



EXPORT COMPETITIVENESS AND DETERMINANTS OF INDONESIA'S FISHERIES COMMODITIES: EVIDENCE FROM A PROVINCIAL-LEVEL ANALYSIS

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Abstract

This study aims to analyze the competitiveness of Indonesian fishery commodity exports and identify factors influencing export performance across Indonesia's provinces. The study uses panel data covering 34 Indonesian provinces for the period 2010–2025. Export competitiveness is measured using the Revealed Comparative Advantage (RCA) index and the Location Quotient (LQ) to assess the comparative advantage of Indonesian fishery commodities in the international market. Furthermore, panel data regression analysis is used to examine the effect of price levels, trade openness, logistics performance, exchange rates, and human resource quality on fishery export performance at the provincial level. The results reveal disparities in the competitiveness of fisheries exports among Indonesian provinces. Some provinces exhibit relatively high export competitiveness, while others remain low in the international market. The regression results indicate that trade openness, exchange rates, logistics performance, and human resource quality have positive and significant effects on the export performance of Indonesian fishery commodities in the global market. In contrast, price levels have significant negative effects. These findings suggest that increasing trade integration, strengthening logistics infrastructure, and developing human capital are key factors in sustainably improving the competitiveness and export performance of Indonesia's fisheries sector.

DAYA SAING DAN DETERMINAN EKSPOR KOMODITAS PERIKANAN INDONESIA: ANALISIS PADA TINGKAT PROVINSI

Abstrak

Keywords:

*Daya saing ekspor;
komoditas perikanan;
revealed comparative
advantage; data panel*

Penelitian ini bertujuan untuk menganalisis daya saing ekspor komoditas perikanan Indonesia serta mengidentifikasi faktor-faktor yang memengaruhi kinerja ekspor perikanan antarprovinsi di Indonesia. Penelitian menggunakan data panel yang mencakup 34 provinsi di Indonesia selama periode 2010–2025. Daya saing ekspor diukur menggunakan indeks Revealed Comparative Advantage (RCA) dan Location Question (LQ) untuk menilai keunggulan komparatif komoditas perikanan Indonesia di pasar internasional. Selanjutnya, analisis regresi data panel digunakan untuk menguji pengaruh tingkat harga, keterbukaan perdagangan, kinerja logistik, nilai tukar, dan kualitas sumber daya manusia terhadap kinerja ekspor perikanan pada tingkat provinsi. Hasil penelitian menunjukkan adanya disparitas daya saing ekspor perikanan antarprovinsi di Indonesia. Beberapa provinsi memiliki daya saing ekspor yang relatif tinggi, sementara provinsi lainnya masih menunjukkan daya saing yang rendah di pasar internasional. Hasil estimasi regresi menunjukkan bahwa keterbukaan perdagangan, nilai tukar, kinerja logistik, dan kualitas sumber daya manusia berpengaruh positif dan signifikan terhadap kinerja ekspor perikanan,

sedangkan tingkat harga menunjukkan pengaruh negatif dan signifikan terhadap kinerja ekspor perikanan Indonesia di pasar global. Temuan ini mengindikasikan bahwa peningkatan integrasi perdagangan, penguatan infrastruktur logistik, dan pengembangan modal manusia menjadi faktor penting dalam meningkatkan daya saing dan kinerja ekspor sektor perikanan Indonesia secara berkelanjutan.

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INTRODUCTION

The fisheries sector is one of the strategic sectors for the national economy. The importance of the fisheries sector to the Indonesian economy is reflected in its contribution to international trade performance. This sector not only contributes to GDP growth but also plays a vital role in job creation and food security (Citaningati & Herianingrum, 2025 ; Trenggono et al., 2025 ; Komariyah et al., 2023) . The effects of job creation and food security ultimately have the potential to boost the public's well-being by improving the livelihoods of coastal communities, while also potentially increasing the country's foreign exchange earnings through export activities in international trade (Pandjaitan et al., 2025) .

As the world's largest archipelago with a long coastline and abundant fishery resources, Indonesia has great potential to develop trade in fishery commodities in international markets. Indonesia's strategic maritime position enhances its role in global trade, with the fisheries sector serving as a key component of the dynamics of international trade cooperation at both the regional and multilateral levels (Arizza et al., 2026; Aldedharma, 2024). In recent years, Indonesian fisheries commodities specifically fish and shrimp have become the primary contributors to national fisheries exports. This is reflected in the sector's inclusion among Indonesia's top 10 commodities in international markets, as shown in Table 1. The sector's export performance also highlights its increasingly important role in supporting economic growth, strengthening food security, and enhancing Indonesia's competitiveness amid the increasingly competitive dynamics of global trade.

However, the vast potential of Indonesia's fisheries resources has not yet been fully translated into equitable export advantages across all regions of the country. Another major challenge facing Indonesia's fisheries sector is the downward trend in export performance over the past five years. Although the fisheries sector as defined by the fish and shellfish subsectors in Indonesia is projected to contribute approximately 3.75 percent to national exports from 2021 to 2025, the sector's export performance is actually projected to contract by 6.97 percent over the same period. This situation indicates that the sector's abundant fisheries resources have not yet been fully converted into sustainable growth in export performance. This decline is certainly not only influenced by a drop in domestic production. Still, it may also be affected by various

factors, such as increased competition in the global market, fluctuations in international demand, limitations in logistics infrastructure, non-tariff barriers, and differences in production and processing capacities across regions.

Based on the above description, although Indonesia is one of the world's largest fisheries producers, the contribution of interprovincial fisheries exports also shows varying levels of development (Marjusni & Idris, 2023; Arrazy et al., 2021). Some provinces have become centers of fisheries production and export with high export values, while others still face various constraints, such as limited logistics infrastructure, low processing industry capacity, restricted market access, and suboptimal human resource quality (Subanpulo et al., 2025) . Differences in economic characteristics, availability of natural resources, and levels of trade openness result in uneven capabilities among provinces to capitalize on international market opportunities (Fadhillah & Zamroni, 2023) . This also indicates that heterogeneity in fisheries export competitiveness across regions persists and warrants deeper analysis to inform the formulation of more effective export development policies tailored to regional potential.

