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Export dynamics of major marine products in India: Trends and instability analysis

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Abstract

The present study analyzes the export trends and instabilities of major marine products from India. The research employed compound annual growth rates (CAGR) to assess export growth and the Cuddy Della Valle Index (CDVI) to measure the instability of major marine product exports. India's marine product exports have undergone a remarkable transformation over the past two decades, reflecting both resilience and vulnerability. From 2003-04 to 2022-23, export volumes more than quadrupled from 4.1 lakh tonnes to 17.30 lakh tonnes, while values surged tenfold to nearly ₹64,000 crores. The expansion has been driven largely by shrimp, alongside steady gains in frozen fish, crustaceans, and molluscs. Growth was especially pronounced during 2010-14, aided by aquaculture expansion, adoption of improved species, and strong global demand. However, instability has remained an enduring feature. Periods of disease outbreaks, global price swings, and COVID-19 disruptions revealed structural vulnerabilities, with export values often more volatile than volumes. The second decade (2013-22) recorded slower but more stable growth, supported by market diversification and better farming practices. Product-wise, dried and chilled seafood exhibited the highest growth but also the high instability, while frozen cuttlefish stagnated in competitive markets.

Keywords: Marine products, growth rate, export, shrimp, instability and global seafood trade

Introduction

The agricultural sector is undergoing diversification towards high-value ventures such as livestock and fisheries. Fisheries represent a crucial aspect of global economic activity (Bene *et al.* 2011) [7]. The evolving social and economic landscape, coupled with increased globalization, has spurred a notable rise in global fish production. Marine products form a significant portion of primary agricultural commodities exported from India.

India is one of the important oceanographic nation with abundant water resources in both inland and marine sector, facilitating the capture and cultured fishes. The Indian fishery sector thrives within diverse ecosystems spanning the country's geographical expanse. The fisheries sector's biodiversity encompasses various physical and biological elements, serving as a vital source of livelihood for approximately 280 lakh people, particularly those economically underprivileged populations residing in coastal regions. Additionally, it significantly contributes to the national income, exports, food security, nutritional well-being and employment opportunities within the Indian

economy (Vinod *et al.* 2023) [30]. The fisheries sector has been instrumental in bolstering national food and nutritional security. Fish are a valuable source of proteins, healthy fats and a range of essential nutrients, including long-chain omega-3 fatty acids, iodine, vitamins A, D and B₁₂, as well as iron, zinc, selenium and calcium. Additionally, fish oil has been crucial in the formulation of medicinal products and tablets (Shinoj *et al.*, 2009) [27].

India has emerged as a global leader in the fisheries sector, achieving several significant milestones. The country stands first in inland capture fish production and cultured shrimp export, and it is the second-largest aquaculture producer globally. Additionally, India ranks as the fourth-largest exporter of marine fish products and the sixth-largest producer of marine capture fish. The nation contributes approximately 8 per cent to global fish production, showcasing its pivotal role in the industry. Between the fiscal years 2014-15 and 2021-22, India's fisheries sector exhibited an impressive average annual growth rate of 8.81 per cent. This growth culminated in a record high fish production of 175.45 lakh tonnes in the fiscal year 2022-23,

with 44.32 lakh tonnes from marine fisheries and 131.13 lakh tonnes from inland sources. In 2020, marine product exports from India totaled USD 6.68 billion (Rs 46,663 crores), comprising approximately 4.2 per cent of global seafood exports and 19.2 per cent of India's total agricultural exports (Suresh *et al.*, 2023) ^[29].

In the fiscal year 2022-23, India's total fish production reached 17,545 thousand tonnes, with 13,113 thousand tonnes from inland sources and 4,432 thousand tonnes from marine sources. The fisheries sector is essential to the national economy, notably contributing to the country's foreign exchange earnings. Since 2000-01, fish production in India has grown from 5.65 million metric tonnes to 16.25 million metric tonnes by 2021-22.

During 2022-23, the leading fish-producing states in India were Andhra Pradesh, West Bengal, Karnataka, Odisha, Kerala and Uttar Pradesh. In terms of fish consumption, states like Uttar Pradesh, Odisha, Bihar, Kerala and Tamil Nadu have the highest total consumption. Andaman & Nicobar, Lakshadweep Islands and Tripura lead in per capita consumption of fish in 2022. Additionally, Tripura has the highest number of households consuming fish, both in rural and urban areas (DoF, 2023).

Additionally, a substantial segment of India's economically disadvantaged population, exceeding 28 million people, especially across the coastal regions, depends on the fisheries sector for livelihoods (India Trade Portal, 2023). The hike in demand for fish products across the world is primarily attributed to dietary shifts favouring fisheries due to their health benefits. Growing consumption trends, along with the origin of Exclusive Economic Zones and international agreements, have stimulated international trade in fisheries. (Ababouch, 2006; Anderson and Fong, 1997; Shinoj *et al.*, 2009) ^[1, 4, 27]. The revenue from fisheries international trade have also shown an upward trajectory, highlighting the sector's potential in developing countries due to abundant human resource and water availability (Ahmed and Lorica, 2002; Sajitha, 2016) ^[2, 25]. Many developing countries including India have a comparative advantage in producing high-value fish varieties (Golub and Varma, 2014; Lima *et al.*, 2020) ^[16, 19].

