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The Impact of Blue Economy Implementation on the Global Competitive Advantage of South Bali Fishermen: The Role of Sustainable Fisheries as a Mediating Variable

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ABSTRACT
This study aims to analyze the effect of blue economy principles on the global competitive advantage of mud crab (Scylla spp.) fishers in the Tahura Ngurah Rai area, South Bali, with sustainable fisheries as a mediating variable, amid challenges following the Benoa oil spill incident. This quantitative explanatory research involved 100 fishers selected through purposive sampling and analyzed using Partial Least Square Structural Equation Modeling (SEM-PLS). The results show that blue economy implementation has a significant positive effect on global competitive advantage, both directly ($\beta=0.430$; $p<0.001$) and indirectly through sustainable fisheries (indirect effect=0.204; $p<0.001$), which also acts as a partial mediator, explaining 52.2% of the variance in global competitive advantage. Importance-Performance Map analysis identifies capture operations, institutional integration, and biosecurity standards as priority areas for improvement. These findings underscore the importance of integrating blue economy and sustainable fisheries as a strategy to enhance the competitiveness of small-scale fishers in global markets.

***Keywords:** Blue Economy; Sustainable Fisheries; Global Competitive Advantage; SEM-PLS; Mud Crab Fishers*

INTRODUCTION

Blue economy (blue) economy) has become an important paradigm in the sustainable management of marine resources as well as a driver of economic growth (Hutajulu et al., 2026; Narwal et al., 2024). According to the World Bank, the global ocean economy is worth around US$1.5 trillion per year, while the Intergovernmental Panel on Climate Change (IPCC) notes that marine ecosystems produce around 50% of the world's oxygen and absorb a third of CO_2 emissions, making their sustainability crucial for climate change (Abubakar et al., 2025; Renur et al., 2025)mitigation . Global attention to this paradigm is reflected in the Sustainable Development Goals agenda, particularly SDG 14 Life Below Water, as well as various multilateral forums that encourage the strengthening of the fisheries, aquaculture, and marine tourism sectors in a sustainable manner (Liang et al., 2022; Ravichandra et al., 2026).

The world production of mud crabs (genus Scylla) continues to increase, reaching around 230,000–296,000 tons per year with an average growth of more than 7.8% per year since 2000, dominated by the aquaculture sector in Asian regions such as China, Vietnam, Indonesia, and Bangladesh (Andayani et al., 2022; Muhaemin et al., 2024; Murak et al., 2026). Indonesia has a strategic role in the global supply chain of this commodity, supported by extensive mangrove ecosystems and high export demand (Meisi, 2023; Normawati et al., 2025; Pandang & Pawenang, 2025). As an archipelagic country with 17,504 islands and a coastline of more than 108,000 km, Indonesia's maritime economic potential is estimated to reach more than US$246 billion per year (World Bank, 2021), although the contribution of the maritime sector to national GDP is currently only around 7.9%, with a target of 15% by 2045 through the implementation of the blue economy in line with the Blue Economy Roadmap and the National Action Plan for Small-Scale Fisheries Management (RAN-PPSK) (Sambodo et al., 2024).

Regionally, Bali Province has a water area of approximately 5,780 km² with significant fisheries potential. Data from the Ministry of Maritime Affairs and Fisheries (KKP) for 2024 recorded the distribution of fishers and capture fisheries production across Bali's eight regencies/cities, as presented in Table 1.

Table 1. Distribution of fishermen and capture fisheries production in Bali Province in 2024

No	Regency/City	Number of Fishermen (people)	Production Amount (Tons)
1	Jembrana	7,352	25,677.37
2	Tabanan	812	782.31
3	Badung	5,560	8,385.99
4	Gianyar	2,972	662.02
5	Klungkung	2,963	3,458.43
6	Karangasem	31,662	28,798.24
7	Buleleng	12,789	17,385.40
8	Denpasar City	13,676	42,985.78
	Total	77,786	128,738.55

The data shows that Bali's total capture fisheries production in 2024 reached 128,738.55 tons. Denpasar City recorded the highest production (42,985.78 tons) despite having fewer fishermen than Karangasem Regency, indicating differences in production capacity and market access between regions. High production in Denpasar is supported by the presence of the Ngurah Rai Grand Forest Park (Tahura) mangrove ecosystem, which functions as a nursery. mangrove crab (BAHARUDDIN, 2023; Prasetio et al., 2023; Wildan et al., 2025)ground , as well as geographical proximity to I Gusti Ngurah Rai International Airport which provides logistical advantages for the distribution of perishable products such as live crabs to export markets.

