

doi: [10.14710/jdep.9.2.133-146](https://doi.org/10.14710/jdep.9.2.133-146)

The Strategic Role of Blue Economy Subsectors in Regional Economic Performance: Empirical Evidence from Eastern Indonesia

Received: 28th February 2026;
Last Revised: 18th October 2026;
Accepted: 18th October 2026;
Available Online: 22nd October 2026

Annisa Sorayya* and Shela Hajjaria Putri

Departement of Management, Faculty of Economics and Business, Universitas Gadjah Mada, Sleman, Indonesia

*Corresponding Email: sorayya.annisa@gmail.com

Abstract

This study examines the contribution of five priority blue economy subsectors: marine capture fisheries, marine aquaculture fisheries, fishery exports, maritime transport, and marine tourism to economic performance in ten provinces of Eastern Indonesia during 2019–2023. Using descriptive statistics and panel data regression with a fixed-effects model and robust standard errors, the study incorporates the Human Development Index (HDI) and Seawater Quality Index (IKAL) as control variables. The results show that marine capture fisheries and fishery product exports are positively associated with regional economic performance, while IKAL is positively and significantly associated with regional economic performance. These findings highlight the importance of sustainable marine ecosystem management.

Keywords: Blue Economy, Economic Performance, Panel Data, Eastern Indonesia, Marine Sector

JEL Classification: Q22, R11, C2

Copyright © 2026 by the authors, published by the Faculty of Economics and Business, Universitas Diponegoro



This is an open-access article under the CC BY-SA 4.0 license

How to Cite: Sorayya, A., & Putri, S. H. (2026). The strategic role of blue economy subsectors in regional economic performance: Empirical evidence from Eastern Indonesia. *Jurnal Dinamika Ekonomi Pembangunan*, 9(2), 133-146. <https://doi.org/10.14710/jdep.9.2.133-146>

Introduction

Indonesia is the largest archipelagic country in the world that has extraordinary marine potential. Based on the Decree of the Ministry of Home Affairs Number 100.1.1-6117 of 2022, there are around 17,001 islands with a water area of 6.4 million km², or more than 70 percent of the country's total area. Its coastline that stretches 108,000 km places Indonesia as one of the countries with the longest coastline in the world ([Ministry of Marine Affairs and Fisheries, 2024](#)). This geographical condition makes Indonesia rich in marine resources, both biological and non-biological, while providing strategic opportunities for the development of the blue economy as a driver of inclusive and sustainable economic performance.

In this context, the concept of the blue economy is becoming increasingly relevant. The concept of the blue economy itself is defined by various international organizations. [The World Bank and UN DESA \(2017\)](#) interpret it as the sustainable management of marine resources to encourage economic growth, improve community welfare, and maintain the health of marine ecosystems. This definition is emphasized by [UNDP \(2023\)](#) that the blue economy is present as a new paradigm in integrating the protection, utilization, and restoration of marine ecosystems in a sustainable manner. From various definitions of the blue economy, it can be concluded that the blue economy is a sustainable development approach that integrates economic, social, and environmental dimensions through the use of marine resources.

The urgency of implementing the blue economy is getting higher considering that most coastal communities in Indonesia depend on marine resources for their livelihoods. According to data from the [Ministry of Marine Affairs and Fisheries \(2024\)](#), there are around 3.2 million fishermen and 2.18 million marine fish farmers throughout Indonesia. However, Indonesia also faces serious challenges in the form

of the declining quality of marine ecosystems, degradation of coastal environments, and pressure on fishery resources. This situation demands a development approach with a blue economy framework that balances economic, social, and environmental aspects. The Indonesian government has responded with a number of policies such as Law No. 32/2014 on Marine Affairs, Presidential Regulation No. 16/2017 on Indonesian Marine Policy, and the blue economy roadmap in the 2020–2024 RPJMN. In addition, the National Development Planning Agency ([BAPPENAS, 2024](#)) also launched the Indonesia Blue Economy Index (IBEI) as an evaluation instrument based on the three main pillars of the blue economy, namely economic, social, and environmental. In the Blue Economy Roadmap 2024 document, the government emphasizes a number of priority subsectors, including capture fisheries and aquaculture, trade, transportation and logistics, marine-based industries, maritime tourism, technology, and governance.

A number of international studies confirm the positive contribution of blue economy subsectors to economic performance. [Rehman et al. \(2019\)](#) found that capture fishery production is positively related to long-term economic growth in Pakistan. [Liza et al. \(2025\)](#) reveal that marine aquaculture production plays a significant role in economic growth in Bangladesh. [Oad et al. \(2022\)](#) also show the significant role of fishery product exports, while [Fratila et al. \(2021\)](#) emphasized the contribution of maritime transportation to global trade. On the other hand, [Rogerson and Rogerson \(2019\)](#) highlight the role of tourism in creating new jobs and encouraging local development. Empirical evidence in Indonesia is shown by [Nugraha and Flora \(2022\)](#), who found that coastal tourism provides a multiplier effect on the local economy.

Currently, research that specifically measures the impact of blue economy subsectors on economic performance in Indonesia, especially in Eastern Indonesia, is still needed. Eastern Indonesia has the largest marine resources and economic potential, ranging from biodiversity and fisheries potential to opportunities for the development of maritime tourism. [BPS data \(2024\)](#) show that more than 80 percent of national seagrass beds that play an important role in maintaining the productivity of marine ecosystems are found in Sulawesi, Maluku, and Papua. This condition makes Eastern Indonesia a strategic area whose marine potential has not been fully utilized; therefore, blue economy research in this region is of high academic and policy relevance. Building on the preceding discussion of development challenges and sustainability priorities, this study focuses on five subsectors that serve as key pillars of the Indonesian Blue Economy Roadmap. The five sub-sectors include capture fishery, aquaculture fishery, fishery product exports, marine transportation, and maritime tourism, which were chosen for their pivotal role in the economic structure of the archipelago. In order to avoid partial analysis, this study goes beyond economic indicators by incorporating selected social and environmental control variables, such as the Human Development Index (HDI) and the Seawater Quality Index (IKAL). This multidimensional approach is adopted to provide a more comprehensive empirical picture and is in line with the principles of the blue economy framework that demands a balance between economic growth and socio-ecosystem well-being. With this design, this study offers significant novelty compared to previous studies, which include: (i) the novelty of the scope of the research area that focuses on specific dynamics in the provinces of the Eastern Indonesia as centres of national maritime excellence; (ii) novelty in model specifications through the integration of HDI and IKAL control variables aimed at mitigating omitted variable bias and capturing the influence of social and environmental aspects or marine ecosystems; and (iii) methodological novelty through the application of strict panel data regression estimation, with emphasis on the selection of the best model based on statistical tests and the use of robust standard errors in order to produce reliable inference and withstand heteroscedasticity and autocorrelation problems.

