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Comparative Dynamics In Marine Product Exports: National Trends Versus Tuticorin's Contribution Over A Decade

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ABSTRACT

This study compares national data with contributions from Tuticorin over a ten-year period to evaluate the dynamics of India's marine product exports, with a focus on frozen shrimp. The study makes use of secondary data from reliable sources including NFDB, MPEDA, and CAA and applies a thorough analytical approach. To identify patterns, three-year moving averages, compound annual growth rates (CAGR), and year-over-year growth rates are computed. The findings show that marine product exports from Tuticorin and across the country have increased significantly in both volume and value, with significant peaks in 2022–2023. Global shocks such as the COVID-19 pandemic caused fluctuations, but the sector showed resilience and recovered well after 2020. Tuticorin's export potential has been greatly enhanced by its advantageous location and state-of-the-art processing facilities, especially in frozen shrimp. Nonetheless, the study draws attention to issues including market volatility and disease vulnerability, highlighting the necessity of strong management procedures and market diversification. In order to secure long-term growth and competitiveness in the international seafood market, the findings highlight the significance of regional contributions to national export strategy and the necessity of focused improvements in infrastructure, market intelligence, and sustainability standards.

Keywords: Export, Frozen Shrimp, Growth, Marine Products, Tuticorin.

India's fisheries sector plays a vital role in the global seafood market, particularly among Asian nations. In 2020, India ranked fifth in global fisheries commodity exports, holding a 4.46 percent share. Additionally, it led in inland fisheries with a 28.32 percent share and was third in aquaculture with a 7.48 percent share, highlighting its substantial role in international markets (Jana, 2023; OECD, 2023). By 2023, India became the third-largest fish producer and the second-largest aquaculture producer worldwide, further emphasizing the critical importance of its fisheries and aquaculture industry. Major importers of India's marine products include Japan, the USA, the EU, China, Southeast Asia, and the Middle East, which absorb the bulk of export volume and value (Thowseaf, et al., 2024; Chandrasekar et al., 2020). The marine export sector not only supports economic development and food security by generating substantial foreign exchange but also provides nutritive food and creates millions of job opportunities (Ancy & Raju, 2016; Shinoj et al., 2009; Salim, 2019; Parappurathu, 2009; Singh, 2017; Nithin & Mahajanashetti, 2015; Das & Rani, 2016). Shrimp farming in India significantly contributes to global food security by providing a rich source of high-quality protein and essential nutrients, while also promoting economic stability through strong export growth (Raveendran and Sacratees, 2024). Over 11 million individuals are engaged in this sector, either directly or in ancillary capacities (Joshi and Asthana, 2006). India's aquaculture industry sustains the livelihoods of millions, deeply woven into the nation's socio-economic fabric, yet it grapples with critical challenges such as rising sea levels, ocean acidification, and increasing water temperatures (Raveendran and Naik, 2023). Marine exports are recognized for their rapid movement in the global food market, driving considerable demand in international trade

(Manjunath et al., 2017), and India is a country which has successfully diversified its export base, meeting its economic and social development goals (Anand et al., 2015).

The liberalization policy of 1991 transformed the Indian marine industry, legalizing deep-sea fishing and joint ventures for major industrial and multilateral businesses, thereby boosting India's marine export capacity (Rajeev, 2009). Later, economic reforms aimed at fostering international commerce and investment further integrated India into the global economy (Kapila et al., 2002). These reforms include negotiating several preferential and free trade agreements to bolster trade, diversify exports, and enhance economic integration (Panagariya, 2004). Earlier studies show that developing countries used to contribute nearly 40% of all maritime exports, with India playing a major role in this industry (Dommen & Deere, 1999). The reason behind the surge in Global demand for marine goods was the changes in food consumption patterns, expanding urbanization, globalization, trade policy liberalization, rapidly changing lifestyles, and the emergence of new markets (Regmi, 2001). However, the competitiveness of prawns, India's primary marine export, has faced challenges due to raw material scarcity for processing and rising domestic production costs (Kamat & Kamat, 2007).

India's extensive coastline of 8118-kilometres and an exclusive economic zone (EEZ) spanning 2.02 million square kilometres and a continental shelf of 0.5 million square kilometres played as an important factor for the robust surplus of fishery products, satisfying domestic demands and supporting external trade (Jana, 2023; Shinoj et al., 2009). Its inland water sources cover over 190,000 square kilometres, and it has open water bodies with a water spread area exceeding 6.6 million hectares (Jana, 2023; GOI, 2000). The growing global appetite for seafood, particularly processed and value-added products like frozen shrimp became pivotal to India's export earnings (Pavithra et al., 2014). This trend aligns with global discussions on climate change and sustainable practices highlighted during the 2023 G20 Summit, emphasizing the critical need for balancing economic growth with environmental stewardship (Raveendran and Naik, 2023). Recognized as a critical sector in India's Foreign Trade Policy's Special Focus Initiative, the marine industry has swiftly gained prominence in the global economy (Swaminathan et al., 2018) and with a gross capital investment of around 42 million USD at 1995 price levels, the industry now stands as a significant foreign exchange earner (Bhatta et al., 2002). Furthermore, the Indian government's Matsya Sampada Yojana proposes sustainable strategies for utilizing the nation's fisheries and aquaculture resources (Singh et al., 2021). Over the past 28 years, the marine sector has shown robust growth and resilience amid global economic upheavals, underscoring its significant role in international markets (Muthusamy, 2014). Despite the variability of export earnings, which presents a development challenge impacting investment planning, resource allocation and affecting broader economic stability (Sarada et al., 2006), the sector significantly impacts livelihoods in coastal regions, warranting systematic scientific inquiry into global marine products (Dhivya & Thangasamy, 2023; Radhakrishnan et al., 2018; Faria et al., 2016).

India's seafood export sector has experienced unprecedented growth, with the fiscal year 2022-23 marking record highs in both volume and value. The country exported 1,735,286 metric tons of seafood, valued at approximately 8.09 billion USD, reflecting a 26.73% increase in quantity and a 4.31% rise in USD value compared to the previous year (MPEDA, 2023). Fisheries exports from India accounted for 0.32 percent of the country's GDP and 2 percent of the Value Added in Agriculture and allied sectors (Jana, 2023; MPEDA, 2022; GOI, 2022). The increased export growth in marine products attributes to its increasing demand from various sectors like animal and human consumption, food processing, and alternative uses such as cosmetics, fishmeal and fish oil, bioactive compounds, pharmaceuticals, and marine proteins (Shyam et al., 2004; Manjunath et al., 2017). Tuticorin, a strategic port city in Tamil Nadu known historically as "Pearl City," has evolved into a major hub for seafood processing and export, particularly frozen shrimp. Its advantageous location along the Gulf of Mannar, combined with proximity to rich fishing grounds and advanced processing facilities, enables Tuticorin to significantly meet the growing global demands. In 2022-23 alone, Tuticorin processed and exported 711,099 metric tons of frozen shrimp (MPEDA, 2023). However, the sector faces enormous challenges such as the susceptibility of shrimp to diseases and the fluctuating demands in major export markets, like the 21.94% decline in shrimp exports to the United States in dollar terms, underscoring the need for robust management practices and diversification of export markets. In contrast, exports to China have shown remarkable growth, with a 51.90% increase in quantity, underscoring the dynamic nature of international trade and the importance of market diversification.

Given the significance and dynamics of the industry, this study aims to achieve critical research objectives of analysing the ten-year growth trends of marine products and frozen shrimp exports, both nationally and from Tuticorin, and to compare the performance of national exports versus Tuticorin in terms of growth rates, annual changes, and compound annual growth rate (CAGR). These objectives are vital to understand the long-term sustainability and strategic planning is necessary for bolstering India's position in the global seafood market, ensuring that both national and regional contributions continue to thrive in an increasingly competitive environment. Thus, understanding the intricacies of regional and national export trends is crucial for devising effective strategies and ensuring sustainable growth in this sector.

