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Note

Economic appraisal of Indian marine products exports – A decadal analysis for the period 2001 to 2021

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Abstract

Fishing is an age-old practice and the fisheries sector is vital to India's economy, which contributes to the primary livelihoods of about 2.8 crores of fishers and many more along the fisheries value chain. Fish and fish products constitute about 17% of India's total agricultural exports. The sector has been reckoned as a promising contributor to foreign exchange earnings. The compound annual growth rates of exports and their instability from 2001 to 2021 have been worked out for crustaceans, molluscs and frozen fish. The study revealed that the quantity of crustacean exports has grown at a comparatively high and significant rate of 11.08% during the decade spanning 2011-2021 (Period-II) than during 2001-2010 (Period-I). The growth in unit value realised from the export of molluscs declined from 5.8% during Period-I to 2.8% during Period-II. The growth in unit value of frozen fish export declined from 10.68% during Period-I to a slow growth rate of 0.11% in Period-II. The decline in the growth of unit values in molluscs and frozen fish indicates a declining demand and, in turn, a declining incentive for future exports from India.

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Indian fisheries sector has undergone a massive transformation in the past two decades from being a supplementary source of subsistence income to becoming recognised as a promising sector for developing the Indian economy (GoI, 2022). Undoubtedly, this would not be possible without the rapid technological improvements, priority shifts in food consumption patterns with the increased awareness about its nutritional benefits at the most amenable cost, development of efficient supply chains and market forces over the recent years (Shinoj *et al*., 2009; GoI, 2021). Das *et al*. (2016) anallysed the growth, instability and forecast of marine products export and the export of fishery products from India. The status, challenges and the way forward have been discussed by Suresh *et al.* (2023).

The Food and Agriculture Organisation reported that out of the total world's fish production, around 37% makes its way into the international market system (FAO, 2021). Developing countries have inevitably acquired a superior position, contributing more than half of the world's total fish exports into the international market channel. Developing countries contribute 54% by value and 61% by quantity to the total world's fish exports (FAO, 2021) and their fishery net exports (the total value of their exports less the total value of their imports), exhibiting an increasing trend continuously since the last two decades, surging from18 billion USD in 2000 to 35 billion USD in 2019 (FAO, 2021). Among the major fishery exporting countries, India occupies the fourth position, contributing 4.2% to the total world's exports, followed by China (12.4%), Norway (7.4%) and Vietnam (5.32%) (MPEDA 2020; FAO, 2021). The Indian exports was low from 2000–01 to 2019–20 and unit prices grew at a rate of 3.46% per year (Navghan and Kumar, 2017).

The fisheries sector contributed immensely to the country's economic development as it is a promising contributor to foreign exchange earnings. The marine exports from India reached 11.5 lakh t by quantity and ₹43,717.26 crores by value during 2020-21 (DoF, 2022) despite the uncertainties and the supply chain disruptions caused by the spread of the COVID-19 pandemic

worldwide (DoF, 2022). Gross Value Added (GVA) by the fisheries sector during 2018-19 accounted for ₹2,12,915 cores. The percentage contribution of the fisheries sector to the total agricultural GVA has been shooting up continuously and reached 6.84% (at constant price 2011-12) during 2018-19 and 7.28% at current prices (DoF, 2020). The recent data shows India shipped 13, 69,264 t of seafood worth ₹57,586.48 crore (USD 7.76 billion) during 2021-22, despite heavy odds. During FY 2021-22, exports improved in rupee terms by 31.71%, in USD terms by 30.26% and in quantity terms by 19.12%. In 2020-21, India exported 11, 49,510 t of seafood worth ₹43,720.98 crore (USD 5,956.93 million) (PIB, 2022). Frozen shrimp remained the major export item in terms of quantity and value. Frozen shrimp, which earned ₹42,706.04 crore (USD 5,828.59 million), accounted for 53.18% in quantity and 75.11% of the total dollar earnings. Shrimp exports increased by 31.68% in USD value and 23.35% in quantity. The export of frozen shrimps during 2021-22 was pegged at 7,28,123 t. USA, the largest market, imported 3, 42,572 t of frozen shrimp, followed by China (1,25,667 t), the European Union (90,549 t), South-East Asia (44,683 t), Japan (38,492 t) and the Middle East (37,158 t). Export of frozen shrimp increased in all the markets by value (PIB, 2022). Shrimp trade in the post-WTO era has been explained by Salim and Biradar (2009). Export of frozen squid, pegged at 75,750 t, showed a growth of 23.82% in quantity and 40.24% in terms of USD and earned ₹2,806.09 crores (383.37 million USD). Export of frozen cuttlefish, pegged at 58,992 t, showed a growth of 26.83% in rupee value and 26.18% in USD value and earned ₹2062.63 crore (280.08 million USD) (PIB, 2022). Live fish, including lobsters and crabs, considered delicacies in a few countries, are exported from India (Thapa *et al.,* 2015; Lee and Lam, 2019). Han *et al*. (2022) reported the market growth phase and the relationship between fish consumption, production and income growth.