The purpose of this study is to provide an overview of the dynamics of economic performance and the development of the blue economy subsector in Eastern Indonesia, analyze the influence of the blue economy subsector on regional economic performance in Eastern Indonesia, and provide strategic recommendations in determining the priorities of inclusive and sustainable blue economy development.

Methodologically, this study uses a quantitative approach with a panel-data regression model from 10 provinces in Eastern Indonesia during the 2019–2023 period. The selection of this method is expected to be able to provide stronger empirical evidence related to the contribution of the blue economy subsector to economic performance. The results of the study are expected not only to provide priority recommendations for subsectors that need to be encouraged, but also to enrich the study of the alignment between empirical findings and the direction of government policies.

Literature Review

Blue Economy and Economic Performance

The blue economy is defined as the sustainable use of marine resources for economic growth, improved livelihoods, and the preservation of marine ecosystems (UNEP, 2025; World Bank & UN DESA, 2017; UNDP, 2023). Sahu and Doppalapudi (2025) in their study emphasized and recognized the role of the blue subsectors (fisheries, aquaculture, maritime transportation, marine biotechnology, renewable energy, and coastal tourism) as vital aspects for global development. These definitions share three dimensions: economic (output, income, employment), social (livelihoods and human well-being), and environmental (the health of marine ecosystems).

The blue economy generally includes various key sectors such as capture fisheries and aquaculture, coastal tourism, marine transportation, marine energy, as well as marine-based industries. Cross-country studies show that fisheries, maritime transportation, trade, marine products, and maritime tourism have significant contributions to economic growth (Martínez-Vázquez et al., 2023). fishery product. In Indonesia, the Blue Economy Roadmap prioritizes capture fisheries and aquaculture, fishery exports, marine transportation, and maritime tourism (KKP, 2023), and the Indonesia Blue Economy Index (IBEI) is built on economic, social, and environmental pillars (BAPPENAS, 2024). Thus, these priority subsectors are the focus of this research because they are considered the most representative in the framework of national blue economy development.

Previous studies mostly examine economic growth, usually proxied by GDP or GRDP. This study focuses on regional economic performance, understood as the level of regional income, so the findings of earlier studies serve as the closest reference rather than a like-for-like comparison. The literature also treats the social and environmental dimensions of the blue economy as conditions that accompany sectoral performance, which this study examines through human development and marine water quality. Seawater Quality Index.

The Relationship of Capture Fisheries to Economic Performance

The production of marine capture fisheries has proven to be closely related to economic growth in various countries. Rehman et al. (2019), through the analysis of time series data using the Autoregressive Distributed Lag (ARDL) approach, found that capture fishery production is positively related to economic growth in Pakistan. Bhattacharya and Dash (2021) used panel regression and Granger's causality test, and the results confirm that the fisheries subsector makes a significant contribution to the economies of developing countries, especially through job creation and increased foreign exchange.

The Relationship of Marine Aquaculture Fisheries to Economic Performance

Liza et al. (2025), through the analysis of time series data using the Autoregressive Distributed Lag (ARDL) approach, found that marine aquaculture production is significantly and positively related to economic growth in Bangladesh. In line with these findings, Geng et al. (2024), using a panel dataset from 1995–2021 and the Generalized Method of Moments (GMM) and Fully Modified OLS (FMOLS) methods in a number of Asian countries, showed that increasing marine aquaculture production contributes significantly to inclusive growth. The impact is not only on job creation, but also on improving household welfare, supporting food security, and sustainability of marine resources.

The Relationship of Marine Fisheries Exports to Economic Performance

Exports of marine fishery products have proven to be one of the important drivers of economic growth in developing countries. Oad et al. (2022) found that marine fisheries exports have a strong relationship with economic growth in Pakistan, especially in the short term, using the Vector Error Correction Model (VECM) and Ordinary Least Squares (OLS) approaches. This study confirms that the increase in the export volume of fishery products is able to increase foreign exchange receipts and strengthen national economic stability. The importance of the role of exports is also emphasized by Elzaki (2024), who found that the export of marine fishery products in Gulf Cooperation Council (GCC) countries contributes significantly to long-term economic growth, as shown by the results of the Fully Modified Ordinary Least

Squares (FMOLS) estimates. The two studies agree on the sign of the relationship but differ in the time horizon of the effect.

The Relationship of Marine Transportation to Economic Performance

Marine transportation has an important contribution in supporting international trade and economic growth. [Fratila et al. \(2021\)](#) found that maritime transportation activities play a significant role in global trade expansion while driving economic growth in the European Union region, based on panel data analysis. This is in line with [Martínez-Vázquez et al. \(2023\)](#), who identified maritime transport as one of the main factors that increase per capita income through a correlation approach and panel data analysis. In the Indonesian context, the role of marine transportation is increasingly crucial because inter-island connectivity, especially in Eastern Indonesia, is highly dependent on sea routes to ensure smooth distribution of goods and economic mobility. Both studies concern developed economies with dense transport networks, whereas connectivity in Eastern Indonesia is limited, so whether their findings carry over to this region is an empirical question. Therefore, H4 states that the number of marine transportation passengers is positively associated with economic performance.