Table 1
Top 10 Major Indonesian Export Commodities

Rank	HS	Description	2021	2022	2023	2024	2025	Trend (%) 2021–2025	Share (%) 2025
1	85	Electrical Machinery/Equipment	2,053	3,175	3,465	4,230	6,032	27.67	19.48
2	61	Knitted Items	2,729	2,877	2,310	2,534	2,809	-0.69	9.07
3	64	Footwear	2,116	2,612	1,920	2,471	2,802	5.19	9.05
4	62	Ready-to-Wear Clothing (Non-Knit)	2,158	2,610	2,066	2,128	2,104	-2.51	6.8
5	15	Animal and Vegetable Fats and Oils	2,123	2,596	1,947	1,784	2,063	-4.23	6.66
6	40	Rubber and Rubber Products	2,176	1,990	1,636	1,685	1,545	-8.15	4.99
7	84	Machinery/Mechanical Equipment	898	999	798	1,019	1,470	10.57	4.75
8	94	Furniture, Home Lighting	1,790	1,733	1,303	1,438	1,423	-6.26	4.60
9	03	Fish and Shrimp	1,471	1,409	1,078	1,098	1,161	-6.97	3.75
10	38	Various Chemical Products	458	549	393	494	989	15.42	3.19

Source: Ministry of Trade of the Republic of Indonesia (2026), processed

From an international trade perspective, export competitiveness is a key indicator of a region's or country's ability to maintain and increase its market share in global markets (Hotsawadi & Widyastutik, 2023; Salvatore, 2013). Competitiveness is

not determined solely by a country’s natural resource endowments. Still, it is also influenced by various economic and institutional factors, such as the level of trade openness, the quality of logistics infrastructure, exchange rates, productivity, investment, and the quality of human resources (Hotsawadi & Gea, 2025; Al-Majali et al., 2026; Gani, 2017; Sinukaban & Karmini, 2026). A study by Hotsawadi & Gea (2025) finds that greater openness to international trade can create opportunities for domestic producers to access broader markets, adopt more advanced technology, and improve their export competitiveness. Meanwhile, studies conducted by Al-Majali et al. (2026) and Gani, (2017) also consistently find that better export logistics performance tends to increase both the volume and value of a country’s exports. This is because relatively better and more precise logistics performance is considered capable of facilitating a smoother and more efficient flow of goods from production to consumers in the global market (Al-Majali et al., 2026; Gani, 2017).

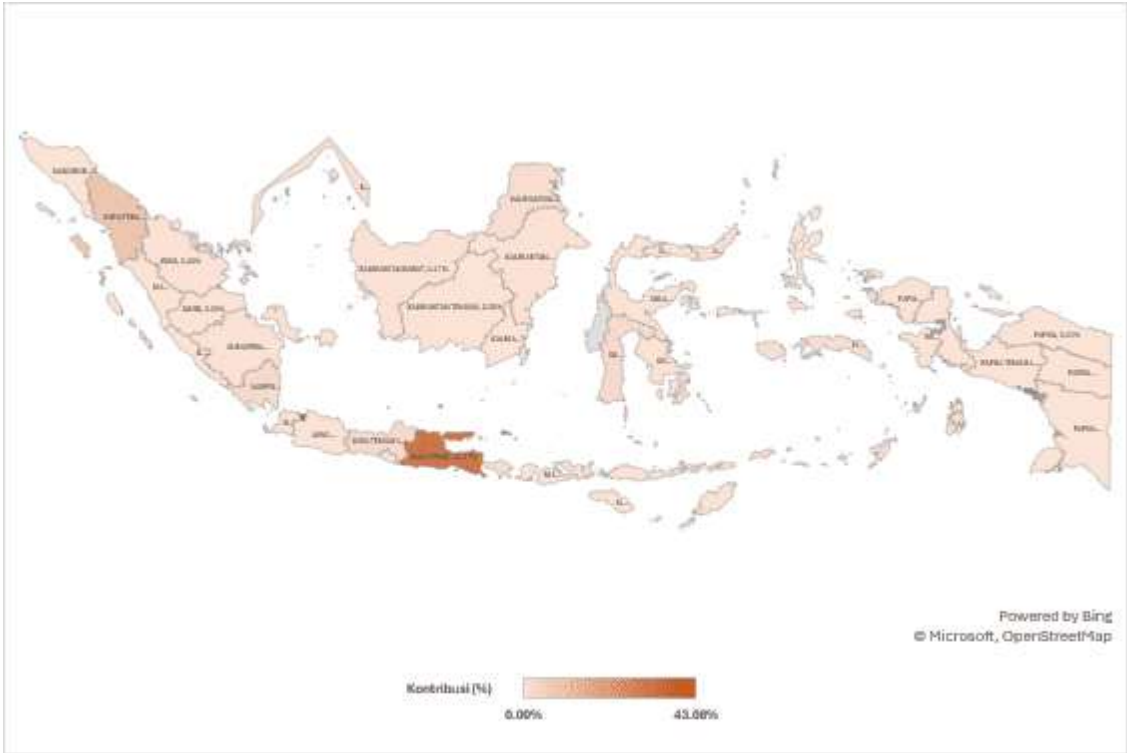


Figure 1
Distribution of Fish and Shrimp Producers by Province in Indonesia, 2012–2025 (%)

Source: Ministry of Trade of the Republic of Indonesia (2026), processed

From another perspective, studies conducted by Nejati & Bahmani (2020), Widyastutik et al., (2023), and Sinukaban & Karmini (2026) Also it indicates that exchange rates can influence competitiveness, export volume, and export value in international markets. This is because depreciation of the domestic currency can enhance competitiveness by making export prices more attractive in global markets,

thereby potentially increasing foreign consumers' purchasing power. Increased purchasing power among foreign consumers simultaneously reflects an increase in the outflow of goods—or, in other words, improved export performance. Based on the above discussion, various previous studies have shown that these factors contribute significantly to increasing a region's export capacity; however, the results remain mixed and have not yet yielded consistent conclusions, particularly in the fisheries sector and in the context of interprovincial analysis in Indonesia. Therefore, identifying the determinants of exports—particularly in the fisheries subsector, including fish and shrimp is crucial for understanding the factors that can drive improvements in the competitiveness of fisheries commodities across various regions.

Most previous studies on Indonesian fisheries exports have focused on the national level or on specific commodities, thus providing limited insight into variations in competitiveness and export determinants at the provincial level. However, spatial and regional approaches are becoming increasingly relevant given the differing production characteristics, economic structures, and export capacities across provinces (Marjusni & Idris, 2023; Arrazy et al., 2021). This research gap highlights the need for studies that not only measure the competitiveness of Indonesia's fisheries commodities but also comprehensively analyze the determinants influencing export performance at the provincial level. By adopting an interprovincial perspective, this study is expected to provide more in-depth empirical evidence regarding the patterns of Indonesia's fisheries export competitiveness and serve as a foundation for formulating more targeted, inclusive, and sustainable fisheries sector development policies.

This study aims to examine the competitiveness and export dynamics of Indonesia's fisheries commodities across provinces by adopting an interprovincial perspective. Specifically, it seeks to identify spatial variations in export competitiveness, analyze the determinants influencing provincial export performance, and provide comprehensive empirical evidence on regional competitiveness patterns. The findings are expected to serve as a scientific basis for formulating more targeted, inclusive, and sustainable fisheries sector development policies, while supporting strategies to enhance Indonesia's fisheries export performance in the global market.