The marine products sector is a cornerstone of India's export economy, significantly contributing to the nation's foreign exchange earnings and employment opportunities. With a coastline stretching over 7,500 kilometers and a rich biodiversity of marine life, India is ideally positioned to leverage its marine resources for both domestic consumption and international trade. The growth in fisheries exports has been significant both in terms of value and volume, with India playing a pivotal role in global seafood exports. Over time, despite the export trade in marine products shown a significant growth but has also become vital for various fishing and post-harvest operations (Sajitha, 2016; Salim, 2013; Shinoj *et al.*, 2009) ^[25, 26, 27].

Over the past few decades, India's marine exports have experienced considerable growth, driven by rising global demand, advancements in aquaculture technology, and strategic government policies aimed at enhancing export competitiveness. The sector has seen a remarkable increase in export volumes, with India emerging as one of the leading exporters of seafood products worldwide. Given these factors, it is crucial to examine the export dynamics of

major marine products ranging from fish and crustaceans to mollusks and cephalopods reflect a complex interplay of trends and instabilities that shape the sector's performance on the global stage. By understanding these dynamics, stakeholders can better navigate the complexities of the global seafood market and contribute to the sustainable development of India's marine export industry. As the sector continues to evolve, a focus on innovation, sustainability, and strategic policy interventions will be crucial in ensuring long-term success and stability in the global marine products market.

Methodology

Data Collection: The time series data on the export of frozen shrimp, frozen fish, frozen squid, frozen cuttlefish, dried items, live items, and chilled items from India were collected for the period from 2003 to 2022. This data was sourced from the Marine Products Export Development Authority (MPEDA) and the ITC Trade Map. The dataset includes export quantities and export values (rupees in crores) for all the categories of marine export products. To facilitate a decadal analysis, the overall study period (2003-2022) was divided into two sub-periods: Period I (2003-2012) and Period II (2013-2022).

Analytical Tools

Compound Annual Growth Rate (CAGR)

The compound annual growth rates (CAGR) were computed to analyze the trends in export growth, including both export quantities and export values (in Rs. crores), during the study period from 2003 to 2022. This approach follows methodologies from previous studies (Rani *et al.* 2012; Radhakrishnan *et al.* 2016).

The compound growth rates were calculated using the following formulae:

$$Y_t = ab^t e^u$$

Where,

Y_t = dependent variable (area/production/productivity)

a = intercept term,

$b = (1 + r)$ and ' r ' is the compound growth rate

t = time period

u = error term.

The above model was expressed in logarithmic form as,

$$\log Y = \log a + t \log b + \log u$$

Thus, calculate the compound growth rate (r) as under:

$$\text{CAGR } (r) = (\text{Antilog of } \log b - 1) \times 100$$

Where,

r = Compound growth rate per annum in per cent,

Instability index

The instability analysis was also conducted using the Cuddy Della Valle Index (CDVI) (Cuddy and Della, 1978) ^[8] for export quantity and value (Rs. crores) realized export from 2003- 2022 in the study period.

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 and export value (Rs. Crores) of export of Indian frozen shrimp, frozen fish, frozen squid, frozen cuttle fish, dried item, live

items and chilled items and so on for the period 2003 - 2022. 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) ^[8], using the formula: The co-efficient of variation (CV) was used as the measure of instability as under,

$$CV (\%) = (S.D / \text{Mean}) \times 100$$

Instability index was calculated by using the equation given below,

$$\text{Instability index} = CV \times \sqrt{1 - \text{Adjusted } R^2}$$

Where,

If the estimated coefficient of the regression equation is insignificant, then the CV is the instability index. CV: co-efficient of variation.

R^2 : Adjusted coefficient of determination

The categorization of instability range as follows:

1. Low instability: $0 > CDVI < 15$;
2. Medium instability: $15 > CDVI < 30$;
3. High instability: $CDVI > 30$

Results and Discussion

Trends in Export Growth and Instability of Major Marine Products from India

Trend in export of total marine products from India

The trends in India's marine products exports from 2003-04 to 2022-23 in terms of quantity (mt) and value (Rs. Crores) exhibit a significant upward trajectory, though with some fluctuations. The quantity of exports increased from 4.12 lakh mt in 2003-04 to 17.35 lakh mt in 2022-23, while the value surged from ₹ 6,091.95 crores to ₹ 63,969.14 crores over the same period (Fig. 1). The graphical representation indicated a steady growth until around 2011-12, followed by a sharp increase in value during 2012-14, largely due to high global demand for Indian shrimp, especially Pacific White Shrimp (*Litopenaeus vannamei*). Post-2014, the growth in quantity continued, but value showed fluctuations, particularly between 2015-16 to 2020-21, attributable to global shrimp price declines, disease outbreaks like Early Mortality Syndrome (EMS), and the COVID-19 pandemic disruptions (FAO, 2016; MPEDA, 2021). The period 2021-23 witnessed a sharp resurgence in both quantity and value, driven by post-pandemic recovery and renewed global demand, especially from the USA, China, and Europe (MPEDA, 2023).