The Relationship of Maritime Tourism to Economic Performance

Maritime tourism has been recognized as one of the important sectors in encouraging regional and national economic growth. [Fratila et al. \(2021\)](#) find that maritime transport supports trade expansion and growth in the European Union, and [Martínez-Vázquez et al. \(2023\)](#) identify maritime transport and coastal tourism as factors that raise per capita income in European countries. [Rogerson and Rogerson \(2019\)](#) show that coastal tourism in South Africa contributes to job creation and local development, while [Nugraha and Flora \(2022\)](#) find a significant multiplier effect of coastal tourism on the local economy in Indonesia. These studies concern developed economies with dense transport networks or local-scale analysis, whereas inter-island connectivity in Eastern Indonesia depends heavily on sea routes. [Rogerson and Rogerson \(2019\)](#).

The Relationship of the Human Development Index (HDI) and the Marine Water Quality Index (IKAL) to Economic Performance

The blue economy framework emphasizes that economic growth cannot be separated from the social and environmental dimensions in supporting economic performance and sustainable development ([BAPPENAS, 2024](#)). On the social side, HDI reflects the quality of human resources. [Bui et al. \(2025\)](#), using Quantile-on-Quantile Regression and Granger causality for Vietnam, find a positive reciprocal relationship between HDI and growth, which implies that causality may run in both directions, whereas [Pritchett \(1996\)](#) cautions that gains in education do not always translate into macroeconomic gains when the economy cannot absorb skilled labor. The role of HDI is therefore theoretically ambiguous. On the environmental side, [Geng et al. \(2024\)](#) conclude that environmental management is important for promoting inclusive growth, and [Martínez-Vázquez et al. \(2023\)](#) find that social and environmental indicators, including HDI, ocean conservation, and emission reduction, are significant determinants of the contribution of blue economy sectors to sustainable development.

Conceptual Framework

Three limitations stand out in these studies. First, evidence on fisheries, aquaculture, and exports comes mainly from national time series or the GCC, which identify national relationships but cannot show how subsector activity relates to income differences across regions within a country. Second, evidence on maritime transport and tourism comes from European or South African settings or from local analysis in Indonesia, so its applicability to eastern Indonesian provinces is uncertain. Third, social and environmental dimensions are emphasized in cross-country work but are rarely included as controls in subnational panels that compare several subsectors simultaneously. To the authors' knowledge, provincial panel evidence that estimates the five roadmap-priority subsectors simultaneously, while controlling for social and environmental conditions, remains limited for Eastern Indonesia.

This study addresses this gap by using a provincial panel of ten provinces, estimating the five subsectors in one model, adding HDI and IKAL as controls following the social and environmental pillars of the IBEL, and using a fixed-effects specification that controls for time-invariant provincial characteristics such as geography and resource endowment. The study treats economic performance, measured by GRDP per capita at constant prices, as an outcome associated with subsector performance, possibly through sector output, household income, and job creation. HDI and IKAL enter as control variables with direct effects, and interaction effects are not examined. Based on the literature reviewed, the study hypothesizes that capture fishery production (H1), marine aquaculture production (H2), fishery export volume (H3), the number of sea transportation passengers (H4), the number of water-based tourism businesses (H5), HDI (H6), and IKAL (H7) are each positively associated with GRDP per capita. The study estimates associations and does not claim causal effects.

Research Method

Research Data and Variables

The data used in this study are secondary data obtained from official publications of Statistics Indonesia (BPS), the Ministry of Marine Affairs and Fisheries (KKP), and the Ministry of Environment and Forestry (KLHK). The selection of secondary data is based on their availability and reliability in representing actual economic conditions and blue economy-related sectors in Indonesia. This study employs panel data covering ten provinces in Eastern Indonesia: North Sulawesi, Central Sulawesi, Southeast Sulawesi, South Sulawesi, Gorontalo, West Sulawesi, Maluku, North Maluku, Papua, and West Papua. The study covers the period from 2019 to 2023, allowing for an examination of regional developments across provinces over time. Panel data are employed because they capture both spatial and temporal variations, thereby strengthening the validity of the analysis examining the effects of blue economy subsectors on economic performance.

The dependent variable in this study is economic performance, measured using Gross Regional Domestic Product (GRDP) per capita at constant prices. To examine the effects of blue economy subsectors on economic performance, this study employs five indicators: (1) marine capture fishery production volume, (2) marine aquaculture production volume, (3) fishery product export volume, (4) the number of marine transportation passengers, and (5) the number of businesses or enterprises operating in marine tourism. These indicators serve as measures of the performance of their respective subsectors (see Table 1). Their selection is based on their direct relevance to marine-based economic activities, which constitute the main pillars of blue economy development.

Table 1. Summary of Research Variables

Variable	Definition	Measurement Unit	Data Source
Economic Performance (PE)	GRDP at constant prices in a province divided by its total population in a given year.	Thousand IDR	BPS
Marine Capture Fishery production (PT)	Total production volume resulting from activities involving the capture and collection of fish and other marine organisms in marine waters.	Tons	BPS
Marine Aquaculture Production (PB)	Total production volume resulting from activities involving the cultivation, rearing, and/or breeding of fish and other marine organisms.	Tons	BPS
Fishery Product Exports (EP)	Total volume of fishery products exported from Indonesia to international markets.	Tons	KKP
Maritime Transportation (AL)	Total number of domestic and international maritime passengers arriving at and departing from ports.	Persons	BPS
Marine Tourism (PM)	Total number of businesses or enterprises engaged in marine-based recreational activities, including diving, surfing, and other water tourism activities.	Business units	BPS
Human Development Index (HDI)	A composite index measuring achievements in three key dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living.	Index (1-100)	BPS
Seawater Quality Index (IKAL)	An index measuring marine water quality based on five parameters: Total Suspended Solids (TSS), Dissolved Oxygen (DO), Oil and Grease, Total Ammonia, and Orthophosphate.	Index (1-100)	KLHK

In addition to the main explanatory variables, this study incorporates control variables relevant to the sustainable blue economy development framework. The Human Development Index (HDI) is selected as a proxy for the social pillar. The quality of healthcare, education, and living standards influences a region's capacity to optimize its blue economy potential and constitutes an important component in promoting economic growth (Bui et al., 2025). Meanwhile, the Seawater Quality Index (IKAL) is employed to represent the environmental pillar, as the quality of marine ecosystems is an important factor in determining the sustainability of maritime economic activities. By incorporating these two control variables, the analysis is expected to provide a more comprehensive understanding of the relationships between blue economy subsectors, social factors, environmental conditions, and economic performance in Eastern Indonesia.