The international trade in the fisheries sector is paramount in income and employment creation. It also encourages related industries such as processing, packaging, transportation and marketing, further contributing to employment generation along the supply chain. Thus, the international trade aspect of the fisheries sector becomes crucial. Indian marine products exports have experienced notable changes over time regarding the quantity exported, the composition of the marine product export basket, and even the destinations.Thus, it is crucial to understand the trends in the export of major marine products to have clear perspectives about the prospects of Indian marine products exports.

The time series data on the export of crustaceans (HS 0306), molluscs (HS 0307) and frozen fish (HS 0303) from India, were obtained for the study period from 2001 to 2021 from the International Trade Center (ITC). The data pertaining to export quantity, export value and unit value of export for all three categories of marine export products were collected. The entire study period (overall period from 2001 to 2021) was divided into two sub-periods *viz*., Period-I spanning the decade from 2001 to 2010 and period-II, spanning from 2011 to 2021) for the decadal study (Radhakrishnan *et al.*, 2018).

The compound annual growth rates were calculated to examine the trends in export growth (Fauzi and Anna, 2012; Jeyanthi and Gopal, 2012; Rani *et al*., 2012; Radhakrishnan *et al*., 2016); export value, export quantity, and unit value realised from export for the two decades, in comparison with the overall study period. The instability analysis (Rani *et al*., 2012) was also conducted using the Cuddy Della Valle Index (CDVI) (Cuddy and Della, 1978) for export value, export quantity, and unit value realised from export for the two decades along with the overall study period. The compound growth rates were calculated using the following formulae:

$Y = AB^t$

Let logY = y, logA = a and log B= b

$y = a + bt$

$r = (\text{antilog } b-1)*100$

where, Y = Export quantity, export value and unit value; t = Time; a = Intercept; b = Regression coefficient and r = Compound annual growth rate (CAGR)

Instability is the deviation from the trend. Researchers have applied the coefficient of variation (CV) in various literature to measure instability. An instability index was calculated to examine the extent of instability in export quantity, export value and unit value of export of Indian crustaceans (HS 0306), molluscs (HS 0307) and frozen fish (HS 0303) for the period 2001 - 2021. As the coefficient of variation (CV) alone does not explain suitable trend components of the time series data; the instability index was worked out by applying the Cuddy-Della Valle Index (CDVI), a measure of variability suggested by Cuddy and Della (1978), using the formula:

Instability index = $CV * \sqrt{1-r^2}$

If the estimated coefficient of the regression equation is insignificant, then the CV is the instability index. CV is the coefficient of variation and R^2 is the coefficient of determination from a time series trend regression adjusted by the degrees of freedom.

