | | |
| Bhopal | 16.79 | | | | | | |

for the period 2003-2009.

Table 4(A): Regression coefficients of overall, positive and negative deviation trend lines for selected Rohu fish markets

| Markets | b | b ⁻ | b ⁺ | F- value | Markets | b | b ⁻ | b ⁺ | F- value |
|-----------|------|----------------|----------------|---------------------|-------------|------|--------------------|----------------|----------|
| Delhi | 0.23 | 0.33 | 0.76 | 76.82 | Shillong | 0.61 | 0.75 | 1.54 | 6.99 |
| Kolkata | 0.45 | 1.12 | 0.99 | 49.76 | Aizwal | 0.13 | 0.00 ^{ns} | 0.14 | - |
| Chittoor | 0.49 | 0.82 | 1.08 | 14.12 | Bhubneshwar | 0.61 | 0.64 | 1.74 | 19.25 |
| Hyderabad | 0.43 | 0.50 | 1.03 | 25.13 | Salem | 0.54 | 0.73 | 1.02 | 25.72 |
| Patna | 0.46 | 0.43 | 1.29 | 53.36 | Agartala | 0.69 | 1.66 | 0.68 | 51.65 |
| Karnal | 0.49 | 0.17 | 1.77 | 44.81 | Allahabad | 0.31 | 0.37 | 0.87 | 22.74 |
| Dhanbad | 0.49 | 0.59 | 1.40 | 46.93 | Lucknow | 0.29 | 0.62 | 0.65 | 57.16 |
| Bhopal | 0.78 | 0.73 | 2.98 | -0.05 ^{ns} | | | | | |

NS = Not significant

Table 4(B): Convergence/divergence of 'positive' and 'negative' deviations in Rohu fish prices in selected markets

| Markets | t* | C/D | tan (θ* - θ) | Markets | t* | C/D | tan (θ* - θ) |
|-----------|-------|-----|--------------|-------------|---------|-----|--------------|
| Delhi | -3.91 | D | 0.34 | Shillong | 10.57 | C | 0.37 |
| Kolkata | 49.47 | C | 0.06 | Aizwal | - | - | - |
| Chittoor | 16.51 | C | 0.14 | Bhubneshwar | 10.49 | C | 0.52 |
| Hyderabad | 16.67 | C | 0.35 | Salem | 3.90 | C | 0.17 |
| Patna | 12.52 | C | 0.55 | Agartala | 57.91 | C | 0.46 |
| Karnal | 13.35 | C | 1.24 | Allahabad | 13.07 | C | 0.38 |
| Dhanbad | -6.81 | D | 0.44 | Lucknow | -287.70 | D | 0.02 |
| Bhopal | - | - | - | | | | |

Table 5(A): Regression coefficients of overall, positive and negative deviation trend line for different Cat & Pomfret fish markets

| Cat Fish | | | | | Pomfret Fish | | | | |
|------------|------|----------------|----------------|----------|--------------|------|----------------|----------------|----------|
| Markets | B | b ⁻ | b ⁺ | F- value | Markets | b | b ⁻ | b ⁺ | F- value |
| Hyderabad# | 0.50 | 0.77 | 1.16 | 14.93 | Chittoor | 0.90 | 1.50 | 2.29 | 80.53 |
| Panaji | 0.25 | 0.38 | 0.60 | 64.48 | Panaji | 2.19 | 2.80 | 6.27 | 81.59 |
| Khozhikode | 1.13 | 1.65 | 2.81 | 25.58 | Nasik# | 0.57 | 0.86 | 0.79 | 31.56 |
| Udaipur | 1.44 | 0.87 | 3.76 | 31.56 | Udaipur | 0.82 | 0.52 | 2.61 | 71.73 |
| Agartala | 1.41 | 2.81 | 3.03 | 86.56 | Portblair | 0.59 | 0.80 | 1.75 | 40.75 |
| Portblair | 0.16 | 0.14 | 0.31 | 14.80 | Lucknow | 0.58 | 0.99 | 1.03 | 14.45 |

Table 5(B): Convergence/divergence of 'positive' and 'negative' deviations in Cat & Pomfret fish prices in selected markets

| Cat Fish | | | | Pomfret Fish | | | |
|------------|---------|-----|-----------------------------|--------------|---------|-----|-----------------------------|
| Markets | t* | C/D | tan ($\theta^* - \theta$) | Markets | t* | C/D | tan ($\theta^* - \theta$) |
| Hyderabad# | 2.04 | C | 0.20 | Chittoor | 1.76 | C | 0.18 |
| Panaji | -0.95 | D | 0.18 | Panaji | -5.43 | D | 0.19 |
| Khozhikode | 11.05 | C | 0.21 | Nasik# | 480.28 | C | 0.04 |
| Udaipur | 13.90 | C | 0.68 | Udaipur | 3.94 | C | 0.88 |
| Agartala | -185.75 | D | 0.02 | Portblair | 7.76 | C | 0.40 |
| Portblair | 3.13 | C | 0.16 | Lucknow | -621.27 | D | 0.02 |

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