Despite this significant potential, the competitiveness of Balinese fishery products in the global market remains relatively low, indicating a gap between resource potential and the ability of business actors to meet international market quality and sustainability standards. This challenge became even more apparent following the oil leak incident in the Benoa area (2025–2026), which potentially polluted the mangrove buffer zone for exports and required fishermen to adapt quickly to ensure their products remained contamination-free. Academically, studies specifically linking the implementation of the blue economy to the global competitive advantage of fishermen in mangrove crab commodities are still limited

(Falah & Aptasari, 2025; Hendarto, 2025); previous research generally focused on macro-level policies (Efani et al., 2024; Rianawati et al., 2024)implemented under relatively stable ecosystem conditions, or placed different mediating variables (Pratama & Farida, 2025). The role of sustainable fisheries, particularly compliance with the Minister of Maritime Affairs and Fisheries Regulation (Permen KP) No. 7 of 2024 concerning the management of lobsters, crabs, and swimming crabs as a mediator between the blue economy and the global competitiveness of fishermen after real ecosystem disturbances has not been widely empirically tested, particularly in mangrove-based tropical fisheries.

This study fills the gap by integrating three theoretical foundations: the blue economy principle that emphasizes a zero-waste cascade system (Hajam & Kumar, 2024; Ismail & Zokm, 2025; Pauli, 2010), the theory of sustainable fisheries systems that emphasizes the four pillars of ecological, socio-economic, community, and institutional sustainability (Cámara & Santero-Sánchez, 2019; Charles, 2023), and the Resource-Based View (RBV) that views sustainable competitive advantage as originating from valuable, rare, difficult to imitate, and organized resources or the VRIO framework (Holz, 2025; Lubis et al., 2026; Münter, 2025). All three are tested in a single structural model in the context of mangrove crab fishermen in the Ngurah Rai Tahura area, South Bali, using a Structural Equation Modeling approach based on Partial Least Square (SEM-PLS). Specifically, this study aims to analyze the effect of the application of blue economy principles on the global competitive advantage of fishermen, both directly and through the mediating role of sustainable fisheries, and to formulate a structural model of adaptive and sustainable global competitive advantage for South Bali fishermen.

RESEARCH METHODS

This research is a quantitative research with an explanatory approach that explains the causal relationship between variables empirically. The research location is the coastal area of South Bali with a focus on the area around the Ngurah Rai Grand Forest Park (Tahura), chosen because this area is one of the largest mangrove ecosystems in Bali which is the main habitat of mangrove crabs (Scylla spp.), the center of coastal fishing activities, as well as having geographical proximity to distribution and export centers.

This research is built on a conceptual framework that integrates three variables: the implementation of the blue economy as an independent variable (X), sustainable fisheries as a mediating variable (M), and global competitive advantage as a dependent variable (Y). Based on this framework, four hypotheses are formulated: H1) the implementation of the blue economy has a positive effect on global competitive advantage; H2) the implementation of the blue economy has a positive effect on sustainable fisheries; H3) sustainable fisheries has a positive effect on global competitive advantage; and H4) sustainable fisheries mediate the effect of the implementation of the blue economy on the global competitive advantage of fishermen.

The study population was all mangrove crab fishermen operating in the Ngurah Rai Tahura area, whose exact number is unknown. The sample was determined through non-probability sampling with a purposive sampling technique based on the following criteria: (1) actively catching or cultivating mangrove crabs; (2) operating in the Ngurah Rai Tahura mangrove area; and (3) having at least one year of experience. The sample size was determined using the Lemeshow approach for unknown populations, resulting in 100 respondents. Primary data was obtained through a five-point Likert-scale questionnaire distributed offline, while secondary data came from the Central Statistics Agency, the Ministry of Maritime Affairs and Fisheries, and relevant scientific literature.

The operationalization of the three variables along with their dimensions and number of indicators is presented in Table 2. The Blue Economy Implementation variable (X) is measured through the dimensions of habitat conservation, waste management, and technological innovation; Sustainable Fisheries (M) through regulatory compliance (referring to Ministerial Regulation No. 7 of 2024), institutional integration, and biosecurity standards; and Global Competitive Advantage (Y) through product differentiation and market reputation, including items related to product resistance to contamination following the Benoa oil leak incident.

