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RESEARCH PAPER

Comparative advantage and direction of trade in export of marine products from India

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Abstract: The study aims to examine the export performance and potential, comparative advantage and direction of trade of Indian marine products and its possible impact on Indian economy. The secondary data required for the study were compiled from various sources likeTrade Mapand Marine Products Export Development Authority for the period of 2002-03 to 2021-22.The Revealed Symmetric Comparative Advantage (RSCA) index and Markov Chain techniques respectively were used to assess the export competitiveness and direction of change in export of Indian marine products.The results of the study revealed that, the RSCA index was around 0.60 in 2002-03 which was highest value till date and reduced to 0.17 during 2009-10. Further it has been observed from the Markov Chain technique that, USA was identified as one of the most loyal importer and Middle East countries and 'Others' were identified as unstable importers of Indian marine products.

Key words: Comparative advantage, Exports, Marine products, Markov Chain

Introduction

India is one of the important oceanographic countries which have ample of water resources both in inland and marine sector to capture and culture fishes. The Indian fishery sector is placed in a distinctive and varied set of ecosystems across the length and breadth of the country. The fisheries biodiversity of the country comprehends a wide range of physical and biological components as a primary source of livelihood (around 280 lakh people) for the economically under privileged population of the country, especially in the coastal areas (GoI, 2021) and acts as an important contributor to national income, exports, food and nutritional security and employment generation in Indian economy.

Globally, India stands 2nd and 4th position with respect to production and export of fish products, respectively and contributes roughly 5 per cent to the global marine products export, marine market products taking brand India from 'Local to Global'(Anon, 2022). India has copious of natural resources, around 8118 kilometers of coastline, exclusive economic zone of 2.02 million square kilometers holds great potential of production as well as exports of the surplus (GoI, 2020). This sector has grown from a conventional livelihood activity in the fifties and sixties to science and technology led commercial enterprise in the past four decades (Ayyappan, 2012; Ayyappan *et al.,* 2013).

The fishery sector contributes about 6.58 per cent and 1.03 per cent to the Gross Domestic Product (GDP) of the agriculture sector and overall GDP of the country, respectively (Lakra and Gopal krishnan, 2021).In value terms, marine product exports have appeared as the leading group in agriculture exports which accounted for Rs. 47 thousand crore in 2019-20 and it has been recognized as a 'Sunrise Sector' with double-digit average annual growth of 10.87 per cent since 2014-15 (GoI, 2021). In India, Andhra Pradesh is foremost in aquaculture production with a boom in fish culture, first observed with Indian major carps (IMCs) and then Pangasius, resulting in expansion of pond area to 142,000 ha and subsequent massive increase in inland farmed fish production to 1.5 million tonne (Belton *et al.,* 2017). In fact, the global fisheries and aquaculture development intended to feed the billions and are all facing the challenges of sustainability issues (Christopher *et al.,* 2015; Taryn *et al.,* 2020). The fisheries sector in the country continues to be among the most critical and fastest growing allied sectors ofagriculture in the country. The fisheries sector has been recognized as an important emerging sector and has established an outstanding annual growth of 10.87 per cent since 2014-15, with record fish production of 161.87 lakh tons (provisional) during 2021-22 (Anon, 2022). The objectives in this study focused on the export performance and potential, comparative advantage and direction of trade of Indian marine products and its possible impact on Indian economy.

Material and methods

The required secondary data were collected from various sources to fulfill the objectives of study. The value of total marine product exports from India and World level and value of total exports from India and World were collected through Trade Map from 2002-03 to 2021-22. In addition, country-wise quantity of marine product exports from India was obtained from Marine Products Export Development Authority from1995-96 to 2020-21.

Revealed symmetric comparative advantage

The Revealed Symmetric Comparative Advantage (RSCA) (Laursen, 2015 and Islam *et al.,* 2021) index was used to obtain the competitiveness of marine products export. It is an efficient and symmetric form of Balassa's Revealed Comparative

Advantage (RCA) index (Balassa, 1965). RSCA index is the best tool for analyzing comparative advantage and widely used (Laursen, 2015). The mathematical depiction of RSCA is as follows:

$$RSCA = (RCA - 1) / (RCA + 1) \quad (1)$$

The index lies between -1 to 1. If RSCA > 0 indicates that a country relishes a comparative advantage in the product that it exports, whereas RSCA < 0 indicates otherwise.