Fig 1: Trend analysis of export of total marine products from India (2003 to 2022)

Growth Rate Analysis

Employing compound annual growth rates (CAGR), the long-term trends in India's marine products exports were assessed across two periods (Table 1). As presented in Table, during Period I (2003-2012), the CAGR for quantity was 9.13 per cent, while for value, it was 12.98 per cent, both statistically significant at the 1 per cent level, indicating robust expansion in both volume and value. Conversely, in Period II (2013-2022), the CAGR moderated to 5.18 per cent for quantity and 8.22 per cent for value, with value growth significant at the 5 per cent level. This slowdown reflects market saturation in key importing countries, price instability, disease outbreaks, and pandemic

impacts (FAO GLOBEFISH, 2018; MPEDA, 2021).

Overall period (2003-2022), the CAGR stood at 7.04 per cent for quantity and a significantly higher 14.64 per cent for value, both at the 1 per cent level of significance. This trend suggests not only sustained growth but also a higher acceleration in value terms compared to quantity, reflecting the shift towards high-value species, improved processing technologies, and value addition in seafood exports (FAO, 2014; MPEDA, 2023). Such growth patterns underline India's strategic progression in the global seafood market despite periodic disruptions.

Table 1: Compound annual growth rates of marine products exports from India

Period	Quantity (%)	Value (%)
Period I (2003-2012)	9.13***	12.98***
Period II (2013- 2022)	5.18***	8.22 **
Overall (2003-2022)	7.04***	14.64***

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level.

Instability in export of total marine products from India

The instability in India's marine products exports, both in terms of quantity and value, has seen notable changes over the years, as shown in the Table 2. During the first period (2003-2012), the exports were quite unstable the quantity had a coefficient of variation (CV) of 27.25 per cent and a Cuddy Della Valle Index (CDVI) of 25.17, indicating noticeable year on year fluctuations. This was mainly due to unpredictable shrimp diseases like White Spot Syndrome Virus and natural calamities affecting production. Similarly, the value of exports during this period was even more volatile, with a CV of 42.68 per cent and CDVI of 42.47, which reflects the frequent price swings in global seafood markets and fluctuating international demand (Raja *et al.*, 2018) ^[24]. In the second period (2013-2022), however, both quantity and value showed improved stability. The CV for quantity dropped to 18.42 per cent and CDVI to 23.72, due to better farming practices, wider adoption of Vannamei

shrimp and improved disease management (FAO, 2016). For export value, the CV came down sharply to 23.84 per cent and CDVI to 17.01, largely because India diversified its markets beyond the traditional USA and EU, tapping into countries like China, the Middle East, and Russia (Bavinck *et al.*, 2018) ^[5]. Even though the overall period from 2003 to 2022 still shows significant value instability (CV: 70.38 %, CDVI: 31.62), much of this is due to historical price shocks, global financial crises and more recently, the COVID-19 pandemic, which disrupted global trade (MPEDA, 2021). These patterns suggest that while India has made significant progress in stabilizing both production and earnings from marine exports, external shocks and global price dynamics continue to pose challenges. Continued efforts in market diversification, value addition, and sustainable aquaculture practices will be key to reducing such instabilities in the future.

Table 2: Instability index of total marine product exports from India

Quantity (mt)	Mean	SD	CV (%)	CDVI
Period I (2003-2012)	642445.00	175047.08	27.25	25.17
Period II (2013- 2022)	1271733.00	234222.92	18.42	23.72
Overall (2003-2022)	942690.15	369369.09	39.18	28.20
Value (Rs. Crores)				
Period I (2003-2012)	10297.98	4395.35	42.68	42.47
Period II (2013- 2022)	45041.01	10736.29	23.84	17.01
Overall (2003-2022)	26928.11	18953.01	70.38	31.62

Note: SD: Standard deviation; CV: Coefficient of variation; CDVI: Cuddy Della Valle Index

Trend in export of frozen shrimp products from India

The export performance of frozen shrimp from India between 2003-04 and 2022-23 reflects a remarkable growth trajectory both in terms of quantity and value. As observed from the fig. 2, the export quantity increased from 129,768 MT in 2003-04 to 711,099 MT in 2022-23, while the value surged from ₹4,013 crores to ₹43,135 crores. A marked acceleration is observed post 2012-13, where the quantity and value both nearly tripled. The period between 2013-14 to 2022-23 saw rapid growth due to several factors such as the expansion of aquaculture, adoption of specific pathogen free shrimp varieties, disease management practices and strong global demand, particularly from the USA, Europe

and Japan. Policy interventions by the Marine Products Export Development Authority (MPEDA) and enhanced processing and value addition infrastructure also played a pivotal role in boosting exports. The dip in exports during 2020-21 can be attributed to the COVID-19 pandemic, which disrupted global supply chains, logistics and market access. However, the industry rebounded swiftly in subsequent years, reflecting the resilience of India's shrimp sector. The overall trend indicates India's growing dominance in the global shrimp market, driven by scientific farming practices, increased investments in aquaculture infrastructure and supportive government policies.

