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Research Article

Assessing Indonesia's fishing port readiness for implementing the Measured Fishing Policy through facility and service quality assessment: Evidence from two ocean fishing ports

Seruni Salsabila Putri Basoeki, Suadi* and Djumanto

Department of Fisheries, Faculty of Agriculture, Gadjah Mada University, Sleman Regency, Indonesia

Corresponding author's e-mail address: suadi@ugm.ac.id

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Abstract

The implementation of Indonesia's Measured Fishing Policy, a pivotal shift from an input-control to an output-control (quota-based) system, has been delayed due to critical readiness gaps. This study assesses the readiness of Indonesia's major ocean fishing ports to support this policy, focusing on the Nizam Zachman and Cilacap Ocean Fishing Ports. Utilizing a mixed-methods approach, the research evaluated physical infrastructure availability and employed the Customer Satisfaction Index (CSI) and Importance-Performance Analysis (IPA) to gauge user satisfaction and prioritize improvements. Data were collected from 140 fisheries actors via purposive sampling between November 2024 and January 2025. This study showed a critical disconnect between physical infrastructure and service quality. Facility availability was rated at 93 % at Nizam Zachman and 86 % at Cilacap, classifying both ports infrastructure as "very adequate". Nizam Zachman demonstrated superior basic and functional infrastructure, whereas Cilacap showed deficits in key assets like watchtowers. However, CSI scores for user satisfaction were slightly lower, at 69.8 % for Nizam Zachman and 70.4 % for Cilacap, classifying them as merely "satisfied". The IPA further identified key bottlenecks hindering policy implementation, prioritizing document processing speed, port capacity, and mooring infrastructure as urgent areas for improvement. The study concludes that, for the Measured Fishing Policy to succeed, strategic investments must move beyond basic infrastructure to address the operational and service inefficiencies that directly impact user effectiveness and compliance.

1. Introduction

The sustainable management of fisheries has become a pivotal issue on the global development agenda, as this sector provides sustenance and livelihoods for millions while serving as a crucial protection of marine ecosystem sustainability (Gebremedhin et al., 2021; Garlock et al., 2022; Cheung et al., 2025). Nonetheless, the significant reliance on fisheries resources has led to overexploitation, causing a decrease in global fish stocks since the late 1980s (Zhang et al., 2021). The rise in demand for fishery products is projected to achieve 35 million metric tons by 2030, and this trend presents considerable challenges to the economic stability of coastal communities and the sustainability of marine ecosystems (Pauly & Zeller, 2016; Hunter, 2011). To address these global challenges, various countries have adopted output-control strategies, such as catch quotas, to ensure that fishing efforts remain within sustainable biological limits. This management strategy is considered more flexible and efficient than input-control (Garlock et al., 2022; Willse et al., 2024).

Output-based systems such as Total Allowable Catch (TACs) and Individual Transferable Quotas (ITQs) have been widely applied in diverse fisheries management regimes, including in New Zealand, Canada, Iceland, and within the European Union. The quota system has shown improvements in economic efficiency and the restoration of fish stocks, as illustrated by cases in New Zealand and the European Union (Anderson et al., 2011; Fernandes & Cook, 2013).

The efficacy of such quota systems is deeply contingent on robust operational infrastructure. International precedents underscore this dependency. New Zealand's Quota Management System (QMS), for instance, relies on fishing ports as integral hubs for monitoring, compliance, and data collection, facilitating the enforcement of Individual ITQs through detailed catch reporting and observer schemes (Aranda & Christensen, 2009; Livingston et al., 2015). Similarly, the European Union's Common Fisheries Policy (CFP) positions ports as critical control points for the success of output measures like the Landing Obligation, requiring ports to have the infrastructure for handling, monitoring, and documenting all catches to ensure compliance with TACs (Catchpole et al., 2017; Gamaza et al., 2020). In both systems, port readiness, which includes physical infrastructure, surveillance capabilities, and administrative services, is a non-negotiable prerequisite for translating policy into practice.