Markov chain technique

The export directions of marine products were examined with the help of first order Markov chain technique (Naik and Nethrayini, 2017) using the Lingo 19.0 software. This particular analysis involves the estimation of the transitional probability matrix P where, the components P_{ij} of the matrix P shows the probability that export will change from nation i to nation j over a period of time. The diagonal elements of the matrix appraise the probability of retention of a nation's export share. Thus, an assessment of the diagonal elements suggests the faithfulness of an importing nation to a particular nation's exports.

In the present circumstances of application, the transformational changes with selected importing nations were treated as a random practice. The average exports to a specific nation was regarded to be a random variable which depends only on the previous exports to that nation, which can be represented algebraically as

$$E_{jt} = \sum_{i=1}^{r} [E_{it-1}]P_{ij} + e_{jt} \quad (2)$$

Where,

E_{jt} = Marine products exports from India to j^{th} nation in the year t.

E_{it-1} = Exports to i^{th} nation in t-1 period.

P_{ij} = Probability of marine products exports that will move from i^{th} country to j^{th} nation.

e_{jt} = The residual term which is statistically independent of E_{it-1}.

t = Time period

r = Number of importing nations

The transitional probabilities P_{ij} of the form (c * r) matrix have the following features.

$$\sum_{i=1}^{n} P_{ij} = 1 \quad (3)$$

and $0 \leq P_{1j} \leq 1$

Thus, the anticipated export shares of each nation in time 't' were obtained by multiplying the export to these nations in the previous period (t-1) with the transitional probability matrix.

To analyze the transitional probabilities of the model, Minimum Absolute Deviations (MAD) estimation method was used, which minimizes the sum of absolute deviations (Nethrayini *et al.,* 2012). For this traditional Linear Programming Technique was employed, as this satisfies the properties of transitional probabilities of non-negativity constraints and row sum constraints in the assessment.

The Linear Programming formulation is stated as

$$\text{Min } OP^* + Ie \quad (4)$$

Subject to,

$XP^* + V = Y$

$GP^* = 1$

$P^* e'' 0$

Where,

0 the vector of zeroes.

P* the vector in which probability P_{ij} are arranged.

I an apparently dimensioned vector of area.

E a vector of absolute error (1 U 1).

Y the vector of export to each nation.

X the block diagonal matrix of lagged values of Y

V the vector of errors

G the grouping matrix to add the row elements of P arranged in P* to unity.

Using the estimated transitional probabilities, the exports of marine products to various destinations were projected by multiplying the same with the respective shares of base year. The value of diagonal elements specify the probability of retention of the previous year values, while values in columns indicates probability of gain of a particular nation from other nations and row values tell the probability that a nation might lose to their share to different nations which were considered for the analysis.

Results and discussion

Comparative advantage of Indian marine products export

The export competitiveness of Indian marine products for the period of 20 years (2002-03 to 2021-22) was assessed using Revealed Symmetric Comparative Advantage (RSCA) approach and the results are given in the Table 1. Over the last 20 years, the RSCA recorded a positive trend (>0) indicated that, India is enjoying comparative advantage in exporting the marine products. It could be seen from the table that, during 2002-03, RSCA was around 0.60 which was maximum and reduced to 0.17 during 2009-10. Afterwards RSCA showed again increasing trend up to 2017-18 (0.54), and it gradually dwindled to 0.48 in 2021-22. Eventhough it diminished, India still retained its comparative advantage in the international market. RSCA values of Indian marine products exports showed the fluctuating trend: this may be attributed to short term responses to policy changes, quality of consignments exported, fluctuations in exchange rate or diversification in the exporting commodities (Singh *et al.,* 2020).The declining trend in RSCA value of marine products exports from India may be due to vagaries of climate change, lack of modern and advanced methods of fishing and harvesting practices, poor infrastructural facilities especially of fishing harbors and landing centers, lack of sufficient cold

Table 1. Revealed Symmetric Comparative Advantage of Indian marine products export