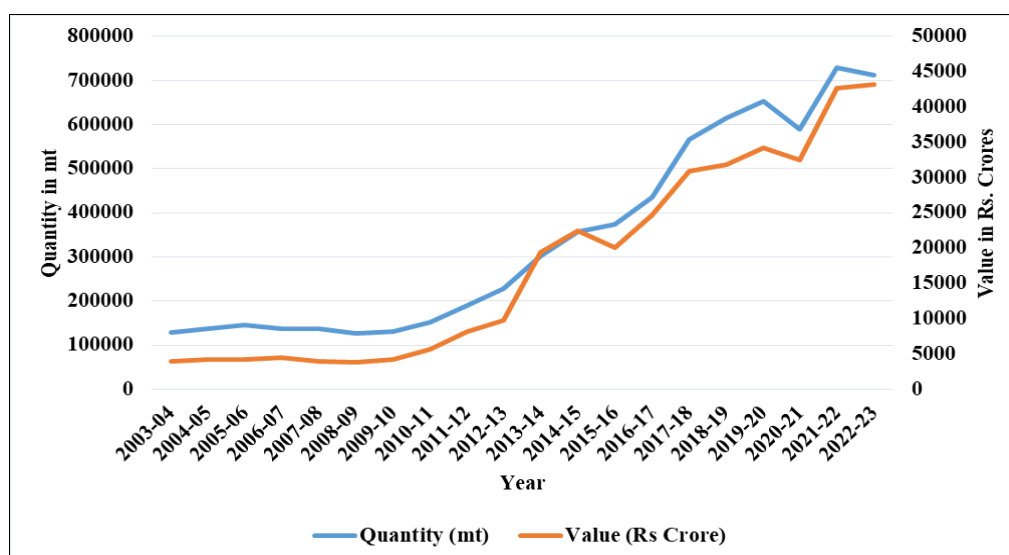


Fig 2: Trend in export of frozen shrimp products from India

Growth rate analysis of frozen shrimp

The compound annual growth rates (CAGR) during Period I (2003-2012) were 4.51 per cent for quantity and 8.70 per cent for value, with the value growth being statistically significant at 5 per cent level (Table 3). This suggests that while the volume of exports grew moderately, the value of exports increased at a faster pace, possibly due to higher global demand, better quality standards, and price improvements during that period. Moving to Period II (2013-2022), the growth rate of quantity more than doubled to 10.37 per cent, and the value grew by 9.60 per cent, both

significant at the one per cent level. This period marks a phase of intensified shrimp production driven by technological adoption in aquaculture, diversification of export destinations, and favourable policy support, especially under schemes facilitated by MPEDA and the Indian government. Over the entire period of 2003 to 2022, the overall growth rates stood at an impressive 11.69 per cent for quantity and 16.71 per cent for value, indicating sustained expansion and India's consolidated position in the global shrimp market.

Table 3: Compound annual growth rates of frozen shrimp exports from India

Period	Quantity	Value
Period I (2003-2012)	4.51***	8.70**
Period II (2013- 2022)	10.37***	9.60***
Overall (2003-2022)	11.69***	16.71***

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level

Instability in export of frozen Shrimp from India

The Instability index of frozen shrimp exports from India over two distinct periods (2003-2012 and 2013-2022) as well as an overall span from 2003 to 2022 (Table 4). The Instability Index is measured in terms Cuddy Della Valle Index (CDVI), offering insights into the variability and consistency of shrimp exports both in terms of quantity and value.

During Period I, the mean quantity exported was 151,245.50 MT, with a coefficient of variation (CV) of 21.56 per cent and a Cuddy Della Valle Index (CDVI) of 15.36, indicating moderate fluctuations. In contrast, during Period II, although the mean quantity surged to 532,916.70 MT, the CV increased to 28.96 per cent, suggesting higher absolute variations, while the CDVI dropped to 8.37, reflecting greater relative stability in exports despite the increase in volumes. For the entire period of analysis, the CV for quantity was 65.45 per cent and CDVI was 18.55, indicating

that although the sector witnessed substantial growth, it was also accompanied by periodic fluctuations, possibly due to global market dynamics, disease outbreaks and changes in trade regulations. Regarding the export value, instability followed a slightly different pattern. In Period I, the CV was 39.00 per cent and CDVI was 25.06, indicating considerable value fluctuations in the early years. However, in Period II, the CV decreased to 28.34 per cent and CDVI of 7.80, highlighting a relative stabilization in export earnings. Overall, the value of exports between 2003-2022 recorded a CV of 79.86 per cent and CDVI of 23.09 per cent, reflecting significant but gradually stabilizing export earnings from frozen shrimp. This pattern emphasizes India's improved capacity to sustain export performance while navigating market volatilities. These findings underscore the dynamic growth and evolving stability of India's frozen shrimp export sector, reinforcing the country's prominent position in the global seafood trade.