Methodology

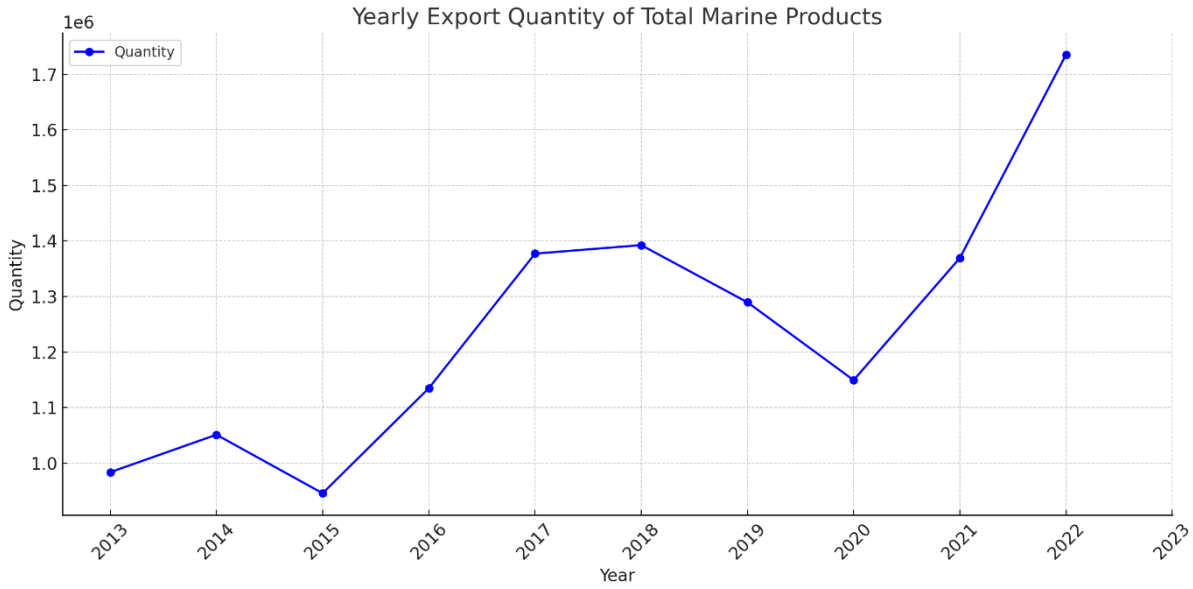
This paper is structured on the basis of the analysis of authentic secondary data, especially from Marine Products Exports Development Authority (MPEDA) India, National Fisheries Development Board (NFDB) India and Coastal Aquaculture Authority (CAA) India. In this study on the export of marine products from Tuticorin, a meticulous and comprehensive methodological framework was employed. The data were standardized and subjected to a detailed analytical process, where year-over-year growth rates were determined, and three-year moving averages were calculated to identify underlying trends. The Compound Annual Growth Rate (CAGR) was computed to assess the average annual growth, factoring in the compounding effects over the period studied. The Compound Annual Growth Rate (CAGR) has been calculated for both the total export of marine products and the export of marine products from Tuticorin port. CAGR is a useful statistic as it provides a smooth annual growth rate that removes the effects of volatility of periodic returns that can render arithmetic means irrelevant. Comparative analysis techniques highlighted the differential growth between Tuticorin and the national figures, providing a granular understanding of Tuticorin's role in the broader context.

Results and Discussions

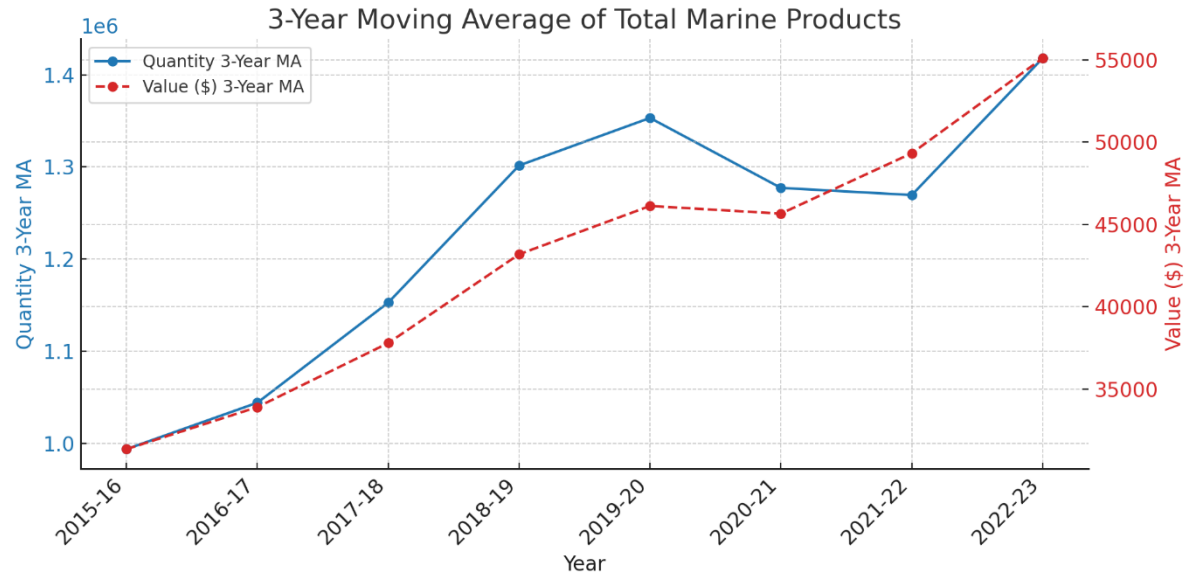
Table 1. Export of Total Marine Products

Year	Quantity (Q)	Value (V)	Dollars ($)
2013-14	983756	30213.26	5007.70
2014-15	1051243	33441.61	5511.12
2015-16	945892	30420.83	4687.94
2016-17	1134948	37870.90	5777.61
2017-18	1377244	45106.89	7081.55
2018-19	1392559	46589.37	6728.50
2019-20	1289651	46662.85	6678.50
2020-21	1149510	43720.98	5956.93
2021-22	1369264	57586.48	7759.58
2022-23	1735286	63969.14	8094.31

(Source: The Marine Products Export Development Authority)



The initial data set shows that India's maritime exports are headed in a positive direction. Following a little downturn in 2015–16, we witness a robust rebound and expansion in the years that follow. The biggest finding is the significant increase in value and quantity in the last year, 2022–2023. This suggests that the perceived worth of Indian marine products in global markets has increased, in addition to their increasing potential for production and export. The reduction observed in 2020–21 can be plausibly attributed to the COVID-19 pandemic's effects on global disruptions. The quick rebound and following export peak point to a robust industry that can endure and bounce back from shocks to the world economy.



