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Indian marine fish products export: Trends and market stability analysis

[1]SA Diwate, [2]DB Malave, [3]SA Wagale and [4]KJ Chaudhari

[1]Ph.D. Scholar, Department of Agriculture Economics, Dr. Balasaheb Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

[2]Associate Professor, Department of Agriculture Economics, Dr. Balasaheb Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

[3]Junior Research Assistant, Department of Agriculture Economics, Dr. Balasaheb Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

[4]Principal Diploma in Fisheries Engineering, Dr. Balasaheb Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra, India

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Corresponding Author: SA Diwate

Abstract

This study analyses the structure, performance, and global competitiveness of India's marine fish product exports over the 26-year period from 1995-96 to 2020-21. Leveraging India's extensive Exclusive Economic Zone (EEZ) and substantial marine resource potential, the research is based on secondary data and employs trend analysis, compound growth rate estimation, instability indices, and the Markov chain transition probability matrix.

The results show sustained growth in export value, both nominal and real, with frozen shrimp emerging as the leading contributor and dried items also showing notable expansion. Conversely, chilled items experienced slower growth in the latter period, indicating possible market or supply limitations.

The Markov chain analysis revealed varying degrees of market loyalty across destinations. Japan recorded the highest retention rates, indicating a stable demand base. The United States and the European Union exhibited moderate stability, while China and Southeast Asia emerged as dynamic, fast-growing markets, reflecting a gradual shift in India's export orientation towards Asia.

Keywords: Market competitiveness, Markov chain analysis, export diversification, global seafood trade, india, trade dynamics, market loyalty, export growth trends

Introduction

India's marine fisheries sector plays a significant role in global seafood trade, supported by its vast Exclusive Economic Zone (EEZ) and diverse species composition. Understanding the dynamics of marine fish product exports is essential for assessing performance and identifying strategic growth opportunities.

Export trend analysis offers valuable insights into the long-term growth trajectory of different product categories. By tracking changes in volume and value over time, it highlights key commodities driving export performance as well as those experiencing stagnation or decline. Alongside growth estimation, instability analysis measures fluctuations in export earnings and volumes, revealing the extent of variability and potential vulnerability to market, environmental, or policy shifts. The Transitional Probability Matrix, based on the Markov chain approach, provides a systematic framework to examine market retention and switching patterns among importing countries. It quantifies the probability of a particular export destination maintaining its share in successive periods or shifting towards alternative markets. This analysis not only captures the stability of trade relationships but also signals emerging opportunities in new or fast-growing markets. Together, these analytical approaches offer a comprehensive understanding of India's marine fish export dynamics, enabling the identification of stable markets, high-growth commodities, and areas requiring strategic diversification.

Methodology

The present study was based on secondary data. The detail information required for the study was collected from secondary sources in order to accomplish the various objectives related to export of marine fish products. The country wise time series data on export of marine fish products in terms of value and quantity from 1995-96 to 2020-21was collected for the study. Further, destination wise time series data on export of marine fish products, international prices, wholesale prices were collected from annual publication of MPEDA (Marine Product Export Development Authority, India) and its website www.mpeda.com, FAO year book, WTO website.

Analytical tools

Estimation of Growth Rates

The compound growth rates were worked out to estimate the

trends in export of marine fish product. The growth in quantity exported and export values realized from exports was analysed using the following exponential growth function of the form

$Y = ab^x e^u$

Where,
Y = Dependent variables
a = intercept
b = regression coefficient
x = Number of years
e^u= Error term

The compound growth rate will be estimated by using the semi-logarithmic form of the equation as below:

Log Y = Log a + Log b

Then, the per cent compound growth rate (g) was computed using:

g = [Antilog of (Log b) - 1] × 100

Instability Analysis
For the estimation of variability and instability in marine fish products export, coefficient of variation for each period was calculated and compared with each other. In order to study variability in export trade of marine fish products an index of instability was used as measure of variability. The coefficient of variation (CV) was calculated by using the following formula:

$$CV\ (\%) = \frac{\text{Standard Deviation}(\sigma)}{\text{Mean}} \times 100$$

The trend coefficient will be tested for its significance. Whenever, the trend coefficient was found to be significant, the variation around the trend rather than variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend.