In emulating such international models, Indonesia, one of the world's largest producers of marine catch, has formally established an output-control management approach through the Measured Fishing Policy under Government Regulation No. 11/2023 (Trenggono, 2023). This policy classifies fish resources for industrial, small-scale, and non-commercial use, setting scientifically derived catch quotas across Indonesia's six Fisheries Management Areas. A critical operational mandate, stipulated in Ministerial Regulation No. 28/2023, requires all fishing vessels to land their catch at designated base ports, thereby positioning these ports as the fundamental nodes for the policy's execution. However, the implementation of this quota-based system has faced significant delays since its inception in 2023. Officially, as stated in Circular Letter of the Minister of Marine Affairs and Fisheries Number B.1954/MEN-KP/XI/2023, this postponement is directly attributed to unresolved readiness issues, specifically the lack of necessary supporting infrastructure. This situation directly illustrates that the efficacy of any quota-based strategy is inherently dependent on the institutional and infrastructural capabilities of its fishing ports (Catchpole et al., 2017; Utomo et al., 2024). Research on the Indonesian setting indicates that this necessitates appropriate service standards, proper physical infrastructure, and robust inter-institutional collaboration (Nurlaela, 2023; Luthfia, 2023). The delays seen in Indonesia correspond with global research indicating that insufficient port infrastructure, ineffective monitoring mechanisms, and restricted technology support are fundamental barriers to successful policy implementation (Brown et al., 2021).

This study focuses on the Nizam Zachman and Cilacap Ocean Fishing Ports, two Category A ports that constitute the highest designation in Indonesia's national port hierarchy and are thus established as essential hubs for the Measured Fishing Policy. Their significance is further underscored by their substantial contribution to the national fleet; with 1,545 and 79 large vessels (over 30 GT) based at Nizam Zachman and Cilacap respectively in 2023, these two ports alone account for 21.6 % of Indonesia's total large-scale capture fishing fleet of 7,512 vessels (KKP Data Portal, 2024). Nizam Zachman, the principal port in western Indonesia and a designated pilot for the policy, and Cilacap, a crucial hub for the Indian Ocean fishery, are both vital to domestic output and the export supply chain. However, they simultaneously exhibit the very challenges that plague the system, inadequate infrastructure, a shortage of supervisory staff, and inefficient catch monitoring systems. Studying these two major hubs therefore provides a highly representative lens through which to diagnose the systemic readiness gaps affecting the national policy.

Therefore, measuring both the availability of physical facilities and the quality of administrative services becomes essential to diagnose the specific bottlenecks in policy implementation. To systematically evaluate these challenges, this study applies two complementary analytical tools, the Customer Satisfaction Index (CSI) and Importance-Performance Analysis (IPA).

CSI quantitatively measures overall user satisfaction and identifies areas needing improvement, capturing multidimensional service attributes such as reliability, responsiveness, assurance, empathy, and tangibility (Sulistiyono et al., 2023). Meanwhile, IPA examines the relationship between the perceived importance of service attributes and their actual performance, providing an intuitive framework for prioritizing strategic improvements (Martilla & James, 1977; Lee & Hu, 2012). This integration is vital for revealing precisely which gaps are critically important to stakeholders and are currently underperforming (Ha et al., 2019; Hua & Chen, 2019). Consequently, the combined CSI and IPA approach delivers an evidence-based blueprint for action, directly informing where institutional and infrastructural investments are most needed to ensure the ports of Nizam Zachman and Cilacap are equipped to fulfill their role as the main nodes for the Measured Fishing Policy.

This study assesses the readiness of port facilities and the quality of services offered by PPS Nizam Zachman and PPS Cilacap in supporting Measured Fishing Policy implementation. The findings are expected to provide empirical insights for policy development and to strengthen the strategic alignment of fishing ports with sustainable fisheries governance objectives.

2. Research methods

2.1 Study site

This study was conducted at the Nizam Zachman and Cilacap Ocean Fishing Port. The research was conducted from November 2024 to January 2025. The research sites are presented in **Figure 1**.

