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Determinants and Potential of Indonesia's Frozen Shrimp Exports

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Abstract

This study examines the main factors influencing the flow of Indonesian frozen shrimp exports and explores opportunities to strengthen trade with key destination countries. The research uses a panel data regression approach, including estimation and potential analysis, focusing on 12 major trading partners from 2012 to 2023. The study analyzes frozen shrimp under HS code 030617, one of Indonesia's leading fishery export commodities. The findings show that importer gross domestic product, importer population, and revealed comparative advantage positively influence frozen shrimp exports. In contrast, Indonesia's gross domestic product, economic distance, and non-tariff barriers have a negative impact. Based on the regression results, the potential analysis identifies several countries with strong export prospects, including Australia, the Netherlands, Hong Kong, the United Kingdom, Japan, Germany, Canada, South Korea, Malaysia, France, and Singapore. These results provide meaningful managerial implications, such as increasing domestic production capacity, enhancing export competitiveness, and developing focused marketing strategies to penetrate high-potential markets.

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INTRODUCTION

Shrimp is one of Indonesia's main commodities and has high economic value in various forms (meat and shell waste). Shrimp meat is exported in frozen or canned form, while domestically, shrimp is processed into derivative products such as shrimp crackers. Shrimp shell waste is processed into active ingredients like chitosan, which is produced through the deacetylation of chitin using a strong base. Chitin and chitosan can be used in various fields, including pharmaceuticals, cosmetics, and papermaking. Indonesia has a substantial water area—81 percent of its overall territory—making it plausible for the nation to dominate the global fisheries industry and indicating strong potential for fishery development. According to UN Comtrade (2024), Indonesia ranks 5th among the largest shrimp-producing countries in the world, with a volume reaching 174,583 metric tons, following India and Ecuador.

Frozen Indonesian shrimp is exported to five countries: the United States, Japan, China, Canada, and Taiwan. The United States was the top destination in terms of export value in 2021 and 2022. However, long-standing issues in international trade have hampered the global shrimp value chain. Non-tariff barriers—such as Sanitary and Phytosanitary (SPs) measures and Technical Barriers to Trade (TBT)—are among the challenges frequently encountered in shrimp trade. These barriers are commonly applied by importing countries like the United States, Japan, and those in Europe (Ariyani, 2016). Apart from trade-related issues, declining domestic production also remains a problem. Several factors drive this decline: (1) theft of marine resources, (2) higher domestic production costs compared to competitor countries, and (3) low adoption of shrimp production technologies. Therefore, it can be concluded that the Indonesian shrimp value chain continues to face multiple challenges, from production and distribution to reaching end consumers.

The growth trend of Indonesia's frozen shrimp exports has averaged an annual increase of 0.89%, with the United States, Japan, and China accounting for 56.2% of the market share. Low shrimp farming productivity is attributed mainly to the structure of business actors—primarily small-scale (traditional) shrimp farmers—who face limited access to capital, technology, and target markets. Regulatory improvements are crucial to boosting domestic production, particularly in providing capital support and encouraging technology adoption. The Ministry of Marine Affairs and Fisheries' (KKP) 2019–2024 Strategic Plan (Renstra) targets shrimp production of 2 million tons by 2024.

On the global stage, the shrimp trade is strongly influenced by non-tariff barriers, which also affect distribution to end consumers in importing countries. Major competitor countries such as India, Ecuador, and Vietnam consistently outperform Indonesia in export values. This disparity is mainly due to their lower production costs, especially input utilization, resulting in more competitive prices and higher export volumes. Indonesia exports frozen shrimp to twelve key countries: the United States, Japan, the United Kingdom, Canada, the Netherlands, France, Hong Kong, Malaysia, South Korea, Singapore, Australia, and Germany. These countries are strategic trading partners and significantly contribute to Indonesia's export performance regarding trade volume and added economic value.