Data Analysis

This study adopts a quantitative approach employing both descriptive and inferential statistical analyses. Descriptive analysis is conducted to examine the dynamics of economic performance and the development of the selected blue economy subsectors. Inferential analysis is used to investigate of the association between blue economy subsectors and economic performance across provinces in Eastern Indonesia. The analysis also incorporates control variables representing the social and environmental pillars of blue economy development. Panel data regression serves as the primary analytical method. To mitigate issues related to outliers and heteroskedasticity arising from variations in the independent variables, the empirical model is specified in a log-linear form as follows:

$$\ln PE_{it} = \alpha + \beta_1 \ln PT_{it} + \beta_2 \ln PB_{it} + \beta_3 \ln EP_{it} + \beta_4 \ln AL_{it} + \beta_5 \ln PM_{it} + \beta_6 \ln IPM_{it} + \beta_7 IKAL_{it} + \varepsilon_{it} \quad (1)$$

Panel data regression analysis in this study is conducted through several stages. First, the most appropriate estimation model is selected among the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) using the Chow test, Hausman test, and Lagrange Multiplier (LM) test. Subsequently, the variance-covariance structure of the residuals is examined to detect heteroskedasticity, cross-sectional dependence, and autocorrelation using the Modified Wald test, Pesaran test, and Wooldridge test, respectively. The results of these diagnostic tests serve as the basis for determining the appropriate estimation method, including the use of robust standard errors when violations of the underlying assumptions are detected. The fixed-effects model was estimated using province-clustered robust standard errors through the “vce(robust)” option in STATA's “xtreg, fe” command. This approach employs a cluster-robust variance estimator that accommodates heteroskedasticity and allows for arbitrary within-province error correlation, while assuming independence across provinces. Given the relatively small number of provincial clusters ($N = 10$) and the short observation period ($T = 5$), conventional cluster-robust inference may be subject to finite-sample limitations. Therefore, statistical significance is interpreted cautiously, particularly for coefficients close to the conventional significance threshold.

Multicollinearity is assessed using the Variance Inflation Factor (VIF). Once the estimation model has been determined, model significance is evaluated using the F-test to assess the joint significance of the independent variables, while the coefficient of determination (R^2) is used to measure the model's explanatory power regarding variations in the dependent variable. Furthermore, the t-test is employed to examine the statistical significance of individual regression coefficients. In addition to the quantitative analysis, this study incorporates a review of government policy documents related to blue economy development to assess the alignment between the empirical findings and existing policy directions.

Results and Discussion

Overview of Economic Performance, Development of Blue Economy Subsectors, HDI and IKAL in the Eastern Region of Indonesia

Figure 1 shows that most provinces in Eastern Indonesia have a positive economic performance trend during the 2019-2023 period. Even during the COVID-19 pandemic in 2020, no pronounced decline is visible in most provinces, except for Papua and West Papua, which experienced a fairly deep decline in 2020.

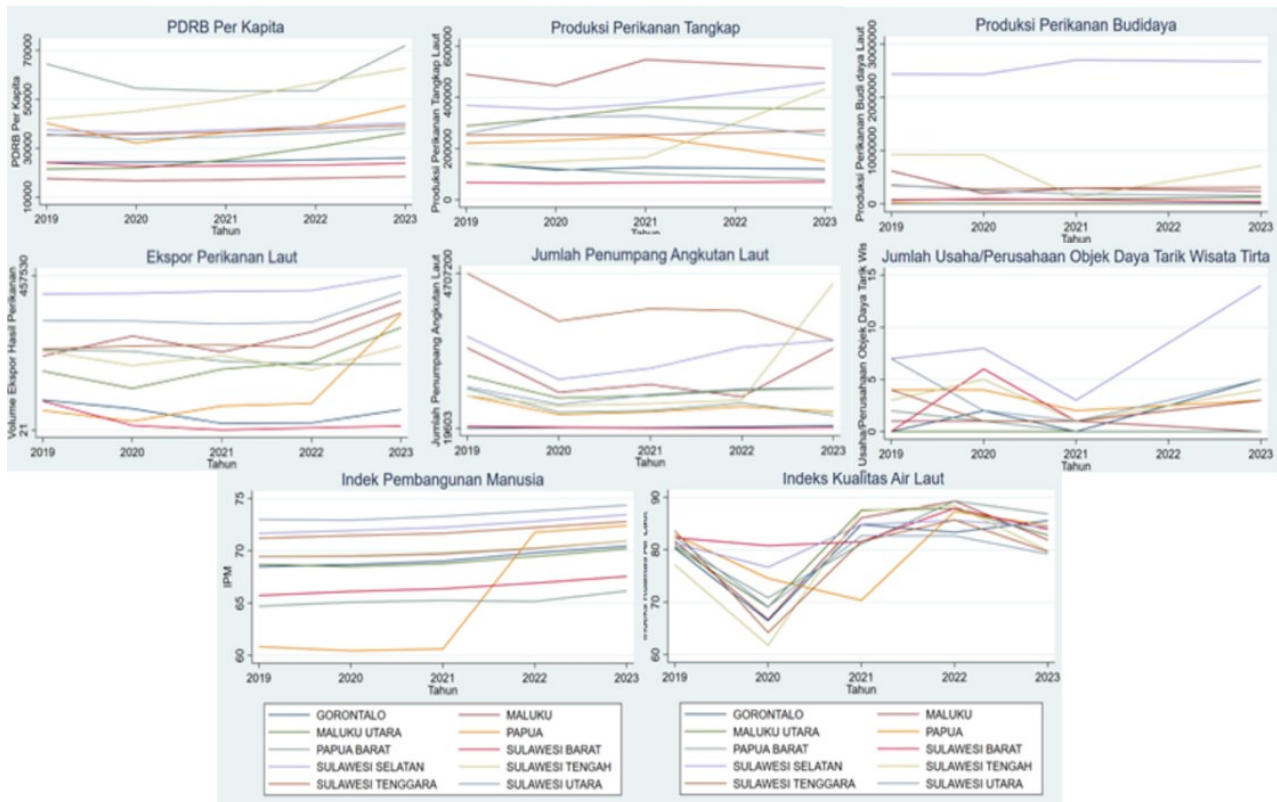


Figure 1. Development of GRDP per Capita, Capture Fishery Production Volume, Aquaculture Production Volume, Fishery Product Export Volume, Number of Marine Transportation Passengers, Number of Marine Tourism Businesses/Companies, HDI, and IKAL by Province in 2019-2023

