Growth, Instability and Demand Elasticity of Indian Fish Exports

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Abstract

Fisheries sector plays a catalyst role in the Indian economy by making significant contributions to the national income, exports, food, nutritional security and employment generation. The present study estimates Compound Annual Growth Rates (CAGR), Coefficient of Variation (CV) and Cuddy Della Valle (CDV) to analyse the growth and instability trends in production and export of fish from India. The study also makes use of double log multiple regression analysis to estimate the demand elasticity of US market for Indian shrimp, which is a major constituent in Indian fishery export basket.

Key Words: Fisheries Sector, Growth trends, Instability and demand elasticity

I. Introduction

China is the biggest fish producer in the world with a massive production of 64.5 million tonnes in 2018 of which aquaculture accounted for 50 million tonnes. India is the second largest fish producer with a total production of 13.7 million tonnes in 2018-19. Currently Indian fisheries sector constitutes only 6.5 per cent of global fish production although it is the second largest producer. The fisheries sector in India has vital economic significance as it contributes nearly 1 percentage of national GDP and accounts for 5.6 percentage share of agricultural GDP. In 1980-85, its share of agricultural GDP was 2.17 percentage and 5.93 percent in 2004-05 registering a slow but consistent growth. It plays a significant role in Indian economy by providing income and employment to more than 14.5 million people. Moreover, Indian fisheries sector provides the much needed nutrition and food security to a large population of the country. [10]

Fisheries sector which is acclaimed to be a sunrise sector under the special focus initiative of the foreign trade policy of Government of India, registered a commendable spurt in growth from 4.9 percentage in 2012-13 to 11.9 percentage in 2017-18 while the growth rate in other agricultural sectors like crop, livestock and forestry displayed a fluctuating trend over these periods. Apart from that fisheries sector is a major foreign exchange earner. During 2017-18, Indian export of fish and fishery products was of the volume of 1.38 million tonnes which fetched Rs.45107 crores in value. Fish and fish product export emerged as the largest group in agricultural exports and in value terms accounted for Rs. 47620 crores in 2018-19 registering a 5.6 percent increase in value in the year. This accounts for around 10 percent of the total exports and nearly 20 percent of the agricultural exports.

The fisheries sector in India is comprised of marine fisheries, fresh water and brackish water aquaculture and inland fisheries using ponds and reservoirs with immense untapped potentials yet to be utilized [9]. The rapid growth rate of culture fisheries enterprises plays a vital role in the overall performance of Indian fisheries sector. A look at the structure and composition of Indian fishery sector over the years reveals that the marine sector contributed more to total fish production than Inland sector in the initial years. In 1950-51, marine fishery contributed a massive 71 percent to total fish production which gradually declined to 43 percent in 2005-2006 and further declined to 29 percent in 2017-18. On the

other hand, 71 percent of total fish production in 2017-18 was from inland sector and about 50 percent of the total production was from culture fisheries. According to the Handbook on Fisheries Statistics-2018, the share of Inland capture fisheries accounted for 8.9 million tonnes while share of marine fishery was 3.69 million tonnes.

The marine fishery sector of India consists of small scale and artisanal fisheries belonging to mechanized, motorised and non-motorised sectors and a range of other stakeholders [12]. Reckless overexploitation of marine fishery resources over the years has led to its depletion causing gloom and doom in the lives of various stakeholders involved in this sector. The global marine fish catch remained almost stagnant after 1990 whereas the marine fish production in India showed a steady increase from 2.3 million tonnes in 1990 to 3.94 million tonnes in 2012.

The present study is organised into six sections. The section I serves as the introductory section. Section II presents the objectives and the methodology applied in the study. Section III delineates the analysis and discussion of the findings of CAGR. Section IV provides a concise discussion on the findings of instability analysis done with the tools of coefficient of variation (CV) and Cuddy Della Valle Index (CVD). Section V analyses the demand elasticity of export of Indian shrimp in US market using multiple regression analysis in double log functional form. Section VI provides some conclusions and suggestions from the study.

II. Objectives and Methodology

Objectives

- To study the production and export scenario of fish from India in the current decade
- To estimate the growth and instability in the production and export of fish from India in the current decade.
- To estimate the growth and instability in the export volume of marine fishery from India in the current decade
- To estimate the demand elasticity of shrimp export from India to US market in the current decade.