Year	RCA	RSCA
2002	4.02	0.60
2003	3.38	0.54
2004	2.60	0.44
2005	2.63	0.45
2006	2.32	0.40
2007	2.18	0.37
2008	1.61	0.23
2009	1.40	0.17
2010	1.81	0.29
2011	2.00	0.33
2012	2.18	0.37
2013	2.70	0.46
2014	2.83	0.48
2015	2.83	0.48
2016	2.89	0.49
2017	3.33	0.54
2018	3.05	0.51
2019	2.95	0.49
2020	2.92	0.49
2021	2.82	0.48

chain and processing facilities for value addition, post-harvest losses and shortage of skilled manpower (Lakra and Gopalkrishnan, 2021). There also exists uncertainty in prices in the international market which lead to delay in payments, loss in revenue, delay in realizing new markets, and additional cost on storage, delay in shipment and increased demurrages (Salim *et al.,* 2015). Even the Covid-19 pandemic had affected the sector severely and sluggish growth of overseas markets casted their shadow over India's resurgent seafood sector as the country exported worth of US$ 5.96 billion during 2020-21 and registering in contraction of 10.81 per cent in value as compared to 2019-20. Another major reason why India is losing out comparative advantage, like most of the developing countries, is that they paid little attention to changing marine ecosystems, and no specific policy existed for inland fisheries and health risks (Allison *et al.,* 2009; Béné and Friend, 2011; Mc Clanahan *et al.,* 2008; Sadovy, 2005).

Direction of trade

The export performance of Indian marine products during the period of 2011-12 to 2020-21 was estimated using the Markov Chain analysis. The transitional probability matrix which depicts the changing directions and stability in Indian marine product exports among the different countries (Table 2). The major importers of Indian marine products were identified based on the volume imports they had imported from India. Thus Japan, United States of America, European Union, China, South East Asia and Middle East countries were identified as the major importers and remaining minor countries were pooled under the category of 'Others' for further analysis of direction of trade. The results of the analysis revealed that, the USA was emerged as one of the most stable importer of Indian marine products over the year since it retained its entire share from the previous year. Since the US's relaxation of its anti-dumping duties has contributed to the rapid growth in fish and fishery exports to the US after 2010 (Nisar, *et al.,* 2020). This encouraging trend over the years indicates that the demand for Indian marine product exports is progressively mounting in the US market and is also able to adapt its export structure to changes in the market composition of the world imports (Fayaz and Ahmed, 2020). Being a loyal importers of Indian marine products, USA gained little amount of import share from China (4.03%) and South East Asian countries (4.10%). The other stable importers were South East Asian countries, followed by China, European Union and Japan as they retained about 80 per cent, 72 per cent, 48 per cent and 42 per cent of their share from the previous year respectively. With reference to the Asian continent is considered, except China and Vietnam, other Asian countries (e.g., Hong Kong, Japan, Thailand, and UAE) had a minor share of India's fish and fishery products exported in TE2018(Average of 2016-2018) (Khanal and Deb, 2022). Whereas, Middle East countries (21%) and 'Others' (19%) were identified as unstable importers of Indian marine products. The Middle East countries and 'Others' minor importing countries lost their major share to European Union (44.06% and 45.58% respectively). Hence these countries may not be considered as a loyal importer of Indian marine products in future and trade relationship with these associates is critical in determining India's success in exporting marine products.

The export basket consists mainly of frozen finfish, frozen squid, dried and live items. Most of the high value products are exported to EU followed by USA and Japan mainly because of higher purchasing power of the consumers in these developed economies (Shinoj *et al.,* 2009). It is also very important to mention from the results that, over the last decade Japan is no way considered as a supreme market for Indian marine products as it suffered a huge shock which indicated by loss in their import share to minor countries (53.37%). The prominent reason for this is the drastic reduction of shrimp exports to Japan due to various reasons like slump in domestic production of shrimp, gradual erosion in preference among Japanese consumers *etc.* (Shinoj *et al.,* 2009).

