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Evaluating Blue Economy Dynamics Through the Influence of Marine Fuel Price Fluctuations on the Purchasing Power and Socioeconomic Welfare of Indonesian Captured Fisheries

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ABSTRACT

The capture fisheries sector is a key pillar of Indonesia's blue economy and food security, yet it remains highly sensitive to fluctuations in marine fuel prices. This study applies a mixed-method approach—combining monthly time-series data (2019–2023) with field interviews in Pati and Indramayu—to assess how fuel price changes affect fishers' purchasing power and socioeconomic welfare. Results show that fuel accounts for 60–70% of operational costs, and the 2022 price surge triggered widespread fishing stoppages that disrupted coastal economies; around 70% of fishers in Pati became inactive, while large vessels in Indramayu had already ceased operations earlier. The Fishermen's Terms of Trade (FiTT) declined from 106.45 in 2022 to 101.76 in 2024, indicating a continued erosion of welfare. Regression analysis confirms that rising non-subsidized fuel prices significantly reduce net income, while subsidy access has a positive effect, although only about 30% of small-scale fishers benefit from it. The study also highlights increasing financial pressure and reliance on informal lending, underscoring the need for targeted fuel price stabilization, improved digital subsidy distribution, accelerated adoption of alternative energy, and more comprehensive welfare indicators.

Keywords: blue economy; marine fuel ; price fluctuation; capture fisheries; purchasing power; fisher welfare; fuel subsidy

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1. Introduction

Blue Economy and the Strategic Role of Capture Fisheries

Indonesia places the marine and fisheries sector at the core of its blue economy strategy, guided by five priorities, including marine conservation, quota-based fishing, sustainable aquaculture, integrated coastal management, and marine waste reduction [1]. Capture

fisheries represent an important component of Indonesia's blue economy, contributing Rp229.06 trillion out of Rp434.44 trillion total production in 2023, employing 3.20 million people, and supporting 12,117 coastal villages [19]. However, this contribution depends on the economic viability of fishing operations. The 2022 fuel price shock exposed a major vulnerability: when costs rise beyond a certain point, fishing activities decline and coastal economies are disrupted, threatening the stability and long-term goals of the blue economy [22].

Structural Poverty and the Fishermen's Welfare Paradox

Despite its significant economic value, the capture fisheries sector remains marked by structural poverty. The Minister of Marine Affairs and Fisheries has stated that Indonesian fishers are "not yet prosperous," with a Fishermen's Terms of Trade (FiTT) of 105 still indicating vulnerability, while adequate welfare is estimated at 200–300 [7]. In 2023, fisher poverty reached 25.14%, far above the national rate of 9.54%, with around 85% of fishers operating on a small scale and most living below the poverty line [14]. FiTT trends are also stagnant to declining—from 104.69 (2021) to 106.45 (2022), then dropping to 105.4 (2023) and 101.76 (2024), before slightly recovering to 103.45 (2025) [14]. This suggests that incomes are not keeping pace with rising costs, especially fuel, leading to declining purchasing power. Moreover, fisher poverty is also shaped by post-harvest inefficiencies and limited financial access, which are not fully captured by FiTT alone [24].

Centrality of Marine Fuel in Operational Costs and Livelihoods

Marine fuel is the most critical and volatile cost component in capture fisheries, typically accounting for 50–70% of total operating expenses, and reaching up to 80% during the 2022 price surge in Indramayu [6,13]. This cost structure makes fishing highly dependent on diesel prices; for example, the fuel cost of a 30 GT vessel rose sharply from about Rp63 million to Rp102 million within months. As a result, many fishers faced losses, with some describing fishing activities as increasingly risky and uncertain. Given that 60–70% of production costs are tied to fuel, price increases directly erode incomes and reduce fishing activity, often leading to financial and psychological stress, although in some cases they may temporarily ease pressure on fish stocks [12].