Sectoral Competitiveness in the International Market

Export competitiveness is the ability of a country, region, or economic sector to produce and market goods that can compete sustainably in international markets. From an international trade perspective, competitiveness not only reflects the ability to increase export market share but also demonstrates a country's capacity to leverage its comparative advantages to create added value and maintain its position amid increasingly intense global competition (Salvatore, 2013 ; Widodo, 2009 ; Wijaya et al., 2020) . The concept of competitiveness is often associated with comparative advantage and competitive advantage, whereby a country is considered highly competitive if it can

produce and export commodities more efficiently than other countries (Oktaviani & Novianti, 2014 ; Hotsawadi & Widyastutik, 2023) . Therefore, competitiveness is a key indicator for assessing international trade performance and the effectiveness of a country's economic policies.

One of the most widely used approaches to measuring export competitiveness is the concept of Revealed Comparative Advantage (RCA), introduced by Bela Balassa. The RCA index measures a commodity's comparative advantage based on actual export patterns in international markets. A commodity is said to have a comparative advantage if its share of a country's total exports is greater than the share of that same commodity in total world exports (Mankiw, 2019 ; Harahap & Widyastutik, 2020). An RCA value greater than one indicates that the country or region has a comparative advantage and relatively strong competitiveness in the commodity under analysis. In contrast, an RCA value less than one indicates weak export competitiveness for that commodity. To date, the RCA approach remains the most widely used tool in international trade research because it provides insight into the patterns of specialization and the competitive position of a country or region in global trade.

Over time, export competitiveness has come to be determined not only by the availability of natural resources but also by various economic, institutional, and technological factors. Factors such as productivity, the quality of logistics infrastructure, trade openness, investment, exchange rates, the quality of human resources, and innovation capacity have been shown to play a crucial role in enhancing a country's ability to penetrate international markets (Hotsawadi & Gea, 2024; Al-Majali et al., 2026 ; Gani, 2017; Sinukaban & Karmini, 2026). Thus, comparative advantages stemming from natural factors must be supported by competitive advantages derived from production efficiency, technological mastery, and conducive policies to generate sustainable export competitiveness. This situation demonstrates that competitiveness is a dynamic concept that can change in line with developments in economic structure, technology, and the global trade environment.

In the fisheries sector, measuring export competitiveness is increasingly important given the intense competition among producing countries vying for international market share. For Indonesia, which possesses vast fisheries resources spread across various provinces, an analysis of export competitiveness can identify regions with comparative advantages and evaluate the effectiveness of fisheries sector development policies. This information serves as a crucial foundation for formulating strategies to boost exports, strengthen the fisheries value chain, and develop a processing industry capable of increasing the value added and competitiveness of Indonesian fisheries commodities in the global market.

Determinants of Fisheries Export Performance in International Markets

Fisheries export performance is a key indicator reflecting a country's or region's ability to leverage its fisheries resource potential to compete in international markets. In international trade theory, export performance is not solely determined by natural resource advantages but is also influenced by various economic, institutional, and infrastructure factors that shape a commodity's competitiveness. Several studies indicate that the success of fishery product exports is influenced by internal factors, such as production capacity, productivity, human resource quality, and the value added by the processing industry, as well as external factors including global market demand, exchange rates, trade openness, logistics costs, and international trade policies (Hotsawadi & Gea, 2024;; Al-Majali et al., 2026 ; Gani, 2017; Sinukaban & Karmini, 2026). Therefore, analyzing the determinants of exports is crucial for understanding the factors that can enhance a country's fisheries export competitiveness and sustainability amid increasingly intense global competition.

One factor often associated with improved export performance is trade openness. The more open an economy is to international trade, the greater the opportunities for domestic producers to access foreign markets, acquire new technologies, and improve production efficiency. Trade openness can also reduce trade barriers, thereby facilitating the flow of goods and services between countries (Nuraini, 2019 ; Hotsawadi & Gea, 2025; Fadhillah & Zamroni, 2023). In the fisheries sector, increased integration into international trade has expanded access to export markets and increased the volume of trade in fishery products.

In addition to trade liberalization, logistics performance is a crucial factor determining the competitiveness of fisheries exports. The perishable nature of fishery products demands an efficient logistics system that spans transportation, warehousing, ports, cold chains, and customs procedures. Good logistics infrastructure can reduce trade costs, shorten delivery times, maintain product quality, and increase international market confidence in a country's fishery products (Al-Majali et al., 2026; Gani, 2017). Research on Indonesia's fisheries exports indicates that the quality of trade facilities and port infrastructure has a significant impact on the export of fisheries and their derivative commodities (Sitompul et al., 2018; Aryudiawan & Suadi, 2022).

Another significant factor is the exchange rate. In international economic theory, a depreciation of the domestic exchange rate tends to enhance the price competitiveness of exports because they become relatively cheaper for foreign buyers. Conversely, an appreciation of the exchange rate can reduce export competitiveness due to the relative increase in the price of domestic products in international markets (Salvatore, 2013; Mankiw, 2021). Various studies on fisheries trade indicate that exchange rate fluctuations are one of the key determinants affecting both the volume and value of

fisheries exports, including in ASEAN fisheries trade and Indonesian fisheries exports (Hotsawadi & Widyastutik, 2023; Arif & Huda, 2025) .

At the regional level, the quality of human resources—generally proxied by the Human Development Index (HDI) can also influence export performance. Improvements in the quality of education, health, and living standards can enhance labor productivity, the ability to adopt technology, production efficiency, and innovation capacity within the fisheries industry (Li, 2025). Regions with higher-quality human resources tend to be better equipped to produce products that meet international food quality and safety standards, thereby enhancing competitiveness and export performance (Eldyani & Wardoyo, 2010; Fajar & Santoso, 2014). From a regional economic perspective, strengthening human capital is a key prerequisite for driving the transformation of the fisheries sector from a resource-based model to a productivity-based model that generates high value-added (Abrha, 2025 ; Ehrenberg & Smith, 2018).

Based on this discussion, this study identifies trade openness, logistics performance, exchange rates, and human resource quality as the main determinants that could potentially influence the export performance of Indonesian fishery commodities at the provincial level. The selection of these variables is based on theoretical and empirical considerations that export success depends not only on the availability of fishery resources but also on a region's ability to create an economic environment that supports production efficiency, smooth distribution, and enhanced competitiveness in international markets.