Methodology

The study utilized secondary data collected from different sources like MPEDA, Handbook on fisheries Statistics-2018 and UNCOMTRADE. The data collected belong to the period from 2010-11 to 2017-18. The tabular analysis of volume of fish production in India and export volume and value of marine fishery from India in the current decade was done to work out the compound annual average growth rates and for making easy comparisons. The compound annual growth rates are calculated using regression analysis to study the growth trends in production of marine fishery and inland fishery of India and to analyse the growth rates in the export volume and value of marine fisher from India in the current decade. The instability analysis is done in the production of marine fishery and inland fishery and also in the export volume and value of marine fishery from India for the period 2010-11 to 2017-18 using Coefficient of Variation (CV) and Cuddy Della Valle (CDV) index. Apart from these a double log multiple linear regression analysis is carried out to find the elasticity of demand for Indian shrimp in the US market.

Compound Annual Growth Rate (CAGR)

$Y = a\, b^t\, e$ (1)

$\widehat{l\_y} = \hat{\beta}_1 + \hat{\beta}_2 t$ (2)

CAGR=(Antilog of $\hat{\beta}_2$-1)100 (3)

Instability Analysis

Instability analysis in this study is done in two ways.

Coefficient of Variation (CV) (4)

$$CV=\frac{STANDARD\ DEVIATION}{MEAN}*100 \quad (5)$$

Cuddy-Della Valle (CDV) index

$$CDV= CV*\sqrt{1-\bar{r}^2} \quad (6)$$

$\bar{r}^2$ is the adjusted R squared of equation (2)

Cuddy Della Valle index was developed by John Cuddy and Della Valle for measuring instability in time series data. Coefficient of Variation is a good measure of instability but while analysing time series data involving trends, Cuddy Della Valle is a better indicator of instability as it is inherently adjusted for trend often observed in time series data [3]

III. Analysis and Discussion of CAGR

The technique of compound annual growth rates (CAGR) is made use to analyse the growth trends in the production and export of fish from India during 2010 to 2018. Table 1 details the volume of fish production in India and Table 2 provides export volume and value of marine products from India. It is significant to find that CAGR of Inland fish production is 8.3% while that of marine fish production is of a meagre 1.82% (Table 3). This sheds light into the resource depletion taking place in the marine segment of Indian fishery. The production in the marine fishery sector is almost stagnating and it is imperative for the government of India to take remedial steps to revive this segment which was contributing more than seventy per cent of total fish production in the early decades of independent India. The silver line in this dismayed state of affairs is the healthy CAGR of inland fishery segment whose potentials are yet to be tapped optimally. The overall compound annual growth rate is around 6.07% which is below par of what Indian fishery is capable of achieving.

When we analyse the marine product export segment, the volume of marine product export registered a CAGR of 6.4% and the value of marine product export registered a CAGR of 19%. The spike in the CAGR in the value of marine product export is inflated as nominal export values are considered in its calculation. While considering the real value of marine product export by discounting the effect of inflation using All India Average Consumer Price Index for Industrial workers for the period 2010-2018 using 2010 as the base year, we get a CAGR of 11% which still reflects a comparatively positive growth rate (Table 3).

Table 1: Volume of fish production in India (in lakh tonnes)

YEAR	MARINE_PRDN	INLAND_PRDN	TOTAL
2010-11	32.5	49.81	82.31
2011-12	33.72	52.94	86.66
2012-13	33.21	57.19	90.4
2013-14	34.43	61.36	95.79
2014-15	35.69	66.91	102.6
2015-16	36	71.62	107.62
2016-17	36.25	78.06	114.31
2017-18	36.88	89.02	125.9

Source: Handbook on Fisheries Statistics-2018

Table 2: Export Volume and Value of Marine Products from India from 2010-11 to 2017-18

YEAR	VOLUME(in tons)	NOMINAL VALUE(in crores)	REAL VALUE(in crores)*
2010-11	813091	12901.47	12901.47
2011-12	862021	16597.23	15245.18066
2012-13	928215	18856.26	15844.91757
2013-14	983756	30213.26	22891.59073
2014-15	1051243	33441.61	23824.95344
2015-16	945892	30420.83	20470.62996
2016-17	1134948	37870.9	24282.77118
2017-18	1377244	45106.89	28219.17885

Source: Handbook on Fisheries Statistics-2018

*Nominal values (Rs. in crores) discounted for inflation using All India average Consumer Price Index of Industrial workers for 2010-2018. Base Year 2010 = 100.