The compound annual growth rates of export quantity, value and unit value of export were calculated to examine the trends in the export performance of crustaceans. A perusal of Table 1 indicates that during Period-I (2001-2010), the export value showed a non-significant and optimistic growth rate of 0.12%, which could be mainly attributed to the positive growth rate of the export unit value (1.98%), which again was non-significant. The export quantity of crustaceans exhibited non-significant negative growth of 1.82%, which could be attributed to several reasons such as decline in production of marine shrimps in India, imposition of anti-dumping

Table 1. Compound annual growth rates of crustacean (HS 0306) exports from India

Period	Quantity (t)	Value (1000 USD)	Unit value (USD per t)
Period-I (2001-2010)	-1.8260^{NS} (0.0153)	0.1190^{NS} (0.0107)	1.9824^{NS} (0.0091)
Period-II (2011-2021)	11.0856** (0.0102)	10.4463** (0.0194)	-0.5758^{NS} (0.0170)
Overall period (2001-2021)	8.7241** (0.0091)	11.6975** (0.0105)	2.7349** (0.0058)

Figures in parentheses represent the standard error of corresponding values
NS: Non-significant; ** Significant at 1% significance level

duty (11.75%) by USA during 2006-07 which also caused number of exporters in India to fall out of the export business reaching 68 in 2009 from a huge number of around 250 exporters in 2005 (Nisar *et al.,* 2020; Singh *et al.*, 2021). In contradiction, during Period-II (2011-2021), the export quantity exhibited significant growth of 11.09%. The export value also grew significantly at a high rate of 10.4%. However, that was just in pace with the increased export quantity as the unit value of crustacean exports over that period was found to be insignificant and declining by 0.57%. This extraordinary growth in the crustacean exports can be attributed to the increased production of shrimps, especially the specific pathogen free *Penaeus vannamei* (Pacific white shrimp), brooders which were imported from USA to India during 2008 and the reduction of anti-dumping duties (to 1.6%) by USA in 2009.

The decline in the growth of unit value during Period-II, could be due to the frequent issues of non-compliance of Indian shrimps with sanitary and phytosanitary (SPS) standards of importing nations (Singh *et al*., 2021) and revival of aquaculture production in Thailand and Vietnam by the year 2015-16 (Arindam, 2023) as well as increased global supply of *P. vannamei* leading to decreased competitiveness and market value (Shyam *et al*., 2019). For the overall period, the growth in export quantity was found to be 8.72% annually, the export value grew at a rate of 11.69% and the unit value grew at a rate of 2.73%. The notable expansion of exports during Period-II points to the growing potential of India's crustacean export. However, numerous SPS measures should be taken up robustly to ensure international hygiene standards for Indian marine products (Salim *et al.,* 2015).

The performance of Indian mollusc exports explored by computing compound growth rates in terms of their value, quantity and unit export value, showed that over Period-I, the quantity of molluscs exported exhibited a positive growth rate of 1.53% per annum (Table 2). In the meantime, the export value grew at a high and significant acceleration of 12.01% annually. This tremendous positive growth of the export value was mainly due to the surge in the export unit value, driven by increased demand. Similarly, the unit value of exports exhibited a higher and more significant growth of 5.93% per annum over Period-I. On the contrary, the growth in export quantity became negative over Period-II, but was non-significant. Meanwhile, the growth in export value stood at 2.11% and was non-significant (p>0.05). The non-significant growth in quantity exported may be the consequence of rejections of Indian exports on the ground of non-compliance to SPS and TBT (Technical Barriers to Trade) standards of importing nations (Swaminathan *et al*., 2018). For the overall period, export quantity growth was 6.55% per annum and export value grew at 10.82% per annum. The unit value of molluscs exported also grew by 4% annually.

The scenario of Indian frozen fish export was analysed by calculating the compound annual growth rates in terms of their quantity, value and unit value of export. During Period-I, the growth in export quantity of frozen fish from India was found to be negative (-1.99%) but non-significant (Table 3). Meanwhile, the export value grew at 8.35% which was also non-significant. This positive growth in the export value, although non-significant, was mainly due to the significant growth in the unit value of frozen fish exports during the Period-I. The unit value of export grew at a high rate of 10.06% per annum, possibly due to the higher demand for the product over that period.

During Period-II, the growth in the export quantity of frozen fish was found to be declining at the rate of 5.25% annually. The growth in export value also declined at 5.41% per annum. This decline in the export value was mainly due to the insignificant growth of the unit value of frozen fish export (0.11% per annum). This decline in the quantity of export of frozen fish during Period-II can be attributed mostly to the supply disruptions that occurred due to COVID-19 pandemic. The rejections of Indian exports by key importers like China on the grounds of SPS and TBT non-compliance is also one of the major concern regarding declining frozen fish exports (Pavitra, 2014; Swaminathan *et al.,* 2018).