Conceptual Framework

The conceptual framework of this study was developed to explain the factors influencing the competitiveness and export performance of Indonesia's fishery commodities at the provincial level, as examined through the fish and shrimp subsectors. Export competitiveness reflects a region's ability to maintain and increase its market share in international markets, which is influenced by various factors from both internal and external sources. Differences in fisheries resource potential, production capacity, infrastructure quality, human development levels, and the degree of interprovincial trade openness result in varying levels of export competitiveness. Therefore, identifying the factors that determine export competitiveness is crucial for formulating policies to improve the fisheries sector's export performance and strengthen its contribution to the national economy.

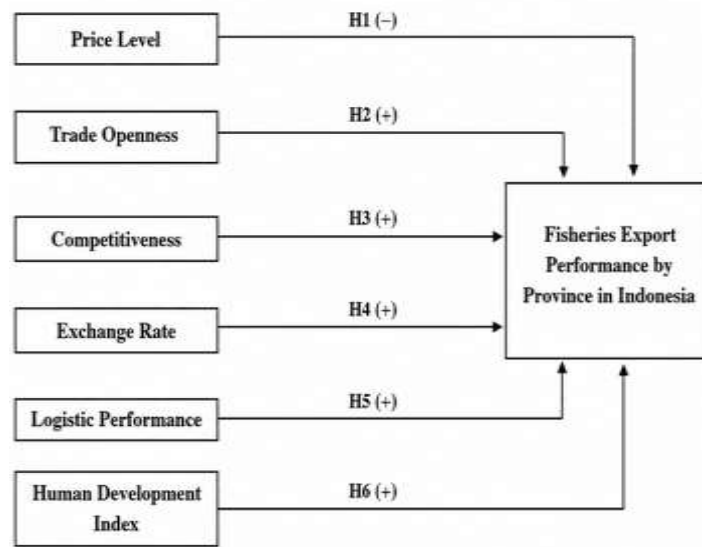


Figure 2
Conceptual Framework

Based on international trade theory and various empirical findings, this study assumes that the competitiveness and export performance of fisheries commodities —as reflected through the export value approach—are influenced by several key factors, namely fisheries production capacity, trade openness, logistics performance, exchange rates, and the quality of human resources, proxied by the Human Development Index (HDI). An increase in production capacity is expected to strengthen comparative advantages and boost export supply. Higher trade openness can expand access to international markets, while an efficient logistics system helps reduce distribution costs and enhance product competitiveness in global markets. Furthermore, exchange rate fluctuations affect the price competitiveness of export products, whereas improvements in human resource quality contribute to productivity, innovation, and the quality of fishery products. Thus, the conceptual framework of this study describes the relationship between these factors and the export performance of Indonesian fishery commodities at the provincial level, serving as the basis for developing an empirical model and testing the research hypotheses.

Mathematically, the relationship tested in this study can be formulated as follows:

$$FEP_{it} = f(Price\ Level_{it}, TO_{it}, LP_{it}, ER_{it}, HDI_{it})$$

Based on the mathematical equation above, the research hypotheses in this study, which are grounded in the background and literature review discussed above, are as follows:

1. H1: Price levels have a negative and significant effect on the export performance of Indonesian fishery commodities at the provincial level in international markets.
2. H2: Trade openness has a positive effect on the export competitiveness of Indonesian fishery commodities at the provincial level in international markets.

3. H3: Logistics performance has a positive effect on the export competitiveness of Indonesian fishery commodities at the provincial level.
4. H4: The exchange rate has an effect on the export competitiveness of Indonesian fishery commodities at the provincial level in international markets.
5. H5: The Human Development Index (HDI) has a positive effect on the export competitiveness of Indonesian fishery commodities at the provincial level.
6. H6: Price levels, competitiveness, trade openness, logistics performance, exchange rates, and the Human Development Index (HDI) simultaneously have a significant effect on the export competitiveness of Indonesian fishery commodities at the provincial level.

METHOD

Data Type and Sources

This study uses secondary panel data that combine time-series and cross-sectional components. The cross consists of 34 provinces in Indonesia, while the time-series dimension covers the observation period from 2010 to 2025. The use of panel data allows for a more comprehensive analysis of variations in the export competitiveness of fishery commodities across provinces and changes over time.

Table 2
Types and Sources of Research Data

No	Variable	Symbol	Unit	Time Period	Data Source	Reference
Dependent Variable						
1	Export Performance by Province in Indonesia	EXP	USD	2012–2025	Ministry of Trade of the Republic of Indonesia	Hotsawadi & Widyastutik, 2023
Independent Variables						
2	Commodity Prices	PRICE	Index	2012–2025	Trademap & Ministry of Trade	(Handley, 2014 ; Jia et al., 2020 ; Gignarta et al., 2024 ; Chakradhar et al., 2025)
3	Trade Openness	TO	Percent	2012–2025	World Bank	(Zhang et al., 2025 ; Hotsawadi & Widyastutik, 2023 ; Al-Majali et al., 2026)

N o	Variable	Symbo l	Unit	Time Period	Data Source	Reference
4	Logistics Performance	LP	Index	2012– 2025	World Bank	(Al-Majali et al., 2026 ; Gani, 2017) .
5	Exchange Rate	ER	LCU/ Rp	2012– 2025	World Bank	(Nejati & Bahmani, 2020 ; Widyastutik et al., 2023) .
6	Human Development Index	HDI	Index	2012– 2025	Central Bureau of Statistics (BPS)	(Li, 2025 ; Choi et al., 2024 ; Teixeira & Fortuna, 2006) .

The dependent variable in this study is the export performance of fishery commodities. Data on fishery commodity exports were obtained from official publications of the Ministry of Trade of the Republic of Indonesia, Trademap, and UN Comtrade. Meanwhile, the independent variables include the competitiveness of the fisheries sector, measured using the Revealed Comparative Advantage (RCA) index; fisheries commodity prices; trade openness; logistics performance; exchange rates; and the Human Development Index. All data were collected through documentation methods from statistical publications, annual reports, and official databases published by relevant agencies. The collected data were then processed and analyzed using the panel data regression method to identify the factors influencing the export performance of Indonesian fisheries commodities at the provincial level.

Competitiveness Analysis Methods: Location Quotient (LQ) and Revealed Comparative Advantage (RCA)

This study employs two analytical approaches the Location Quotient (LQ) and Revealed Comparative Advantage (RCA) to assess the competitiveness of Indonesia's fishery commodities at the provincial level. These two methods complement each other in evaluating competitiveness from both domestic and international perspectives. The Location Quotient (LQ) analysis is used to determine whether the fisheries sector is a base or leading sector in a province by comparing its relative specialization to the national level. In contrast, the Revealed Comparative Advantage (RCA) measures a commodity's comparative advantage in international markets based on its export performance. The combination of these two approaches has been widely used in international trade research and regional competitiveness analysis because it provides a more comprehensive picture of a region's competitive position (Balassa, 1965; Cavenaile & Sougné, 2012). Mathematically, the equations for calculating competitiveness using the LQ and RCA approaches are as follows.