Table 3: Comparison of CAGRs of Volume and Value of Marine Product Export from India from 2010-11 to 2017-18.

	CAGR(%)
Marine Production (Volume)	1.82***
Inland Production (Volume)	8.3***
Total Fish Production (Volume)	6.07***
Marine Export (Volume)	6.4***
Marine Export (Value in Nominal terms)	19***
Marine Export (Value in Real terms)	11***

*** indicates level of significance at 1 per cent.

III.1 CAGR calculation of the volume of marine fish production from India from 2010-11 to 2017-18

Model 1: OLS, using observations 1-8
Dependent variable: l_MARINE_PRDN

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−32.9975	3.92327	−8.411	0.0002	***
YEAR	0.0181511	0.00194848	9.316	<0.0001	***

R-squared 0.935330 Adjusted R-squared 0.924552

$\widehat{l\_MARINE\_PRDN} = \hat{\beta}_1 + \hat{\beta}_2 year$
$\widehat{l\_MARINE\_PRDN}$= -32.99+0.01815 YEAR
CAGR=(Antilog of $\hat{\beta}_2$-1)100
= (1.01832-1)100=1.82%

III.2 CAGR calculation of the volume of Inland fish production from India from 2010-11 to 2017-18

Model 2: OLS, using observations 1-8
Dependent variable: l_INLAND_PRDN

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−158.053	6.42420	−24.60	<0.0001	***
YEAR	0.0805677	0.00319056	25.25	<0.0001	***

R-squared 0.990678 Adjusted R-squared 0.989125

$\widehat{l\_INLAND\_PRDN} = \hat{\beta}_1 + \hat{\beta}_2 year$
$\widehat{l\_INLAND\_PRDN}$= -158.05+0.0806 YEAR
CAGR=(Antilog of $\hat{\beta}_2$-1)100
= (1.08389-1)100=8.3%

III.3 CAGR calculation of the volume of total production of fish from India from 2010-11 to 2017-18

Model 3: OLS, using observations 1-8
Dependent variable: l_TOTAL

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−114.082	4.82994	−23.62	<0.0001	***
YEAR	0.0589445	0.00239878	24.57	<0.0001	***

R-squared 0.990161 Adjusted R-squared 0.988521

$\widehat{l\_TOTAL\_PRDN} = \hat{\beta}_1 + \hat{\beta}_2 year$
$\widehat{l\_TOTAL\_PRDN}$= -114.082+0.0589 YEAR
CAGR=(Antilog of $\hat{\beta}_2$-1)100
= (1.0607-1)100=6.07%

III.4 CAGR calculation of the export volume of marine products from India from 2010-11 to 2017-18

Model 4: OLS, using observations 1-8
Dependent variable: l_EX_VOLUME

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−110.524	23.5860	−4.686	0.0034	***
YEAR	0.0617528	0.0117139	5.272	0.0019	***

R-squared 0.822440 Adjusted R-squared 0.792846

$\widehat{l\_EX\_VOLUME} = \hat{\beta}_1 + \hat{\beta}_2 year$

$\widehat{l\_EX\_VOLUME}$= -110+0.0617 YEAR

CAGR=(Antilog of $\hat{\beta}_2$-1)100

= (1.064-1)100= 6.4 %

III.5 CAGR calculation of the export value of marine products from India from 2010-11 to 2017-18 (nominal)

Model 5: OLS, using observations 1-8
Dependent variable: l_EX_VALUE

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−335.554	42.6424	−7.869	0.0002	***
YEAR	0.171702	0.0211783	8.107	0.0002	***

R-squared 0.916354 Adjusted R-squared 0.902413

$\widehat{l\_EX\_VALUE} = \hat{\beta}_1 + \hat{\beta}_2 year$

$\widehat{l\_EX\_VALUE}$= -335.55+0.1717 YEAR

CAGR=(Antilog of $\hat{\beta}_2$-1)100

= (1.19-1)100= 19%

III.6 CAGR calculation of the export value of marine products from India from 2010-11 to 2017-18 (real)

Model 6: OLS, using observations 1-8
Dependent variable: l_DEFLATED_VALUE

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−196.598	36.6143	−5.369	0.0017	***
YEAR	0.102554	0.0181844	5.640	0.0013	***