International trade involves the exchange of goods, services, and production factors across countries. According to Krugman et al. (2012), international trade is driven by two main factors: differences in production inputs and the pursuit of economies of scale. Global trade is critical for enhancing national economic growth (Salvatore, 2015). Trade is closely linked to economic growth, as reflected in a country's export and import activities, which are components of GDP. A country typically exports goods that can be produced more cheaply and imports those that would be more expensive to produce domestically (Kindleberger & Linbert, 1978).

Various studies have explored the determinants of international trade, particularly for seafood products. Using the gravity model, Natale et al. (2015) identified key factors influencing global seafood trade flows from 1990 to 2010 across 20 countries. These factors include exporter and importer GDP, shrimp production

and consumption in the importing country, geographic distance, regional trade agreements, and exporter per capita income. Ardiyanti & Saputri (2018) examined the impact of non-tariff measures (NTMs) on Indonesia's shrimp exports from 2005 to 2015, finding that NTMs negatively affected both raw and processed shrimp exports to nine countries. Their study highlighted that Technical Barriers to Trade (TBT) have a more substantial negative impact than Sanitary and Phytosanitary (SPs) measures. Specifically, the volume of shrimp exports to countries applying TBTs was 30.2% lower than that to countries without such barriers.

Furthermore, Kusuma & Sari (2021) found that the Real Effective Exchange Rate (REER), shrimp export prices, and economic distance significantly negatively influence the volume of Indonesian shrimp exports to eight major countries. Similarly, Pramastya (2023) analyzed export data from 2001 to 2020 across six countries and concluded that the GDP of the destination country, shrimp prices, and economic distance positively influence export volumes, while inflation also showed a significant positive relationship.

The global shrimp trade is becoming increasingly competitive, with many countries rapidly expanding their market share through aggressive trade strategies, technological advancements, and adherence to international standards. In this context, Indonesia must sustain and strengthen its competitiveness to maintain export growth. Achieving this requires a comprehensive understanding of policy gaps, infrastructure constraints, and trade facilitation measures influencing export performance.

Moreover, the growing international demand for traceability, sustainability, and product quality necessitates a more substantial alignment between Indonesia's national export policies and global trade requirements. Understanding these dynamics is essential to formulating a responsive trade strategy that can secure Indonesia's role in the global shrimp value chain.

However, the seafood trade also faces critical challenges such as exploiting natural resources, food safety regulations and standards, income inequality, and shifts in global demand and supply (Natale et al., 2015). The growth of fishery production and shrimp processing significantly impacts the seafood trade, which is often hindered by the varying food safety standards across countries. These discrepancies create trade barriers and restrict market access for seafood-producing nations, especially developing countries.

Indonesia continues to face stiff competition in the global shrimp market. Non-tariff barriers complicate product distribution to consumers in importing countries, while competitors benefit from lower production costs through more efficient input utilization. Indonesia must enhance its practices and adapt to evolving global standards to remain competitive. As the global market becomes increasingly complex and health and safety regulations become more stringent, ensuring the sustainability of Indonesia's shrimp value chain is imperative. Embracing innovation and regulatory support will help unlock the industry's full potential and strengthen Indonesia's position as a key player in the global shrimp market.

Indonesia is one of the world's largest shrimp exporters, focusing on twelve central destination countries. These countries have a high demand for shrimp, driven by established downstream industries and high consumption levels. Over the past two decades, these countries have shown consistent import growth from Indonesia (UN Comtrade, 2025). The dynamics of international shrimp trade influence how Indonesia prioritizes its export destinations, particularly concerning efficiency and maximizing export potential.

Indonesia is optimizing shrimp production through both extensification and intensification to increase foreign exchange and meet rising consumption needs. Nevertheless, the performance of Indonesia's shrimp exports remains volatile and varies across destination markets. Existing studies often overlook key macroeconomic determinants, which this research aims to address. Policy interventions to enhance export value are fragmented and reactive without a thorough understanding of these factors.