Projection of Indian marine products export

Table 2. Export direction of Indian marine products

Countries	Japan	USA	EU	China	SEA	Middle East	Others
Japan	0.4663	0.0000	0.0000	0.0000	0.0000	0.0000	0.5337
USA	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EU	0.0623	0.0000	0.4818	0.0000	0.4558	0.0000	0.0000
China	0.0385	0.0403	0.0000	0.7224	0.0000	0.0000	0.1988
SEA	0.0041	0.0410	0.0316	0.0308	0.7998	0.0164	0.0763
Middle East	0.3535	0.0000	0.4406	0.0000	0.0000	0.2059	0.0000
Others	0.0394	0.0000	0.4558	0.0000	0.0000	0.3112	0.1936

In continuation with examination of export direction of Indian marine products, as a next step we estimated the projection of Indian marine products export to different countries using the transitional probability matrix. The outcome of projected quantity of export and their respective share up to 2025-26 has been presented in Table 3. It could be seen from results that, the share of actual and estimated export of marine products to Japan had shown declining trend over the study period. Even the projected share is showing the same trend from 2021-22 (7.11%) to 2025-26 (6.27%). However, Japan is still the third largest importer of fish products in the world market (Pramod *et al.,* 2017). Prior to 1990-91 the trade structure of Japan turned out to be of great importance for Indian exports of fish products (Fayaz and Ahmed, 2020) afterwards there was drastic reduction in the import of fish products from India. This declining trend indicates that India is losing its competitiveness in Japan. The Japanese fish imports have been declining due to weaker domestic demand accompanied with reduced fish consumption (Chandran, 2012).

As a loyal importer of Indian marine products, the actual and estimated USA imports are increasing over the years and even the projection trend also showed the same from 2021-22 (26.94%) to 2025-26 (32.58%). This positive trend mainly attributed to US's relaxation of its anti-dumping duties in fish and fishery products especially after 2010. This kind of favorable trend over the years exhibits that the demand for Indian marine products is steadily growing in the US market and is also able to reconcile its export structure to changes in the market composition of the world imports. With reference to European Union is concerned, both actual and estimated share had shown declining trend during the study period until 2019-20. This was due to its SPS standards, a complex system of quota/ tariff and anti-dumping/anti-subsidy measures in place to Indian fish products. Further, tariff profile charged by the EU to the fish exports of India is also high, which might have resulted in declining fish exports to this market (Fayaz and Ahmed, 2020). The projected market share is expected to marginally increase from 2021-22 (14.15%) to 2025-26 (14.44%). This fluctuating trend in the export share suggests adapting good safety standards, promotion of better harvesting practices and value addition in exports.

The export share of Indian marine products to China and South East Asian nation is exhibiting an alarming rate of volatility as we can observe from the results, the trend showing the much fluctuation over the years. The actual per cent share of exports to China has decreased from 2011-12 to 2017-18 and after that it has increased suddenly from 3.61 per cent in 2017-18 to 25.55 per cent in 2019-20 then again declined to 18.99 per cent during 2020-21. Similarly the projected share is expecting to reduce drastically in 2025-26 to about 7.04 per cent from 18.99 per cent in 2020-21. The sudden decline in the export share to China during 2020-21 is due to the existence of white spot disease, coronavirus nuclei on packed cartoons in imported shrimps from India, there by banning almost 20 processing units from exporting to China. The trend continued even in case of South east Asian nations, being major importing partners of Indian marine products their both actual and estimated share was showing the diminishing trend. On the contrary the projected share is giving a positive sign indicating it may increase during 2025-26 (27.14%) from 2021-22 (21.20%) onwards. In case of Middle East and other minor importing countries the export share is showing the diminishing trend. The results of the present study highlights that India is losing its share in fish exports in Asia corroborate with earlier studies

Table 3.Actual and predicted quantity of Marine products export from India to selected countries (Qty in MT)