R-squared 0.841295 Adjusted R-squared 0.814844

$\widehat{l\_DEFLATED\_EX\_VALUE} = \hat{\beta}_1 + \hat{\beta}_2 year$

$\widehat{l\_DEFLATED\_EX\_VALUE}$= -196.598+0.102554 YEAR

CAGR=(Antilog of $\hat{\beta}_2$-1)100

= (1.108-1)100= 11%

IV. Instability Analysis

As far as instability analysis is concerned, the two measures of instability are used in this study are Coefficient of Variation (CV) and Cuddy Della Valle (CVD) index. The table 4 details on the findings of instability analysis. Coefficient of Variation in the volume of marine fish production in the current decade is 4.57% whereas it is 20.2% in the volume of inland fish production. As per Cuddy Della Valle index, the instability in the volume of marine fish production is 1.26% and in the volume of inland fish production it is 2.11%. In both measures, instability is low in the production of marine fishery. The low instability in the volume of marine fish production is misleading. It is mainly due to the stagnation taking place in that segment. Hence it cannot be considered as a positive sign.

While looking into the instability of volume in the marine export segment, the value of coefficient of variation is 17.6% and that of cuddy Della Valle index is 8.01%. Both the values are significantly high which is a cause of worry for policy makers. The analysis of nominal values of marine product export indicates a high rate of instability both in terms of coefficient of variation and Cuddy Della Valle index. The values are 39.6% and 12.37% respectively. But the consideration of real values of marine product export reflects a comparatively less instability with 25.9% of coefficient of variation and 11.14% of Cuddy Della Valle index.

IV.1 Analysis of Instability in the volume of Marine fish production in India during 2010-2017

Mean	34.835
Standard deviation	1.5934
C.V.	0.045742 (4.57%)
CVD	1.26%

IV.2 Analysis of instability in the volume of Inland fish production in India during 2010-2017

Mean	65.864
Standard deviation	13.307
C.V.	0.20203 (20.2%)
CVD	2.11%

IV.3 Analysis of instability in the total volume of fish production in India during 2010-2017

Mean	100.70
Standard deviation	14.819
C.V.	0.14716 (14.76%)
CVD	1.58%

IV.4 Analysis of instability in the export volume of marine fishery in India during 2010-2017

Mean	1.0121e+006
Standard deviation	1.7901e+005
C.V.	0.17688 (17.6%)
CVD	8.01%

IV.5 Analysis of instability in the export value (Nominal) of marine fishery in India during 2010-2017

Mean	28176.
Standard deviation	11160.

C.V.	0.39608 (39.6%)
CVD	12.37%

IV.6 Analysis of instability in the export value (real) of marine fishery in India during 2010-2017

Mean	20460.
Standard deviation	5314.1
C.V.	0.25973 (25.9%)
CVD	11.14%

Table 4: Comparison of CVs and CVD indices of Volume and Value of Fish Production and Export from India from 2010-11 to 2017-18.

	Coefficient of Variation(%)	Cuddy Della Valle (%)
Marine fishery Production	4.57	1.26
Inland fishery Production	20.2	2.11
Total fishery Production	14.76	1.58
Marine fishery Export (Volume)	17.6	8.01
Marine fishery Export (Value in nominal terms)	39.6	12.37
Marine fishery Export (Value in real terms)	25.9	11.14

V. Calculation of Demand Elasticity

The analysis of the fishery sector for the period from 2010 to 2017 reveals the fact that the predominant share of the value and volume of marine products exported from India to the world market is constituted by shrimp. A further analysis into the market share of importing countries from India especially for shrimp, it is found that United States of America dominate as a country in the import share. These above mentioned facts are validated in table 5 and table 6. Hence the study takes the case of Indian shrimp export to United States during the period 2010 to 2017 in order to estimate the demand elasticity of shrimp export to USA.