Table 2. Operationalization of research variables

Construct	Dimensions	Number of Items
Implementation of Blue Economy (X)	Habitat Conservation	3
	Waste Management	2
	Technological Innovation	2
Sustainable Fisheries (M)	Regulatory Compliance	3
	Institutional Integration	2
	Biosecurity Standards	2
Global Competitive Advantage (Y)	Product Differentiation	3
	Market Reputation	3

Data were analyzed using Structural Equation Modeling based on Partial Least Square (SEM-PLS) with the help of SmartPLS software, including two stages: evaluation of the measurement model (outer model) and the structural model (inner model). The outer model was tested through convergent validity (outer loading > 0.5; Average Variance Extracted/AVE > 0.50), discriminant validity (Fornell-Larcker criteria, cross loading, and Heterotrait-Monotrait Ratio/HTMT < 0.90), and construct reliability (Cronbach's Alpha, Composite Reliability, and rho_A > 0.60). The inner model was evaluated through R-Square, path coefficient, effect size (f^2), and hypothesis testing through bootstrapping, with significant criteria at T-statistic > 1.96 and P-value < 0.05. The mediating effect of sustainable fisheries was tested through an indirect effect analysis with the bootstrapping method, declared significant if the P-value < 0.05. Next, an Importance-Performance Map (IPM) analysis was conducted which combined the total effect value (importance) from the SEM model with the average implementation score (performance) of each indicator, resulting in a mapping of four priority quadrants: maintained (quadrant I), improved (quadrant II), low priority (quadrant III), and potential resource reallocation (quadrant IV).

RESULTS AND DISCUSSION

Respondent Characteristics

This study involved 100 mangrove crab fishermen in the Ngurah Rai Tahura area as respondents. Distribution based on length of service (Figure 1) shows that the majority of respondents had 6–10 years of experience (29), followed by those with >15 years (25), those with 11–15 years (24), those with 1–5 years (19), and those with <1 year (3). This predominance of experienced fishermen indicates that the research data reflects relatively consistent blue economy and sustainable fisheries practices.

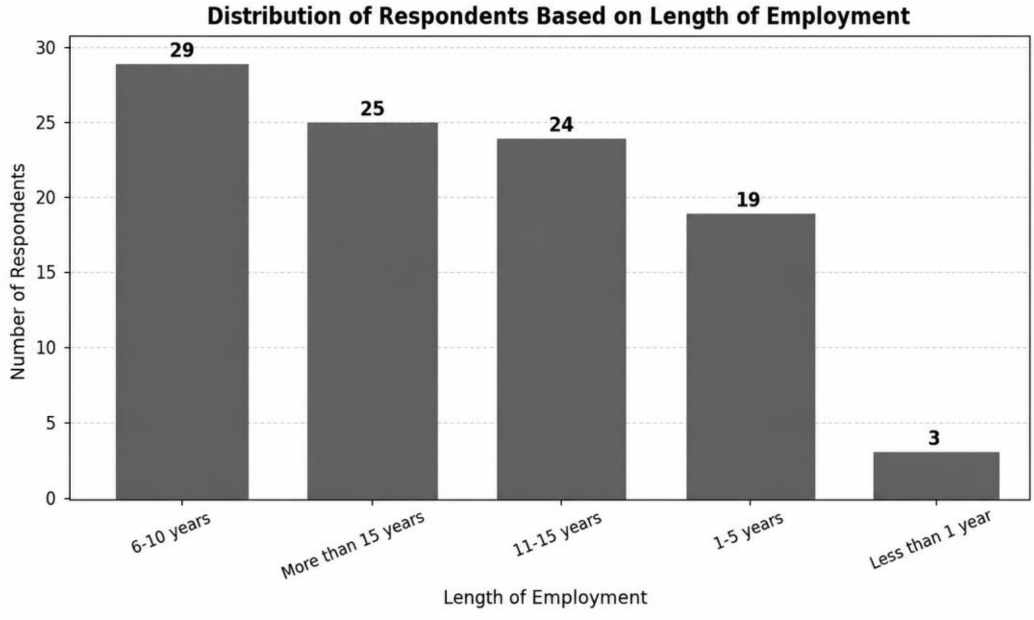

Figure 1. Distribution of respondents based on length of service

Descriptive Analysis of Variables

Descriptive analysis using class intervals (range 0.8 on a 1–5 Likert scale) yielded five categories: 1.00–1.80 Strongly Disagree; 1.81–2.60 Disagree; 2.61–3.40 Neutral; 3.41–4.20 Agree; and 4.21–5.00 Strongly Agree.