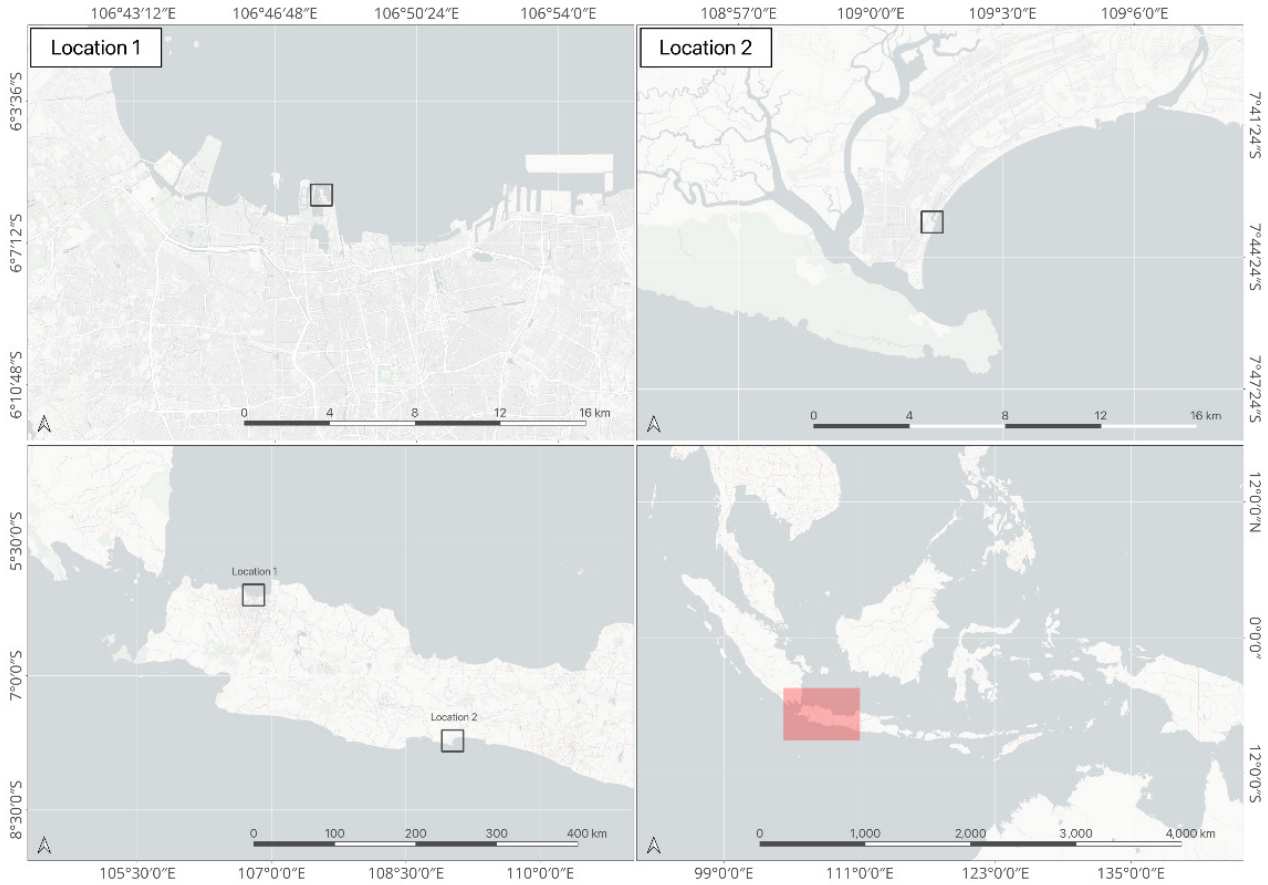


Figure 1 Research sites.

Figure 1 shows the two research locations: (1) the Nizam Zachman Ocean Fishing Port in North Jakarta, DKI Jakarta, and (2) the Cilacap Ocean Fishing Port in Cilacap Regency, Central Java. Both ports are located on the island of Java. According to the zoning system of the Measured Fishing

Policy, Nizam Zachman is categorized within Zone 06, while Cilacap falls under Zone 04. Nizam Zachman, situated in Indonesia's capital, is the nation's largest fishing port, encompassing 110 hectares with an additional 40-hectare port pool. The Cilacap Ocean Fishing Port, located on the southern coast of Java, shares the same core operational structure as Nizam Zachman, comprising four main units: Port Operations, Harbor Master, Business Service, and Facilities and Infrastructure Governance.

Table 1 Quantity and value of production of Nizam Zachman and Cilacap (2017 - 2023).