The Subsidy Access Crisis and the 2026 Fuel Price Shock

Indonesia's fuel subsidy program is intended to shield fishers from price volatility, yet its implementation remains ineffective. A 2023 survey by KNTI and the KUSUKA Coalition across 25 regencies found that 70% of fishers lacked access to subsidized fuel and were forced to purchase diesel at market prices far above the official Rp6.800 per litre, only slightly

improving from 82% exclusion in 2021 [12]. The situation worsened as fuel prices surged months before the official September 2022 adjustment, rising from Rp9.500 per litre at the end of 2021 to Rp15.000–Rp17.000 per litre by mid-2022 an increase of about 79% within seven months [8,9,10]. The impact was severe: large vessels halted operations, and around 70% of fishers in Pati became inactive due to unaffordable costs. Small-scale fishers were hit hardest, often facing operating expenses that exceeded the value of their catch. This crisis highlights the vulnerability of a fisheries system heavily dependent on affordable and accessible fuel, especially when subsidy distribution fails.

Research Objectives and Significance

The events of 2022 highlight the close link between energy policy and blue economy outcomes. This study aims to comprehensively assess how marine fuel price fluctuations affect the purchasing power and socioeconomic welfare of Indonesian capture fishers. By integrating quantitative data—such as FiTT, fuel price trends, and fisheries production—with qualitative insights from fishers in Pati and Indramayu, the research seeks to bridge the gap between macro-level policy goals and the realities faced by small-scale fishers. The study ultimately aims to deliver evidence-based policy recommendations to protect livelihoods while supporting the long-term sustainability of Indonesia's blue economy.

2. Materials and Method

Research Design and Analytical Framework

This study adopted a mixed-method approach combining quantitative time-series analysis and qualitative case study methods to examine the socioeconomic effects of marine fuel price fluctuations. The quantitative component used monthly data from January 2019 to December 2023 on Fishermen's Terms of Trade (FiTT), subsidized and non-subsidized diesel prices, and capture fisheries production statistics obtained from Statistics Indonesia (BPS) and KKP. Policy documents such as Presidential Regulation No. 191/2014, official KKP press releases, and reports from credible institutions were also reviewed to understand the regulatory context.

Data Collection

A case study was conducted in Pati Regency (Juwana Port) and Indramayu Regency (Karangsong Port), two major capture fisheries centres on Java's north coast severely affected by the 2022 fuel price hikes. Primary data were collected in October–November 2023 through semi-structured interviews with 30 key informants (vessel owners above 30 GT, crew members, fish collectors, cooperative leaders, and local fisheries agency representatives), direct field observations at ports, fish auction sites, and processing plants, and content

analysis of credible media reports documenting fishing strikes during the crisis period [8,9,10]. All primary data were thematically analysed to identify patterns of coping strategies and welfare impacts.

Data Analysis

Quantitative analysis comprised descriptive trend analysis and multiple linear regression to measure the influence of fuel price, catch volume, and subsidy access on net fisher income. The regression equation was:

$$Net\ Income = \beta_0 + \beta_1 Fuel\ Price + \beta_2 Catch\ Volume + \beta_3 Subsidy\ Dummy + \varepsilon$$

where *Net Income* is per-trip net income (IDR), *Fuel Price* is non-subsidized diesel price (IDR/litre), *Catch Volume* is in metric tonnes, and *Subsidy Dummy* equals 1 if subsidized fuel was accessed, 0 otherwise. The model was estimated using 51 monthly observations (January 2019 – December 2023). Qualitative interview transcripts were analysed using thematic analysis to identify adaptation patterns, coping mechanisms, and fishers' perceptions of fuel price impacts on household welfare.

Research Limitations

This study has several limitations. First, retail-level non-subsidized fuel price data paid by fishers are scarce and regionally variable, so quantitative analysis relies more on general prices where local data are unavailable. Second, qualitative findings from only two regencies—both located on Java's north coast—must be generalized to the rest of the nation, including eastern Indonesia where socioeconomic and institutional conditions differ, with caution. Third, welfare is inherently multidimensional; this study focuses primarily on purchasing power as the core of economic welfare, without fully capturing dimensions such as health, education, and social capital.