Furthermore, limited attention has been given to exploring Indonesia's untapped shrimp export potential in emerging markets. Addressing these determinants and identifying new export

opportunities are crucial to strengthening Indonesia's global position and developing more strategic, evidence-based trade policies.

While many previous studies have examined the determinants of shrimp trade, few have conducted a comprehensive potential analysis. Therefore, this research seeks to identify optimal export destination countries for Indonesian policymakers and fill the gap in the existing literature. This study is also significant in supporting the synergy between optimizing Indonesian shrimp production and increasing exports in the future.

RESEARCH METHODS

The data used in the trade flow analysis are secondary data on shrimp commodities exported as frozen shrimp (HS 030617) from 2012 to 2023. The export destination countries in this study consist of 12 countries, as determined by the Ministry of Maritime Affairs and Fisheries Strategic Plan 2019–2024, namely Australia, Canada, France, Germany, Hong Kong, Japan, Malaysia, the Netherlands, South Korea, Singapore, the United Kingdom, and the United States. Secondary data were obtained from various sources, including the World Bank, UN Comtrade, the Ministry of Maritime Affairs and Fisheries (KKP), UNCTAD, national and international journals, and other relevant literature.

Table 1. Variable Used in This Study

Notation	Variable	Source
GDP_{it}	Indonesia's gross domestic product	World Bank
GDP_{jt}	Importer's gross domestic product	World Bank
$DIST_{ijt}$	Economic distance	Time and date; World Bank
POP_{jt}	Population in the importing country	World bank
EXR_{ijt}	Exchange rate	World Bank
NTR_{jt}	Non-Tariff Measure	UNCTAD
RCA_{ijt}	Revealed Comparative Advantage	UN Comtrade

Source: Data Processed (2025)

A trade flow model using panel data regression was employed to analyze international trade. The model aims to predict shrimp export flows between Indonesia and its importing countries based on relative economic size and geographical distance. Commonly used variables include GDP, geographical distance, population, and other factors influencing trade flows between countries. This approach is supported by Sanny et al. (2021), who identified additional influencing factors such as economic distance and the exchange rate of the exporting country. Studies by Wahyudi et al. (2019) and Wicaksana et al. (2022) developed a model incorporating the value of Indonesian shrimp exports to destination countries, Indonesia's real GDP, the real GDP of export destination countries, Indonesia's real exchange rate against the destination countries' currencies, economic distance, Indonesia's shrimp production volume, global shrimp prices, the production volume of competing shrimp-exporting countries, and the total shrimp demand in export destination countries.

Panel data regression in this study is conducted using three models: the Common Effect Model (CEM), the Fixed Effect Model (FEM), and the Random Effect Model (REM). The appropriate model will be selected using the Chow Test (to compare CEM and FEM) and the Hausman Test (to compare FEM and REM). Accordingly, the panel data regression equation in this model is as follows:

$$LnX_{ijt} = \beta_0 + \beta_1 LnGDP_{it} + \beta_2 LnGDP_{jt} + \beta_3 LnDIST_{ijt} + \beta_4 POP_{jt} + \beta_5 LnEXR_{ijt} + \beta_6 NTR_{jt} + \beta_7 LnRCA_{ijt} + \varepsilon_{ijt} \quad \text{..... (1)}$$

Where LnXijt represents the natural logarithm of shrimp export volume from Indonesia (i) to an importing country (j) in year (t). Among the explanatory variables, GDPit refers to Indonesia's gross domestic product, which reflects the country's production capacity and overall economic scale. GDPjt captures the economic size and demand potential of the importing country. DISTijt measures the economic distance between Indonesia and the importing country, serving as a proxy for transport costs and trade frictions that may hinder export activities. POPjt is the population in the importing country. EXRijt

denotes the bilateral exchange rate between Indonesia and its trading partner, capturing relative price competitiveness in international markets. The variable NTRFjt represents non-tariff measures (NTMs) imposed by the importing country in year t, including various administrative, licensing, and quality control requirements that may affect market access without altering price structures directly. RCAijt refers to the Revealed Comparative Advantage index, indicating Indonesia's trade competitiveness in shrimp exports relative to other products and exporters. Eijt is an unobserved factor that may influence export performance but is not explicitly included in the model, and Ln is the natural logarithm.