While looking at the overall period, the quantity of frozen fish export was growing at a low rate of 2.99%, which was significant only at 5% probability level. The growth in export value stood at 6.76%, and the unit value of export grew at 3.67% annually, both of which were significant. A similar trend was reported by Guledagudda *et al*. (2020).

Instability analysis was carried out to understand the behaviour of the export products in terms of quantity, value and unit value. Instability indices were computed employing the Cuddy Della Valle Index (CDVI). In order to examine the year-over-year fluctuations in the export of Indian crustaceans, the CDVI instability indices were calculated for quantity, value and unit value of exports (Table 4).

Table 2. Compound Annual Growth Rates of molluscs (HS 0307) exports from India

Period	Quantity (t)	Value (1000 USD)	Unit value (USD per t)
Period-I (2001-2010)	1.5339**(0.0152)	12.0195**(0.0166)	5.9344**(0.0086)
Period-II (2011-2021)	-0.31862 NS(0.0108)	2.1143 NS(0.0140)	2.4416**(0.0072)
Overall period (2001-2021)	6.5517**(0.0077)	10.8242**(0.0091)	4.0097**(0.0032)

Figures in parentheses represent the standard error of corresponding values
NS: Non-significant; ** Significant at 1% significance level

Table 3. Compound annual growth rates of frozen fish (HS0303) exports from India

Period	Quantity (t)	Value (1000 USD)	Unit value (USD per t)
Period-I (2001-2010)	-1.9929NS(0.0446)	8.3522 NS(0.0431)	10.0637**(0.0122)
Period-II (2011-2021)	-5.2537**(0.0163)	-5.1473**(0.0153)	0.1113NS(0.0094)
Overall period (2001-2021)	2.9903*(0.0139)	6.7614**(0.0149)	3.6714**(0.0065)

Figures in parentheses represent the standard error of corresponding values
NS: Non-significant; ** Significant at 1% level; * Significant at 5% level

Table 4. Instability Index of crustacean (HS 0306) export from India

Period	Mean	SD	CV (%)	Cuddy Della Valle Index (CDVI)
Quantity (t)				
Period-I (2001-2010)	161176.10	21401.76	13.28	12.99
Period-II (2011-2021)	454744.18	149623.80	32.90	10.45
Overall period (2001-2021)	314949.86	182870.12	58.06	26.27
Value (1000 USD)				
Period-I (2001-2010)	896318.00	79296.05	8.85	9.35
Period-II (2011-2021)	3646284.18	1116901.41	30.63	15.13
Overall period (2001-2021)	2336776.48	1594591.40	68.24	28.08
Unit value (USD per t)				
Period-I (2001-2010)	5614.40	523.59	9.33	7.86
Period-II (2011-2021)	8120.82	1382.60	17.03	17.69
Overall period (2001-2021)	6927.29	1642.81	23.72	18.17

The crustacean export was found to be least instable during both the periods in terms of export quantity. Whereas, both value and unit value of export were found to be moderately unstable during Period-II, indicating the volatility due high price competition. Considering the overall period, in terms of all the three aspects *viz.*, quantity, value and unit value, the exports were found to be moderately unstable.

The results of instability indices for the export of Indian molluscs over time are given in Table 5. Instability was found to be the lowest in the unit value of exports for both the periods and the overall period. Instability was 7.90% during Period-I; 7.38 during Period-II, and for the overall period, it was 7.87%. The instability in the export value was higher than in the export quantity during both periods and for the overall period. However, export quantity and value fell under the low instability range, *i.e.,* below 30%. Hence, it could be inferred that there was stability in export quantity, export value and unit value realisation for Indian molluscs over the entire period under study.