Table 4: Instability index of frozen shrimp exports from India

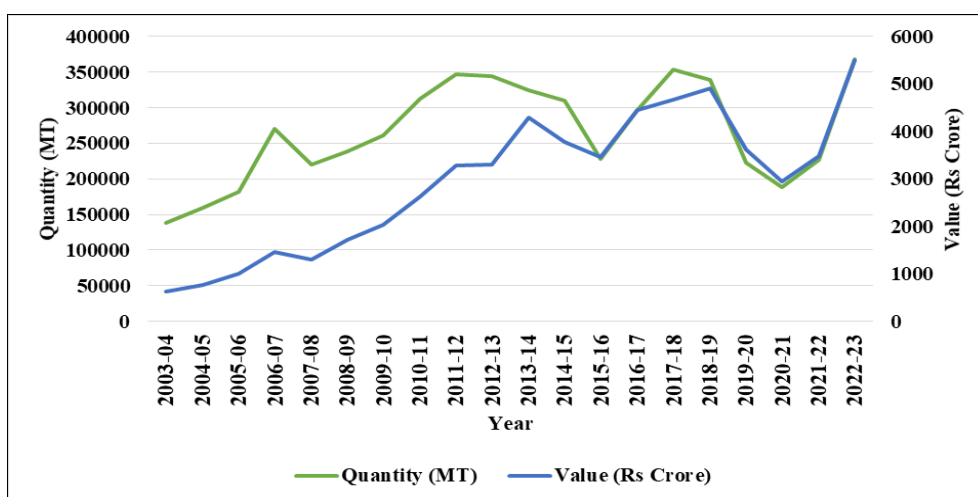
Quantity (mt)	Mean	SD	CV (%)	CDVI
Period I (2003-2012)	151245.50	32615.60	21.56	15.36
Period II (2013- 2022)	532916.70	154350.09	28.96	8.37
Overall (2003-2022)	342081.10	223883.67	65.45	18.55
Value (Rs. Crores)				
Period I (2003-2012)	5251.49	2048.01	39.00	25.06
Period II (2013- 2022)	30177.59	8551.04	28.34	7.80
Overall (2003-2022)	17714.54	14146.57	79.86	23.09

Note: SD: Standard deviation; CV: Coefficient of variation; CDVI: Cuddy Della Valle Index

Trend in export of frozen fish from India

The export trend of frozen fish from India between 2003-04 to 2022-23 shows a significant long-term increase in both quantity and value, though with periodic fluctuations (Fig. 3). Quantity rose from 1.38 lakh MT in 2003-04 to a record 3.68 lakh MT in 2022-23, while value increased more sharply from ₹620.73 crore to ₹5503.18 crore. Major growth phases occurred from 2006-07 to 2011-12 and again from 2016-18, driven by rising global demand, expansion of

aquaculture, improved cold-chain infrastructure, and supportive export policies. Declines in 2015-16, 2019-20, and 2020-21 were mainly due to disease outbreaks, climate variability, and COVID-19 disruptions affecting production and logistics. The strong rebound in 2022-23 reflects recovery in global markets, higher unit prices, and diversification into value-added products, highlighting the sector's resilience and competitiveness.

**Fig 3:** Trend in export of frozen fish from India

Growth rate analysis of export of Frozen fish from India

The compound annual growth rate (CAGR) of frozen fish exports from India reveals two distinct phases in performance (Table 5). During period I (2003-2012), both quantity and value of exports showed strong and statistically significant growth, with quantity expanding at 10.39 per cent and value rising at an even higher rate of 20.96 per cent per annum. This suggests a simultaneous increase in export volumes and unit values, reflecting favourable global market conditions. Likely contributing factors include a surge in international seafood demand, particularly from major importing countries such as the US, EU and East Asia, expansion in aquaculture production, improvements in cold-chain infrastructure, and favourable trade policies. Additionally, depreciation of the Indian rupee during certain years enhanced export competitiveness, while reduced competition from some traditional exporters further supported market gains.

In contrast, period II (2013-2022) witnessed a reversal of this trend, with quantity growth turning negative (-1.74 %) and statistically insignificant, while value growth stagnated at just 0.15 per cent and was also insignificant. Several factors may explain this slowdown. Increasing global

competition from countries such as Vietnam, Thailand, and Indonesia eroded India's market share in frozen fish. There was also a shift in India's seafood export focus toward higher-value processed and ready-to-eat products, which may have diverted attention from bulk frozen fish exports. Domestic constraints, including fluctuating raw material availability caused by overfishing, climate variability and stricter fishing regulations, further limited supply. Moreover, quality rejections in key markets due to stringent safety and residue standards, along with disruptions caused by the COVID-19 pandemic particularly affecting logistics and demand from the hospitality sector contributed to the stagnation.

When considering the overall period (2003-2022), quantity grew at a modest 2.27 per cent (significant at 5 %) while value grew at 9.98 per cent (significant at 1 %). This indicates that most of the growth momentum was concentrated in the earlier years, with the later period contributing little to overall performance. The results highlight the need for strategic interventions to regain competitiveness in global frozen fish markets through product diversification, quality enhancement, and sustainable resource management.

Table 5: Compound annual growth rates of frozen fish exports from India

Period	Quantity	Value
Period I (2003-2012)	10.39***	20.96***
Period II (2013- 2022)	-1.74 ^{NS}	0.15 ^{NS}
Overall (2003-2022)	2.27**	9.98***

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level. NS: Non significance

Instability in export of frozen fish from India

The Table 6 indicated that the instability analysis of frozen fish exports from India shows contrasting patterns across periods. In Period I (2003-2012), quantity exhibited moderate instability (CV: 29.80 %, CDVI: 10.05), while value showed high variability (CV: 54.22 %, CDVI: 8.82), indicating fluctuations in prices and earnings despite steady volumes. In Period II (2013-2022), quantity instability (CV: 22.31 %) decreased but CDVI rose sharply to 21.73, suggesting more frequent year-to-year fluctuations, while value instability reduced in CV terms (19.22 %) but

increased in CDVI (19.21), reflecting unpredictable market conditions. Overall (2003-2022), both quantity and value displayed considerable instability (CDVI above 23), implying volatility in exports over the long term. These patterns can be attributed to global market price fluctuations, competition from other exporters, variations in domestic fish availability, climate impacts on marine catch, stricter international quality standards, and disruptions such as COVID-19 affecting logistics and demand, particularly in food service sectors.