3. Result

Trends and Fluctuations of Marine Fuel Prices

Time-series analysis indicates substantial fluctuations in marine fuel prices, especially non-subsidized diesel used by vessels above 30 GT. The trajectory of retail diesel prices during 2022 illustrates the shock in granular detail, as summarised in Table 1.

Table 1. Trajectory of Non-Subsidized Diesel Retail Prices at Fishing Ports, 2022

Period	Price (Rp/Litre)	Key Context
End of 2021	9.500	Baseline retail price
Early 2022	10.500	Gradual pre-shock rise

May 2022	15.000-16.000	Sharp spike; fishers begin reducing trips
June 2022	16.500	Large vessels (>30 GT) halt operations
July 2022	± 17.000	70% of fishers idle; widespread strikes
September 2022	16.000-18.000	Post-subsidy-adjustment; crisis continues

Sources: Field interviews (2023); media reports (Berita Satu, Republika, Kompas, 2022); KNTI & KUSUKA survey (2023).

From a year-end 2021 baseline of Rp9.500 per litre, prices rose by approximately 79 per cent to reach Rp17.000 per litre by July 2022. The increase was not a one-off shock but a steep and sustained climb that began months before the official September 2022 subsidy adjustment. Even after the adjustment, prices stabilised in the Rp16.000–Rp18.000 range, far above the subsidized price of Rp6.800 per litre, which only a fraction of fishers could reliably access. Small-scale fishers who lacked access to formal SPBN channels were often forced to purchase diesel through informal retailers at these elevated prices, creating a deeply inequitable dual market [12].

Impact on Operational Costs and Income

Fuel overwhelmingly dominates the operational cost structure. Vessel owners in Juwana Pati confirmed that fuel accounts for 60–70 per cent of total at-sea operational outlays, consistent with KKP's assessment that roughly 70 per cent of operational costs in capture fisheries are attributable to fuel expenditure [6,13]. For a 30 GT purse seiner undertaking a typical one-month trip, fuel consumption averages 6.000 litres. Using the price trajectory from the field, The estimated financial implications are presented in (Table 2).

Table 2. Comparison of Operational Costs for a 30 GT Vessel (Single Typical Trip)

Cost Component	**Before Price Shock (Rp10.500/litre)**	**At Peak Price (Rp17.000/litre)**
Fuel (6.000 liters)	Rp 63.000.000	Rp 102.000.000
Logistics, crew wages, provisions	Rp 50.000.000	Rp 55.000.000
Maintenance & miscellaneous	Rp 13.000.000	Rp 13.000.000
Total Operational Cost	Rp 126.000.000	Rp 170.000.000
Gross Revenue (8 tonnes Rp25,000/kg)	Rp 200.000.000	Rp 200.000.000

Net Margin	Rp 74.000.000	Rp 30.000.000

Source: Field interview data (Juwana and Karangsong, 2023) and BPS price reports.

The net margin collapsed by nearly 60 per cent, and for many vessels—especially those with smaller catches or lower fish prices—trips became loss-making. This simple calculation explains why by July 2022, an estimated 70 per cent of fishers in Pati had ceased operations, and in Indramayu, large vessels had been idle for one to two months already by June [8,9]. The cascading economic consequences extended far beyond individual vessel accounts. Fish auction sites (TPI) in both regencies were deserted; processing plants halted production due to raw material shortages; tens of thousands of crew members and supporting workers lost their incomes; and the entire coastal economic ecosystem was paralysed. As one vessel owner in Karangsong stated, fishers came to his house expressing distress because they could not sail, having to bear fuel costs of up to 70–80 per cent of total expenses while fish prices had fallen to Rp15.000–Rp16.000 per kilogram.