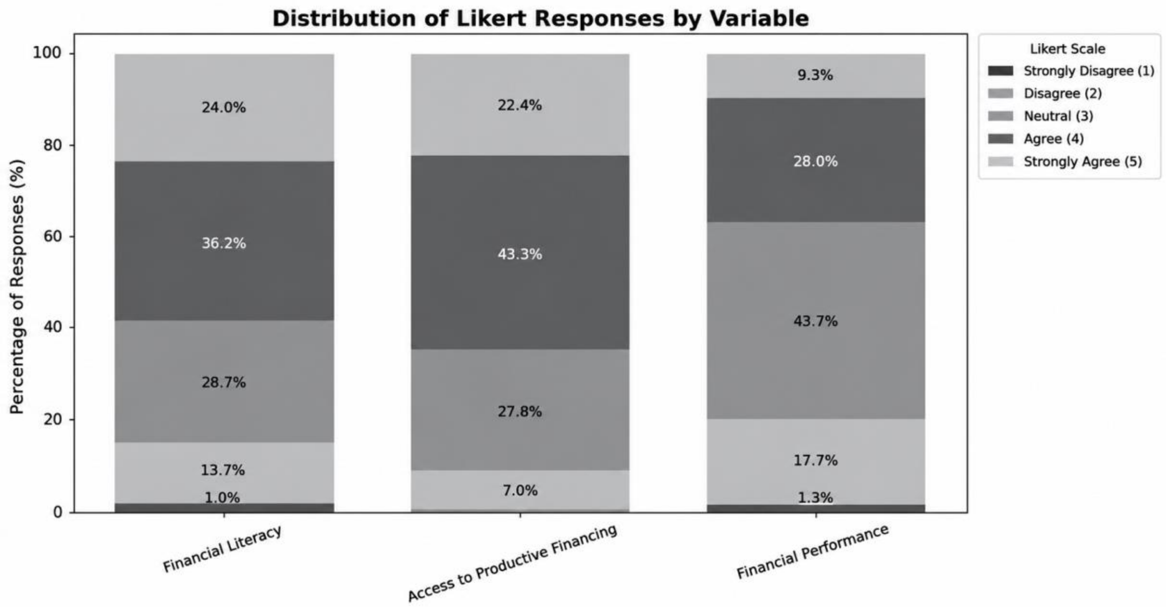

Figure 2. Distribution of answers to the Blue Economy Implementation variable (X)

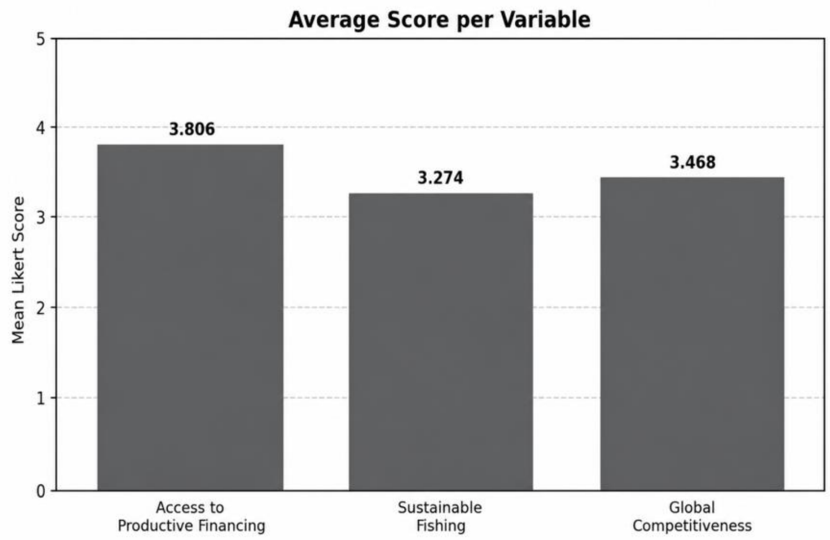

Figure 3. Distribution of answers to the Sustainable Fisheries (M) and Global Competitive Advantage (Y) variables

As shown in Figure 2 and Figure 3, the Blue Economy Implementation variable (X) obtained an average score of 3.806 (43.3% answered Agree, 22.4% Strongly Agree), reflecting the active participation of fishermen in mangrove conservation, waste management, and the use of environmentally friendly technologies. The Sustainable Fisheries variable (M) obtained an average of 3.274, dominated by Neutral (40.7%) and Agree (29%) responses, indicating that regulatory compliance and biosecurity practices are already in place but their consistency can still be improved. The Global Competitive Advantage variable (Y) obtained an average of 3.468 (36.2% Agree, 14% Strongly Agree), indicating fishermen's positive assessment of product differentiation and the reputation of the Balinese mangrove crab market. This pattern aligns with the research's conceptual framework: strengthening the blue economy goes hand in hand with sustainable practices and fishermen's perceived competitiveness.

Evaluation of Measurement Model (Outer Model)

The evaluation of the outer model is summarized in Tables 3, 4, and 5.