Source: Badan Pusat Statistik (BPS)

Based on Table 1, it can be seen that the highest value of ADHK GDP per capita reached IDR 71,924,230 and the lowest was IDR 16,688,120, with an average value of IDR 35,333,790. This reflects the considerable economic disparity between provinces in Eastern Indonesia during the research period.

The development of the marine capture fisheries sub-sector, as measured by the volume of capture fishery production in Figure 1, can be seen to have fluctuating dynamics. The highest volume of marine capture fishery production of 547,463 tons was in Maluku Province in 2021. Figure 1 also shows that the volume of capture fishery production in Maluku Province is the highest among other provinces. Meanwhile, the lowest production volume was in West Sulawesi Province in 2020 at 64,182 tons.

Marine aquaculture production also varies considerably across provinces. In Table 1, it can be seen that the average value of production volume is 424,732.4 tons, with the smallest value of 526 tons and the largest up to 2,703,138 tons. Based on Figure 1, it is clear that South Sulawesi Province has a production volume far above other provinces. This indicates that South Sulawesi has a strong dominance in this subsector. According to BPS data (2016), South Sulawesi has the largest marine aquaculture area compared to other provinces in Eastern Indonesia, which is one of the drivers of high aquaculture production in the region.

The export volume of fishery products also shows a gap between provinces. The summary of statistics in Table 2 shows the average value of fishery product export volume of 31,780.62 tons. However, the highest export volume reached 457,530 tons in 2023 in South Sulawesi Province. This indicates that there is a difference in logistics effectiveness and market competitiveness between provinces in Eastern Indonesia.

In terms of connectivity, the number of marine transportation passengers was recorded to have an average of 1,271,299 people. The highest marine transportation passenger activity occurred in Southeast Sulawesi Province in 2019, with a maximum number of passengers reaching 4,707,200 people. In 2020, along with the COVID-19 pandemic, the implementation of Large-Scale Social Restrictions (PSBB) rules that restricted movement caused a sharp decrease in the number of

passengers in almost all provinces in Eastern Indonesia.

Table 2. Statistical Summary

Variable	Mean	Std. Dev	Min	Max
PE	35,333.79	13,081.70	16,688.10	71,924.23
PT	253,117.50	137,613.00	64,182.00	547,463.00
PB	424,732.40	761,146.00	526.00	2,703,138.00
EP	31,780.62	77,658.39	21.00	457,530.00
AL	1,271,299.00	1,181,878.00	19,603.00	4,707,200.00
PM	2.57	2.79	0.00	14.00
IPM	69.32	3.36	60.44	74.36
IKAL	80.73	6.81	61.76	89.30

However, the opposite phenomenon occurs in the maritime tourism subsector. Figure 1 shows that the number of tourism businesses/companies increased in 2020, during the COVID-19 pandemic. Maritime tourism activity, as measured by the number of tourism businesses/companies, is still relatively low. Each province has about 2-3 business units/tourism companies, and there are even provinces that do not have a business/tourism company. Meanwhile, the highest number of water-based tourism businesses/companies was recorded in South Sulawesi Province in 2023. This indicates the uneven utilization of maritime tourism potential among the provinces in Eastern Indonesia.

In addition to describing the dynamics of the blue economy subsector, the control variables representing the social and environmental dimensions also show important characteristics for understanding the conditions of Eastern Indonesia. The HDI value was relatively homogeneous, with an average of 69.32 and a range of 60.44 - 74.36, reflecting that human development capacity in this region is in the middle category without extreme disparities between provinces. This homogeneity explains why HDI variation is not very strong in differentiating economic growth performance. In contrast, IKAL showed a more prominent heterogeneity, with an average of 80.73 as well as a wide range of 61.76 to 89.30. This difference indicates a gap in the quality of marine ecosystems among the Eastern Indonesia provinces, where some regions face greater environmental pressures than others. The wide variation in IKAL is in line with inferential findings that show that seawater quality has a positive and significant relationship with economic growth, confirming the important role of environmental aspects in supporting the sustainability of blue economy activities in the region.

Blue Economy Subsectors and Performance in Eastern Region of Indonesia

Panel data regression analysis was conducted to assess the influence of the blue economy subsector on regional economic performance in Eastern Indonesia provinces. As a first step, the best model was selected. Based on Table 3, it can be seen that the Chow test produces a p-value of 0.0000 ($< \alpha = 0.05$), thus concluding that the effect model is better than the common effect model. The test was followed by the Hausman Test, which yielded a p-value of 0.0000 ($< \alpha = 0.05$). Thus, the results of this test confirm that the fixed effect model is the best model.

Table 3. Results of the Chow Test and the Hausman Test

Test Type	p - value
Chow Test	0.0000
Hausman Test	0.0000

The next stage is to test the variance-covariance structure to check whether there is a violation of the assumption of homoskedasticity, cross-sectional independence, and no autocorrelation. The results of each test can be seen in Table 4.