Year	Volume of Production Nizam Zachman (tons)	Production Value of Nizam Zachman (IDR Million)	Volume of Production Cilacap (tons)	Production Value of Cilacap (IDR Million)
2017	152,030	3,214,828	-	-
2018	188,401	5,152,359	-	-
2019	182,796	4,282,313	12,104	270,263
2020	181,829	4,077,570	17,201	344,428
2021	325,041	6,465,247	17,083	426,682
2022	-	-	19,369	552,394
2023	-	-	25,880	596,907
Average	**206,019**	**4,638,463**	**18,327**	**438,136**

The volume of marine capture fisheries production in Indonesia in 2021 reached 6,767,565 tons (KKP Data Portal, 2024). In comparison, the combined production of Nizam Zachman Ocean Fishing Port and Cilacap Ocean Fishing Port totaled 342,124 tons in the same year, meaning that these two ports contributed approximately 5.05 % to Indonesia's total marine capture fisheries production.

Combined data from Nizam Zachman (2017 - 2021) and Cilacap (2019 - 2023) show different dynamics in the achievement of fisheries production volume and value (**Table 1**). As the largest ocean fishing port in Indonesia, Nizam Zachman consistently recorded significantly higher production levels than Cilacap. This aligns with its strategic role as a centralized national landing hub that accommodates large-capacity vessels, diverse fishing gear, and an established distribution network serving both domestic and export markets. Over a five-year period, Nizam Zachman reached an average annual production volume of 206,019 tons and an average production value of IDR 4.63 trillion. Its peak production occurred in 2021, achieving 325,041 tons with a value of IDR 6.47 trillion, a substantial increase likely driven by post-pandemic recovery and improved vessel operational efficiency. In contrast, Cilacap plays a key role at the regional level, particularly within Fisheries Management Area 573. Although smaller in scale, the port demonstrates steady and progressive growth. Production volume rose from 12,104 tons in 2019 to 25,879 tons in 2023, while production value increased from IDR 270.26 billion to IDR 596.91 billion. This trend reflects the port's adaptive capacity and gradual increase in productivity.

The stark contrast in production performance highlights the fundamental structural and functional differences between the two ports. Nizam Zachman embodies a centralized industrial model, supported by high-density infrastructure and mature operational systems, positioning it as a

critical national production and marketing center (Afriliani et al., 2020; Alfianto et al., 2023). Conversely, Cilacap represents a more polycentric development model. Its steady growth, though smaller in scale, is driven by diverse local actors and contributes to regional economic resilience while aligning with more community-oriented and sustainable development pathways (Utami et al., 2025; Wicaksono et al., 2019). Thus, while Nizam Zachman's industrial-scale capacity is essential for maintaining national output, Cilacap offers a complementary model of equitable and locally grounded fisheries port development that directly supports regional livelihoods.

2.2 Methods

This study employs a mixed method, descriptive-evaluative approach to assess the preparedness of the ocean fishing ports in facilitating the execution of the Measured Fishing Policy. The evaluation was conducted on two main aspects: (1) the availability of port facilities based on applicable regulatory standards, and (2) the quality of service perceived by port users using the Customer Satisfaction Index (CSI) and Importance-Performance Analysis (IPA) methods. The selection of CSI and IPA is based on their synergistic capacity to provide a diagnostic framework specifically suited for policy readiness evaluation (Phadermrod et al., 2019). CSI offers a quantitative measure of user satisfaction, allowing the overall condition of port services to be benchmarked and compared across facilities (Putera et al., 2022; Sembiring & Rahayu, 2019). However, CSI alone does not explain which attributes require corrective action. Therefore, IPA is used to enhance diagnostic precision by mapping the relative importance of each service attribute against its performance, enabling the identification of priority areas that directly affect policy implementation outcomes (Phadermrod et al., 2019; Ganguly & Shankar, 2018). The combined application of CSI and IPA has been widely recommended for strategic decision-making in infrastructure and public service evaluation because it not only quantifies satisfaction but also translates the results into actionable improvement strategies (Nur et al., 2023; Mahendra & Djuneydi, 2025). This dual-method approach thus provides added value by offering both a readiness benchmark and a prioritization framework.

Respondents were selected from port users directly involved in port operations, including port administrators and port service users such as ship operators, ship agents, ship owners, and fish processors. The sampling technique used is a combination of purposive random sampling and accidental sampling. Purposive sampling was conducted based on the following criteria: (1) participation in the socialization of the Measured Fishing Policy, (2) willingness to provide the necessary information, and (3) status as a ship agent, ship manager, or ship owner. Meanwhile, accidental sampling was applied based on the availability of respondents at the research location during the field survey. The sample size is 140 respondents, consisting of 80 from Nizam Zachman and 60 from Cilacap, which is justified by the different operational structures at the two ports. At Nizam Zachman, which operates under a corporate model, the sample represents the population of shipping agents who are the main actors in the policy. In contrast, at Cilacap, which relies on a direct ownership model, the sample consists of ship owners and managers involved in policy socialization. Although the overall population of eligible respondents at both ports is relatively limited, the sample covers almost all individuals who meet the selection criteria and are directly involved in the implementation of the measured fishing policy. Therefore, the number of respondents is considered adequate to capture the perspectives of key stakeholders and to support the qualitative nature of this study.