TABLE 5: Percentage Share of Shrimp in The Total Export of Marine Products from India

Item		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Fr. Shrimp	Quantity in ton	18.63	21.94	24.63	30.64	34.01	39.53	38.28	41.10
	Value in Crore	44	49	51	64	67	66	65	68
	US$ Million	44	50	51	64	67	66	64	68

Source: UNCOMTRADE

TABLE 6: Percentage Share of Importing Countries in The Total Export of Marine Products from India

		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Japan	Quantity	9	10	8	7	7	8	6	6
	Value	13	13	11	8	9	9	7	6
USA	Quantity	6	8	10	11	12	16	17	18
	Value	15	18	21	26	26	28	30	33
EU	Quantity	21	18	17	18	18	20	17	14
	Value	27	23	22	20	20	21	18	16
China	Quantity	20	10	9	8	6	5	4	4
	Value	15	8	8	6	4	5	4	3
South East Asia	Quantity	29	40	37	39	39	35	43	45
	Value	16	25	23	27	26	25	30	32
Middle East	Quantity	5	4	4	6	6	6	5	5
	Value	5	5	6	5	6	6	5	4
Others	Quantity	10	10	14	11	11	10	9	9
	Value	8	8	9	8	9	7	6	6

Source: UNCOMTRADE

A multiple regression analysis is applied to estimate the elasticity of demand for Indian shrimp export to US market. The functional form of regression equation is double log function. The major determinants of export demand for Indian shrimp in US market are assumed to be the domestic production of shrimp, price of Indian shrimp in US market and the Per Capita income of USA. [4] The price of Indian shrimp is expressed in terms of US$ per KG. The GDP Per capita data of US is in constant 2011 international dollar terms to discount for the impacts of inflation. The production of shrimp is measured in terms of tonnes. The study considers the period from 2010 to 2017. The equation is expressed as follows

$$\widehat{l\_DMND\_SHRIMP} = \widehat{\beta 1} + \widehat{\beta 2}\ l\_PRICE\_SHRMP + \widehat{\beta 3}\ l\_PCI + \widehat{\beta 4}\ l\_PRDN\_SHRMP$$

Model 7: OLS, using observations 2010-2017 (T = 8)
Dependent variable: l_DMND_SHRIMP

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−91.3634	20.4656	−4.464	0.0111	**
l_PRICE_SHRMP	−0.431549	0.148064	−2.915	0.0435	**
l_PCI	9.38434	1.93708	4.845	0.0084	***
l_PRDN_SHRMP	0.158735	0.0551981	2.876	0.0452	**

R-squared 0.960325 Adjusted R-squared 0.930569

The regression results reveal that a one per cent increase in export prices of Indian shrimp leads to a 0.4 per cent decrease in the demand for Indian shrimp in US market. This result confirms to the findings of previous studies made in this regard which show relative price inelasticity of US demand for Indian shrimps. The one per cent increase in the US per capita income leads to 9.38 per cent increase in the export demand for Indian shrimp. This reveals high income elasticity of demand for Indian shrimp in US. At the same time one per cent increase in the production of shrimp in India leads only 0.16 per cent increase in the exports of shrimp to US. It means that the demand for Indian shrimp in US market is relatively inelastic to the Indian production of shrimp. In the regression analysis all the coefficients of explanatory variables are found to be statistically significant.

VI. Suggestions and Conclusion

The fishery sector of India is a crucial sector not just as foreign exchange earner or as a major employment provider, but more importantly it is the provider of much needed food and nutrition to millions of people. Hence the strength of this segment is the need of the nation. The findings of study discussed in the section III and IV with respect to the growth trends and instability in the production and export of fish in the current decade sheds light on some worrying facts which needs to be addressed without delay.

Export is the engine of economic growth for a country. Exports are of immense importance for a developing country like India. The analysis done in the section V of the study clearly points to the export potential of shrimp in US which is a predominant market for Indian seafood exports. The relative price inelasticity and high income elasticity of US demand for Indian shrimps are really positive signs which can be judiciously made use of by policy makers by equipping the Indian shrimp farmers to avail the opportunities and thereby augmenting the much needed foreign exchange earnings from US market.

Marine segment of Indian fishery is going through a rough weather. The government needs to do remedial measures to check the fast depletion of resources in marine fishery and the same time it has to find ways to better utilize the potentials of deep sea fishing. The government has to prioritize the inland fishery in the wake of declining marine fishery and chalk out various measures to augment production and export of inland fishery segment which has lots of untapped potentials. In this post –WTO phase, marine product importing countries are putting forth stringent regulations in the forms of Sanitary and Phyto Sanitary (SPS), Technical Barriers to Trade (TBT) agreements and Hazard Analysis Critical Point (HACCP). Many initiatives are already made by the government and still further needed to equip our stakeholders in the export segment to comply with these regulations and the realization of these initiatives can make the second largest producer of fish in the world a true gainer and a leader in global spectrum.

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