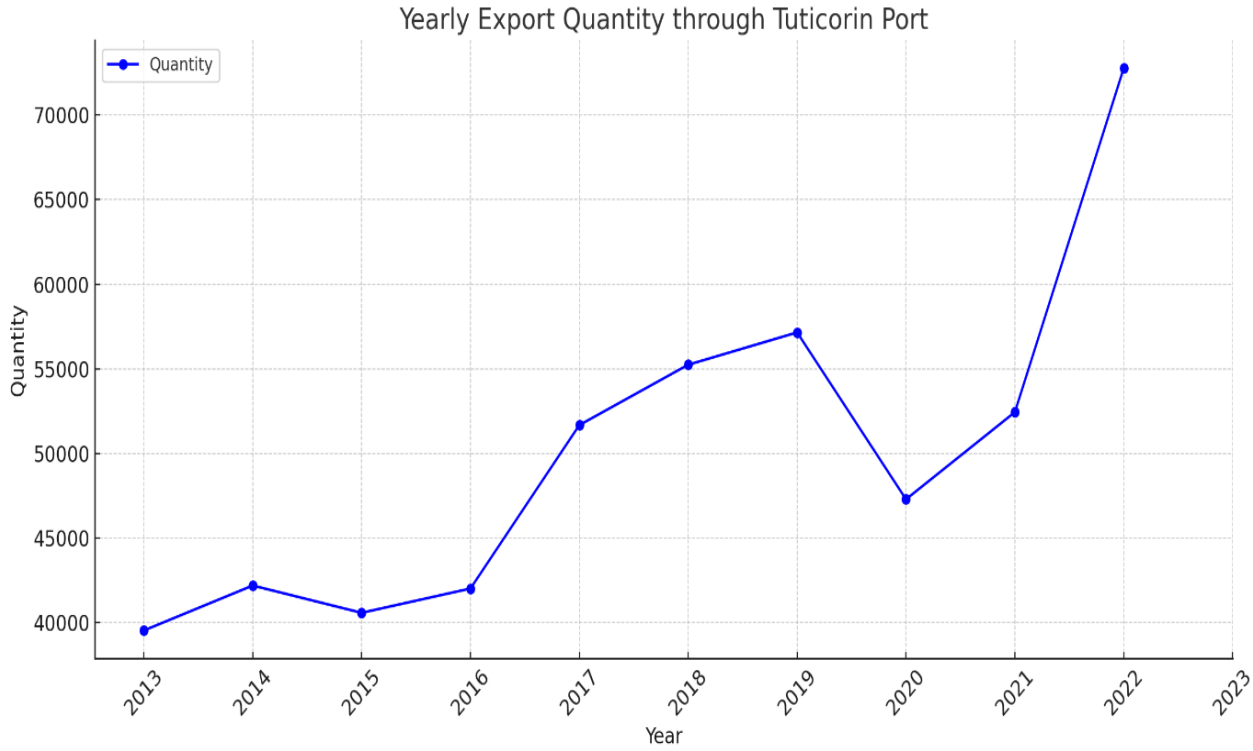
The graph shows a 3-year moving average of the total amount and value of marine products shipped between 2015–16 and 2022–2023 years. Longer-term trends or cycles are highlighted while short-term fluctuations are smoothed out using this statistical technique. The three-year moving average of the number of marine products shipped is shown by the blue line. Over the period, there has been a constant upward trend that suggests an increase in the volume of exports. There is a discernible decline in 2019–20, which might be the result of environmental effects on marine output or market interruptions. The gain that followed points to a robust recovery and an overall upward trend in exports of marine products. The export value in USD during a three-year period is represented by the red dashed line. The value follows the quantity's upward trend, albeit at a higher incline. This implies that the pace of increase in the value of marine products is greater than that of the volume. Strong rise in the amount and value of exported marine products is shown by the graph, which is encouraging for the marine industry as well as the economy as a whole. The fact that the value increase has outpaced the quantity increase is especially encouraging since it points to the marine export sector's growing profitability, which might improve the nation's trade balances and increase exporters' gross margins. The

slump and rebound coincide with world events like the COVID-19 pandemic, which underscores the sector's resilience.

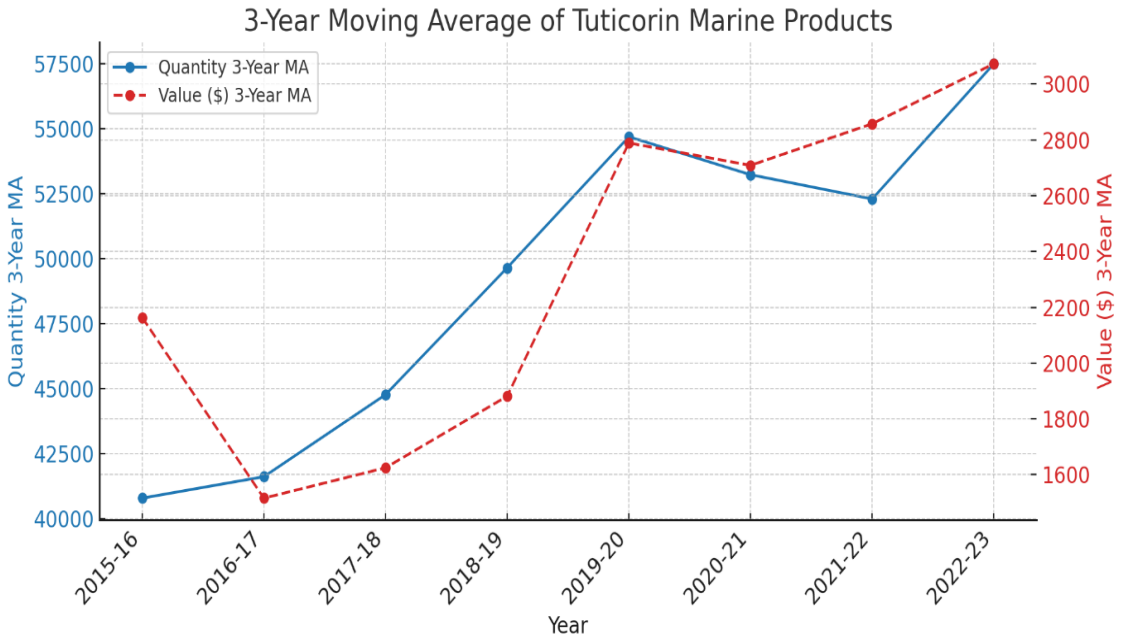
Table 2. Export of Marine Products through Tuticorin Port

Year	Quantity (Q)	Value (V)	Dollars ($)
2013-14	39547	2163.18	358.6
2014-15	42203	2328.27	383.92
2015-16	40591	1999.16	308.25
2016-17	42026	220.52	334.77
2017-18	51684	2654.96	417.09
2018-19	55251	2768.77	401.22
2019-20	57159	2942.64	421.04
2020-21	47299	2414.66	328.74
2021-22	52449	3216.18	437.43
2022-23	72780	3587.52	453.21

(Source: The Marine Products Export Development Authority)