Export potential analysis can be done by dividing the actual value and the predicted frozen shrimp exports in Indonesia, following the previous study by S. Abbas & Waheed (2015), Irshad et al. (2018), and Suryana et al. (2023). If the actual and predicted division is above 1, then the export is said to be under trade, or vice versa. The equation of potential analysis could be described as follows:

$$XSP = XSA/XSPR \quad \text{.....(2)}$$

Where XSP is the export potential of Indonesian shrimp, XSA is the actual value of Indonesian shrimp export, and XSPR is the predicted value of Indonesian shrimp export.

RESULTS AND DISCUSSION

The results and discussion present the empirical findings from analyzing Indonesia's frozen shrimp exports to key destination countries. Using panel data regression techniques and supported by classical assumption testing, the study identifies the Fixed Effect Model (FEM) as the most appropriate approach for capturing variations across trading partners. The analysis highlights the significant influence of variables such as GDP, population, geographic distance, non-tariff barriers, and Indonesia's revealed comparative advantage on export performance. In addition, by expanding the analysis through potential export calculations, the study reveals that most destination countries, except for the United States, remain under-traded. These findings emphasize the factors driving shrimp exports and the untapped opportunities for further market development.

This concentration of exports, as shown in Table 2, directly relates to the empirical findings from the panel data analysis, which highlight the economic and structural factors influencing Indonesia's shrimp trade. The strong dependence on a few countries, particularly the United States and Japan, mirrors the significant impact of variables such as the importing countries' GDP, population, and trade barriers identified in the regression results. At the same time, the export potential analysis reinforces the urgency of diversification, revealing that many other countries remain under-traded despite having favorable conditions for expansion (Rindayati & Akbar, 2022). This alignment between descriptive and econometric results underscores the importance of strategic market development in reducing export concentration and improving Indonesia's global shrimp market competitiveness.

Table 2 presents the export performance of Indonesian shrimp to its main destination countries. The data reveals a significant concentration of exports to just two markets: the United States and Japan. The United States dominates with an average export volume of 847.94, accounting for approximately 69.98% of Indonesian shrimp exports. Japan follows with 284.61, or 23.49% of total exports. All other countries—including the United Kingdom, Canada, the Netherlands, France, and several Asian and European nations—contribute less than 2% each to the total export share. This pattern highlights a critical vulnerability in Indonesia's shrimp export strategy: overdependence on a limited number of markets. Such concentration poses risks if demand in these key markets declines due to economic fluctuations, changes in trade policy, or food safety regulations. Therefore, Indonesia has clear potential and a strategic need to diversify its

shrimp export markets to enhance resilience and sustainability.

Table 2. The Indonesian Shrimp Export to Main Destination Countries

Country	Average	Percentage
United States	847.94	69.98%
Japan	284.61	23.49%
United Kingdom	15.00	1.24%
Canada	13.83	1.14%
Netherlands	8.62	0.71%
France	8.04	0.66%
Hong Kong	7.55	0.62%
Malaysia	6.95	0.57%
South Korea	6.20	0.51%
Singapore	5.72	0.47%
Australia	3.81	0.31%
Germany	3.39	0.28%
Total	1,211.66	100.00%

Source: Data Processed (2025)

Table 3 provides the descriptive statistics of the variables used in the panel data regression analysis. The results show that several variables—namely export volume (Xijt), GDP of the importing country (GDPjt), and population of the importing country (POPjt)—have a higher standard deviation than their mean, indicating substantial variability across countries and over time. This variation is important as it allows the regression model to detect differences and relationships between countries with diverse economic and demographic conditions. In contrast, variables such as Indonesia's GDP (GDPit), distance between countries (DISTij), exchange rate (EXRijt), trade relationship dummy (NTRjt), and revealed comparative advantage (RCAjt) show more stable patterns, with standard deviations lower than their respective means.