$$\text{Instability Index} = \frac{\text{Standard Deviation}(\sigma)}{\text{Mean}} \times 100 \times \sqrt{1 - r^2}$$

r^2 = Coefficient of multiple determination

Diversification Analysis
The trade direction of marine fish product export was analysed using the first order Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicate the probability that export will switch from country i to country j with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's export.
The average export to a particular country was considered to be a random variable which depends only on the past export to that country, which can be denoted algebraically as;

$$E_{jt} = \sum_{i=1}^{r} (E_{it-1} \times P_{ij} + ejt)$$

Where,
E_{jt}= Export from India to j^{th} country during the year t
E_{it-1} = Export to i^{th} country during the period t-1
P_{ij}= Probability that the exports will shift from i^{th} country to j^{th} country
e_{jt} = The error term which is statistically independent of E_{it-1}
t = Number of years considered for the analysis
r = Number of importing countries

Considering the limitations of software Lingo for estimating transition probability matrix for 1995-1996 to 2008-09and 2009-10 to 2020-21 period triennium averages and for overall period quinquennial averages was used.

Results and Discussion
Trends and Instability in Marine Fish Product Exports
Period-wise analysis (1995-2007 and 2008-2020) of Indian marine fish product exports shows (Table1.) distinct growth patterns across commodities. Frozen shrimp recorded the most notable improvement, accelerating from 3.51% CAGR in Period I to 16.44% in Period II, with strong overall growth (8.13%). Frozen fin fish showed negligible growth initially (0.49%, NS) but rose sharply in Period II (13.41%), resulting in 3.5% overall growth.

Table 1: Period wise trends in quantity of marine Fish products Export:

Sr. No.	Type of marine fish product	Period I (1995-2007)		Period II (2008-2020)		Overall (1995-2020)	
		CAGR	R^2	CAGR	R^2	CAGR	R^2
1	Frozen Shrimp	3.51***	0.87	16.44***	0.96	8.13***	0.85
2	Frozen Fin Fish	0.49NS	0.01	13.41***	0.81	3.5 ***	0.52
3	Frozen Cuttle fish	3.98***	0.66	1.23 NS	0.15	3.56***	0.81
4	Frozen Squid	1.12 NS	0.08	2.24 NS	0.19	4.49***	0.74
5	Dried items	9.9***	0.65	5.85**	0.46	13.57***	0.88
6	Live items	3.19***	0.56	4.51**	0.36	6.85***	0.84
7	Chilled items	9.26***	0.76	-1.6NS	0.074	12.42***	0.79
8	Other	19.45***	0.95	5.89***	0.80	11.3***	0.90

Significant levels: ******* (1% level), ****(5**% level), NS = Non-significant

Frozen cuttlefish maintained moderate growth (3.56% overall), despite a slowdown in Period II (1.23%, NS). Frozen squid exhibited low and statistically non-significant growth in both sub-periods but achieved 4.49% CAGR overall. Dried items consistently performed well, with high overall growth (13.57%) and strong stability (R^2 = 0.88).

Live items grew steadily (6.85% overall), though growth eased in Period II.

Chilled items rose strongly in Period I (9.26%) but declined in Period II (-1.6%, NS), reflecting demand fluctuations. The "Other" category posted the highest growth in Period I (19.45%), slowing to 5.89% in Period II but still sustaining an overall CAGR of 11.3%.

Overall, high-value products like frozen shrimp and dried items showed strong performance and stability, while chilled items and squid exhibited greater instability and slower growth in the later period.

Transitional probability matrix of marine fish products export from India

The Transitional Probability Matrix serves as a robust analytical tool to evaluate the dynamics of export destinations for Indian marine products over time. By capturing the likelihood of export flows remaining within the same market or transitioning to alternative destinations, this matrix offers critical insights into market stability, diversification, and the evolving structure of India's marine export trade during the period 1995-96 to 2020-21

Table 2: Transitional Probability Matrix of marine fish products export from India for period I (1995-96 to 2007-2008):