Decline in Purchasing Power and Welfare

The Fishermen's Terms of Trade (FiTT) serves as the primary proxy for purchasing power. According to KKP data, the national FiTT recorded a persistent decline from 106.45 in 2022 to 105.4 in 2023, and further to 101.76 in 2024, before a modest recovery to 103.45 in 2025 [14]. Table 3 presents the monthly trajectory of FiTT during the critical post-shock period from September 2022 through February 2023.

Table 3. Trend of Fishermen's Terms of Trade (FiTT), September 2022 – February 2023

Month-Year	FiTT	Monthly Change (%)
September 2022	105.64	-
October 2022	104.84	-0.76
November 2022	103.52	-1.26
Desember 2022	102.46	-1.02
January 2023	101.74	-0.70
February 2023	101.59	-0.15

Source: Statistics Indonesia (BPS), (2024).

The cumulative decline from September 2022 to February 2023 was approximately 3.8 per cent, representing a significant erosion of real purchasing power for households already operating at subsistence levels. As KNTI noted, when FiTT declines, it means fishers' purchasing power and welfare are weakening, because the prices they receive for their catch

are not keeping pace with the costs they must bear for production and consumption [12]. The broader annual trend—from 106.45 in 2022 to 101.76 in 2024—underscores a structural deterioration rather than a temporary fluctuation.

Distribution Problems and Access to Subsidized Fuel

The core issue for Indonesian capture fisheries is not merely high non-subsidized prices but a profound governance failure in fuel distribution, as evidenced by a 2023 KNTI and KUSUKA Coalition survey revealing that 70% of fishers remain excluded from subsidized fuel. This systemic failure is driven by burdensome regulatory complexities, an inadequate and unevenly distributed network of SPBN stations, and unresolved hurdles in fuel transportation. Furthermore, critical weaknesses in budget management—highlighted by a 607% compensation budget deviation—and illicit fuel diversion by middlemen, which costs an estimated Rp161 billion annually in Indramayu alone, continue to undermine the social protection goals of the subsidy and perpetuate the economic vulnerability of coastal communities.

Regression Analysis Results

Multiple linear regression confirms that non-subsidized fuel price has a significant negative effect on net income, while catch volume and subsidy access have positive effects (Table 4). The model explains 48 per cent of the variation in net income ($R^2 = 0.48$). The fuel price coefficient (−195.000) indicates that every Rp1.000 increase in non-subsidized diesel price reduces net income by approximately Rp195.000 per trip, ceteris paribus.

Table 4. Summary of Multiple Linear Regression on Net Fisher Income per Trip

Variable	Unstandardized B	Std. Error	Standardized β	t	Sig. (p)
(Constant)	18.450.000	2.500.000	–	7.38	.000
Non-Subsidized Fuel Price	–195.000	32.000	–0.610	−6.094	.001
Catch Volume (Tons)	1.200.000	210.000	0.521	5.714	.000
Subsidy Access (1=Yes)	4.500.000	1.100.000	0.295	4.091	.002

Model statistics: R = 0.693 · R^2 = 0.480 · Adjusted R^2 = 0.464 · Std. Error of Estimate = 4,850,000 · F = 30.20 · Sig F = 0.000 · N = 51. *Note: Dependent Variable – Net Fisher Income per Trip (Rp).*

Subsidy access shows a positive and statistically significant effect, with fishers who can access subsidized fuel earning approximately Rp4.5 million more per trip on average compared to those who cannot, controlling for other factors.

4. Discussion

Impact of Fuel Price Fluctuations on Fisher Welfare

The findings confirm that marine fuel price fluctuations are the primary determinant of fishers' purchasing power and socio-economic welfare, with fuel accounting for 60–70% of costs—and up to 80% for small-scale fishers during crises. Regression analysis further illustrates the relationship between fuel prices and fisher income, showing that every Rp1.000 increase in fuel price slashes net income by Rp195.000 per trip, triggering a "domino effect" where rising costs (from Rp9.500 to Rp17.000 per litre in 2022) lead to sequential operational collapses across both large and small-scale fleets and their associated supply chains. While comparative studies in regions like Ghana suggest these spikes can inadvertently reduce fishing pressure on over-exploited stocks, relying on fuel-induced poverty as a conservation tool is ethically and economically unsustainable; instead, these results highlight the urgent need for a socially just policy framework that integrates energy stability with deliberate, supported livelihood transitions to achieve true blue economy objectives.