Table 3. Outer loading of convergent validity test

Indicator	Global Competitive Advantage	Implementation of Blue Economy	Sustainable Fisheries
X1.1		0.811	
X1.2		0.859	
X1.3		0.852	
X2.1		0.843	
X2.2		0.858	
X3.1		0.839	
X3.2		0.871	
M1.1			0.783
M1.2			0.850
M1.3			0.835
M2.1			0.844

M2.2			0.841
M3.1			0.826
M3.2			0.850
Y1.1	0.871		
Y1.2	0.892		
Y1.3	0.824		
Y2.1	0.815		
Y2.2	0.859		
Y2.3	0.841		

All indicators in the three variables have outer loadings above 0.70 (X: 0.811–0.871; M: 0.783–0.850; Y: 0.815–0.892), indicating good convergent validity.

Table 4. Discriminant validity (Fornell-Larcker criterion)

	Global Competitive Advantage	**Implementation of the Blue Economy**	**Sustainable Fisheries**
Global Competitive Advantage	0.851		
Implementation of Blue Economy	0.634	0.848	
Sustainable Fisheries	0.620	0.508	0.833

The Fornell-Larcker criterion shows that the AVE root of each construct (Y=0.851; X=0.848; M=0.833) is greater than the correlation between constructs (0.508–0.634), fulfilling the requirements for discriminant validity.

Table 5. Construct reliability and validity

Construct	**Cronbach's Alpha**	**rho_a**	**rho_c**	**AVE**
Global Competitive Advantage	0.923	0.924	0.940	0.723
Implementation of Blue Economy	0.935	0.936	0.947	0.719
Sustainable Fisheries	0.926	0.929	0.941	0.694

Construct reliability was also met, with Cronbach's Alpha of 0.923–0.935, Composite Reliability (rho_a) of 0.924–0.936 and (rho_c) of 0.940–0.947, and AVE of 0.694–0.723, all exceeding the minimum threshold (0.60 for reliability; 0.50 for AVE). These results confirm that the research instrument is valid and reliable for measuring the three latent variables, so that the analysis can proceed to the inner model stage.

Structural Model Evaluation (Inner Model) and Hypothesis Testing

The structural model diagram (Figure 4) shows an R-Square value of 0.258 for Sustainable Fisheries (M) meaning that 25.8% of the variation is explained by the Implementation of the Blue Economy (X) and 0.522 for Global Competitive Advantage (Y), meaning that X and M together explain 52.2% of the variation in Y, while the rest is influenced by factors outside the model.

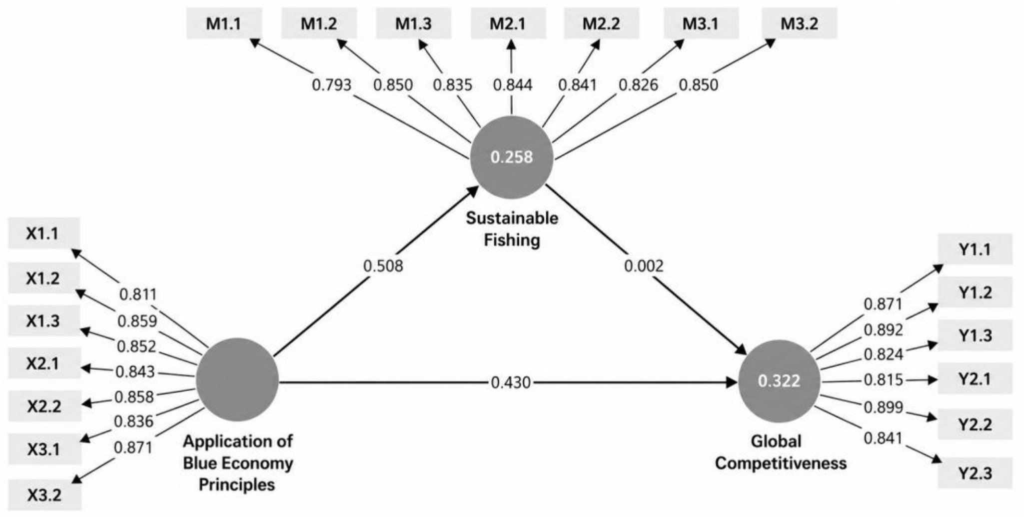

Figure 4. SEM diagram of the structural model

Table 6. Effect size (f²)

	Global Competitive Advantage	**Implementation of Blue Economy**	**Sustainable Fisheries**
Global Competitive Advantage			
Implementation of the Blue Economy	0.286		0.348
Sustainable Fisheries	0.251		

The effect size (f²) value shows the influence of X on Y of 0.286 and M on Y of 0.251 (both moderate effects), and X on M of 0.348 (moderate to large effect) (Hair & Alamer, 2022).