Table 4. Modified Wald, Pesaran, and Wooldridge Test Results

Test Type	p - value
Modified Wald Test	0.0000
Pesaran Test	0.4320
Wooldridge Test	0.1147

Testing the assumption of homoscedasticity with the Modified Wald Test yielded a p-value of 0.0000 ($< \alpha = 0.05$), thus concluding that heteroscedasticity exists. Furthermore, a cross-sectional independence examination was carried out with a Pesaran test, which produced a p-value of 0.4320 ($> \alpha = 0.05$), so that it can be concluded that the assumption of cross-sectional independence is met. Then, an examination of the assumption of no autocorrelation with the Wooldridge Test was carried out, which showed a p-value of 0.1147. Given the evidence of groupwise heteroskedasticity, the fixed-effects model was estimated using province-clustered robust standard errors. This approach accommodates heteroskedasticity and within-province error correlation. However, the relatively small number of provincial clusters warrants caution when interpreting the statistical significance of the estimated coefficients.

As part of the assumption check to ensure reliable parameter estimation values, a multicollinearity check is also performed. Based on Table 5 it can be seen that no VIF value is greater than 10. Thus, it is concluded that there is no evidence of severe multicollinearity based on the specified VIF threshold.

Table 5. VIF Value

Variable Name	VIF
LnPT	3.82
LnPB	3.71
LnEP	2.88
LnAL	2.47
LnPM	1.99
IPM	1.17
IKAL	1.04

The results of the estimation of the parameters of the research model can be seen in Table 6. The results of the simultaneous test (F test) show a p-value of 0.0000 ($< \alpha = 0.01$). Thus, it can be concluded that all blue economy subsectors that are within the scope of the research, along with HDI and IKAL, together have a significant effect on the dependent variables. The model's R² (within) value of 0.5717 indicates that 57.17 percent of the variation of the dependent variable can be explained by the model after controlling for the provincial fixed effect. Thus, the model has a good enough ability to explain the variations of dependent variables.

Table 6. Summary of Parameter Estimation Results

Variable Name	Coefficients	t Statistics	p-value
C	7.0408	5.26	0.001***
lnPT	0.1916	2.14	0.062*
lnPB	-0.0171	-0.40	0.696
lnEP	0.0423	2.29	0.048**
lnAL	0.0081	0.24	0.814
lnPM	0.0172	0.90	0.393
IPM	0.0060	1.00	0.344
IKAL	0.0042	2.41	0.040**
F test			0.000***
R ² (within)			0.5717

Meanwhile, the influence of each sub-sector of the blue economy, HDI, and IKAL on economic performance can be seen from the results of the following partial testing:

Marine Capture Fisheries Subsector

Based on Table 6, the variable of marine capture fishery production has a coefficient of 0.1916 and a p-value of 0.062. Given that the model used has been transformed into a linear-log form, the value of this

variable's coefficient is interpreted as elasticity, which indicates that every 1 percent increase in marine capture fishery production volume has an impact on an increase in GRDP per capita of 0.1916 percent, assuming *ceteris paribus*. A p-value of 0.062 shows that the effect is significant at the 10 percent level. Thus, these findings support the first research hypothesis, namely the existence of a positive and significant relationship between the marine capture fisheries subsector and regional economic performance in Eastern Indonesia. These results are also in line with the findings of [Rehman et al. \(2019\)](#), which show a positive relationship between the two variables.

Marine Aquaculture Subsector

Table 6 shows a coefficient value of -0.0171 and a p-value of 0.696 for the variable volume of marine aquaculture production. These results show a negative but statistically insignificant estimated coefficient between the marine aquaculture subsector and economic performance. This finding is in line with the empirical findings of [Vaulina and Ramadhan \(2023\)](#), who found that the fisheries subsector is often in the position of a lagging sector. Despite the occurrence of production activities, the growth rate is slower than that of other base sectors (such as mining or the processing industry), so that statistically its contribution to the regional economic aggregate becomes unreal or even negatively corrected due to competitive disadvantage.

Thus, these findings do not support the hypothesis of the second study, which states that there is a positive and significant relationship between the marine aquaculture fisheries subsector and provincial economic performance in Eastern Indonesia.

Fishery Products Export Subsector

In Table 6, the variable of export volume of marine fishery products has a coefficient of 0.0423 and a p-value of 0.048. These results show that every 1 percent increase in the volume of fishery product exports has an impact on an increase in GRDP per capita of 0.0423 percent, assuming *ceteris paribus*. A p-value of 0.048 indicates that the effect is statistically significant at a significance level of 5 percent. These empirical findings provide statistical support for the third research hypothesis, which states that there is a positive and significant relationship between the export sub-sector of marine fishery products and economic performance. These results are in line with and reinforce previous studies, where [Oad et al. \(2022\)](#) also showed the significant role of fishery product exports as a catalyst for economic growth in developing countries. [Oad et al. \(2022\)](#) emphasized that foreign exchange receipts from the fisheries sector are able to increase regional cash reserves and stimulate other supporting sectors through a multiplier effect.

In the context of Eastern Indonesia, the significance of this variable is very reasonable considering that fishery export commodities (such as tuna, shrimp, and seaweed) have a much higher selling value in the global market than in the domestic market. The high exchange rate received by exporters and fishery business actors will increase the per capita income of coastal communities, which ultimately contributes in aggregate to the formation of the province's GRDP. Thus, these findings support the third research hypothesis, namely the existence of a positive and significant relationship between the export subsector of marine fishery products and regional economic performance in Eastern Indonesia.

Maritime Transport Subsector

In Table 6, it can also be seen that the variable number of maritime transportation passengers has a coefficient value of 0.0081 and a p-value of 0.814. Although these results show that the number of sea freight passengers has a positive relationship with GRDP per capita, the effect is not statistically significant because it has a p-value greater than the significance level of 10 percent. Thus, these findings fail to support the fourth research hypothesis, which states that there is a positive and significant relationship between the marine transportation subsector and regional economic performance in Eastern Indonesia.

Maritime Tourism Subsector

Based on Table 6, the variable of the number of tourism businesses or companies has a coefficient value

of 0.0172 and a p-value of 0.393. These results show that the number of tourism businesses or companies has a positive relationship with the provincial GRDP per capita in Eastern Indonesia. However, the effect was not statistically significant at a significance level of 10 percent. Thus, these findings fail to support the hypothesis of the fifth study, which states that there is a positive and significant relationship between the maritime tourism subsector and regional economic performance in Eastern Indonesia.