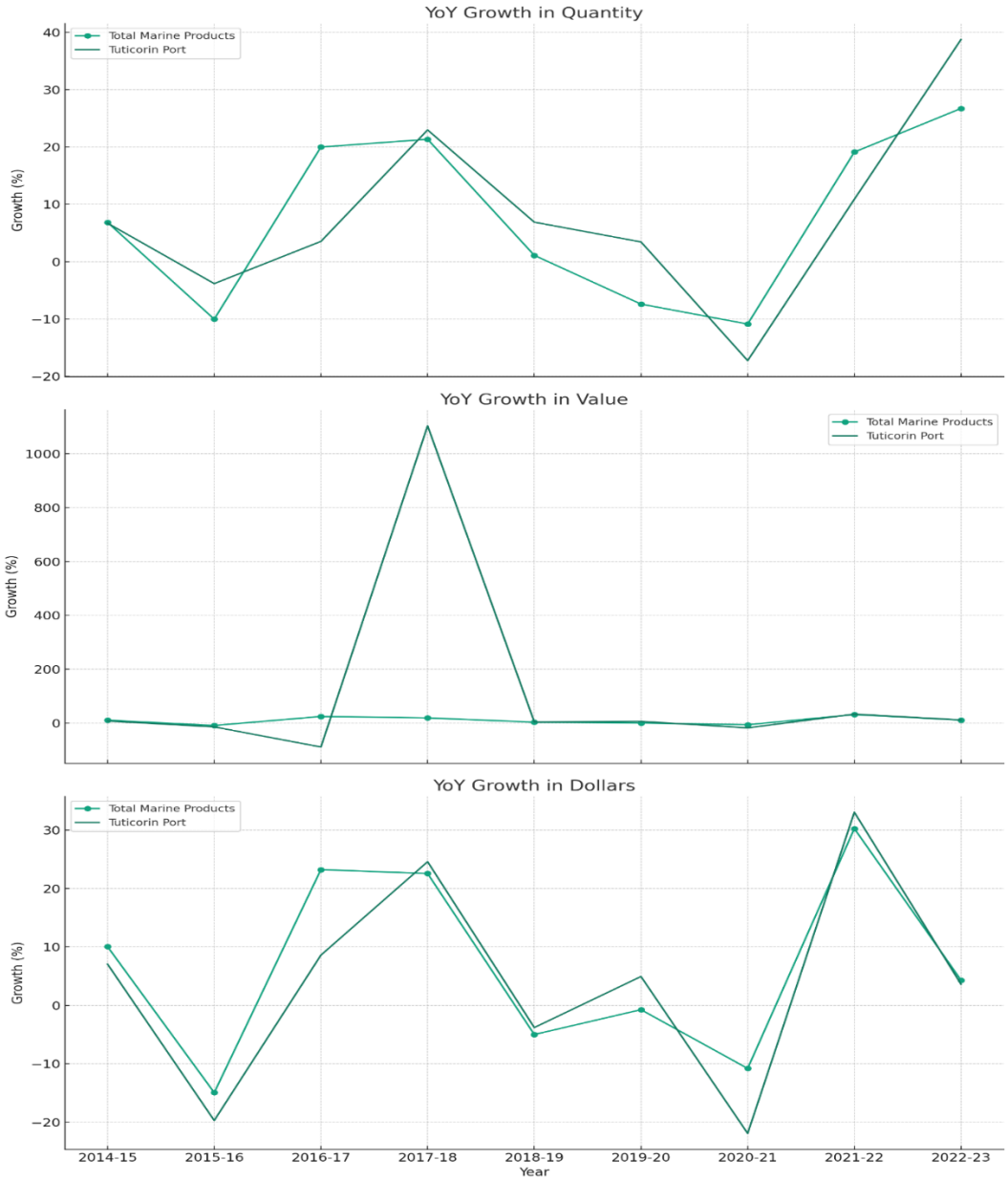
The graph shows the annual export volume through Tuticorin Port from 2013 to 2023. With occasional variations, it indicates a generally rising trend in export quantities. 2020 sees a significant increase following a decrease in 2019. The export quantity peaks in 2023, which may indicate more export growth in the sectors using this port or better port management and logistics. The general increase in the marine products industry is complemented by the trend in Tuticorin Port's export activity, which may suggest that the port plays a major role in the export of marine products. Tuticorin Port, also known as V.O. Chidambaranar Port, is strategically located close to the main international sea routes in Tamil Nadu, India. Because of its close proximity to processing facilities and good connections to important fishing grounds, it plays a crucial role in the export of marine products. The infrastructure of the port makes it easier to handle and process maritime commodities while guaranteeing their quality is maintained in transit. Its ability to manage significant volumes of marine product exports effectively is further strengthened by its proximity to important export hubs and the presence of sufficient infrastructure for transportation and storage. Due to its advantageous position, well-developed infrastructure, and excellent connectivity, Tuticorin Port is an important hub for the export of marine goods from India.



This graph illustrates the 3-year moving average (MA) of the amount and value of marine items exported through Tuticorin from 2015–16 to 2022–2023. The 3-year moving average of the amount of marine products exported is represented by the blue line, which indicates a noticeable rise over time. Following a period of initial stasis and slight volatility, there is a notable increase from 2017 to 2018, peaking in 2022–2023. This points to a strong increase in export activity, which may be the result of rising demand or expanded capacity in Tuticorin. The 3-year moving average for the value of exports in dollars is displayed by the red dotted line, and it also shows an upward trend. The value is initially more variable, but between 2017 and 2018, it increases significantly, suggesting a growth in the total value of exports. Beginning in 2019–20, the value trend outpaces the quantity trend, indicating that export items are likely seeing a rise in market prices. This could be because of a shift toward higher-value products or better market circumstances that permit higher pricing. Both the volume and the financial returns generated by Tuticorin's marine product export industry have been increasing, as seen by the graph. The steady upward trend, particularly in value, suggests a favourable economic impact that is probably boosting employment, affluence, and income creation in the area. The moving averages' rising patterns indicate a steady and optimistic growth trajectory for the marine exports through Tuticorin, highlighting the port's critical role in the broader context of the national export economy.

Table 3. Year over Year Growth Comparison of Total Export of Marine Products and Export of Marine products from Tuticorin.

Year	Total Marine Products - Quantity Growth (%)	Total Marine Products - Value Growth (%)	Total Marine Products - Dollars Growth (%)	Tuticorin Port - Quantity Growth (%)	Tuticorin Port - Value Growth (%)	Tuticorin Port - Dollars Growth (%)
2013-14	N/A	N/A	N/A	N/A	N/A	N/A
2014-15	6.86%	10.69%	10.05%	6.72%	7.63%	7.06%
2015-16	-10.02%	-9.03%	-14.94%	-3.82%	-14.14%	-19.71%
2016-17	19.99%	24.49%	23.24%	3.54%	-88.97%	8.60%
2017-18	21.35%	19.11%	22.57%	22.98%	1103.95%	24.59%
2018-19	1.11%	3.29%	-4.99%	6.90%	4.29%	-3.80%
2019-20	-7.39%	0.16%	-0.74%	3.45%	6.28%	4.94%
2020-21	-10.87%	-6.30%	-10.80%	-17.25%	-17.94%	-21.92%
2021-22	19.12%	31.71%	30.26%	10.89%	33.19%	33.06%
2022-23	26.73%	11.08%	4.31%	38.76%	11.55%	3.61%



The above graph presents a visual comparison of Year-over-Year (YoY) growth percentages in three distinct categories quantity, value, and dollars for total marine products versus those specifically through Tuticorin Port. This tripartite graph format provides a year-wise comparative snapshot from 2014-15 to 2022-23. The first segment of the graph shows the percentage change in the quantity of marine products year-over-year. Both lines, representing the total marine products and those through Tuticorin Port, display fluctuations. Notably, there's a substantial increase in growth for both categories in the most recent year shown, with Tuticorin Port's growth outpacing the overall national trend. This suggests a potential surge in productivity or market access for marine products in Tuticorin relative to the national level.

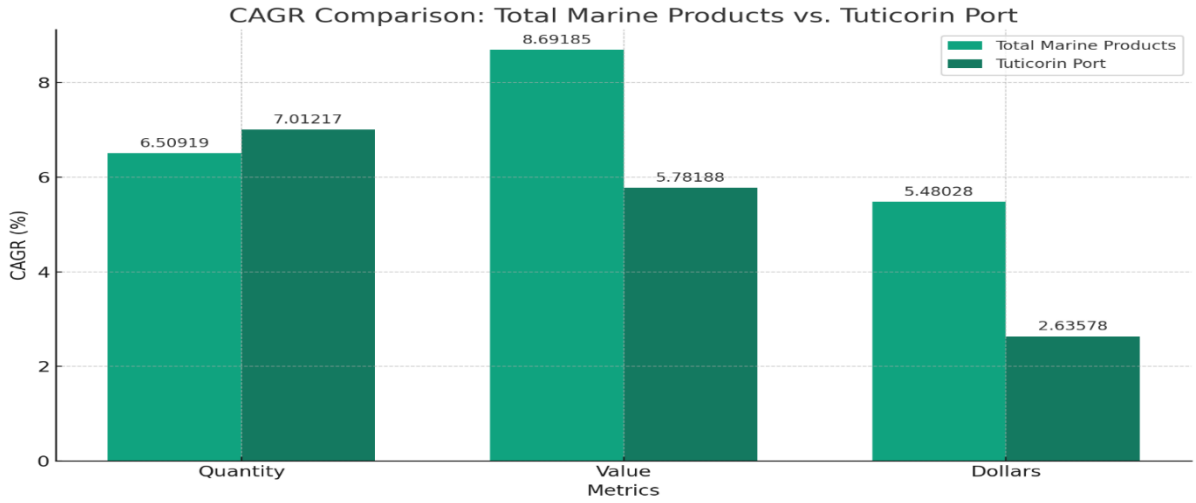
The middle graph demonstrates the YoY growth in the value of exports. The sharp peak for Tuticorin Port in one of the years stands out, suggesting an extraordinary increase in value, which could be due to significant high-value transactions or adjustments in product pricing strategies. Overall, the trend is less consistent compared to quantity, indicating that value is subject to more volatile market forces. The final segment represents the growth in dollar terms, reflecting the financial returns from exports. Similar to the value trend, there's a noticeable peak for Tuticorin Port, and both lines follow a similar pattern, with peaks and troughs coinciding across the years. The latest year marks a robust recovery from the previous year's downturn for both, with Tuticorin Port again surpassing the general trend.