Table 7. Results of testing the direct influence hypothesis

Hypothesis	**Original Sample**	**T-Statistics**	**P-Values**
H1: Blue Economy → Global Competitive Advantage	0.430	5,890	0,000
H2: Blue Economy → Sustainable Fisheries	0.508	6,960	0,000
H3: Sustainable Fisheries → Global Competitive Advantage	0.402	5,494	0,000

Hypothesis testing through bootstrapping (Table 7) confirmed that H1 is accepted: the implementation of the blue economy has a significant positive effect on global competitive advantage ($\beta=0.430$; $t=5.890$; $p<0.001$). H2 is accepted: the blue economy has a significant positive effect on sustainable fisheries ($\beta=0.508$; $t=6.960$; $p<0.001$). H3 is accepted: sustainable fisheries has a significant positive effect on global competitive advantage ($\beta=0.402$; $t=5.494$; $p<0.001$).

Table 8. Results of testing the hypothesis of indirect influence (mediation)

Hypothesis	**Original Sample**	**T-Statistics**	**P-Values**
H4: Blue Economy → Sustainable Fisheries → Global Competitive Advantage	0.204	4,405	0,000

The indirect effect analysis (Table 8) confirmed H4: sustainable fisheries partially and significantly mediate the effect of the blue economy on global competitive advantage (indirect effect=0.204; t=4.405; p<0.001). Part of the blue economy's influence on fishermen's global competitiveness is channeled through strengthening fisheries sustainability practices—including regulatory compliance, institutional integration, and biosecurity standards—so that the effectiveness of the blue economy in increasing competitiveness is not only direct, but also indirectly strengthened through sustainability channels.

Importance-Performance Map (IPM) Analysis

The HDI analysis of the Sustainable Fisheries construct (Table 9, Figure 5) shows an average importance of 0.085 and a performance of 63.37. Indicators X2.1 (zero-waste principle), X3.2 (fishing time effectiveness), and X1.2 (water cleanliness) are in quadrant I (high importance and performance) and are therefore a priority for maintenance. Indicator X2.2 (fishing operations) is in quadrant II (high importance, low performance) and is a top priority for improvement. Indicators X1.3 (mangrove protection) and X3.1 (environmentally friendly fishing gear) are in quadrant III/IV with relatively lower influence, while X1.1 (ecosystem restoration) is in quadrant IV—its implementation is high but its influence on global competitiveness is relatively small.

Table 9. Importance-Performance Map of Sustainable Fisheries constructs

Indicator	**Importance (Total Effect)**	**Performance**
X1.1 Habitat Conservation – Ecosystem Restoration	0.081	66,000
X1.2 Habitat Conservation – Clean Waters	0.092	63,000
X1.3 Habitat Conservation – Mangrove Protection	0.078	61,667
X2.1 Waste Management – Zero Waste Principle	0.086	69,500
X2.2 Waste Management – Capture Operations	0.087	58,000
X3.1 Technological Innovation – Environmentally Friendly Fishing Gear	0.083	61,667
X3.2 Technological Innovation – Capture Time Effectiveness	0.091	63,750
Average	0.085	63,369