This suggests less fluctuation, especially in structural or geographic variables like distance and Indonesia's economic indicators. Overall, the statistical characteristics support the suitability of the dataset for regression modeling, ensuring sufficient variability where needed and stability where expected.

Table 3. Descriptive Statistics

Variables	Mean	Median	Max	Min	Std. Dev.
Xijt	1.E+08	8.E+06	1.E+09	3.E+05	2.E+08
GDPit	1.E+12	1.E+12	1.E+12	7.E+11	1.E+11
GDPjt	3.E+12	2.E+12	2.E+13	3.E+11	5.E+12
DISTij	5187	4106	14311	769	3578
POPjt	7.E+07	5.E+07	3.E+08	5.E+06	8.E+07
EXRijt	101	98	157	58	18
NTRjt	0	0	1	0	0
RCAjt	10	3	73	0	15

Source: Data Processed (2025)

Table 4 summarizes the results of classical assumption tests conducted before performing the panel data regression. The normality test shows a probability value 0.545, indicating that the residuals are normally distributed. The heteroskedasticity test result, with a probability of 0.147, suggests that the data meet the assumption of homoscedasticity—i.e., the variance of the errors is consistent across observations. Furthermore, the correlation values among all independent variables are below 0.8, confirming the absence of multicollinearity. These findings collectively validate the appropriateness of the regression model. Since all key assumptions—normality, homoscedasticity, and no multicollinearity—are satisfied, the panel data regression can be reliably conducted to explore the determinants of Indonesian shrimp exports.

Table 4. Classical Assumption Analysis

Type of Test	Result (Prob.)	Conclusion
Normality	1.214 (0.545)	Normal
Heterokedasticity	22.570 (0.147)	Homokedasticity
Multicollinearity	All variables have a correlation value below 0.8	No Multicollinearity Indication

Source: Data Processed (2025)

Table 5 outlines the results of model selection tests, specifically the Chow and Hausman Test, used to determine the most suitable panel data regression approach for analyzing Indonesian frozen shrimp exports. The Chow Test, which tests whether a pooled Ordinary Least Squares (OLS) model is appropriate compared to the Fixed Effect Model (FEM), yields a highly significant test statistic (571.438) with a p-value < 0.01, clearly favoring the FEM over the pooled OLS. This suggests that unobserved heterogeneity across countries (cross-sectional units) significantly influences the model and needs to be controlled.

Following this, the Hausman Test was employed to choose between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The test result (67.405, also significant at the 1% level) rejects the null hypothesis that the individual effects are uncorrelated with the explanatory variables—thereby supporting the use of FEM over REM. These tests imply that country-specific effects are not random and must be explicitly controlled, which the Fixed Effect Model does by allowing each country to have its own intercept. Consequently, the FEM is deemed the appropriate and robust specification for estimating the relationship between the independent variables and Indonesia's shrimp exports.

Table 5. The Selection of an Appropriate Model

Type of Test	Result	Conclusion
Chow-Test	571.438***	FEM
Hausman-Test	67.405***	FEM

Source: Data Processed (2025)

Table 6 presents the estimation results using the Fixed Effect Model (FEM) to analyze the relationship between independent variables and Indonesia's frozen shrimp exports. The variables tested include Indonesia's Gross Domestic Product (GDP), GDP of the importing country, geographic distance, population of the importing country, exchange rate, non-tariff barrier dummy, and the Revealed Comparative Advantage (RCA) index. The analysis results show that all variables, except the exchange rate, significantly affect Indonesia's frozen shrimp exports to the main destination countries. The coefficient of determination (R-squared) value of 98.9% indicates that the model can explain most of the export variation.

