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Implementation Review of Indonesia's Measured Fishing Policy (PIT) Supporting Sustainable Tuna Fishery in Banda Aceh

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***Abstract*—**Indonesia introduced the Measured Fishing Policy (PIT) through Government Regulation No. 11 of 2023 to regulate fishing effort using a quota-based system aligned with fish stock potential in each Fisheries Management Area (WPPNRI). However, empirical evidence regarding its local economic and productivity impacts remains limited. This study aims to evaluate changes in tuna, skipjack, and frigate tuna productivity and purse seine fishers' income before and after PIT implementation in Banda Aceh. A mixed-method approach was applied using production and fishing effort data (2021–2024) from PPS Kutaraja combined with structured interviews of active purse seine operators. Catch per Unit Effort (CPUE), profitability, and payback period analyses were conducted, supported by thematic analysis. Results show significant increases in tuna production (395.95 tons in 2024) and skipjack production (1,502.79 tons in 2024). The average annual net income reached IDR 6.49 billion with a payback period of 0.27 years. The findings indicate that PIT contributes to improved productivity performance; however, income stability remains sensitive to operational costs and seasonal variability. This study provides localized empirical evidence to support adaptive fisheries governance under output-control policy frameworks.

Keywords— Measured Fishing Policy, fisheries policy, productivity, fisher's income, Banda Aceh

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I. INTRODUCTION

Indonesia, as an archipelagic country, possesses a vast potential of fisheries resources. One of its prominent commodities is tuna, which contributes approximately 20% of the global production of tuna, skipjack, and frigate tuna [1]. However, overexploitation and unsustainable fishing practices have threatened the sustainability of these resources. To address these issues, the government, through the Ministry of Marine Affairs and Fisheries (KKP), has implemented the Measured Fishing Policy (PIT). Several studies have examined the implementation of PIT in various regions of Indonesia. [2] Emphasized the importance of quota systems in maintaining sustainable fisheries. Nevertheless, these studies were largely at the macro level and did not specifically assess the impacts of PIT on fishing productivity and local fishers' income.

Furthermore, a study by [3] investigated fishers' perceptions of PIT from socioeconomic and environmental perspectives, yet it did not specifically examine its effects on catch productivity and income. In addition, [4] developed a PIT management model in the fishing zones of Semarang City, focusing mainly on institutional aspects and not directly addressing fishers' economic outcomes. This study provides novelty by focusing on evaluating the impact of PIT on tuna catch productivity and fishers' income in Banda Aceh City. Using both quantitative and qualitative approaches, the research aims to provide empirical evidence of changes before and after PIT implementation. The results are expected to contribute to the formulation of more effective and sustainable local fisheries policies.

The Measured Fishing Policy (PIT), regulated under Government Regulation No. 11 of 2023, aims to control catch volumes through a quota system determined based on fish resource potential in each Fisheries Management Area of the Republic of Indonesia (WPPNRI) (PP No. 11/2023). PIT is an output control approach that manages fishing zones, catch quotas, and technology-based monitoring, including the use of the e-PIT application and satellite surveillance. The policy is intended to maintain a balance between economic and ecological aspects of fisheries management.

Banda Aceh City, located in WPPNRI 571, has significant tuna fisheries potential. However, PIT implementation in this region faces challenges such as limited port infrastructure and low awareness and participation of local fishers. Another major issue is the lack of empirical data demonstrating PIT's effects on catch productivity and local fishers' income. Before PIT, Banda Aceh fishers faced uncertain catch volumes and fluctuating income. With PIT, it is expected that fishing activities will become more efficient and predictable. Nevertheless, no comprehensive study has yet assessed changes in productivity and income following PIT

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implementation, highlighting an important research gap. Therefore, this study aims to analyze trends in tuna catch productivity and changes in fishers' income in Banda Aceh City before and after PIT implementation.

Despite increasing academic discussion on quota-based fisheries governance in Indonesia, empirical evaluation at the operational fishing port level remains limited. Previous studies primarily examine institutional design, regulatory frameworks, or fisher perceptions without quantitatively measuring changes in catch productivity (CPUE) and income performance before and after policy implementation.

This study addresses that gap by conducting a port-level empirical assessment in Banda Aceh (WPPNRI 571). The novelty lies in integrating productivity indicators (CPUE), financial feasibility analysis (profit and payback period), and qualitative stakeholder insights under the context of Indonesia's output-control fisheries policy. This localized evaluation provides evidence-based recommendations for adaptive fisheries governance.