1. The Location Quotient equation is formulated as follows:

$$LQ = \frac{\left(\frac{x_{ij}}{x_j}\right)}{\left(\frac{x_i}{x}\right)} \dots \dots \dots (1)$$

Based on equation (1) above, the explanation of each variable is as follows:

X_{ij}= value of fishery commodity exports in the provincej ;

X_j= total exports of all commodities in the provincej ;

X_i= total exports of fisheries commodities in Indonesia;

X= total national exports of all commodities

2. The RCA equation is formulated as follows:

$$RCA = \frac{\left(\frac{x_{ij}}{x_j}\right)}{\left(\frac{x_{iw}}{x_w}\right)} \dots \dots \dots (2)$$

Based on equation (2) above, the explanations for each variable are as follows:

X_{ij}= value of the province's fishery commodity exportsj ;

X_j= total exports of all commodities in the provincej ;

X_{iw}= the value of global fisheries exports;

X_w= total global exports of all commodities.

The results of the Location Quotient (LQ) and Revealed Comparative Advantage (RCA) analyses were integrated to classify the competitiveness levels of fishery commodities in each province. Provinces with LQ > 1 and RCA > 1 are categorized as having both domestic and global competitiveness, indicating that the fishery sector is a key economic pillar and possesses a comparative advantage in international markets. Conversely, an LQ > 1 and an RCA < 1 indicate domestic competitiveness, meaning the sector is a regional flagship but is not yet globally competitive. Meanwhile, an LQ < 1 and an RCA > 1 indicate global competitiveness, meaning the commodity possesses a comparative advantage even though it has not yet become a regional pillar sector. Furthermore, LQ < 1 and RCA < 1 indicate that the commodity does not yet possess a competitive advantage in either the domestic or international markets. This classification provides a basis for identifying the competitive position of each province and for formulating more effective export development policies (Balassa, 1965; Widodo, 2009).

Analysis of Factors Determining Fisheries Export Performance: A Panel Data Regression Approach

Data analysis was conducted using a panel data regression model. This is because panel data regression is considered optimal for simultaneously accommodating data with both a time dimension (time series) and an individual dimension (cross-section), thereby capturing the dynamics of changes over time as well as differences in characteristics across provinces (Gujarati & Porter, 2013; Wooldridge, 2015;

Blackburne & Frank, 2007). Furthermore, the use of panel data can increase the number of observations, reduce the potential for omitted variable bias, and yield more efficient and consistent parameter estimates compared to the separate use of cross-sectional or time-series data (Gujarati & Porter, 2013; Wooldridge, 2015). Thus, the panel data regression model is well-suited for analyzing the determinants of fisheries export performance by region in Indonesia within global markets that exhibit heterogeneous characteristics and evolve dynamically over time. Based on the above discussion, the empirical equations used in this study are formulated as follows:

$$EXPORT_{it} = \beta_0 + \beta_1 PRICE_{it} + \beta_2 TO_{it} + \beta_3 LP_{it} + \beta_4 ER_t + \beta_5 HDI_{it} + \varepsilon_{it} \dots (3)$$

Given that the variables used in this study have different units of measurement—such as export value (USD), fishery commodity prices (USD), exchange rates, the human development index, and indicators of logistics and trade openness—some variables were transformed into natural logarithms. This transformation aims to standardize the measurement scales across variables, reduce potential heteroscedasticity, improve the distribution of data that tends to be non-normal, and facilitate the interpretation of regression coefficients in the form of elasticity (Gujarati & Porter, 2013 ; Wooldridge, 2015; Hotsawadi et al., 2025). Thus, the estimated results are more stable, efficient, and easier to interpret when explaining the relationship between changes in independent variables and provincial export performance in Indonesia.

RESULTS AND DISCUSSION

Results

This study aims to analyze and identify the level of competitiveness of Indonesian fishery commodity exports at the provincial level in international markets, as well as the factors influencing it during the 2012–2025 period. Competitiveness analysis was conducted using the Location Quotient (LQ) and Revealed Comparative Advantage (RCA) approaches, while the determining factors were analyzed using a panel data regression model.

Competitiveness of the Fisheries Sector by Province in Indonesia

The results of the analysis indicate disparities in the competitiveness of fishery commodities across Indonesian provinces during the 2012–2025 period. Table 3 presents the results of the analysis of the competitiveness of Indonesia's fishery commodities at the provincial level during the 2012–2025 period. Based on average export values in millions of USD, DKI Jakarta has the highest at 1,443.13 million USD, followed by East Java at 1,080.83 million USD and North Sumatra at 283.70 million USD. These three provinces also have Location Quotient (LQ) and Revealed Comparative Advantage (RCA) values greater than one. DKI Jakarta has an LQ of 16.01 and an RCA of 15.94; East Java has an LQ of 10.03 and an RCA of 11.94; while North

Sumatra has an LQ of 3.11 and an RCA of 3.13. These results indicate that all three provinces are highly competitive both domestically and globally.

From another perspective, Central Java and Maluku have LQ values of 1.04 and 2.00, respectively, but their RCA values remain below one, at 0.92 and 0.41. This indicates that both provinces possess domestic competitiveness but do not yet have a comparative advantage in international markets. In contrast, Lampung has an RCA of 1.11 and an LQ of 0.52, indicating that the province is globally competitive even though the fisheries sector has not yet become a key regional sector. Based on the analysis results shown in Table 3 above, most other provinces exhibit LQ and RCA values less than 1, thus being categorized as non-competitive at both the domestic and global levels.

Table 3
Results of the Analysis of Domestic and Global Competitiveness of the Fisheries Sector by Province in Indonesia

Province	Average Exports 2012–2025 (Million USD)	Average Domestic Competitiveness (LQ) 2012–2025	Average Global Market Competitiveness (RCA) 2012–2025	Notes
DKI Jakarta	1,443.13	16.01	15.94	Competitive domestically and globally
East Java	1080.83	10.03	11.94	Domestic and global competitiveness
North Sumatra	283.70	3.11	3.13	Domestic and global competitiveness
Lampung	100.92	0.52	1.11	Global competitiveness
Central Java	83.25	1.04	0.92	Domestic competitiveness
South Sulawesi	74.83	0.48	0.83	Not competitive
Bali	59.57	0.39	0.66	Not competitive
North Kalimantan	52.32	0.53	0.58	Not competitive
North Sulawesi	39.23	0.25	0.43	Not competitive