Table 6. FEM Estimation

Variables	Coefficient	Std.Error	Prob.
Constant	-13.412	14.763	0.3654
Ln(GDPit)	-0.265***	0.037	0.0008
Ln(GDPjt)	1.116***	0.385	0.0044
Ln(DISTij)	-0.678**	0.313	0.0324
Ln(POPjt)	0.131***	0.010	0.0001
Ln(EXRijt)	-0.395	0.343	0.2522
NTRjt	-0.026***	0.012	0.0000
Ln(RCAijt)	1.014***	0.038	0.0000
R-Squared	0.989		
Adj. R-Squared	0.987		
F-Statistic	610.992***		
(Prob.)	(0.000)		

Source: Data Processed (2025)

In addition, the significant F-statistic value at the 95% confidence level (p-value <0.05) indicates that simultaneously, the independent variables in the model contribute significantly to the dependent variable. Thus, the FEM model is considered statistically valid and can be used as a reference in analyzing the determinants of Indonesia's frozen shrimp exports. Moreover, this study also conducted the regression result of the Indonesian shrimp export determinant by using PPML, found a similar result as the FEM regression (Table 7). This study used FEM to estimate the determinant of Indonesian shrimp exports due to a higher value in adjusted R-Square (0.987>0.969)

Table 7. PPML Estimation

Variables	Coefficient	Std. Error	Prob.
Constant	-15.969	8.803	0.070
Ln(GDPit)	-1.833	0.381	0.000
Ln(GDPjt)	0.052	0.245	0.832
Ln(DISTij)	0.109	0.273	0.689
Ln(POPjt)	-1.900	0.159	0.000
Ln(EXRijt)	-1.287	0.264	0.000
NTRjt	-0.262	0.125	0.037
Ln(RCAijt)	0.020	0.004	0.000
R-Squared	0.970		
Adjusted R-squared	0.969		
LR-Statistic	4.48E+10		
Prob (LR Statistics)	0.000		

Source: Data Processed (2025)

Indonesia's GDP was found to have a negative and significant effect on Indonesia's frozen shrimp exports to the main destination countries. A negative Indonesian GDP can be indicated as domestic consumption, as decreasing domestic consumption will reduce export value. On the other hand, importer GDP was found to have a positive and significant effect. Conversely, increasing the importer's GDP will create much demand for food products, including frozen shrimp. Increasing demand can spur export activities from producing countries and fulfill importers' domestic needs. The results of this study are in

accordance with several findings from previous studies, which state that GDP can have negative and positive effects (Rahman et al., 2019; Sheikh et al., 2018; Tadesse & Abafita, 2021; Tandra & Suroso, 2023; Yusiana et al., 2022).

Economic distance was found to have a negative and significant effect on Indonesia's frozen shrimp exports to the main destination countries. This shows that the further the distance between Indonesia and the destination country, the export volume tends to decrease. Economic distance represents transportation costs, logistics risks, and distribution time constraints, so increasing distance can impact decreasing exports. This result is supported by the findings of several previous studies that discussed the negative relationship between economic distance and exports (Anh Thu et al., 2019; Natale et al., 2015; Wahyudi et al., 2019).

The importer population was found to have a positive and significant effect on Indonesia's frozen shrimp exports to the main destination countries. This finding suggests that the increasing population in the destination country can reflect the potential growth in demand for frozen shrimp commodities. The larger the population, the larger the potential consumer base that requires food products, including seafood. In international trade, especially in exports to the main destination countries, countries with large populations are often attractive export targets because they promise a large and sustainable market. This study's results follow previous studies' findings (Az-zakiyah, 2023; Ngoma, 2020; Nugroho et al., 2018).