The graph collectively suggests that while the general trend in export quantities and values is increasing, the marine product sector—and particularly the exports through Tuticorin Port—is subject to significant yearly variations. The notable peaks in Tuticorin Port's value and dollar growth rates could signify breakthroughs in market access or pricing, possibly from securing lucrative contracts or entering new markets that offer better prices. Economically, the data indicates that Tuticorin Port is a critical engine for growth in the marine product export sector, at times outperforming the national averages in both quantity and value. Such performance will

have considerable positive impacts on the local economy, including job creation, increased income for fishing communities, and revenue generation for associated industries. Moreover, the YoY growth patterns point to the need for strategic planning to sustain and enhance this upward trajectory, potentially influencing policy decisions around infrastructure investment, market development, and trade negotiations.

Table 4. Compound Annual Growth Rate (CAGR) Analysis of Marine Products Exports from 2013-14 to 2022-23.

Category	Quantity CAGR	Value CAGR	Dollars CAGR
Total Marine Products	6.51%	8.69%	5.48%
Marine Products through Tuticorin Port	7.01%	5.78%	2.64%



The graph depicts a comparison of the Compound Annual Growth Rate (CAGR) between total marine product exports from India and exports specifically from Tuticorin Port across three different metrics: quantity, value, and dollar return.

- Quantity CAGR shows the annual growth rate of the physical volume of marine products exported. Tuticorin Port's exports have a slightly higher CAGR in quantity than the total exports, indicating that Tuticorin has been increasing its volume of exports at a faster pace compared to the overall national rate.
- Value CAGR measures the growth rate of the export value of marine products. Here, the total value CAGR is substantially higher than Tuticorin's, which suggests that on a national level, the value of marine exports is increasing more rapidly.
- Dollars CAGR reflects the growth rate of the financial returns from marine product exports. Again, the total exhibits a higher CAGR compared to Tuticorin, implying that the overall revenue from marine exports is growing at a greater rate nationally.

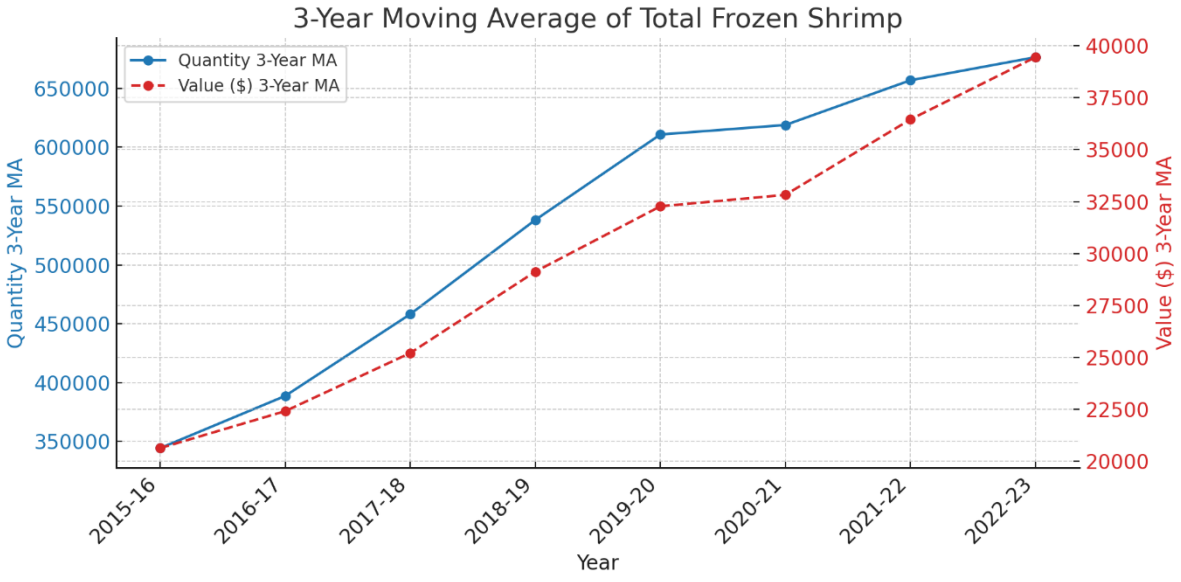
The economic conclusion drawn from this graph is that, although Tuticorin Port is exhibiting notable and noteworthy growth in terms of quantity, the country as a whole is outperforming it in terms of value and revenue from marine exports. This implies the existence of broader economic dynamics operating at the national level that are facilitating increased export revenue. It also emphasizes how crucial places like Tuticorin are to the quantity growth, pointing to possible areas for additional funding and the creation of new policies to capture and magnify this regional growth for the good of the entire country.

Table 5. Export of Frozen Shrimp

Year	Quantity (Q)	Value (V)	Dollars ($)
2013-14	301435	19368.30	3210.94
2014-15	357505	22468.12	3709.76
2015-16	373866	20045.50	3096.68
2016-17	434486	24711.32	3726.38
2017-18	565980	30868.17	4848.19
2018-19	614145	31800.51	4610.59
2019-20	652253	34152.03	4889.12
2020-21	590275	32520.29	4426.19
2021-22	728123	42706.04	5828.59
2022-23	711099	43135.58	5481.63

(Source: The Marine Products Export Development Authority)

The attached graph plots the yearly export quantity of frozen shrimp over a period from 2013-14 to 2022-23. The blue line indicates the amount of frozen shrimp that has been exported each year, with data points marked for each fiscal year. From the start of the recorded period, there is a notable upward trend in the quantity of frozen shrimp exports. This increase is consistent through 2017-18, demonstrating a growing demand for this commodity in the international market, which could be attributed to its popularity as a seafood item, India's increasing production capacity, or effective export strategies. The graph does show a slight dip in 2018-19, followed by a more pronounced decrease in 2020-21. These fluctuations might correspond to the pandemic affecting supply and demand, changes in global market conditions and operational challenges. However, there is a quick recovery observed in 2021-22, followed by a slight drop in the following year, yet the quantity remains on a higher level than the beginning of the timeline. The overall increasing trend, despite the short-term fluctuations, suggests that the frozen shrimp export industry has been expanding over the decade.