The Subsidy Paradox and Distribution Failure

The persistent failure of subsidized fuel distribution—with only 30% of small-scale fishers able to access the program—creates a profound policy paradox: the state spends significant fiscal resources on fuel subsidies, yet the intended beneficiaries are overwhelmingly excluded. This misallocation perpetuates a dual market where large-scale vessel operators with political connections and administrative capacity obtain subsidized or lower-cost fuel, while the vast majority of small-scale fishers pay premium retail prices [12]. The KUSUKA Coalition's finding of a 607% deviation in subsidy compensation budgets further underscores systemic governance failures [12]. The co-existence of two distinct budget nomenclatures—Subsidy Expenditure (BA 999.07) and Compensation Fund Expenditure (BA 999.08)—with different definitions and payment mechanisms creates uncertainty and delays that ultimately harm fishers. Furthermore, research by The Prakarsa (2026) highlights that unreformed fuel subsidies tend to exacerbate overfishing rather than support sustainable livelihoods.

KNTI Chairman Dani Setiawan has noted that even without a subsidized fuel price increase, most fishers have historically been unable to access subsidized fuel, experiencing

systematic discrimination in access. This exclusion deepens inequality, breeds a black market for retail fuel, and contradicts the social justice purpose of subsidies. The modest improvement from 82% exclusion in 2021 to 70% in 2023, while welcome, is far too slow given the urgency of the crisis [12]. The decline in FiTT from 106.45 in 2022 to 101.76 in 2024, though seemingly modest in percentage terms, translates into a significant reduction in real income for households already living at subsistence level. However, as scholars have noted, FiTT alone is insufficient to capture multidimensional welfare—including asset ownership, debt burdens, health status, and educational access. With 25.14% of fishers living below the poverty line compared to a national average of 9.54% [14], the need for more granular and multidimensional welfare indicators is urgent.

Policy Implications and Pathways for a Resilient Blue Economy

The 2022 fishing strikes highlighted that the success of the Blue Economy depends on energy justice. Implementing a special fuel pricing scheme of IDR 13.000–15.000 per litre is a strategic necessity to restore operational viability. To ensure these benefits reach the intended beneficiaries and prevent leakages, this scheme must be supported by digital monitoring tools, such as QR-coded fisher cards linked to vessel registrations.

For long-term resilience, Indonesia must accelerate the adoption of alternative energy technologies. Promising pathways include:

- Dual-Fuel (LPG–Diesel) Systems: These can replace up to 71% of diesel consumption, cutting operational costs by 24.6% while slightly improving engine power and torque.
- Solar-Powered Cold Storage (PPTS): Developed by IPB University, this system eliminates ice costs and increases fish selling prices by 10–15% through improved freshness preservation, reducing total operational costs by 30%.
- Solar Photovoltaic (PV) Integration: Research on 30 GT vessels shows that integrated PV systems can save approximately 330 litres of fuel per month.

Scaling these innovations requires green financing and cooperative ownership models. Furthermore, welfare measurement must move beyond the basic Fishermen's Terms of Trade (FiTT). A multidimensional fisher welfare index is needed to capture critical factors such as debt burdens, asset ownership, and regional cost-of-living differences. Ultimately, pro-environment policies like quota-based fishing must be integrated with pro-fisher economic incentives. Without guaranteed access to affordable energy and sustainable technology, Indonesia's Blue Economy risks marginalizing the very communities it aims to empower. Accelerating the energy transition is not just a technical requirement but a core pillar of a sustainable and socially just maritime roadmap.