The Non-Tariff Dummy variable was found to have a negative and statistically significant effect on Indonesia's frozen shrimp exports to major destination countries. This result suggests that non-tariff barriers, such as sanitary and phytosanitary regulations, quality standards, food safety certification, and complicated administrative procedures, can hinder the efficiency of the export process. Even when import tariffs are minimal or eliminated, these non-tariff measures often create implicit trade barriers by delaying shipments, increasing compliance costs, and potentially causing product rejections at ports of entry (Atif et al., 2019). This finding is consistent with previous empirical studies that report similar negative relationships between non-tariff barriers and export performance (A. Abbas et al., 2023; Ardiyanti & Saputri, 2018; Sidiq et al., 2019).

Competitiveness, as measured by the Revealed Comparative Advantage (RCA) index, has positively and significantly influenced Indonesia's frozen shrimp exports to major destination countries. This finding shows that the higher the level of competitiveness, the greater Indonesia's ability to increase the volume of frozen shrimp exports to the global market. A high RCA value reflects Indonesia's superiority in terms of the availability of natural resources, efficiency of the production process, and accumulation of experience and specialization in the shrimp sector. These factors can increase productivity and strengthen Indonesia's export position in the international market. In line with this, a previous study by Suryana et al. (2023) has also shown that competitiveness is an important factor contributing significantly to a country's international trade performance.

The exchange rate has no significant impact on Indonesia's bilateral shrimp exports. In the context of trade, many transactions are governed by long-term contracts and fixed prices, which protect exporters from the direct impact of the exchange rate. As a result, USD depreciation or appreciation does not affect export volumes. This result differs from previous studies that significantly affect exports in Indonesian shrimp bilateral trade (Kea et al., 2019; Tadesse & Abafita, 2021; Tandra & Suroso, 2023).

To complement the regression results and provide strategic trade insights, this study extends the analysis by evaluating the export potential of Indonesian frozen shrimp to its major destination countries. Table 8 presents the potential analysis using the A/P ratio, where "A" refers to the actual export value, "P" denotes the predicted or potential export value based on the regression model, and "A/P" indicates the degree of trade realization. An A/P ratio less than 1 signifies over-trade, suggesting that the actual export volume already exceeds the predicted

potential. Conversely, an A/P ratio greater than 1 signals under-trade, indicating untapped export potential and opportunities for further market development.

Table 8. The Potential Analysis

Country	A	P	A/P	Conclusion
United States of America (USA)	20.532	23.280	0.882	Over Trade
Australia	14.572	10.905	1.336	Under Trade
Netherlands	15.894	8.928	1.780	Under Trade
Hongkong	15.792	7.500	2.106	Under Trade
United Kingdom	16.235	14.867	1.092	Under Trade
Japan	19.459	18.604	1.046	Under Trade
Germany	14.941	13.958	1.070	Under Trade
Canada	16.374	13.091	1.251	Under Trade
South Korea	15.577	11.069	1.407	Under Trade
Malaysia	15.676	7.522	2.084	Under Trade
France	15.869	14.483	1.096	Under Trade
Singapore	15.490	7.212	2.148	Under Trade

Source: Data Processed (2025)

The results show that the United States is the only country classified as over-traded, with an A/P ratio of 0.882. This implies that Indonesia's shrimp exports to the U.S. have surpassed the expected trade level based on economic and structural factors, reflecting a highly mature and saturated market. Meanwhile, all other main export destinations demonstrate under-trade conditions, revealing significant potential for export growth

For instance, Singapore (A/P = 2.148), Malaysia (A/P = 2.084), and Hong Kong (A/P = 2.106) show the highest under-trade ratios, suggesting that Indonesia's current exports to these markets are far below their estimated potential. These countries represent promising targets for future trade expansion due to proximity, increasing seafood demand, and relatively liberal trade regimes. Similarly, large economies like Japan (A/P = 1.046), Germany (A/P = 1.070), and Canada (A/P = 1.251) also present viable opportunities for scaling up shrimp exports, even though they already import significant volumes.