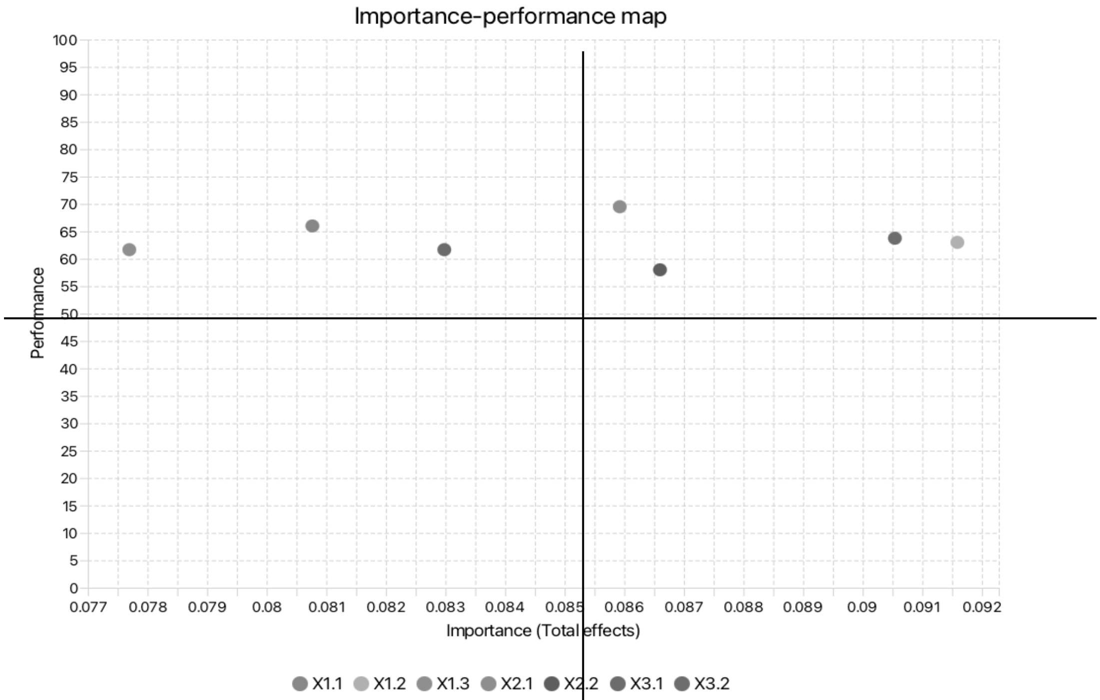

Figure 5. Importance-Performance Map of Sustainable Fisheries construct

For the Global Competitive Advantage construct (Table 10, Figure 6), the average importance is 0.073 and performance is 60.11. Quadrant I is filled by X1.1, X1.2, X1.3, X3.1, X3.2, and X2.1, indicating that the blue economy indicators are consistently the main strength that has been implemented well and has a significant influence. Quadrant II (priority for improvement) is filled by X2.2 (fishing operations), M3.1 (post-harvest biosecurity standards), M2.2 (institutional integration), and M1.2 (release of egg-laying crabs). Quadrant III is filled by M3.2, M1.1, M2.1, and M1.3, while there are no indicators in quadrant IV indicating that high implementation in the sustainable fisheries dimension in general has not been balanced by an equivalent influence on global competitiveness, so strengthening the indicators in quadrant II is the key to increasing the effectiveness of the overall model.

Table 10. Importance-Performance Map of Global Competitive Advantage construct

Indicator	Importance (Total Effect)	Performance
M1.1 Regulatory Compliance – Export Standards >150g	0.064	59,000
M1.2 Regulatory Compliance – Releasing Egg-Laying Crabs	0.077	57,000
M1.3 Regulatory Compliance – Carapace Size	0.068	59,250
M2.1 Institutional Integration – Active KUB	0.067	54,250
M2.2 Institutional Integration – Active Group Meetings	0.075	58,000
M3.1 Biosecurity Standards – Hygienic Postharvest Techniques	0.073	54,500
M3.2 Biosecurity Standard – Contamination Free	0.059	56,000
X1.1 Habitat Conservation – Ecosystem Restoration	0.0701	66,000
X1.2 Habitat Conservation – Clean Waters	0.079	63,000
X1.3 Habitat Conservation – Mangrove Protection	0.097	61,667
X2.1 Waste Management – Zero Waste Principle	0.075	69,500
X2.2 Waste Management – Capture Operations	0.0756	58,000
X3.1 Technological Innovation – Environmentally Friendly Fishing Gear	0.0722	61,667
X3.2 Technological Innovation – Capture Time Effectiveness	0.0784	63,750
Average	0.073	60,113