The data collection was conducted using a structured questionnaire based on two main reference frameworks. The facility availability indicator was developed through a comprehensive analysis of three official regulations: Government Regulation No. 11/2023, Ministerial Regulation No. 28/2023, and Ministerial Regulation No. 8/2012 on Fishing Ports. These regulations outline the minimum standards for infrastructure required to support the implementation of the Measured Fishing

Policy. From that analysis, 20 Measured Fishing Policy support facilities were identified, 15 of which are included in the required core, functional, and supporting facilities. Facility availability is assessed through direct observation and is verified with port management. The classification of the measured facilities is presented in **Table 2**.

Table 2 Classification of facilities.

Basic Facilities	Functional Facilities	Supporting Facilities	Supplementary for Measured Fishing Policy
1) Breakwater	1) Fish Auction Sites	1) Meeting Hall	1) Indonesian-Flagged Refrigerated Fish Cargo Ship
2) Revetment	2) Telephone	2) Operator's Mess	2) CCTV
3) Groin	3) Internet	3) Fishermen's House	3) Fisheries Surveillance Vessel
4) Pier	4) Communication Radio	4) Place of Prayer	4) Basket
5) Jetty	5) Signage	5) Restroom	5) Digital Scale
6) Port Pond	6) Beacon Light	6) Retail Outlet	
7) Shipping Channel	7) Watchtower	7) Guard Station	
8) Port Road	8) Clean Water		
9) Drainage	9) Fuel Facilities		
10) Land	10) Ice Factory		
	11) Electrical Facilities		
	12) Ship Docking		
	13) Port Workshop		
	14) Net Repair Facilities		
	15) Quality Control Laboratory		
	16) Administrative Office		
	17) Integrated Service Office		
	18) Financial Services		
	19) Fish Transportation Equipment		
	20) Integrated Wastewater Treatment Plant		
	21) Temporary Disposal Site		
	22) Perimeter Fence		

For service quality, the indicators were developed by adapting the SERVQUAL framework (Parasuraman et al., 1988), which has been widely applied to service quality evaluation, including in fisheries-related services. The five dimensions are operationalized in alignment with the administrative service requirements stated in Ministerial Regulation No. 28/2023. The final list of service indicators is presented in **Table 3**.

Table 3 Dimensions of service quality.

Dimension	Indicator
Reliability	1) The number of port officers is adequate
	2) The harbor master is always on standby
	3) The meticulousness of inspecting the catch logbook by port officers
	4) The quality of inspection and monitoring of catch results
Responsiveness	5) Administrative services for fishing vessels
	6) The speed of processing fishing vessel documents
	7) The speed of processing the arrival and departure of fishing vessels
Assurance	8) Fish loading and unloading services
	9) Disaster mitigation
	10) Guarantee of cleanliness in fishing ports
	11) Fish auction and the availability of fish auction facilities
Empathy	12) The friendliness and communication of the port officers in providing service
	13) Strategy for socializing the Measured Fishing Policy
	14) Communication and coordination of port officers with fishermen and stakeholders
Tangibles	15) Availability of transportation access and supporting facilities
	16) The suitability of port capacity with the number of vessels
	17) The number of downstream industries available around the port
	18) The implementation of monitoring and management technology for fishing in the port area
	19) Provision of fishing market facilities
	20) Adequacy of fishing mooring facilities

Before use, the instrument's validity and reliability were tested. Validity was tested using Pearson's Product Moment correlation by comparing the calculated r value to the table r value at a significance level of 5 %. Reliability was measured using Cronbach's Alpha coefficient, with a minimum threshold of 0.60 considered adequate for social research (Malhotra & Dash, 2016). Then, the collected data were analyzed in three main stages: (1) Facility availability analysis using a comparative method to assess the readiness of facilities at both ports based on categories in the regulations; (2) Customer Satisfaction Index (CSI) analysis to determine the overall satisfaction level of users with the quality of port services, using a formula defined by weighted score (WS) and weighted factor (WF) for each service dimension (Thai, 2016; Syahrianda et al., 2025); and (3) Importance-Performance Analysis (IPA) to determine service improvement priorities (Martilla & James, 1977).