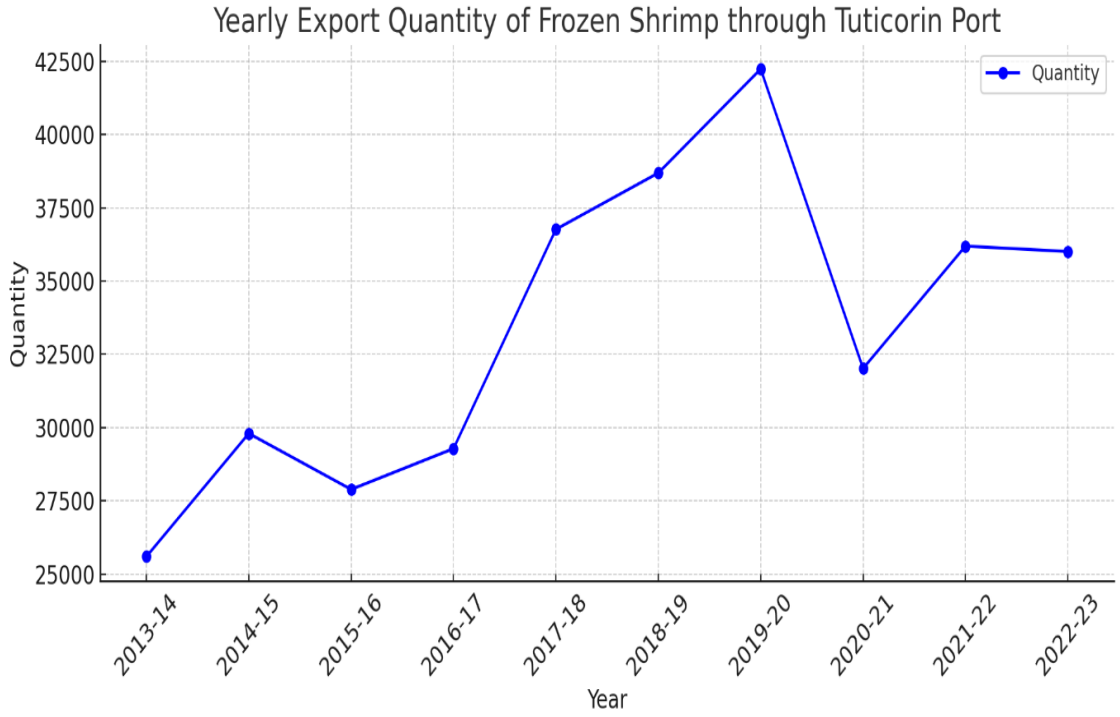
The graph shows the 3-year moving average (MA) of both the quantity and value of total frozen shrimp exported from 2015-16 to 2022-23. The blue line indicates the 3-year MA for the quantity of frozen shrimp, which displays a steady increase throughout the period. This suggests a consistent upward trend in the volume of frozen shrimp being exported, pointing to increased production, sustained or growing demand in international markets, or both. The red dotted line shows the 3-year MA for the value of the exported frozen shrimp. This line also trends upward, and notably, the slope is steeper than that of the quantity line, especially after 2018-19. This indicates that the value of exports is increasing at a faster rate than the quantity, which could suggest that exporters are receiving higher prices per unit over time, there's a shift toward more valuable shrimp products, or a combination of both. Overall, the graph signals a positive trend in the frozen shrimp market, with both the volume and value of exports on the rise. This trend is indicative of a strong sector with potential

beneficial impacts on the economy, including increased revenue for exporters, greater contributions to the trade balance, and potentially, the stimulation of related sectors in the economy due to the growth in shrimp exports.

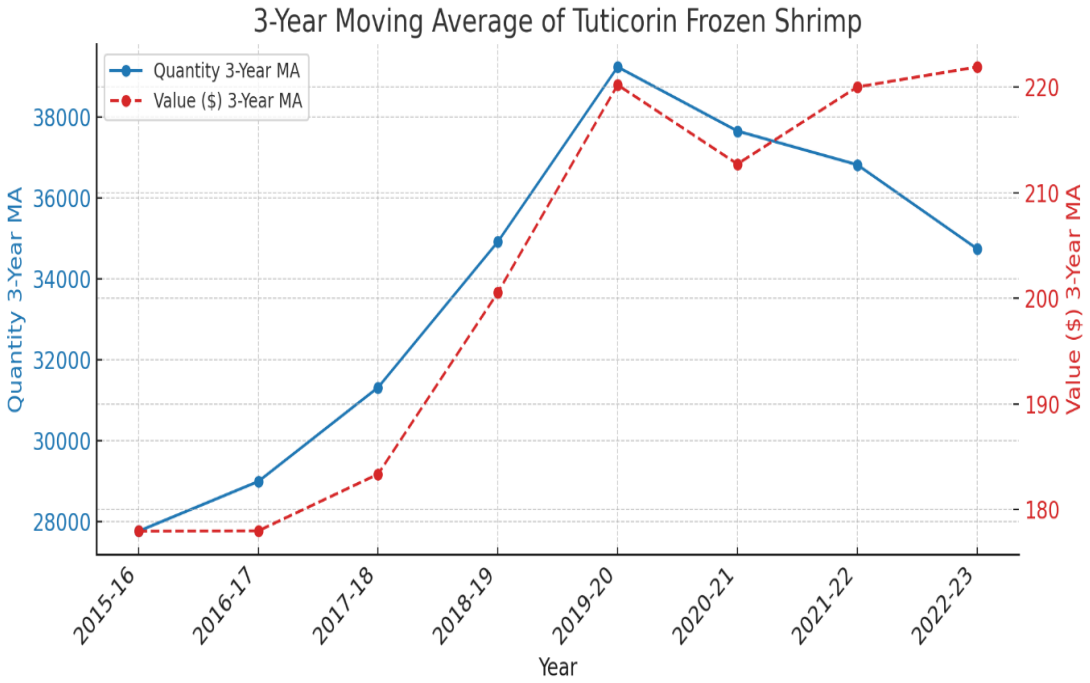
Table 6. Export of Frozen Shrimp through Tuticorin Port

Year	Quantity (Q)	Value (V)	Dollars ($)
2013-14	25594	178268.27	295.37
2014-15	29798	194638.62	321.02
2015-16	27888	160954.02	248.29
2016-17	29281	178374.68	268.89
2017-18	36768	210751.17	331.17
2018-19	38692	212520.02	308.55
2019-20	42240	237330.53	339.77
2020-21	32017	188293.07	256.13
2021-22	36195	234409.80	318.88
2022-23	36010	243001.99	307.76

(Source: The Marine Products Export Development Authority)



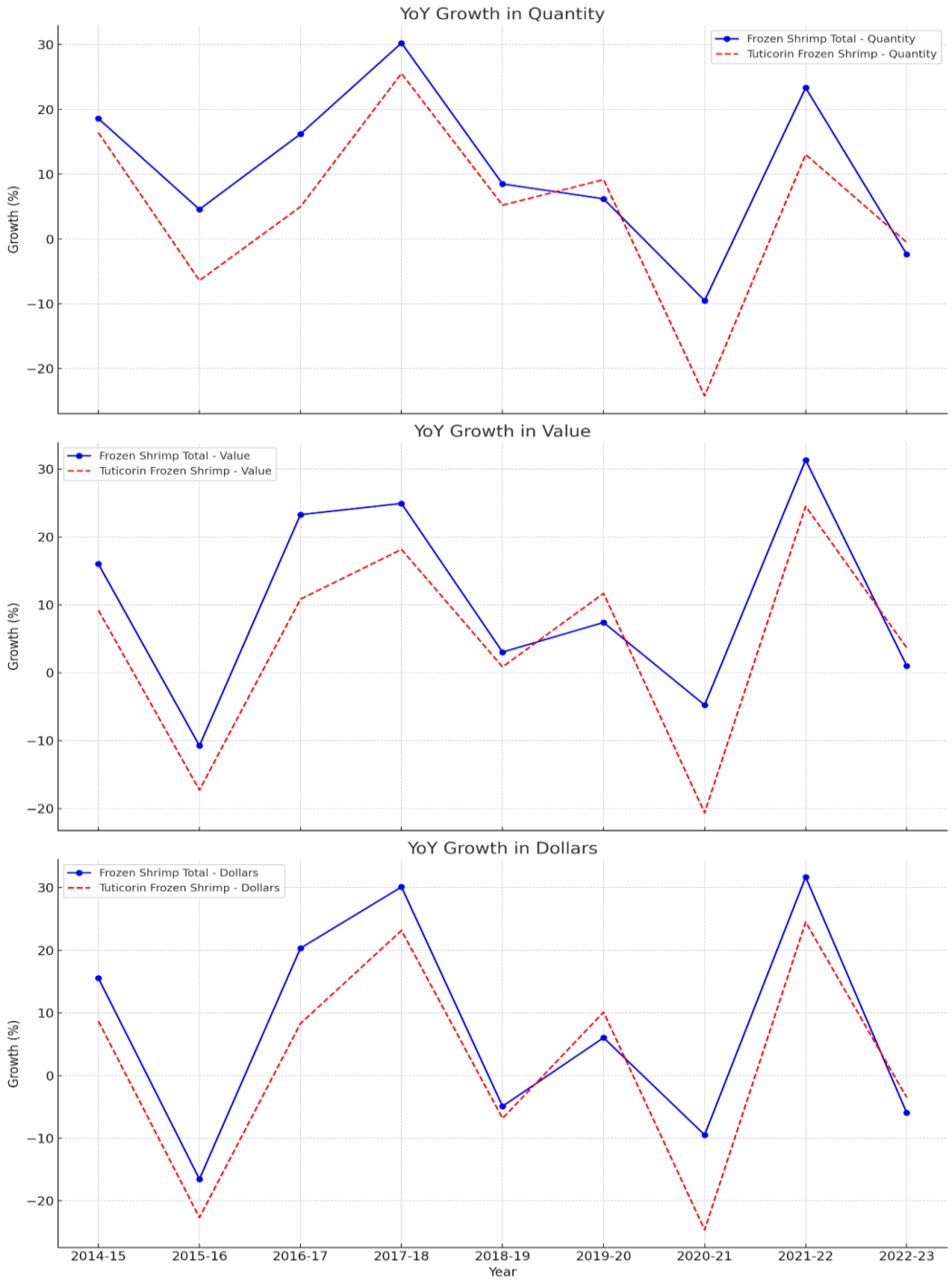
The graph tracks the yearly export quantity of frozen shrimp through Tuticorin Port over a period from 2013-14 to 2022-23. Starting from 2013-14, there's a general ascending trend in the quantity of frozen shrimp exported through Tuticorin, with some year-to-year fluctuations. Between 2013-14 and 2016-17, there is a steady increase, suggesting a growth phase for the industry. This could be due to rising global demand, improvements in shrimp farming practices, or expansions in export capacity. The subsequent years, from 2017-18 to 2019-20, show a more volatile pattern. There's a sharp increase in 2017-18, followed by a significant drop in 2019-20, which reflect the pandemic influencing the export quantities. In the final years, 2020-21 to 2022-23, the graph shows a recovery and then a plateau, which could indicate a stabilization in the market after dealing with earlier disruptions. The overall upward trend, despite the fluctuations, points towards a growing importance of Tuticorin Port in the shrimp export market. This graph could serve as an indicator of the economic health of the region's export sector, with the shrimp export quantity being a tangible measure of Tuticorin's contribution to the seafood export industry and its implications on employment, revenue, and economic development in the region.