Table 6: Instability index of frozen fish exports from India

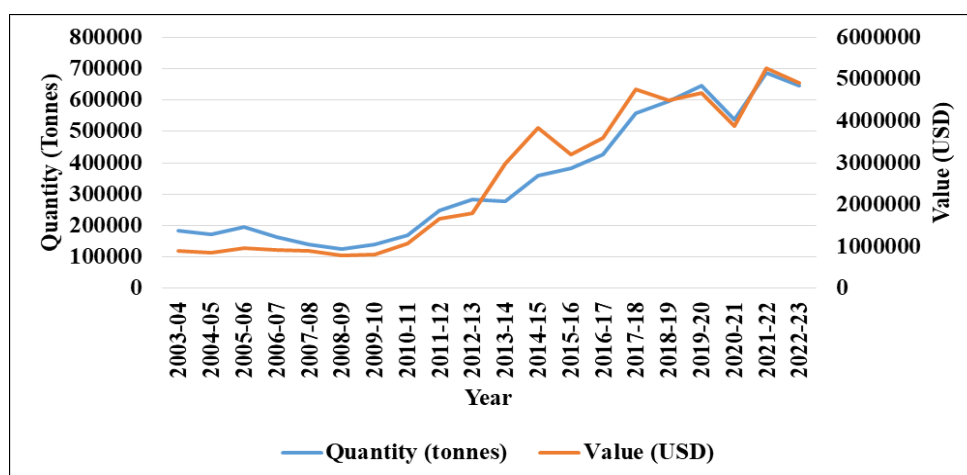
Quantity (mt)	Mean	SD	CV (%)	CDVI
Period I (2003-2012)	247388.20	73716.87	29.80	10.05
Period II (2013- 2022)	285801.20	63754.97	22.31	21.73
Overall (2003-2022)	266594.70	69912.60	26.22	23.21
Value (Rs. Crores)				
Period I (2003-2012)	1809.46	981.17	54.22	8.82
Period II (2013- 2022)	4111.41	790.15	19.22	19.21
Overall (2003-2022)	2960.43	1465.00	49.49	24.17

Note: SD: Standard deviation; CV: Coefficient of variation; CDVI: Cuddy Della Valle Index

Trend in export of Crustaceans from India

The export trend of crustaceans from India between 2003-04 and 2022-23 shows a strong long-term growth in both quantity and value, despite intermittent declines. Quantity increased from 1.82 lakh tonnes in 2003-04 to a peak of 6.88 lakh tonnes in 2021-22, while export value rose sharply from USD 0.90 million to over USD 5.25 million in the same year. Major growth phases were observed after 2010-

11, driven by expansion of aquaculture, improved processing facilities, and rising international demand for high-value shrimp. Declines in 2007-09 and 2020-21 were linked to disease outbreaks, climate-related impacts, and COVID-19 disruptions. The slight fall in 2022-23, despite remaining high, may reflect price corrections and global market adjustments after the pandemic recovery.

**Fig 4:** Trend in export of Crustaceans from India

Growth rate analysis of export of Crustaceans from India

An analysis of the compound annual growth rates of crustaceans (HS code 0306 which includes crustaceans whether in shell or not, live, fresh, chilled, frozen, dried,

salted or in brine etc., exports from India over different periods. The data is collected from trade map and it is divided into two distinct periods, 2003-2012 (Period I) and 2013-2022 (Period II), with an overall period from 2003 to 2022. The growth rates are measured in terms of both the

quantity (in tonnes) and value (in US dollars) of exports, with indications of statistical significance.

The CAGR of crustacean exports from India reveal distinct trends across periods (Table 7). In Period I (2003-2012), quantity grew at 3.27 per cent (non-significant), while value rose significantly at 6.64 per cent annually, suggesting that price increases and higher unit value contributed more to export earnings than volume expansion. In Period II (2013-2022), quantity growth accelerated sharply to 9.60 per cent (significant at 1 %), driven by expansion in aquaculture, adoption of improved farming techniques, and

diversification into high-demand shrimp varieties, while value grew at 5.23 per cent (significant at 5 %), reflecting relatively stable prices. Overall (2003-2022), both quantity and value recorded significant growth of 9.70 per cent and 12.61 per cent respectively, indicating robust performance. Factors influencing these trends include rising global demand, enhanced processing and cold-chain infrastructure, supportive export policies, and strong market positioning of Indian shrimp, though disease outbreaks, climatic variability, and COVID-19 disruptions caused intermittent slowdowns.

Table 7: Compound annual growth rates of Crustaceans (0306) exports from India

Period	Quantity	Value
Period I (2003-2012)	3.27 ^{NS}	6.64 ^{**}
Period II (2013- 2022)	9.60 ^{***}	5.23 ^{**}
Overall (2003-2022)	9.70 ^{***}	12.61 ^{***}

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level; NS: Non significance.