II. METHOD

Time and Location Reseacrh

The research method involved observation and interviews using structured questionnaires. Observation was conducted by monitoring tuna fisheries activities in Banda Aceh. Data collection included direct documentation of fishing gear and related information obtained from interviews with fishers and stakeholders. The research was conducted from May to October 2025 at the Kutaraja Ocean Fishing Port (PPS Kutaraja), Banda Aceh.

Data Collection Techniques

The data used in this research consisted of primary and secondary data. Primary data were obtained directly from the sources through data collection methods such as interviews, surveys, and observations. Secondary data were previously collected and documented by other parties, usually including statistical data, tuna catch production over the last five years, fishing effort for tuna, skipjack, and frigate tuna over the last five years, and operational costs associated with catching these species. Sample determination was conducted using the census method, which involves taking the entire population as the sample [5]. The population in this study comprised all purse seiner at PPS Kutaraja, totaling 287 unit vessels. The research sample consisted of 6 unit active purse seiner, ranging in size from 76–120 GT, with operational permits issued by the central government and implementing the PIT policy.

The research instruments included questionnaires, interview guides, and observation checklists. The questionnaire and interview guide were designed to capture information regarding fishing activities, catch volumes, operational costs, and fishers' income before and after the implementation of the PIT policy. Observation checklists were used to document the type and condition of fishing gear, vessel characteristics, and operational practices.

Data Analysis

Data analysis employed a mixed-methods approach, combining quantitative analysis of catch productivity and fisher's income with qualitative analysis from interviews and observations. Quantitative data on catch production were analyzed to calculate catch per unit effort (CPUE) and fisher's profitability, considering both investment and operational costs. Qualitative data were analyzed thematically to support and explain trends observed in the quantitative data, providing a comprehensive understanding of the impacts of PIT implementation.

Data analysis was conducted using CPUE (Catch per Unit Effort) analysis. The calculation of CPUE aims to determine the level of utilization of tuna fishing units, based on the division of total catch by fishing effort, according to [6]. The formula used is as follows:

$$CPUE = \frac{C}{E} \quad (1)$$

with:
CPUE = Catch per Unit Effort (ton/trip or kg/day)
C = Total catch (ton)
E = Fishing effort (number of trips, days at sea, or other standardized effort unit)

CPUE serves as an indicator of fishing productivity and the level of resource exploitation. Higher CPUE values indicate greater efficiency, while declining CPUE may suggest overexploitation or reduced fish stock abundance. This measure is commonly used in fisheries science to assess trends in fish stocks and support sustainable fisheries management. To strengthen comparative analysis, production and income data were grouped into two periods: pre-PIT implementation (2021–2022) and post-PIT implementation (2023–2024). Comparative descriptive trend analysis was conducted to observe differences in productivity and economic performance between periods.

Fishers' profitability was analyzed using profit analysis to determine the magnitude of profit for each fishing enterprise [7]. Profit measures the success of a business by assessing inputs and outputs, and is calculated as follows:

$$\pi = TR - TC \quad (2)$$

with:
π = Profit (fishing enterprise; boat rental business)
TR = Total revenue
TC = Total cost

This analysis provides an empirical measure of economic performance for each fishing operation before and after the implementation of PIT. The Payback Period (PP) provides information on the duration required to recover the initial investment of a fishing operation, which is essential for evaluating financial feasibility.The Payback Period (PP) was calculated following [8]:

$$PP = n + \frac{a-b}{c-b} \times 1\ year \quad (3)$$

with:

n = The last year in which cumulative cash flow has not yet covered the initial investment
a = Initial investment amount
b = Cumulative cash flow at year n
c = Cumulative cash flow at year n+1

Qualitative data obtained from interviews and observations were analyzed using thematic analysis. This approach aimed to identify patterns and insights regarding fisher's perceptions, challenges in implementing PIT, and operational practices. The qualitative findings were used to support and explain quantitative results, providing a comprehensive understanding of PIT's impact on fishing productivity and income.

III. Results and Discussion

Productivity of TCT Catches at PPS Kutaraja Lampulo

a. Productivity of Tuna Catches at PPS Kutaraja Lampulo

Production of tuna tangkapan throughout four years (2021–2024) at PPS Kutaraja. Figure 1 shows the evolution of tangkapan results over the course of four years.