Table 4 Facility availability assessment criteria.

Interval (%)	Category
0 - 9.99	Very Inadequate
10 - 39.99	Inadequate
40 - 59.99	Moderately Adequate
60 - 79.99	Adequate
80 - 100.00	Very Adequate

Facility availability was determined by calculating the percentage of available infrastructure across four regulatory categories: basic, functional, supporting, and supplementary facilities. The interpretation of readiness used a five-tier classification adapted from Sudjana (2005) (**Table 4**). In this study, availability scores ≥ 60 % (Adequate-Very Adequate) are categorized as operationally efficient, indicating that the port can support Measured Fishing Policy implementation. Scores below 60 % represent operational limitations that may hinder policy execution.

For service quality, CSI values were interpreted using widely adopted criteria in port and fisheries research (Thai, 2016; Putera et al., 2023), as shown in **Table 5**.

Table 5 Customer satisfaction index interpretation.

CSI Value (%)	Interpretation
0 - 34	Very Dissatisfied
35 - 50	Dissatisfied
51 - 65	Moderately Satisfied
66 - 80	Satisfied
81 - 100	Very Satisfied

Table 6 Characteristics of respondents at Nizam Zachman and Cilacap.

Number	Characteristic	Category	Nizam Zachman		Cilacap	
			Number of People	Percentage (%)	Number of People	Percentage (%)
1	Gender	Male	80	100.0	42	70.0
		Female	0	0.0	18	30.0
		Total	**80**	**100.0**	**60**	**100.0**
2	Position	Agent	80	100.0	0	0.0
		Ship owner	0	0.0	9	15.0
		Ship manager	0	0.0	51	85.0
		Total	**80**	**100.0**	**60**	**100.0**
3	Age Range	≤ 30 years	27	33.8	20	33.3
		31 - 40 years	21	26.3	23	38.3
		41 - 50 years	23	28.8	10	16.7
		≥ 51 years	9	11.3	7	11.7
		Total	**80**	**100.0**	**60**	**100.0**
4	Last Education	Elementary school	0	0.0	3	5.0
		Junior high school	6	7.5	6	10.0
		High school	46	57.5	41	68.3
		Associate's degree	8	10.0	2	3.3
		Bachelor's degree	18	22.5	8	13.3
		Graduate's degree	2	2.5	0	0.0
		Total	**80**	**100.0**	**60**	**100.0**
5	Income Range	IDR 1,000,000 - 2,999,999	0	0.0	3	5.0
		IDR 3,000,000 - 4,999,999	32	40.0	31	51.7
		IDR 5,000,000 - 9,999,999	44	55.0	17	28.3
		IDR 10,000,000 - 20,000,000	4	5.0	9	15.0
		Total	**80**	**100.0**	**60**	**100.0**

In this study, CSI scores ≥ 66 % (Satisfied-Very Satisfied) are considered indicative of efficient service performance, while values below 66 % are classified as service limitations likely to constrain policy implementation. This framework provides a systematic basis for evaluating user satisfaction across the five SERVQUAL dimensions: reliability, responsiveness, assurance, empathy, and tangibles (Putera et al., 2023).

3. Results

3.1 Respondent profiles

All participants were engaged users actively involved in port activities. At Nizam Zachman, all respondents were ship agents, because this port operates under a corporate-based management structure in which ship agents act as the formal representatives of vessel owners, assume administrative responsibility, and are the only actors authorized to coordinate port services and policy compliance. Unlike Cilacap, where vessel owners are directly involved in day-to-day port interaction, ship owners in Nizam Zachman delegate operational and administrative functions entirely to ship agents. This uniformity arose because ship owners in this region were typically not directly engaged and have insufficient understanding of port operating services (**Table 6**).