Instability in export of Crustaceans from India

The instability index for India's exports of crustaceans (HS code 0306), measured in both quantity (tonnes) and value (US dollars) across two periods was presented in the Table 8.

The instability index of crustacean exports from India indicates notable differences between the two periods. For quantity, Period I (2003-2012) recorded a mean of 1.82 lakh tonnes with a CV of 27.28 per cent and CDVI of 25.21, reflecting moderate instability due to disease outbreaks, climatic variability, and fluctuating demand. In Period II (2013-2022), the mean quantity rose sharply to 5.12 lakh tonnes, with a similar CV (27.51 %) but a much lower

CDVI (11.06), suggesting greater stability despite higher volumes, aided by improved aquaculture practices, disease management, and strong export infrastructure.

For value, instability reduced more significantly—from a CV of 33.80 per cent and CDVI of 25.16 in Period I to 18.49 per cent and 10.96 in Period II—indicating more stable earnings, driven by sustained international demand and better market positioning of Indian shrimp. Overall (2003-2022), high CV values for both quantity (57.10 %) and value (64.79 %) reflect long-term fluctuations, though the declining CDVI shows improved stability in the later years.

Table 8: Instability index of Crustaceans exports from India

Quantity (Tonnes)	Mean	SD	CV (%)	CDVI
Period I (2003-2012)	181737.70	49576.91	27.28	25.21
Period II (2013- 2022)	511594.90	140722.58	27.51	11.06
Overall (2003-2022)	346666.30	197933.44	57.10	21.91
Value (US Dollars)				
Period I (2003-2012)	1063124.70	359366.15	33.80	25.16
Period II (2013- 2022)	4156670.50	768567.00	18.49	10.96
Overall (2003-2022)	2609897.60	1690977.32	64.79	23.11

Note: SD: Standard deviation; CV: Co-efficient of variation; CDVI: Cuddy Della Valle Index

Trend in export of Molluscs from India

India's mollusc exports have shown an interesting journey over the past two decades (Fig. 5). In the early years, there was steady and impressive growth of exports jumped from about 65,000 tonnes worth USD 146,000 in 2003 to nearly 173,000 tonnes valued at USD 590,000 by 2011. This boom was largely fuelled by rising international demand, India's growing seafood processing capacity, and stricter adherence to global quality standards.

After 2013, however, export volumes began to fluctuate,

moving between 167,000 and 197,000 tonnes, while the value continued to inch upward, supported more by higher prices than by bigger shipments. The sudden dip in 2020, when volumes dropped to 138,000 tonnes, highlights the severe impact of COVID-19 on global seafood trade. Encouragingly, India bounced back quickly by 2022, even though exports were around 170,000 tonnes, the value soared to USD 858,000, showing the strength of value addition and rising global prices.

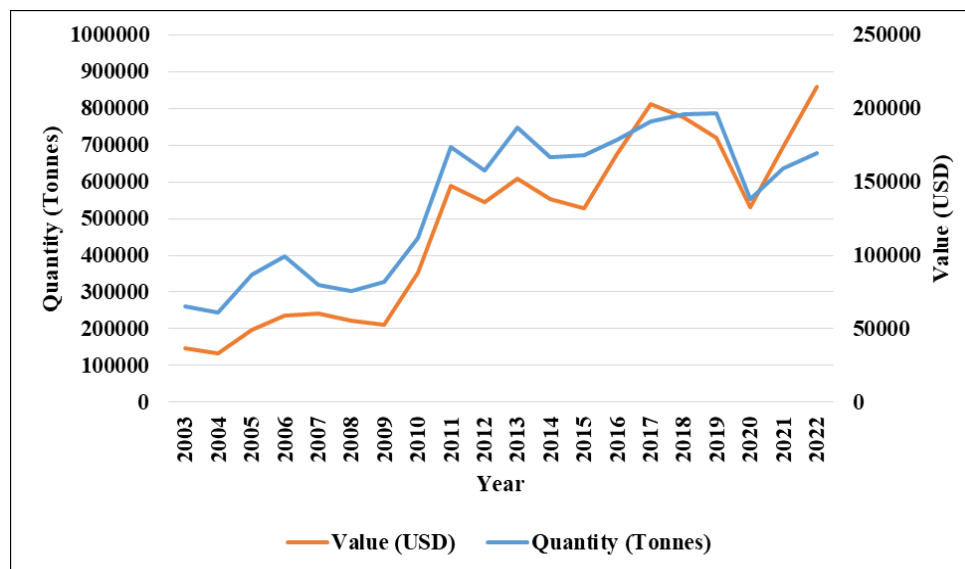


Fig 5: Trend in export of Molluscs from India

Growth rate analysis of export of molluscs (HS code 0307) from India

The India's exports of molluscs (HS code 0307) from 2003 to 2022, showing both exported quantity (in tonnes) and export value (in USD) was depicted in the Table 9. During the first period (2003-2012), exports expanded significantly, with compound annual growth rates (CAGR) of 10.08 per cent in quantity and 16.10 per cent in value, both statistically significant at 5 and 10 per cent, respectively. This growth may be attributed to rising global seafood demand, improvements in India's processing capacity, and better compliance with international quality standards. In the second period (2013-2022), however, the trend shows a slowdown. Quantities recorded a negative CAGR of -1.13

per cent (not significant), while values grew modestly at 2.96 per cent (significant at 10 %). This divergence suggests that although export volumes stagnated or declined, higher unit prices sustained value growth. Reasons could include stricter international regulations, resource constraints, overfishing concerns, or competition from other exporting nations. The drop in 2020 reflects the COVID-19 pandemic's disruption of seafood supply chains and demand shocks. Overall (2003-2022), India's mollusc exports grew at 5.88 per cent (quantity) and 9.87 per cent (value), both highly significant. This indicates that while growth momentum slowed in the later period, long-term performance remains positive, driven by value-added exports and rising global prices.