Province	Average Exports 2012–2025 (Million USD)	Average Domestic Competitiveness (LQ) 2012–2025	Average Global Market Competitiveness (RCA) 2012–2025	Notes
Maluku	37.33	2.00	0.41	Domestically competitive
Riau Islands	32.75	0.90	0.36	Not competitive
Bangka Belitung	12.38	0.28	0.14	Not competitive
Southwest Papua	10.01	0.35	0.11	Not competitive
Riau	8.55	0.40	0.09	Not competitive
South Sumatra	6.30	0.03	0.07	Not competitive
West Kalimantan	5.73	0.07	0.06	Not competitive
East Kalimantan	5.09	0.05	0.06	Not competitive
South Papua	4.81	0.41	0.05	Not competitive
Southeast Sulawesi	2.26	0.03	0.02	Not competitive
West Papua	1.89	0.05	0.02	Not competitive
South Kalimantan	1.10	0.01	0.01	Not competitive
North Maluku	0.64	0.00	0.01	Not competitive
East Nusa Tenggara	0.59	0.02	0.01	Not competitive
Special Region of Yogyakarta	0.53	0.02	0.01	Not competitive
Papua	0.43	0.01	0.00	Not competitive
West Java	0.38	0.00	0.00	Not competitive
Aceh	0.30	0.00	0.00	Not competitive
West Sumatra	0.23	0.00	0.00	Not competitive
West Nusa Tenggara	0.15	0.00	0.00	Not competitive
Central Sulawesi	0.14	0.00	0.00	Not competitive

Province	Average Exports 2012–2025 (Million USD)	Average Domestic Competitiveness (LQ) 2012–2025	Average Global Market Competitiveness (RCA) 2012–2025	Notes
Banten	0.13	0.00	0.00	Not competitive
Central Papua	0.08	0.01	0.00	Not competitive
Gorontalo	0.04	0.00	0.00	Not competitive
Central Kalimantan	0.02	0.00	0.00	Not competitive
Mountainous Papua	0.00	0.00	0.00	Not competitive
Jambi	0.00	0.00	0.00	Not competitive
Bengkulu	0.00	0.00	0.00	Not competitive

Source: (Ministry of Trade of the Republic of Indonesia, 2026; Badan Pusat Statistik, 2026; International Trade Centre, 2026), processed

In this regard, 30 out of 36 provinces have LQ values < 1 and RCA values < 1 , and are therefore categorized as non-competitive at both the domestic and global levels. These provinces include Bali, Bangka Belitung, Banten, Bengkulu, Yogyakarta Special Region, Gorontalo, Jambi, West Java, West Kalimantan, South Kalimantan, Central Kalimantan, East Kalimantan, North Kalimantan, Riau Islands, North Maluku, Nanggroe Aceh Darussalam, West Nusa Tenggara, East Nusa Tenggara, Papua, West Papua, Southwest Papua, Papua Pegunungan, South Papua, Central Papua, Riau, South Sulawesi, Central Sulawesi, Southeast Sulawesi, North Sulawesi, West Sumatra, and South Sumatra. This phenomenon indicates that most Indonesian provinces have not yet made the fisheries sector a pillar of their regional economies and do not yet possess strong comparative advantages in international markets. The export competitiveness of Indonesia's fisheries commodities remains concentrated in a small number of provinces. At the same time, most other regions still face challenges in enhancing the specialization of their fisheries sectors and strengthening their competitive positions in international markets.

Determinants of Indonesia's Fisheries Sector Export Performance by Province in International Markets

The use of panel data regression models in this study was conducted in several stages to obtain the best model, or in other words, a model classified as BLUE (Best Linear Unbiased Estimator). The best model was selected using the Chow, Hausman, and Lagrange Multiplier tests to determine whether the Common Effects Model

(CEM), Fixed Effects Model (FEM), or Random Effects Model (REM) was appropriate. In this case, the results of the analysis using these three tests indicated that the Fixed Effects Model (FEM) was the best. Meanwhile, based on the multicollinearity test results, all independent variables had VIF values below the tolerance threshold of 10. These findings indicate that there are no multicollinearity issues in the regression model; therefore, all independent variables are suitable for use in further estimation (Gujarati & Porter, 2013; Wooldridge, 2015; Hotsawadi et al., 2025).

Table 4
Results of the Chow Test, Hausman Test, and Lagrange Multiplier Test

Best Model Test	Probability Values	Conclusion
Chow Test	0.0000**	Best FEM
Hausman Test	0.0004**	Best FEM

Note: Standard errors are reported in parentheses. ** $p < 0.01$, * $p < 0.05$ – 0.10 .

Source: Authors' estimates, processed

Table 5
Results of the Multicollinearity Test

Variable	VIF	1/VIF
PRICE _{it}	2.184	0.458
TO _{it}	3.127	0.320
LP _{it}	2.746	0.364
ER _{it}	1.893	0.528
HDI _{it}	1.435	0.697
Mean VIF	2.277	-

Source: Processed primary data (2026).

The final step in producing a BLUE model for panel data regression is to test for heteroscedasticity and autocorrelation. The results of the Breusch–Pagan/ test for heteroscedasticity show a p-value of 0.233, which is greater than the 5% significance level. Thus, the null hypothesis stating that the residual variance is constant cannot be rejected. These results indicate that the panel data regression model is free of heteroscedasticity; therefore, the estimated regression coefficients are efficient and consistent. Meanwhile, the Wooldridge autocorrelation test yielded a p-value of 0.264, which is greater than 0.05. Additionally, the Durbin–Watson statistic of 2.041 is close to two, indicating the absence of autocorrelation in the model's residuals. Therefore, the residuals across observation periods are independent, and the assumption of no autocorrelation is satisfied. Consequently, it can be concluded that the panel data regression model used to analyze the determinants of Indonesia's fisheries export performance in international markets meets the assumptions of the Best Linear Unbiased Estimator (BLUE).

Table 6
Results of the Heteroskedasticity Test and Autocorrelation Test

Test	Statistic	Probability	Decision
Breusch–Pagan	6.842	0.233	Homoscedasticity
Wooldridge Test for Autocorrelation	1.284	0.264	No autocorrelation
Durbin–Watson Statistic	2.041	-	No autocorrelation

Source: Processed primary data (2026)

Next, tests were conducted using the simultaneous test (F-test) and the coefficient of determination (R^2) to evaluate the significance and ability of the model to explain variations in fisheries export performance across provinces in Indonesia. Based on the results of the analysis using classical assumption tests including tests for multicollinearity, heteroscedasticity, and autocorrelation the model satisfied the relevant assumptions. Furthermore, the R-squared value of 0.864 indicates that 86.4% of the variation in the competitiveness of fisheries commodity exports across Indonesian provinces is explained by fisheries commodity prices, trade openness, logistics performance, exchange rates, and the Human Development Index (HDI).