HDI and IKAL

The HDI and IKAL variables have coefficient values of 0.0060 and 0.0042, respectively. Both coefficients are positive, although only the coefficient for IKAL is statistically significant. Thus, the sixth and seventh studies that HDI and IKAL have a positive effect on provincial economic growth in Eastern Indonesia are not fully confirmed because empirical support is only found for IKAL.

The HDI coefficient was positive but not statistically significant. This phenomenon is very well explained by [Pritchett \(1996\)](#) through the theory of the Micro-Macro Paradox. He argues that improvements in education and health statistics (human capital) often do not have an immediate impact on macroeconomic growth if the region's economic structure is not able to absorb educated labor (job-skills mismatch). In Eastern Indonesia, this indicates that human development investment requires a longer time lag to be converted into real economic productivity. Thus, the hypothesis of the sixth and seventh studies stating that HDI and IKAL have a positive effect on provincial economic performance in Eastern Indonesia, respectively, is not fully confirmed because empirical support is only found for IKAL.

From the results of the inferential analysis, it can be concluded that the backbone of regional economic performance in Eastern Indonesia rests on the synergy between the base sector and the marine ecosystem. Specifically, strengthening activities in the marine capture fisheries and fishery products sub-sectors has proven to be the main engine of growth. These findings confirm that export-led growth strategies based on marine commodities have a real multiplier effect on increasing regional per capita income.

However, the success of the two real sectors cannot stand alone. The statistically significant coefficient of the Marine Water Quality Index (IKAL) suggests that better marine environmental quality is associated with higher regional economic performance, which is consistent with the view that healthy marine ecosystems underpin the economic value derived from marine resources. Thus, the ideal blue economy development model for Eastern Indonesia is one that integrates the increase in capture fishery production capacity and global market access (export), which goes hand in hand with the management of marine ecosystems. These findings suggest that strengthening marine capture fisheries, expanding fishery product exports, and maintaining marine environmental quality may support regional economic performance in Eastern Indonesia.

However, although the results of parameter estimation have used robust standard errors, this study has a number of limitations that need to be considered for future research, including (i) the limited quality and availability of data used as performance indicators for each blue economy subsector, and (ii) the relatively small number of observations. By mitigating these limitations, it is hoped that it can provide a more comprehensive explanation, especially related to subsectors that do not show significant influence in this study.

Alignment of Empirical Results with Government Policies

The findings of this study substantively provide empirical validation of the strategic policy direction being taken by the government, as well as confirm that the Indonesia Blue Economy Roadmap is on the right track. The positive significance in the capture fisheries and fishery products export sub-sectors confirms that sustainable management of marine resources is an absolute prerequisite for economic performance, not an obstacle to it. This is in line with the ecosystem quality restoration agenda in the roadmap, which includes the expansion of Marine Protected Areas, rehabilitation of critical habitats such as mangroves, seagrasses, and coral reefs, and strict waste control. In parallel with conservation efforts on the upstream side, these findings also justify the downstream strategy contained in the National Medium-Term Development Plan (RPJMN), where the government focuses on encouraging competitiveness through global quality standardization, sustainability certification, and strengthening logistics and cold chain systems. This synergy between ecological policies and trade strategies has

proven to be effective in creating positive economic transmission to GRDP in the Eastern Region of Indonesia.

Conclusion and Recommendations

Conclusions

The results of this study indicate that the marine capture fisheries and fishery product export subsector are positively associated with regional economic performance in the provinces of Eastern Indonesia. Both subsectors exhibit positive and statistically significant associations, while IKAL has also shown a consistent positive influence. These findings confirm that marine environmental quality is an important consideration for blue economy development. Thus, policy direction needs to shift from a volume-based approach to a value-based approach that emphasizes product quality, supply chain efficiency, and sustainability standards. The implementation of cold chain modernization, quality certification and eco-labeling, and strengthening of aquatic conservation zoning are key strategies that are in line with the empirical results of this research.

On the other hand, the statistically insignificant coefficients for maritime transportation and HDI and the negative coefficients in the aquaculture subsector indicate structural challenges that limit the contribution of these three variables to economic performance. The low efficiency of the cultivation production process, technological limitations, and the suboptimal connection between the production center and the market indicate the need for corrective policy intervention. The transformation of aquaculture towards technology-intensive practices such as smart farming, the restructuring of marine economic management policies that prioritize the sustainability of marine ecosystems, and the strengthening of vocational curricula to close the maritime workforce skills gap are strategic steps that are in line with the findings of the research.

Recommendations

In the future, it is hoped that local governments at the provincial and district/city levels in the Eastern Region of Indonesia can be more responsive in adopting and translating this development framework into local policies. It is highly recommended that local governments explicitly mainstream the principles of the Blue Economy into regional planning documents, both the Regional Long-Term Development Plan (RPJPD) and the Regional Medium-Term Development Plan (RPJMD). The planning commitment must be accompanied by the establishment of measurable performance indicators and adequate budgetary allocations and political support to ensure that the evaluation mechanism runs consistently, so that blue economy development translates into tangible benefits for regional communities rather than remaining solely a national policy objective. This study has limitations in the scope of the analysis area and the variables used. To enrich the understanding of the dynamics of the blue economy, further research is suggested to expand the unit of analysis to the district/city level to capture spatial heterogeneity in more detail. The addition of independent variables such as digital infrastructure and climate change indicators, including sea surface temperatures, is also highly relevant considering that these two factors are expected to be important determinants of productivity of the blue economy subsector in the future. With this expansion, empirical analysis can provide a more comprehensive picture of the future direction of Indonesia's blue economy development.

CRedit Author Statement

Annisa Sorayya: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, and/or Writing – review and editing. **Shela Hajjaria Putri:** Data curation, Formal analysis, Writing – original draft, and/or Writing – review and editing. Both authors reviewed and approved the final manuscript.

Funding Statement

The authors received no financial support for the research, authorship, and/or publication of this article.