Based on the data shown in the graph, tuna catch production using purse seine fishing gear fluctuated from 2021 to 2024. In 2021, production was recorded at 33.99 tons per year. This result is consistent with [9], who reported that declining fishery yields can cause fishers to stop fishing due to the reluctance to take the risk of low catches. Production then increased sharply in 2023 to 288.00 tons per year. This increase is presumed to be influenced by favorable water conditions and increased fishing activities targeting pelagic species.

The increasing production trend after 2023 suggests improved effort allocation under the PIT framework. The quota system may have contributed to better planning and more targeted fishing operations. However, further stock assessment would be necessary to confirm long-term biological sustainability.

The highest increase occurred in 2023, with production reaching 288.00 tons per year. This surge indicates the effectiveness of the fishing gear, an increase in the number of fishing fleets, and marine environmental conditions that supported pelagic fish productivity. Furthermore, in 2024 production increased again to 395.95 tons per year, indicating the implementation of the PIT policy in fishing activities, which became the main target of purse seine fishing operations.

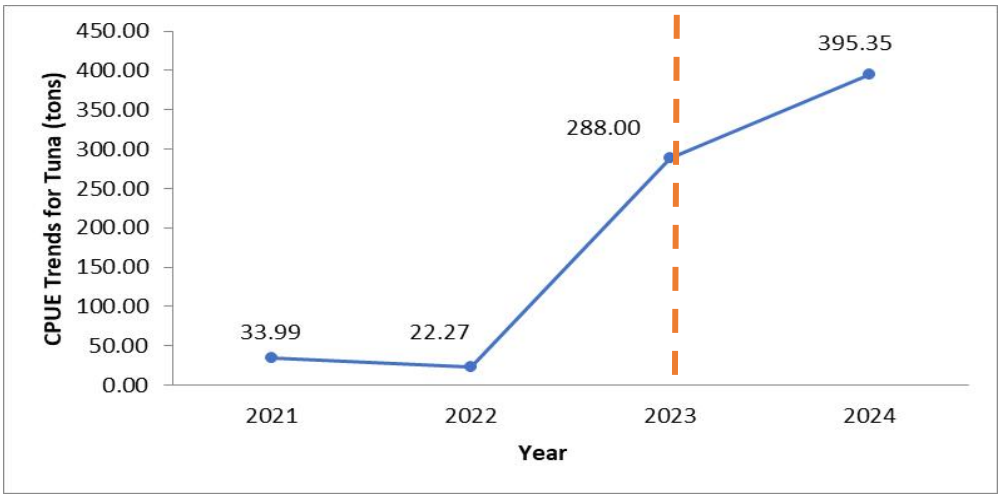

Figure 1. Productivity of Tuna Catches at PPS Kutaraja Lampulo

b. Productivity of Skipjack Catches at PPS Kutaraja Lampulo

The production of tuna catches over a four-year period (2021–2024) landed at the Kutaraja Lampulo Oceanic Fishing Port (PPS Kutaraja Lampulo). The development of catch production during the 2021–2024 period can be seen in Figure 2.

According to the production graph of skipjack tuna (Katsuwonus pelamis) caught using purse seine fishing gear from 2021 to 2024, there are fairly significant annual variations. Production in 2021 reached 102.10 tons, but slightly decreased to 75.15 tons in 2022. This decline was likely caused by unfavorable weather conditions and an unproductive fishing season, which made it difficult for fishers to carry out fishing activities.

The sharp increase in 2024 indicates possible interaction between favorable oceanographic conditions and regulated fishing intensity. This pattern reflects the importance of integrating ecological monitoring with quota-based governance.

Annual skipjack tuna production increased to 1,502.79 tons in 2024. This increase indicates that environmental conditions in the fishing grounds had improved and that skipjack tuna stocks were more readily available. Sea surface temperature, ocean currents, and oceanographic conditions have a significant influence on the movement of skipjack tuna, which is a large pelagic species. Therefore, sea surface temperature, current patterns, and climate variability can greatly affect the distribution and catch yields of skipjack tuna in the

area. Overall, the production trend of skipjack tuna caught using purse seine fishing gear increased significantly from 2021 to 2024, peaking in 2024.

Annual fish production at fishing ports tends to fluctuate, as observed at the Muara Angke Fishing Port [10] and the Tegalsari Coastal Fishing Port [11].