Table 9: Compound annual growth rates of Molluscs (0307) exports from India

Period	Quantity	Value
Period I (2003-2012)	10.08**	16.10***
Period II (2013- 2022)	-1.13 ^{NS}	2.96*
Overall (2003-2022)	5.88***	9.87***

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level; * significant at 10 per cent significance level; NS: non significance.

Instability in export of Molluscs from India

The instability index of India's mollusc exports shows a clear shift between the two periods (Table 10). From 2003-2012, exports were highly unstable, with a CV of 38.30 per cent in quantity and 55.25 value in value, reflecting fluctuations in production, global demand, and compliance with international standards. The high CDVI values (20.97

and 22.96) confirm this volatility. In contrast, 2013-2022 witnessed greater stability, as CV fell to 10.55 per cent in quantity and 17.53 per cent in value, indicating more consistent export performance. This improvement can be attributed to better resource management, diversification of export markets, and strong processing infrastructure. Overall, stability improved though moderate risks remain.

Table 10: Instability index of Molluscs (0307) exports from India

Quantity (Tonnes)	Mean	SD	CV (%)	CDVI
Period I (2003-2012)	99275.60	38017.84	38.30	20.97
Period II (2013- 2022)	175100.20	18478.79	10.55	10.02
Overall (2003-2022)	137187.90	48573.46	35.41	19.51
Value (US Dollars)				
Period I (2003-2012)	287704.00	158951.45	55.25	22.96
Period II (2013- 2022)	675244.70	118360.93	17.53	15.18
Overall (2003-2022)	481474.35	241095.40	50.07	20.56

Note: SD: Standard deviation; CV: Co-efficient of variation; CDVI: Cuddy Della Valle Index

Growth and instability in export of Indian Marine products

The growth and instability analysis of India's marine product exports from 2003 to 2022 was presented in the Table 11. Among the different product categories, dried items stand out with the highest growth in both quantity (12.74 %) and value (14.54 %), though accompanied by high instability (38.07 in quantity and 34.88 in value). This reflects volatile demand but also indicates the growing global preference for shelf-stable seafood with longer storage life, especially in African and Asian markets. Similarly, chilled items also recorded strong growth (8.67 % in quantity and 14.04 % in value), but their instability remains high due to perishability, cold chain limitations, and sensitivity to global logistics disruptions.

Frozen squid and live items show moderate but significant

growth trends, with CAGRs of 4.07 per cent and 6.90 per cent in quantity, and 12.29 per cent and 12.58 per cent in value, respectively. While demand for squid is consistent in East Asian and European markets, instability (19.53 and 18.54) indicates supply-side fluctuations, possibly due to resource constraints and competition. Live items, though lucrative in niche Asian markets, remain unstable because of transport challenges and strict sanitary standards.

On the other hand, frozen cuttlefish shows the lowest growth (1.86 % in quantity and 8.98 % in value) and moderate instability, reflecting a more saturated market and possible substitution by squid. Overall, India's marine product exports demonstrate robust growth in value terms, but addressing instability through better infrastructure, resource management, and market diversification is essential for sustaining competitiveness.

Table 11: Growth and instability in export of Indian Marine products (2003 to 2022) ^[20]

Marine Products	CAGR (Per cent)		Instability Index	
	Quantity	Value	Quantity	Value
Frozen Cuttle Fish	1.86**	8.98***	15.2	22.3
Frozen Squid	4.07***	12.29***	19.53	18.54
Dried Items	12.74***	14.54***	38.07	34.88
Live Items	6.90***	12.58***	20.93	21.42
Chilled Items	8.67***	14.04***	35.31	27.1

Note: *** significant at 1 per cent significance level; ** significant at 5 per cent significance level.

Conclusion

The Indian fishing industry has undergone significant transformation over the past two decades, characterized by a substantial increase in overall fish production, driven primarily by a surge in inland fish production. While marine fish production has also grown, it has been outpaced by the rapid expansion of inland aquaculture. This shift reflects improvements in inland aquaculture practices, a growing focus on sustainable inland fishery resources, and the increasing contribution of inland fish production to the overall fish output in India. In terms of marine product exports, frozen shrimp and frozen fish have emerged as the dominant products, accounting for a significant portion of the total export quantity and value. The country has also exported a diverse range of other marine products, including dried items, frozen squid, and frozen cuttlefish. While the overall export of marine products has shown steady growth, the instability index analysis reveals that the value of exports has become more stable over time, suggesting a maturing and less volatile export market. Diversifying marine product exports while frozen shrimp and frozen fish have been key drivers of marine product exports, efforts should be made to diversify the export basket. This could involve promoting value-added products, exploring new markets, and enhancing product quality and safety standards.

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