Year	Japan		USA		EU		China		SEA		Middle East		Others	
	A	P	A	P	A	P	A	P	A	P	A	P	A	P
2011	85800	-	68354	-	154221	-	84515	-	343962	-	38155	-	87014	-
	(9.95)		(7.93)		(17.89)		(9.80)		(39.90)		(4.43)		(10.09)	
2012	76648	71208	92447	85855	158357	141661	87777	71649	340944	345383	41419	40584	130623	105681
	(8.26)	(8.26)	(9.96)	(9.96)	(17.06)	(16.43)	(9.46)	(8.31)	(36.73)	(40.07)	(4.46)	(4.71)	(14.07)	(12.26)
2013	71484	70185	110880	109956	174686	164872	75783	73912	380061	344855	58040	54776	112822	109658
	(7.27)	(7.56)	(11.27)	(11.85)	(17.76)	(17.76)	(7.70)	(7.96)	(38.63)	(37.15)	(5.90)	(5.90)	(11.47)	(11.81)
2014	78772	73665	129667	129508	188031	173188	59519	66454	409931	383582	64608	53303	120716	104056
	(7.49)	(7.49)	(12.33)	(13.16)	(17.89)	(17.60)	(5.66)	(6.76)	(38.99)	(38.99)	(6.15)	(5.42)	(11.48)	(10.58)
2015	75393	80025	153695	148863	186349	187055	50042	55626	328900	413554	53905	57602	97609	108520
	(7.97)	(7.61)	(16.25)	(14.16)	(19.70)	(17.79)	(5.29)	(5.29)	(34.77)	(39.34)	(5.70)	(5.48)	(10.32)	(10.32)
2016	69039	72952	188617	169189	189833	168433	45443	46283	484819	347982	52973	46877	104224	94177
	(6.08)	(7.71)	(16.62)	(17.89)	(16.73)	(17.81)	(4.00)	(4.89)	(42.72)	(36.79)	(4.67)	(4.96)	(9.18)	(9.96)
2017	85651	70600	247780	210314	190314	177648	49701	47766	616707	474267	62220	51304	124871	103050
	(6.22)	(6.22)	(17.99)	(18.53)	(13.82)	(15.65)	(3.61)	(4.21)	(44.78)	(41.79)	(4.52)	(4.52)	(9.07)	(9.08)
2018	84080	83164	281913	275052	165571	195536	225519	54905	446966	579964	60232	61800	128278	126823
	(6.04)	(6.04)	(20.24)	(19.97)	(11.89)	(14.20)	(16.19)	(3.99)	(32.10)	(42.11)	(4.33)	(4.49)	(9.21)	(9.21)
2019	78507	86400	305178	309321	165773	178922	329479	176679	223398	432934	57387	59662	129929	148640
	(6.09)	(6.20)	(23.66)	(22.21)	(12.85)	(12.85)	(25.55)	(12.69)	(17.32)	(31.09)	(4.45)	(4.28)	(10.07)	(10.67)
2020	86814	85962	291948	327618	152770	171448	218343	244887	217710	254228	48606	55918	133319	149591
	(7.55)	(6.67)	(25.40)	(25.40)	(13.29)	(13.29)	(18.99)	(18.99)	(18.94)	(19.71)	(4.23)	(4.34)	(11.60)	(11.60)
2021	-	81750	-	309673	-	162679	-	164431	-	243751	-	55071	-	132155
		(7.11)		(26.94)		(14.15)		(14.30)		(21.20)		(4.79)		(11.50)

(Ashish and Kannan, 2015; Shinoj and Mathur, 2008). Major competitors to Indian fish exports in the international market are China, Thailand, Indonesia, the Philippines and Vietnam (Jagdambe, 2016).

Keeping a beady eye on the foregoing discussions, India must give more stress on USA, Southeast Asia, China, European Union and Japan in sustaining their respective share in the future. The threat becomes intense to India when the competitors such as China, Thailand, Indonesia, the Philippines and Vietnam are increasing the share of sustainable marine products in the world markets, especially in the USA, Japan and European Union nations which are fastly adjusting for the consumption of certified and quality marine products.

Indian exports of marine products have shown a positive trend of comparative advantage in the world market as revealed by the values of RSCA. However, there are chances of losing comparative advantage as trade measures have stream lined this sector and made it more competitive in the international markets (Fayaz and Ahmed, 2020). Thus, for further boosting fish exports, various Sanitary and phytosanitary measures (SPS) measures comparable to the international level should be taken robustly. Looking into the export directions of Indian marine products, it has been found that there was a declining trend in import share from the major importing countries.From 2010-11, there has been a continuous increase in the production of Vannamei shrimps. This is the only variety of shrimps that has made our farmers survive and we are mainly depending on only two markets, where more than 50% of our volume goes to the US and China. India needs to broaden its export markets for seafood as it cannot bank on only 2 markets. Additionally, Indian exporters must be offered incentives so that they can sustain in the world market from stiff competition from Vietnam, Thailand, Japan, and Malaysia. Finally, the availability of key infrastructure facilities in fish production and processing in marine products may play major role in utilizing the potential of India's blue economy.

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