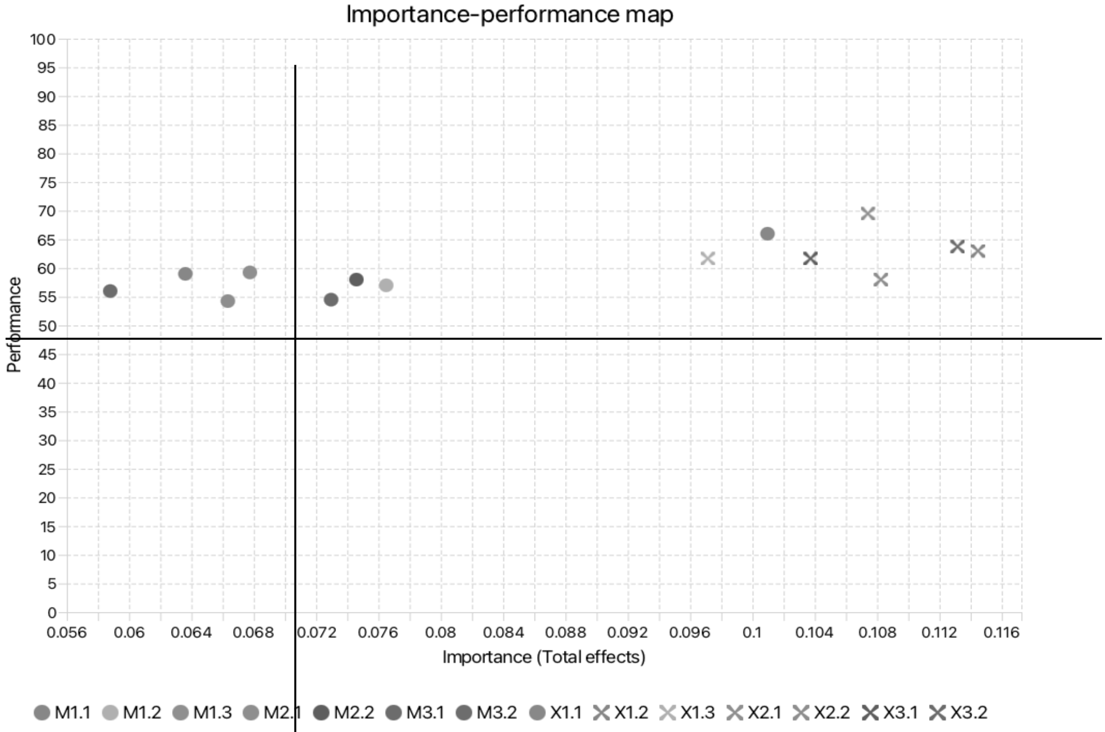

Figure 6. Importance-Performance Map of the Global Competitive Advantage construct

Discussion

These findings empirically support the three theoretical frameworks underlying the study. The direct influence of the blue economy on global competitive advantage (H1) aligns with the Resource- Based View (Münter, 2025), where habitat conservation practices and environmentally friendly technological innovations become valuable, scarce, and difficult-to-imitate resources for global competitors—especially amidst the pressures following the Benoa oil spill incident that demanded rapid adaptation by fishermen. The influence of the blue economy on sustainable fisheries (H2) reflects the logic of the zero-waste cascade system popularized by Pauli (2010), where operational waste management and mangrove conservation serve as the foundation for broader sustainability practices. The mediating role of sustainable fisheries (H3, H4) confirms the relevance of sustainable fisheries systems theory. (Charles, 2023)which emphasized that ecological sustainability alone is not enough without the support of institutional pillars in this case compliance with Ministerial Regulation No. 7 of 2024 to truly be converted into a competitive advantage in the international market.

In practice, the IPM results indicate that further strengthening needs to be directed at the operational aspects of fishing, institutional integration (KUB/cooperatives), and post-harvest biosecurity standards —important dimensions, but their implementation still lags behind that of relatively well-established habitat conservation. These findings are consistent with previous research demonstrating the importance of institutions and technical regulations in bridging the blue economy philosophy into a real competitive force (Efani et al., 2024; Noerhidayanti et al., 2025), while expanding the literature by confirming the mediating role specifically in the context of mangrove crab commodities in post-ecosystem disturbance mangrove areas, which have not previously been empirically tested (Pratama & Farida, 2025; Rianawati et al., 2024).

CONCLUSION AND SUGGESTIONS

This study concludes that the application of blue economy principles has a positive and significant effect on the global competitive advantage of South Bali fishermen, both directly (β=0.430; p<0.001; f^2=0.286) and indirectly through increasing sustainable fisheries (indirect effect=0.204; p<0.001). The blue economy is also proven to strongly encourage sustainable fisheries (β=0.508; p<0.001; f^2=0.348), which in turn contributes significantly to global competitive advantage (β=0.402; p<0.001; f^2=0.251). Sustainable fisheries act as a partial mediator in this relationship, and the constructed structural model is able to explain 52.2% of the variation in global competitive advantage and 25.8% of the variation in sustainable fisheries, confirming that sustainable marine resource management is a strategic path, not just a complement, for increasing the competitiveness of mangrove crab fishermen in the international market, especially after ecosystem disturbances such as the Benoa oil spill incident.

Based on these findings, several practical implications can be formulated. First, fishermen and business groups need to continue strengthening existing blue economy practices, such as mangrove habitat conservation and zero-waste waste management, while prioritizing improvements to aspects identified as weak through the Importance-Performance Map analysis, namely fishing operations, institutional integration (KUB/cooperatives), and post-harvest biosecurity standards. Second, local governments and the Ministry of Maritime Affairs and Fisheries need to strengthen their support for the dissemination of Ministerial Regulation No. 7 of 2024 and institutional incentives so that regulatory compliance is not only formal but also improves fishermen's bargaining position in the export market. Third, given the strategic role of the Ngurah Rai Tahura area as an ecological and logistical buffer, periodic HDI-based monitoring and evaluation are recommended to ensure each indicator remains in the appropriate priority quadrant as market and environmental conditions change post-crisis.

This study has limitations, including its limited sample size to a single area (Ngurah Rai Natural Park), requiring caution in generalizing to other coastal areas in Bali. Furthermore, its cross-sectional design fails to capture the longitudinal dynamics of post-Benoa incident recovery. Future research is recommended to expand the coverage and integrate longitudinal data to test the resilience of this global competitive advantage model over time.

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