Generative AI Statement

During the revision of this manuscript, the authors used ChatGPT (OpenAI) and Claude to assist with language editing, manuscript restructuring, and identifying inconsistencies in the text. The authors are responsible for reviewing the suggested revisions, verifying the accuracy of the data and references, and approving the final manuscript.

References

- BAPPENAS. (2024). *Peta jalan ekonomi biru Indonesia* (Edisi 2). Badan Perencanaan Pembangunan Nasional.
- Bhattacharya, P., & Dash, A. K. (2021). Determinants of blue economy in Asia-Pacific island countries: A study of tourism and fisheries sectors. *Ocean & Coastal Management*, 211, 105774. <https://doi.org/10.1016/j.ocecoaman.2021.105774>
- BPS. (2016). *Luas area usaha budi daya perikanan menurut provinsi dan jenis budi daya (ha), 2005–2016*. Badan Pusat Statistik.
- BPS. (2020-2024). *Statistik objek daya tarik wisata*. Badan Pusat Statistik.
- BPS. (2020-2024). *Statistik sumber daya laut dan pesisir*. Badan Pusat Statistik.
- BPS. (2020-2024). *Statistik transportasi laut. jakarta*. Badan Pusat Statistik.
- Bui, T. T. T., Nguyen, N. T., & Nguyen, N. L. H. T. (2025). The relationship between foreign direct investment, human development, and economic growth in Vietnam: A quantile-on-quantile regression approach. *International Journal of Sustainable Development and Planning*, 20(5), 1983–1995. <https://doi.org/10.18280/ijstdp.200516>
- Elzaki, R. M. A. (2024). Does fish production influence the GDP and food security in Gulf Cooperation Council countries? Evidence from the dynamic panel data analysis. *Aquaculture*, 582, 740982. <https://doi.org/10.1016/j.aquaculture.2023.740982>
- Fratila, A., Gavril, I. A., Nita, S. C., & Hrebenciuc, A. (2021). The importance of maritime transport for economic growth in the European Union: A panel data analysis. *Sustainability*, 13(14), 7961. <https://doi.org/10.3390/su13147961>
- Geng, B., Wu, D., Zhang, C., Xie, W., Mahmood, M. A., & Ali, Q. (2024). How can the blue economy contribute to inclusive growth and ecosystem resources in Asia? A comparative analysis. *Sustainability*, 16(1), 429. <https://doi.org/10.3390/su16010429>
- KKP. (2023). *Laporan kinerja kementerian kelautan dan perikanan 2023*. Kementerian Kelautan dan Perikanan.
- KKP. (2022 & 2024). *Kelautan dan perikanan dalam angka*. Kementerian Kelautan dan Perikanan.
- KLHK. (2022). *Laporan indeks kualitas lingkungan hidup*. Kementerian Lingkungan Hidup dan Kehutanan.
- Liza, J. I., Majumder, S. C., & Rahman, M. H. (2025). Scrutinizing the impact of blue economy factors on the economic growth in Bangladesh: An empirical study. *Marine Policy*, 173, 106542. <https://doi.org/10.1016/j.marpol.2024.106542>
- Martínez-Vázquez, R. M., Milán-García, J., Pires Manso, J. R., & de Pablo Valenciano, J. (2023). Impact of blue economy sectors using causality, correlation, and panel data models. *Frontiers in Marine Science*, 10. <https://doi.org/10.3389/fmars.2023.1034054>
- Nugraha, Y. E., & Flora, V. A. S. M. (2022). Economic impact of tourism development in Coastal area: A multiplier effect analysis approach. *Advances in Social Science, Education and Humanities Research*, 647. <https://doi.org/10.2991/assehr.k.220301.022>
- Oad, S., Jinliang, Q., Hussain, S. S. B., Ali, M., & Jattak, Z. U. (2022). The exports of marine resources and its impact on economic development in Pakistan: An econometric analysis using vector error correction model (VECM). *Journal of Animal & Plant Sciences*, 32(3), 798–808. <http://doi.org/10.36899/JAPS.2022.3.0482>
- Pritchett, L. (1996). Where has all the education gone? *The World Bank Economic Review*, 15(3), 367–391. <https://doi.org/10.1093/wber/15.3.367>
- Ramadhan, M. E., & Vaulina, S. (2023). Identifikasi subsektor unggulan perikanan di Kabupaten Rokan Hilir Provinsi Riau. *Dinamika Pertanian*, 39(3), 225–236. [https://doi.org/10.25299/dp.2023.vol39\(3\).16436](https://doi.org/10.25299/dp.2023.vol39(3).16436)

- Rehman, A., Deyuan, Z., Hena, S., & Chandio, A. A. (2019). Do fisheries and aquaculture production have dominant roles within the economic growth of Pakistan? A long-run and short-run investigation. *British Food Journal*, 121(8), 1926–1935. <https://doi.org/10.1108/BFJ-01-2019-0005>
- Rogerson, C. M., & Rogerson, J. M. (2019). Emergent planning for South Africa's blue economy: Evidence from coastal and marine tourism. *Urbani Izziv*, 30, 24–36. <https://doi.org/10.5379/urbani-izziv-en-2019-30-supplement-002>
- Sahu, R. P. K., & Doppalapudi, R. (2025). Blue economy: Framework for integrating economic growth with marine ecosystem. *International Journal of Marine Engineering Innovation and Research*, 10(1), 165–174. https://iptek.its.ac.id/index.php/ijmeir/article/view/22577/pdf_339
- UNDP. (2023). *Blue economy: A sustainable ocean economic paradigm*. United Nations Development Programme. <https://www.undp.org/blog/blue-economy-sustainable-ocean-economic-paradigm>
- United Nations Environment Programme. (2025). *Sustainable blue economy*. <https://www.unep.org/topics/ocean-seas-and-coasts/regional-seas-programme/sustainable-blue-economy>
- World Bank & UN DESA. (2017). *The potential of the blue economy: Increasing long-term benefits of the sustainable use of marine resources for small island developing states and coastal least developed countries*. Washington, DC: International Bank for Reconstruction and Development/World Bank. <https://openknowledge.worldbank.org/handle/10986/26843>