This analysis emphasizes that Indonesia's shrimp export market is still heavily concentrated in the United States, while substantial untapped opportunities exist in other established and emerging markets. Therefore, policy attention and strategic trade initiatives should be directed toward diversifying export destinations, enhancing bilateral trade relations, and addressing non-tariff barriers to unlock the full export potential of Indonesian shrimp.

Reviewing some previous studies about the challenge of export expansion in frozen shrimp shows several challenges to shrimp industry development. In Vietnam, Nguyen et al. (2019) stated that super-intensification in shrimp farming, with the application of technologies such as the biofloc system, has the potential to increase production per unit of land while minimizing environmental impacts by reducing water use and waste emissions. The challenges faced include the need for large investments and the limitations of small farmers in meeting international standards, which can be overcome through the formation of cooperatives and integration with large companies to expand access to technology, markets, and financing. Research conducted by various countries shows that the efficient use of resources, technology adoption, and integrated policy support are key to success in shrimp farming. Indonesia has advantages in land use efficiency; however, more attention needs to be paid to water consumption and energy efficiency to support sustainability. The experience in Tamil Nadu emphasizes the

importance of farmer education, ongoing training, and the role of digital media in encouraging technology adoption.

Technologies such as Biofloc in China and Vietnam have been shown to increase production while reducing environmental impacts. However, challenges such as high investment requirements and the limitations of small farmers in meeting international standards are still obstacles. Forming cooperatives and partnerships with large companies is an important strategy for increasing small farmers' access to technology, markets, and financing. Research from several Asian countries also shows that the efficient use of resources and adoption of innovative technologies can improve RCA's competitiveness. Optimizing technologies such as biofloc, diversifying target markets, and strengthening training for small farmers are strategic steps to overcome regulatory barriers and improve logistics efficiency. Technology-based approaches applied in other countries can be adapted to Indonesia to increase domestic productivity, strengthen export competitiveness, and ensure the sustainability of the fisheries sector in the international market.

Research conducted by N'Souvi et al. (2024) shows that shrimp production in China has increased significantly by 120% in the last two decades, driven by the expansion of intensive aquaculture. However, this growth presents environmental challenges, such as aquatic ecosystem degradation and spreading diseases, including AHPND. Technologies such as Biofloc systems and multi-trophic cultures have been identified as potential solutions to reduce environmental impacts and increase production efficiency, while improving seed quality and disease control are key to the industry's long-term sustainability.

CONCLUSION

This study examines the key factors influencing Indonesia's shrimp export flow and assesses its potential across major destination countries using panel data regression analysis. The findings indicate that importer GDP, importer population, and comparative advantage (RCA) positively influence Indonesia's shrimp exports. In contrast, Indonesia's GDP, economic distance, and non-tariff barriers exert a negative impact. Based on the regression outcomes, the potential analysis highlights several countries that could serve as priority markets for future export expansion: Australia, the Netherlands, Hong Kong, the United Kingdom, Japan, Germany, Canada, South Korea, Malaysia, France, and Singapore. Hence, these countries must be optimized to increase Indonesian shrimp exports. The result also implies some policies, especially for the Indonesian government. The policy implications of this study emphasize the importance of increasing domestic productivity through technology support and access to capital for small farmers to increase their production scale. Optimization of national programs, such as the 2019–2024 KKP Strategic Plan, which targets an increase in production of up to 2 million tons by 2024, is expected to encourage increased capacity.

On the other hand, diversifying and expanding Indonesia's shrimp export market is expected to increase international competitiveness. The government needs to develop policies that support opening new markets and facilitate wider access to potential export-destination countries. Policies to improve the quality and quantity of shrimp production through farmer empowerment and the application of modern technology. This aims to ensure Indonesian shrimp meet strict international standards to compete in the global market..

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