The given graph illustrates the 3-year moving average (3-Year MA) for both the quantity and value of frozen shrimp exports through Tuticorin Port from the fiscal year 2015-16 to 2022-23. The blue line, representing the 3-year MA for quantity, shows an increasing trend from 2015-16 to 2018-19, indicating steady growth in the volume of shrimp exported through the port. The trend peaks in 2019-20, after which there is a noticeable decline, followed by a plateau in the subsequent years. The initial rise suggests an expansion in export activity, possibly due to increased production or rising global demand. The peak might reflect an exceptionally productive season or increased market access, while the decline caused by the pandemic affected the production and other economic events impacting trade. The red dotted line reflects the 3-year MA for the value of these exports, in dollars. The value shows a similar overall increase but with a slightly delayed peak in 2020-21, followed by a decline. This could indicate that while the quantity of exports began to fall in 2019-20, the value of exports continued to rise, possibly due to improved pricing, shifts to higher-value product types, or a favourable currency exchange movement. The subsequent decrease in value despite a steady quantity suggests a possible drop in prices or changes in the product mix toward lesser valuable items. The graph's dual trend lines indicate a strong and growing economic contribution from Tuticorin's shrimp exports, at least until the most recent years where we see signs of a plateau or decline. This pattern points to the need for adaptive strategies to sustain the growth and value of shrimp exports in the face of fluctuating market dynamics, environmental conditions, and global economic trends.

Table 7. Year over Year Growth Comparison of Total Export of Frozen Shrimp and Export of Frozen Shrimp from Tuticorin.

Year	Frozen Shrimp - Quantity Growth (%)	Frozen Shrimp - Value Growth (%)	Frozen Shrimp - Dollars Growth (%)	Tuticorin - Quantity Growth (%)	Tuticorin - Value Growth (%)	Tuticorin - Dollars Growth (%)
2013-14	N/A	N/A	N/A	N/A	N/A	N/A
2014-15	18.60%	16.00%	15.54%	16.43%	9.18%	8.68%
2015-16	4.58%	-10.78%	-16.53%	-6.41%	-17.31%	-22.66%
2016-17	16.21%	23.28%	20.33%	4.99%	10.82%	8.30%
2017-18	30.26%	24.92%	30.10%	25.57%	18.15%	23.16%
2018-19	8.51%	3.02%	-4.90%	5.23%	0.84%	-6.83%
2019-20	6.21%	7.39%	6.04%	9.17%	11.67%	10.12%
2020-21	-9.50%	-4.78%	-9.47%	-24.20%	-20.66%	-24.62%
2021-22	23.35%	31.32%	31.68%	13.05%	24.49%	24.50%
2022-23	-2.34%	1.01%	-5.95%	-0.51%	3.67%	-3.49%



The graph presents the Year-over-Year (YoY) growth in quantity, value, and dollars for the total export of frozen shrimp alongside the specific figures for Tuticorin Port. The solid blue line represents the total metrics for frozen shrimp exports, while the dashed red line corresponds to the Tuticorin Port.

YoY Growth in Quantity: The top graph shows the YoY growth in quantity for both the total exports and Tuticorin. Both lines exhibit fluctuations, indicating years of growth and decline. Notably, there's a trend where both lines peak and trough around the same years, which suggests that factors affecting the quantity of frozen shrimp exports in Tuticorin might also be impacting the broader market, or vice versa.

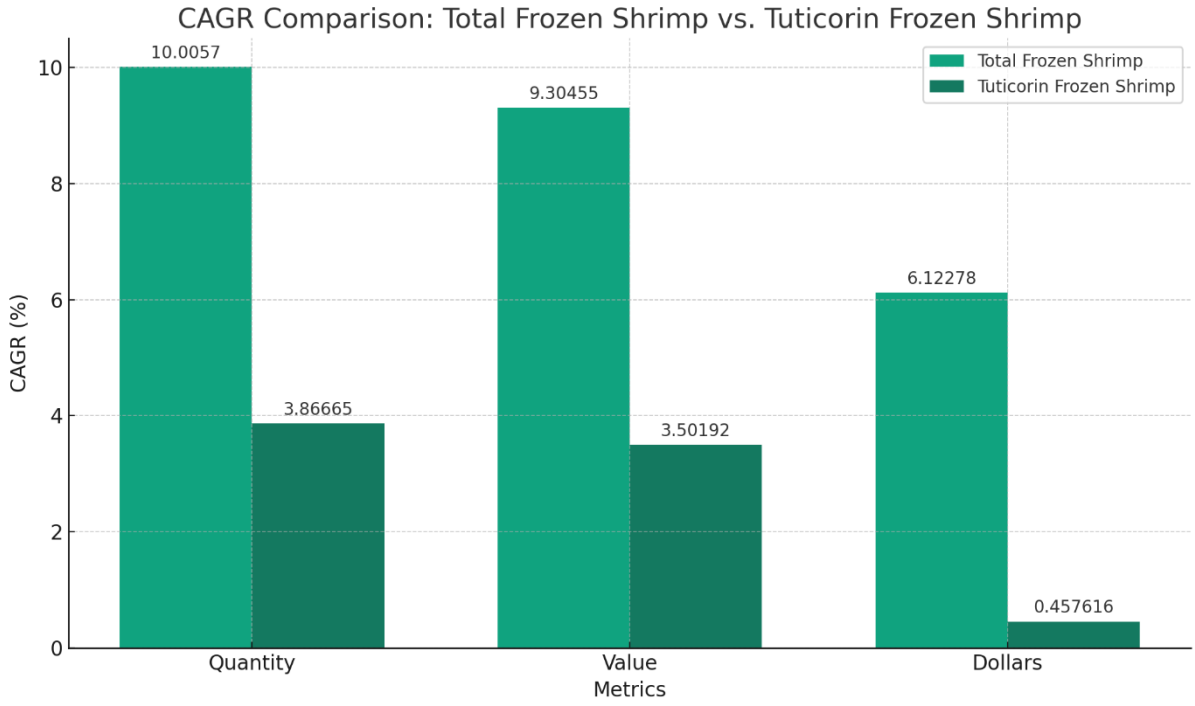
YoY Growth in Value: The middle graph represents the YoY growth in the value of exports. The pattern is similar to the quantity, with both lines again showing synchronous movements. This indicates that the changes in quantity are closely linked to the value of the exports. The high peaks and sharp drops illustrate the volatility in the market value of frozen shrimp exports.