Table 7
Results of Panel Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.183	0.456	4.787	0.038**
PRICE _{it}	-0.318	0.074	-4.297	0.000***
TO _{it}	0.247	0.061	4.049	0.071*
LP _{it}	0.192	0.058	3.310	0.001***
ER _{it}	0.128	0.047	2.723	0.068*
HDI _{it}	0.285	0.093	3.065	0.024**
R-squared		0.864		
Adjusted R-squared		0.851		
F-statistic Prob(F-statistic)		65.42		
Prob(F-statistic)		0.0000		

Note: Standard errors are reported in parentheses.** $p < 0.01$, * $p < 0.05$ –0.10.

Source: Authors' estimates, processed.

Meanwhile, the remaining 13.6% is influenced by other factors outside the research model. Furthermore, the results of the simultaneous test (F-test) yielded an F-statistic value of 65.420 with a Prob. (F-statistic) value of 0.0000, which is smaller than the 5% significance level. These results indicate that, taken together, the variables of fishery commodity prices, trade openness, logistics performance, exchange rates, and the Human Development Index (HDI) have a significant effect on the export

competitiveness of Indonesian fishery commodities at the provincial level. Thus, the panel data regression model used is effective in explaining the relationship between the independent variables and the export competitiveness of fishery commodities (Gujarati & Porter, 2013 ; Wooldridge, 2015 ; Blackburne & Frank, 2007) .

The results of the panel data regression presented in Table 7 show that fishery commodity prices have a negative and significant effect on the export competitiveness of Indonesian fishery commodities. Conversely, trade openness, logistics performance, the exchange rate, and the Human Development Index (HDI) positively affect export competitiveness, with varying degrees of significance. These results indicate that increased trade openness, improved logistics infrastructure, a competitive exchange rate, and higher-quality human resources enhance the export competitiveness of fishery commodities. In contrast, rising commodity prices tend to reduce competitiveness in international markets.

Discussion

Competitiveness of the Fisheries Sector by Province in Indonesia

The research results show that only DKI Jakarta, East Java, and North Sumatra possess both competitive and comparative advantages. According to (Balassa, 1965), Aryudiawan & Suadi (2022) and Hotsawadi & Gea (2024) these sources consistently state that an RCA value greater than one indicates a comparative advantage in international trade, while an LQ value greater than one indicates that the sector is a base sector in the regional economic structure (Miller & Blair, 2009). Thus, the high LQ and RCA values in these three provinces indicate a greater ability to utilize fishery resources, develop trade networks, and access international export markets.

The dominance of DKI Jakarta and East Java indicates that fisheries export competitiveness is determined not only by the availability of fisheries resources but also by the support of trade infrastructure, logistics facilities, processing industries, and the presence of adequate export ports (Pratama, 2025; Achsa et al., 2021). On the other hand, findings in Central Java and Maluku indicate that the presence of the fisheries sector as a regional pillar does not automatically translate into international competitiveness. An RCA value below 1 indicates barriers in the process of transforming domestic advantages into export advantages. These barriers may include limited access to international markets, low value-added products, a lack of quality certification, or high logistics costs that reduce product competitiveness in global markets.

Conversely, Lampung exhibits an interesting phenomenon: its RCA is above 1 even though its LQ is below 1. These results suggest that export competitiveness does not always depend on the level of sectoral specialization in a region but is also influenced by production efficiency, product quality, and connectivity to international

trade networks. These findings align with the view that a region's comparative advantage can be established through increased productivity and market integration, rather than solely due to the sector's contribution to the regional economy (Widodo, 2009; Aryudiawan & Suadi, 2022; Ramadhan & Chaerul, 2023) .

The fact that the majority of provinces have LQ and RCA values below one indicates that the fisheries sector has not yet become a leading sector and lacks sufficient competitiveness in international markets. This situation suggests the persistence of structural constraints, including low productivity, limited logistics infrastructure, minimal downstream processing activities, and weak integration into global value chains. Therefore, efforts to enhance the competitiveness of Indonesia's fisheries commodities should focus on strengthening production capacity, developing fisheries-based processing industries, improving the quality of human resources, and enhancing logistics connectivity to expand access to export markets and improve Indonesia's competitive position in international markets (Widodo, 2009 ; Aryudiawan & Suadi, 2022 ; Ramadhan & Chaerul, 2023) .

Determinants of Indonesia's Fisheries Sector Export Performance by Province in International Markets

To provide a comprehensive understanding of the factors influencing the export performance of Indonesia's fisheries sector at the provincial level, this study examines the effects of commodity prices, trade openness, logistics performance, exchange rates, and the Human Development Index (HDI) on export competitiveness. Overall, the results indicate that commodity prices have a negative effect on export competitiveness, whereas trade openness, logistics performance, exchange rates, and HDI exert positive effects. These findings suggest that improving export competitiveness depends not only on maintaining competitive prices but also on enhancing logistics infrastructure, expanding trade openness, ensuring macroeconomic stability, and strengthening human capital. The influence of each determinant is discussed in detail in the following sections.

The Effect of Commodity Prices on Competitiveness of the Fisheries Sector Export Indonesia

The panel data regression results presented in Table 7 indicate that the price of fisheries commodities (PRICE) has a coefficient of -0.318 and exerts a statistically significant negative effect on the export competitiveness of Indonesian fisheries commodities. This finding suggests that an increase in domestic fishery commodity prices weakens Indonesia's competitive position in international markets (Salvatore, 2013; Zakry, 2026). From an economic perspective, higher export prices reduce the relative price advantage of Indonesian products compared with competing exporting countries, making importers more likely to substitute toward lower-priced alternatives (Widyastutik et al., 2023; Hotsawadi & Widyastutik, 2023). This mechanism is

consistent with the law of demand and the concept of price competitiveness in international trade, whereby higher relative prices decrease export demand and reduce market share. Moreover, fisheries products are generally traded in highly competitive global markets with relatively elastic demand, implying that even modest price increases can significantly reduce export volumes. Therefore, maintaining production efficiency and controlling production costs are essential strategies for sustaining export competitiveness. These findings are consistent with international trade theory Krugman et al., (2018) and empirical studies by Sinukaban & Karmini (2026) have shown that price remains one of the primary determinants of export performance.