Frozen fish export, both in terms of quantity and value, was found to be highly unstable during Period-I which indicates that the export quantity has become more volatile than value (Table 6). Even during Period-II, quantity was found to be moderately instable, while value

Table 5. Instability Index of molluscs (HS 0307) export from India

Period	Mean	SD	CV (%)	Cuddy Della Valle Index (CDVI)
Quantity (t)				
Period-I (2001-2010)	78476.50	16419.01	20.92	14.20
Period-II (2011-2021)	173838.09	17425.82	10.02	10.55
Overall (2001-2021)	128427.81	50554.29	39.36	20.18
Value (1000 USD)				
Period-I (2001-2010)	197099.90	69920.53	35.47	16.89
Period-II (2011-2021)	638904.18	96564.29	15.11	14.22
Overall (2001-2021)	428521.19	236430.73	55.17	22.40
Unit value (USD per t)				
Period-I (2001-2010)	2450.00	439.23	17.93	7.90
Period-II (2011-2021)	3672.91	383.12	10.43	7.38
Overall period (2001-2021)	3090.57	736.06	23.82	7.87

Table 6. Instability index of frozen fish (HS 0303) export from India

Period	Mean	SD	CV (%)	Cuddy Della Valle Index
Quantity (t)				
Period-I (2001-2010)	175141.75	57144.17	32.63	34.13
Period-II (2011-2021)	292957.73	64922.10	22.16	16.08
Overall period (2001-2021)	236854.88	85000.33	35.89	33.37
Value (1000 USD)				
Period-I (2001-2010)	268750.80	120870.27	44.97	38.07
Period-II (2011-2021)	620059.45	123372.67	19.90	14.05
Overall period (2001-2021)	452769.62	213808.91	47.22	35.95
Unit value (USD per t)				
Period-I (2001-2010)	1549.75	472.44	30.48	12.80
Period-II (2011-2021)	2131.27	190.80	8.95	9.44
Overall period (2001-2021)	1854.36	457.94	24.70	16.34

was found least instable. Unit value was least instable during both the periods. Considering overall period, export was found to be highly instable, both in terms of quantity and value and moderately instable in terms of unit value of exports.

Fluctuations in the export market of any commodity restrict investment in the production of that commodity and also create insecurity among the producers (Kumar, 2020). Hence, taking necessary measures and concrete policy planning is necessary. The study revealed that crustacean export grew significantly at 11% during Period-II. This high export growth was propelled by the introduction of Pacific white shrimp farming in India. This has significantly contributed to the boom of total marine products exports over that period. Despite the growing crustacean exports demand, growth in unit value realisation was not up to the mark (-0.57%). While the crustacean exports both in terms of value and unit value, was found to be moderately instable during Period-II, indicating the volatility due to high price competition. The growing competition from other suppliers from all around the world like China, Vietnam and Thailand, required compliance with the increasingly high standards of SPS and TBT measures which continue to pose challenge to the Indian crustacean exports. In the case of export of molluscs, the massive positive growth of the export value (12.01%) during Period-I was mainly due to the sharp growth of the unit value of export by 5.8% annually, driven by increased demand. However, later over the Period-II, the growth in unit value was reduced to 2.8% and lower as well as insignificant growth in both export quantity and value was observed. Meanwhile, the export value was found to be moderately instable during Period-II. The frozen fish exports were severely affected by COVID-19 pandemic. The supply disruptions due to unavailability of freight, reduced capture production, rejection of most of the shipments on the grounds of contamination, by major importers like China has severely impacted frozen fish exports causing significant decline in both quantity (-5.25%) and value of export (-5.14%) during Period-II. The positive growth rates in the overall period among all three marine product categories in all the aspects, points to the growing potential of the sector and demand for Indian marine products at the international market.

In conclsion, it is imperative to streamline domestic processing efficiency by adhering to Hazard Analysis Critical Control Point (HACCP) principles. This approach is essential for elevating the quality of Indian fisheries products to meet international standards. To avoid the risks associated with India's huge dependency on a single product (shrimps), there is a need for product diversification. More emphasis is needed to improve the competitiveness of Indian molluscs and frozen fish in the world market to fetch greater unit values and boost their exports. To further enhance the marine products exports potential, deep understanding of world market's regulatory environment and their competitive strategies becomes essential.

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