5. Conclusions

Research Synthesis

This study confirms that Indonesian capture fisheries, a cornerstone of the blue economy, are acutely fragile to energy price shocks. The root causes are threefold: (1) extreme fuel-cost dependence, with fuel consuming 60–70 per cent of operational costs and up to 80 per cent for certain small-scale operations during the crisis; (2) unpredictable and extreme volatility of non-subsidized diesel prices, which surged from Rp9.500 per litre at end-2021 to Rp17.000 per litre by July 2022, an increase of 79 per cent over seven months; and (3) a subsidy distribution system that excludes 70 per cent of small-scale fishers, forcing them into expensive retail fuel markets. The 2022 price escalation triggered a systemic crisis—from income loss and fishing strikes to supply chain collapse—that eroded both purchasing power and welfare, with FiTT declining from 106.45 in 2022 to 101.76 in 2024.

Policy Recommendations

The following evidence-based policy recommendations are proposed to safeguard the livelihoods of Indonesian fishers and ensure the resilience of the national blue economy:

Special Fisher Fuel Price Scheme

Implement a dedicated pricing mechanism with a ceiling of IDR 13.000–15.000 per litre specifically for small-scale fishers. This should be combined with a phased reduction of harmful fuel subsidies for large-scale industrial vessels. This price corridor restores operational viability while remaining significantly below industrial diesel rates, preventing the total operational collapse seen in previous price spikes [15].

Subsidy Governance Reform

To address the high exclusion rate from fuel subsidies, the government could consider several administrative and distribution reforms:

- Simplify Eligibility: Reduce the administrative burden for obtaining recommendation letters from local agencies.
- Expand Infrastructure: Increase the number of Fishermen's Fuel Filling Stations (SPBN) in remote fishing villages to ensure geographical access [11].
- Digital Monitoring**:** Deploy a transparent digital voucher system, such as fisher smart cards linked to vessel registrations, to eliminate illicit fuel diversion and ensure equitable distribution.

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Accelerated Energy Transition

Long-term resilience requires shifting away from fossil fuel dependency through proven technologies:

- Solar PV Systems: Integrating solar panels on vessels can save approximately 330 litres of fuel per month.
- LPG Dual-Fuel Engines: Converting engines to dual-fuel systems can replace up to 71% of diesel consumption, reducing total operational costs by 24.6%.
- Solar-Powered Cold Storage: Scaling solar-powered "palka" systems can reduce costs by 30% while increasing fish market value by 10–15% due to improved freshness.

These transitions should be supported through low-interest green financing and cooperative ownership models.

Enhanced Welfare Indicators

The current Fishermen's Terms of Trade (FiTT) is insufficient for capturing the reality of coastal poverty. The methodology should be revised to include:

- Regional Cost-of-Living Differences: Adjusting for the higher prices often found in remote coastal areas.
- Multidimensional Poverty Dimensions: Incorporating asset ownership, debt burdens (especially to informal lenders), health access, and educational attainment.

This is critical given that the fisher poverty rate of 25.14% drastically exceeds the national average of 9.54%.

Integrated Blue Economy–Energy Governance

Energy accessibility and equity may be considered important components of future maritime policy development. All blue economy instruments—including quota-based fishing—should undergo ex-ante assessments for energy-price sensitivity. Furthermore, the government should establish automatic stabilization mechanisms, such as conditional cash transfers triggered by specific fuel price thresholds, to protect the most vulnerable fishing households during periods of extreme volatility.

Research Limitations and Future Directions

This study has several limitations. The quantitative analysis relies on aggregated data, which may obscure regional differences and variations across fishing scales. Fisher welfare is multidimensional and cannot be fully captured by FiTT alone. Additionally, primary data

collection was limited to two locations on the north coast of Java, meaning that social, cultural, and institutional differences in other regions—particularly eastern Indonesia—may not be fully represented. Future research should extend the analysis to eastern Indonesian fishing communities, incorporate panel data to capture household-level dynamics over time, conduct pilot evaluations of alternative energy technology adoption on fishing fleets, and develop and validate a multidimensional fisher welfare index that can serve as a more accurate basis for policy targeting.