The Effect of Trade Openness on Competitiveness of the Fisheries Sector Export Indonesia

Trade openness (TO) exhibits a positive coefficient of 0.247, indicating that greater integration into international markets enhances the competitiveness of Indonesian fisheries exports. The positive relationship can be explained through several economic channels. First, trade liberalization lowers tariff and non-tariff barriers, thereby expanding market access and increasing export opportunities (UNCTAD, 2013). Second, greater openness facilitates technology transfer, knowledge diffusion, and access to international production networks, enabling domestic producers to improve productivity and product quality (Salvatore, 2013). Third, exposure to international competition encourages firms to become more efficient and innovative, resulting in stronger comparative advantages over time (Widyastutik et al., 2023). These mechanisms are in line with the new trade theory and endogenous growth theory, which argue that openness promotes productivity gains through economies of scale, specialization, and technological progress (UNCTAD, 2013; Salvatore, 2013; Widyastutik et al., 2023). Consequently, increased trade openness strengthens Indonesia's integration into global value chains and improves the international competitiveness of fisheries products. This finding supports previous research by Nuraini, (2019) and Fitriani et al., (2021), which stated that trade openness contributes to increasing export competitiveness through expanding market access, increasing trade efficiency, and strengthening integration in international trade.

The Effect of Logistics Performance on Competitiveness of the Fisheries Sector Export Indonesia

Logistics performance (LP) has a positive coefficient of 0.192 and is statistically significant at the 1% level, highlighting the critical role of logistics efficiency in enhancing export competitiveness. Fisheries commodities are highly perishable products that require efficient transportation, cold-chain facilities, and timely delivery to maintain freshness and quality. Improvements in logistics infrastructure reduce transportation costs, minimize spoilage, shorten delivery times, and increase supply chain reliability (Al-Majali et al., 2026 ; Gani, 2017). These improvements not only lower transaction costs but also enhance buyers' confidence in

the consistency and quality of Indonesian fishery exports. From the perspective of transaction cost economics, better logistics reduce coordination and distribution costs, thereby increasing firms' competitiveness in international markets (Sitompul et al., 2018; Aryudiawan & Suadi, 2022). Consequently, investments in ports, transportation infrastructure, cold storage systems, and customs efficiency become important determinants of fisheries export performance. These findings corroborate previous studies by Harahap & Widyastutik (2020), Al-Majali et al., (2026), Gani, (2017) who found that better logistics and transport infrastructure enhance export competitiveness and trade performance.

The Effect of Exchange Rates on Competitiveness of the Fisheries Sector Export Indonesia

The exchange rate (ER) variable shows a positive coefficient of 0.128 and is significant at the 10% level, suggesting that exchange rate movements contribute positively to export competitiveness. The economic mechanism and theoretical basis underlying this finding that the exchange rate negatively impacts Indonesian fisheries export performance is that the depreciation of the Indonesian Rupiah lowers the price of Indonesian fisheries products in foreign currency, making them relatively cheaper for overseas buyers while simultaneously increasing exporters' income when converted into domestic currency. This price advantage stimulates foreign demand and encourages export expansion, particularly in industries with sufficient production capacity to respond to increased demand (Inayah et al., 2015). However, the positive effect also depends on the Marshall–Lerner condition, whereby the combined price elasticities of export and import demand exceed unity. In the fisheries sector, where export demand is generally price-sensitive, exchange rate depreciation can substantially improve international competitiveness (Tacon et al., 2013; Wang & Wang, 2021). Nevertheless, excessive exchange rate volatility may increase production costs through higher prices of imported inputs, suggesting that exchange rate stability remains essential for sustaining long-term export performance. These findings are consistent with the trade elasticity theory, which argues that exchange rate depreciation enhances export competitiveness by lowering the relative price of domestic products in international markets, provided that exchange rate fluctuations remain stable and predictable. These findings are consistent with the trade elasticity theory (Salvatore, 2013; Oktaviani & Novianti, 2014).

The Effect of Human Development on Competitiveness of the Fisheries Sector Export Indonesia

The Human Development Index (HDI) has a positive coefficient of 0.285 and is statistically significant at the 5% level, indicating that improvements in human capital significantly strengthen export competitiveness. This relationship can be explained by the role of education, health, and workforce skills in increasing labor productivity, technological adoption, innovation capacity, and product quality. A more

educated and healthier workforce is better able to implement modern production technologies, comply with international food safety and quality standards, and adapt to changing market requirements. In the fisheries industry, these capabilities are particularly important for improving post-harvest handling, processing efficiency, traceability systems, and value-added production, all of which contribute to stronger competitiveness in international markets. This finding supports endogenous growth theory, which emphasizes human capital accumulation as a fundamental driver of productivity growth and long-run economic competitiveness (Li, 2025; Damanik et al., 2025).

Overall, these findings demonstrate that Indonesia's fisheries export competitiveness is shaped by both price-related factors and broader structural determinants. While competitive pricing remains essential for maintaining market share, export performance increasingly depends on institutional quality, infrastructure, human capital development, and international market integration. The results imply that policies aimed solely at controlling prices are insufficient to achieve sustainable competitiveness. Instead, a comprehensive policy framework is needed to improve logistics infrastructure, deepen trade integration, maintain a stable and competitive exchange rate, and strengthen human capital through education, vocational training, and technological upgrading. Such integrated policies would enhance productivity, reduce trade costs, improve product quality, and ultimately strengthen the long-term competitiveness of Indonesian fisheries commodities in global markets while increasing their contribution to national economic growth (Citaningati & Herianingrum, 2025; Hotsawadi & Gea, 2024; Salvatore, 2013; Aryudiawan & Suadi, 2022).

CONCLUSION

This study shows that the export competitiveness of Indonesian fishery commodities remains concentrated in a few provinces. In contrast, most provinces do not yet possess a competitive advantage at either the domestic or global level. The analysis also confirms that fishery commodity prices hurt export competitiveness. In contrast, trade openness, logistics performance, exchange rates, and the quality of human resources have a positive effect. These findings indicate that improving export competitiveness requires not only competitive prices but also an open trading system, efficient logistics infrastructure, macroeconomic stability, and adequate human resource quality. Therefore, policies to enhance the competitiveness of fisheries exports need to be implemented in an integrated manner by strengthening productivity, promoting downstream industrialization, improving logistics connectivity, and expanding access to international markets.

The results of this study imply that the government needs to prioritize policies to improve logistics efficiency, expand access to international trade, strengthen

downstream processing in the fisheries industry, and develop human resources. On the other hand, businesses need to improve product quality, meet international standards, adopt more efficient production and distribution technologies, and diversify export markets to enhance sustainable competitiveness. This study still has limitations, particularly regarding the use of the LQ and RCA indicators to measure competitiveness, as well as the inclusion of several macroeconomic variables as determining factors. Therefore, future research is recommended to use competitiveness indicators such as the Trade Competitiveness Index (TCI) or Constant Market Share Analysis (CMSA), and to consider other variables, including institutional quality, innovation, trade digitization, investment, and the sustainability of fishery resources. In addition, the use of more advanced econometric methods, such as dynamic panel or spatial panel analysis, has the potential to provide a deeper understanding of the dynamics of interprovincial export competitiveness in fishery commodities.

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