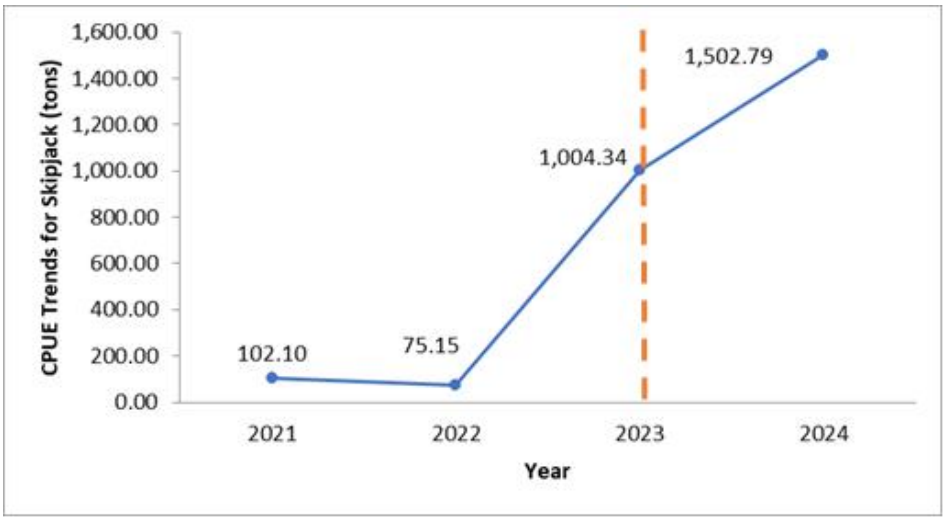

Figure 2. Productivity of Skipjack Catches at PPS Kutaraja

c. Productivity of Frigate Tuna Catches at PPS Kutaraja

The production graph of frigate tuna caught using purse seine fishing gear from 2021 to 2024 shows fairly significant annual variations. In 2021, frigate tuna production reached 33.12 tons per year, which was relatively high. However, in 2022 production declined sharply to 13.64 tons per year. Extreme weather conditions and high-wave seasons that limited fishing activities, as well as reduced availability of frigate tuna stocks in the fishing grounds, are believed to be the main causes of this decline.

The fluctuation pattern indicates sensitivity to environmental variability and fishing pressure. This highlights the need for adaptive quota adjustment mechanisms under PIT implementation.

Production increased again to 144.71 tons per year in 2023. This increase indicates a recovery of the frigate tuna population in the fishing grounds and improvements in marine environmental conditions. The increase may also be attributed to higher fishing operation intensity following reduced fishing activities in the previous year. The positive trend continued in 2021, with production reaching 33.12 tons per year, and increased again in 2023 to 144.71 tons per year. This rise in production indicates that water conditions and the availability of frigate tuna stocks during this period were relatively good. However, in 2024 production declined again to 157.29 tons per year. This decline is suspected to be the result of increased fishing pressure (overfishing) in previous years, as well as changes in current patterns and sea temperature that affect the migration of frigate tuna.

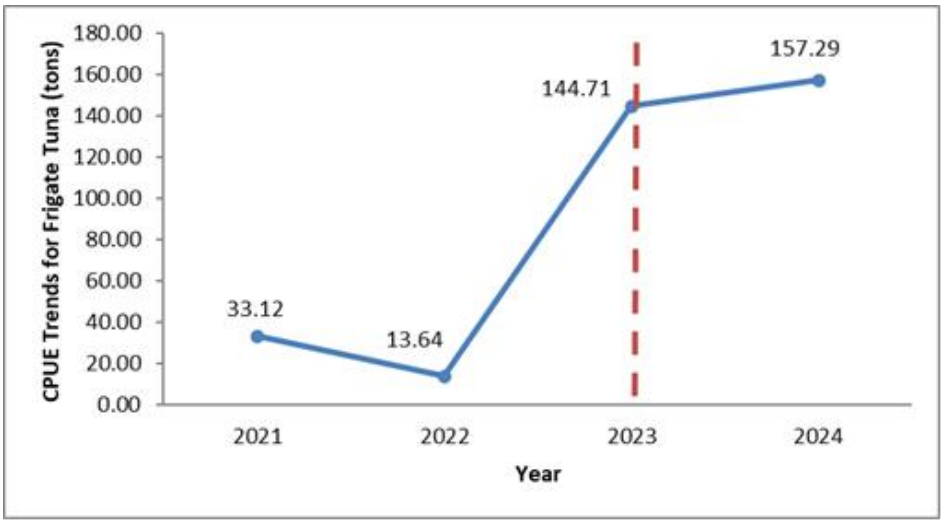

Figure 3. Productivity of Tongkol Catches at PPS Kutaraja

Income of Purse Seine Fishers at PPS Kutaraja

The use of income as the main indicator aims to provide an objective and measurable overview of the fishers' income conditions. The indicators observed in the profitability of this fishing business are based on investment values, which include vessels, engines, fishing gear, and auxiliary fishing equipment, as well as fishing operational costs and investment maintenance costs.