YoY Growth in Dollars: The bottom graph showcases the YoY growth in dollar returns. This financial indicator mimics the trends observed in quantity and value, confirming that the financial returns from the frozen shrimp exports are in tune with the physical and value-based changes in the market. The significant swings in this metric underscore the economic sensitivity of the shrimp export market to various external factors.

Interpreting the Economic Impact: Together, these graphs highlight the variability and vulnerability of the frozen shrimp export market to economic conditions especially the response to the pandemic like situations. The parallel trends in Tuticorin and the overall market suggest that Tuticorin's exports are a significant reflection of global market conditions. The occasional divergence between the total and Tuticorin-specific figures can be insightful, pinpointing local factors like fluctuating water quality due to monsoons and pollution, disease outbreaks intensified by high stocking densities and poor biosecurity practices, land-use conflicts and environmental degradation, impacting the sustainability of shrimp farming operations. The clear volatility also speaks to the need for robust risk management strategies in the shrimp export industry to navigate the cyclical nature of global markets. The economic impact of such YoY changes is profound, as they affect revenue for exporters, influence market strategy, and inform policy decisions in the seafood industry.

Table 8. Compound Annual Growth Rate (CAGR) Analysis of Frozen Shrimp Exports National and Tuticorin from 2013-14 to 2022-23

Category	Quantity CAGR	Value CAGR	Dollars CAGR
Total Export of Frozen Shrimp	10.01%	9.30%	6.12%
Export of Frozen Shrimp through Tuticorin	3.87%	3.50%	0.46%



The attached graph compares the Compound Annual Growth Rate (CAGR) of the total export of frozen shrimp with the export of frozen shrimp through Tuticorin Port across three different metrics: quantity, value, and dollars.

CAGR for Quantity: The first pair of bars show the CAGR for the quantity of frozen shrimp. The total exports have a much higher CAGR than those through Tuticorin, indicating that the overall volume of frozen shrimp exports from India has been growing at a more rapid pace than the exports specifically through Tuticorin Port.

CAGR for Value: The second set of bars compares the CAGR for the value of exports. Again, the total exports of frozen shrimp have a significantly higher CAGR than those through Tuticorin Port. This suggests that the increase in the value of total frozen shrimp exports is greater at the national level than at Tuticorin.

CAGR for Dollars: The final set of bars present the CAGR for the dollar returns from the exports. The trend is consistent with the previous metrics, where the total exports of frozen shrimp have a higher CAGR compared to the exports from Tuticorin. However, the CAGR for dollars from Tuticorin's exports is notably low, which might suggest that even though there is an increase in the quantity and possibly the value, the revenue generated in dollar terms has not kept pace, possibly due to currency exchange rates, price per unit changes, or other financial factors.

Economic Interpretation: This CAGR comparison underscores the larger growth impact of total frozen shrimp exports on the national economy compared to the regional export activity through Tuticorin Port. The data suggests that while Tuticorin plays a role in the industry, there are additional growth drivers at the national level that may be contributing to the significant growth in the value and revenue of the shrimp exports in national level like infrastructure, marketing, advancements in aquaculture technology, enhanced quality control and certification processes, investments in research and development to combat disease and improve shrimp breeding etc. Here the study shows that while Tuticorin shows significant growth in the export of

marine products compared to the national level, it lags behind in the growth of frozen shrimp exports. This discrepancy highlights the need to focus on enhancing aquaculture activities in Tuticorin, particularly shrimp farming, which has high demand in international markets. By addressing region-specific challenges and implementing targeted solutions to improve shrimp farming practices, Tuticorin can be developed into a key hub for aquaculture. This focus will not only boost its frozen shrimp exports but also enable it to surpass national growth trends, mirroring its success in overall marine product exports. This information is critical for policymakers and business leaders as it highlights where to focus efforts for potential improvements by focusing on region specific issues and prioritizing infrastructure improvements, disease management, and sustainable practices which will be crucial in maximizing economic benefits for the region.

Policy Implications

Based on the comprehensive analysis a number of significant and operational policy implications can be generated for the development of shrimp farming and marine products in India. Upgradation of infrastructure and logistics, like building interconnected cold chain logistics and storage facility under the Sagarmala Programme, is essential for maintaining quality from harvest to export. Furthermore, the installation of a national network of cold chain infrastructure will minimize post-harvest losses. Strengthening the Market intelligence system under the MPEDA framework with real-time data on global trends, real time market intelligence platform to respond dynamically to pricing volatility and predict the future can give new hope to the exporters. To make certain long-term viability and environmental compliance, National Fisheries Policy should be enhanced with sustainable aquaculture principles especially focussing on disease management protocols and setting up a national shrimp disease surveillance and management system. In order to address the institutional vacuum, skill development and capacity building is vital which requires focused training programmes under the banner of National Skill Development Mission for organizing training programmes and establishing Aquaculture Innovation and Training Centres in major shrimp farming regions. New policy recommendations include establishing a full-fledged Blue Economy Initiative for convergence of all activities related to marine resource management and providing financial support through subsidies and incentives to small and marginalised farmers for transitioning to modern technologies and sustainable practices. By establishing a blockchain-based national digital traceability system to track the journey of shrimp from farm to fork will lead to high transparency, enhance food safety, and build consumer trust. At the same time, giving focus on research and development will promote innovation and productivity in developing disease-resistant shrimp strains and efficient aquaculture systems. Finally, encouraging public-private partnerships will boost the productivity and inventiveness of the private sector by funding processing facilities, enhancing port infrastructure, and opening up new markets. By putting these suggestions into practice, the Indian government can ensure that the marine product export sector, which includes shrimp farming, continues to be a major engine of economic growth and employment creation.

Conclusion

This paper studies the dynamics of marine product export, with special reference to frozen shrimp, and explains the growth trend and economic impact of marine fisheries, particularly focusing on Tuticorin. Over the past decade, exports from both national levels and Tuticorin have shown substantial increases in volume and value, demonstrating resilience against global shocks like the COVID-19 pandemic. The robust recovery underscores sector robustness and the benefits of Tuticorin's strategic location and modern facilities in enhancing export capabilities. However, the study also highlights vulnerabilities such as market volatility and disease outbreaks, necessitating resilient management practices and market diversification. The study concludes that while Tuticorin has shown significant growth in marine product exports, it lags behind in frozen shrimp exports compared to the national level. This discrepancy indicates the need for targeted improvements in shrimp farming practices in Tuticorin to meet international demand and enhance its role as a key hub for aquaculture. Enhancing infrastructure, implementing effective disease management, and promoting sustainable practices are crucial to boosting Tuticorin's frozen shrimp exports and maximizing economic benefits. While Tuticorin's growth in export value and revenue has lagged behind the national level, its substantial contributions to the national export strategy are noteworthy. This means while the volume of exports is considerably high through Tuticorin, the rise in value and revenues from the port do not sync with the national growth trends, and strategic interventions are required to drive this trend. The study emphasizes the importance of tailoring export strategies to regional strengths while addressing specific challenges. Key priority areas identified for action include infrastructure, marketing, disease management, and sustainability. The study's findings provide critical insights for policymakers to design strategic planning and policy initiatives aimed at future sustainability and global competitiveness of India's marine product exports. By addressing these issues, the industry can maintain its position as a key contributor to employment and economic growth, enhancing India's position in the global seafood market. This comprehensive analysis underscores the broader economic implications and highlights the necessity for targeted efforts to bolster Tuticorin's role in the national export framework, ultimately benefiting the regional and national economy.

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