Sr. no	Particulars	Japan	USA	European Union	China	South East Asia	Others
1	Japan	0.87	0.07	0.05	0.008	0.002	0
2	USA	0	0.78	0.12	0	0.019	0.081
3	European Union	0	0	0.62	0.22	0.01	0.15
4	China	0.15	0.22	0.21	0.17	0.11	0.14
5	South East Asia	0	0	0.01	0.28	0.71	0
6	Others	0	0	0	0.34	0.15	0.51

In table 2. the matrix shows strong market stability with Japan (87%), USA (78%), and EU (62%) retaining most of their import share. Japan and USA had minimal diversification, while the EU redirected part of its imports to China (22%) and Others (15%). China exhibited a diversified sourcing pattern, indicating its emergence as a growing market. Southeast Asia retained 71% of its imports but shifted 28% to China. The "Others" category redirected significantly to China (34%) and partly to Southeast Asia (15%). Overall, traditional partners dominated, but China's growing share signaled the start of a structural shift in India's marine export destinations.

Table 3: Transitional Probability Matrix of marine fish products export from India for period II (2008-09 tom2020-21):

Sr. no	Particulars	Japan	USA	European Union	China	South East Asia	Others
1	Japan	0.30	0	0.10	0.41	0	0.19
2	USA	00	0.95	0	0	0.01	0.04
3	European Union	0.01	0	0.63	0.09	0.25	0.02
4	China	0.05	0.18	0	0.70	0	0.07
5	South East Asia	0.06	0.11	0	0	0.76	0.07
6	Others	0.11	0	0.28	0.17	0	0.44

Period II (2008-2020) Market Dynamics - Japan's retention fell sharply to 30%, with major redirection to China (41%) and Others (19%), signaling reduced dominance. The USA strengthened as a stable market, retaining 95% of its imports. The EU maintained 63% retention, diversifying notably to Southeast Asia (25%) and China (9%). China retained 70% and gained shares from Japan and Others, reinforcing its growing role. Southeast Asia remained stable at 76% retention, with limited shifts. The Others category showed moderate stability (44%) and redirected mainly to the EU and China. Overall, trade patterns became more diversified, with China and Southeast Asia rising in prominence alongside the USA's consistent demand.

Table 4: Transitional Probability Matrix of marine fish products export from India for overall period (1995-96 to 2020-21):

Sr. no	Particulars	Japan	USA	European Union	China	South East Asia	Others
1	Japan	0.88	0	0	0.06	0.06	0
2	USA	0	0.53	0.12	0	0.10	0.23
3	European Union	0	0	0.43	0.31	0.17	0.092
4	China	0	0.27	0.09	0.21	0.12	0.31
5	South East Asia	0	0.91	0	0.084	0	0
6	Others	0	0	0.95	0.01	0.04	0

Overall Period (1995-2020) Market Dynamics

Table 4. Revealed that Japan remained the most stable market with 88% retention, showing minimal diversification to China (6%) and Southeast Asia (6%). The USA retained 53% of its imports, with notable redirection to Others (23%), the EU (12%), and Southeast Asia (10%). The EU showed moderate stability (43%) but shifted significantly to China (31%) and Southeast Asia (17%). China retained 21% and attracted substantial shares from the EU and Others, confirming its growing influence. Southeast Asia was highly dependent on the USA market (91%), while the Others category largely redirected to the EU (95%). Overall, Japan's dominance persisted, but trade flows indicate gradual diversification toward China and Southeast Asia, alongside continued relevance of the USA and EU.

Conclusion

India's marine fish exports have shown strong long-term growth, with frozen shrimp and dried items emerging as the most consistent and high-performing segments. Frozen fin fish and live items recorded steady gains, while frozen cuttlefish maintained moderate growth. In contrast, frozen squid and chilled items experienced slower or negative growth in the later period, reflecting market volatility. The "Other" category demonstrated exceptional growth in the early years but moderated thereafter, highlighting the need for targeted strategies in less stable segments. The Transitional Probability Matrix analysis indicates a structural shift in export destinations over time. During Period I (1995-2007), traditional partners—Japan, the USA, and the EU—dominated, with high retention rates. In Period II (2008-2020), Japan's share declined, while China and Southeast Asia emerged as significant markets, and the USA strengthened its stability. Over the full period, Japan remained the most stable partner, but diversification toward dynamic Asian economies became evident. Strengthening both established relationships and emerging market presence will be key to sustained growth and resilience.

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