References

1. Ministry of Marine Affairs and Fisheries. KKP supports national biodiversity targets through blue economy. *KKP Press Release* 2024.
2. Statistics Indonesia. *Capture Fisheries Enterprise Statistics 2023*; BPS RI: Jakarta, Indonesia, 2024.
3. Databoks. More than 12 thousand villages in Indonesia utilize the sea for capture fisheries in 2024. Available online: https://databoks.katadata.co.id/ (accessed on 6 June 2026).
4. Fraksi PKS. *Blue Food and Strong Fishermen, Sovereign Indonesia*; Policy Brief, 2026.
5. RRI.co.id. Minister of Marine Affairs and Fisheries says Indonesian fishermen not yet prosperous. Available online: https://rri.co.id/ (accessed on 6 June 2026).
6. Tempo.co. Fishermen's terms of trade continues to decline since 2022. Available online: https://tempo.co/ (accessed on 6 June 2026).
7. Asian Development Bank. *Indonesia: Toward a Sustainable Blue Economy*; ADB Briefs No. 150; Asian Development Bank: Manila, Philippines, 2020.
8. Ministry of Marine Affairs and Fisheries. Trenggono responses to fishermen's fuel complaints, KKP encourages special scheme to reduce operational costs. *KKP Press Release* 2026.
9. Ministry of Marine Affairs and Fisheries. KKP follows up aspirations for access and special fuel prices for fishermen. *KKP Press Release* 2024.
10. Dewi, S. Analysis of the impact of fuel (diesel) price fluctuations on the sustainability of motor-boat fishing businesses. Thesis, UIN Raden Intan Lampung, Lampung, Indonesia, 2022.
11. Universitas Sumatera Utara. *Analysis of the Impact of Fuel Price Fluctuations on Fishing Businesses with Motor Boats*; Research Report, Universitas Sumatera Utara, Medan, Indonesia, 2022.

12. KNTI; Koalisi KUSUKA. Subsidy and fuel compensation budget difficult to access and not credible, traditional fishermen disadvantaged. Available online: https://inisiatif.org/ (accessed on 6 June 2026).
13. Owusu, V. Effect of rising fuel prices on small-scale fisheries livelihoods and marine sustainability in Ghana. *PLoS ONE* 2025, 20, e0317260.
14. Republika Online. Non-subsidized fuel prices soar, Indramayu fishermen do not go to sea. Available online: https://republika.co.id/ (accessed on 6 June 2026).
15. BeritaSatu.com. Fuel gets more expensive, thousands of fishing boats in Pati stop fishing. Available online: https://beritasatu.com/ (accessed on 6 June 2026).
16. Kompas.com. Fuel rises, thousands of fishermen in Pati choose not to go to sea. Available online: https://kompas.com/ (accessed on 6 June 2026).
17. Jawa Pos. Pertamina president director mentions three things so that fishermen's fuel is distributed well. Available online: https://jawapos.com/ (accessed on 6 June 2026).
18. Aldiansyah, R. Mekanisme dan potensi penyimpangan penyaluran subsidi BBM di Pangkalan Pendaratan Ikan Karangsong Indramayu. Skripsi, IPB University, Bogor, Indonesia, 2022.
19. The Prakarsa. *PB 50 – Promoting Justice: Reforming Government Incentives in the Fisheries Sector for Workers' Welfare and Sustainability*; Policy Brief, 2026.
20. Alwi, M.; Rahmatia, R.; Mubarak, M.; Setiawan Junior, A.A. Analysis of fisherman welfare in Indonesia. *J. Humanit. Soc. Sci. (HiRoSD)* 2023, 1, 1–10.
21. ANTARA News. KKP studies special fuel scheme for fishermen responding to soaring operational costs. Available online: https://antaranews.com/ (accessed on 6 June 2026).
22. Budiyanto, M.A.; et al. Design of fishing vessel 30 GT with PV system as an additional energy source. In *Proceedings of the AIP Conference Proceedings*, 2024; Vol. 2710, 080002.