TABLE 1
FINANCIAL DETAILS OF TCT CATCHES AT PPS KUTARAJA

	Financial Details	Description
A.	Revenue	
1.	Total catch (kg/year):	9.842
2.	Selling price of catch Tuna per trip (Rp/kg): Selling price of catch Skipjack per trip (Rp/kg): Selling price of catch Frigate tuna per trip (Rp/kg):	10.000 10.000 10.000
3.	Number of fishing trips (trips/year):	12
4.	Total Revenue (Rp/year) (Total catch × price):	Rp. 9.510.000.000,00
B	Fixed Costs	
1.	Economic life of vessel (years):	5
2.	Economic life of fishing gear (months):	1
3.	Economic life of engine (years):	5
4.	Maintenance cost (Rp/year): Subtotal Fixed Costs:	Rp. 5.222.222,22 Rp. 5.222.222,22
C.	Variable Costs	
1.	Fuel (Rp/year):	Rp. 58.666.666,67
2.	Ice blocks (Rp/year):	Rp. 16.666.666,67
3.	Food supplies (Rp/year):	Rp. 14.166.666,67
4.	Fresh water (Rp/year):	Rp. 2.250.000,00
5.	Oil (Rp/year): Subtotal Variable Costs:	Rp. 3.766.666,67 Rp. 1.146.200.000,00
D.	Profit	
1.	Profit (Rp/year) (Total Revenue – Total Cost):	Rp. 6.499.866.665,67
E.	Payback Period (Years):	0,27
F.	Payback Period (Months):	3

The results of the study show that purse seine fishers operating under the PIT policy earned a net income of IDR 6,499,866,665.67 per year. This income represents the difference between total revenue of IDR 9,510,000,000.00, obtained from catches of tuna, skipjack tuna, and frigate tuna, and total fixed and operational costs amounting to IDR 1,146,200,000.00. Tuna catches were sold at a price of IDR 10,000/kg, skipjack tuna at IDR 10,000/kg, and frigate tuna at IDR 10,000/kg, with a total annual catch of 9,842 kg. These conditions indicate that this fishing business is relatively profitable compared to other fishing methods in the surrounding area. Income is one of the key indicators used to assess the welfare level of fishers. In general, fishers' income is highly dependent on catch volume, fish market prices, fishing seasons, and the effectiveness of the fishing gear used. The results indicate that although purse seine fishers applying the PIT policy at PPS Kutaraja Lampulo earn a relatively high annual net income of IDR 6,499,866,665.67, with a payback period of approximately 3 months or 0.27 years, this income remains fluctuating and dependent on many external factors.

The high operational cost structure, particularly fuel costs (IDR 58,666,666.67) and food supplies (IDR 14,166,666.67), poses a major challenge that reduces business efficiency. Dependence on daily catches without supporting activities or economic diversification makes fishers highly vulnerable to production disruptions caused by adverse weather, fluctuations in fish prices, and lean fishing seasons. This condition is in line with the findings of [12], who stated that traditional fishers are often trapped in a cycle of income uncertainty due to high operational costs and business systems that remain traditional and highly dependent on natural conditions. Similar findings were also reported by [13][14] in his study of small-scale fishers along the coast of Central Java. He found that although fishers' income from their main activities appears relatively high on an annual aggregate basis, irregular cash inflows and limited financial management cause fishers to remain in a fragile economic position [15][16][17]. Budiman also emphasized that business diversification, whether through fishery product processing, aquaculture, or small non-fishery enterprises, can enhance the economic resilience of fisher households [18][19]20].

IV. CONCLUSION

This study demonstrates that PIT implementation in Banda Aceh is associated with increased tuna and skipjack productivity between 2021 and 2024. Financial analysis indicates strong short-term profitability and rapid capital recovery. Nevertheless, income stability remains influenced by operational costs and seasonal factors. Therefore, while PIT strengthens productivity governance, complementary economic resilience strategies are necessary to ensure long-term sustainability.

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