Based on gender, all respondents at the Nizam Zachman Ocean Fishing Port were male, indicating the limited involvement of women in administrative and technical roles within the port sector. The age distribution indicates that younger age groups dominated both ports, with respondents aged 30 years or younger and those aged 31 - 40 years accounting for a combined proportion of 60.1 % at Nizam Zachman and 71.6 % at Cilacap. This age composition suggests that the fisheries agent profession is predominantly occupied by younger age groups, potentially facilitating stakeholder renewal within the fisheries industry. Regarding education, respondents at Nizam Zachman fishing port were predominantly high school graduates (57.5 %) and bachelor's degree holders (22.5 %). The predominant number of responders possessed a high school education, adequate for facilitating port administration and technical operations. Based on monthly income, the study showed that respondent income is comparatively elevated in relation to the DKI Jakarta provincial minimum wage of IDR 5,396,761, while some respondents still earn below the provincial minimum wage.

At the second research site, Cilacap Ocean Fishing Port, the respondents comprised 85 % ship managers and 15 % ship owners. Ship managers serve as the primary technical agents in fishing operations in this research site. Regarding gender, 70 % of responders were male, while 30 % were female. The participation of women signifies greater gender inclusion relative to PPS Nizam Zachman and demonstrates enhanced acknowledgment of women's efforts to productive endeavors in the fisheries sector. The age distribution of respondents at Cilacap indicates that a majority (71.6 %) are over 40 years old, highlighting the prevalence of the mature demographic in port activities. The majority of respondents are high school graduates (68.3 %). The disparity in educational attainment indicates that the fishing sector in Cilacap successfully attracts entrepreneurs from diverse academic backgrounds. The majority of respondents received income exceeding the Cilacap regency minimum wage of IDR 2,640,248. The varied revenue distribution in contrast to Nizam Zachman indicates substantial disparities in the responsibilities and statuses of ship managers and ship owners at this port.

3.2 The availability of fishing port facilities

The analysis of facility availability in this study goes beyond a basic state; it serves as a diagnostic tool to identify physical bottlenecks that may hinder the operationalization of the Measured Fishing Policy. Since the policy relies on quota-controlled landings, catch documentation, monitoring, and traceability, the effectiveness of the policy is directly tied to the adequacy of port infrastructure. To assess physical readiness, a comparative evaluation was conducted at two major ocean fishing ports using four regulatory-based facility categories: (1) basic facilities, (2) functional facilities tied to Measured Fishing Policy mechanisms, (3) supporting facilities, and (4)

supplementary facilities. This structured assessment links specific facility gaps to their potential consequences for policy implementation, providing evidence-based insight into whether current infrastructure can support the Measured Fishing Policy (**Table 7**).

Table 7 Availability of Nizam Zachman and Cilacap facilities.

Facilities	Availability			
	Nizam Zachman	**Remarks**	**Cilacap**	**Remarks**
Fundamental	10	Some facilities are damaged (breakwater), submerged in floods (docking, jetty, port roadway), and experiencing overcapacity (port pond)	10	Some facilities have suffered damage (revetment, pier), and the port pond has experienced siltation and overcapacity
Functional	21	Some are unused (fish auction sites), damaged (wastewater treatment plant), or unavailable (quality control laboratory)	18	Some are non-functional (communication radios), damaged (fish auction sites), or not yet available (watchtower, net repair facility, quality control laboratory, wastewater treatment plant)
Supporting	6	Some facilities are limited in number (operator mess, restrooms), inadequate (retail outlets), or unavailable (fishermen's house)	6	There is no fishermen's house; adequate worship are available, including a mosque and a Buddhist temple
Supplementary Measured Fishing Policy	4	Refrigerated fishing vessels are not available, some are not optimal (CCTV), and digital scales have been replaced by weighbridges	4	Refrigerated fishing vessels are not available, some are not optimal (CCTV, digital scales)
Total	**41**		**38**	
Percentage	**93 %**		**86 %**	

In the basic facility category, both ports satisfy all designated criteria. The Nizam Zachman encompasses a space of 110 hectares, featuring a 40-hectare port pond, two primary piers, internal port roadways, and a drainage system spanning about 17 kilometers, as well as breakwaters and revetments. Meanwhile, Cilacap occupies an area of 30.78 hectares, featuring three port ponds, four piers, two breakwaters, a shipping channel, a 16,565 m² port road, and 3,765 meters of drainage. However, this does not reflect their functional adequacy. At Nizam Zachman, critical infrastructure, such as breakwaters, is damaged, while docking areas, jetties, and port roadways are regularly inundated by floods, highlighting the need for elevation improvements. The port pond is also facing

overcapacity, especially when all the vessels are docked, which poses risks to navigational safety. These conditions in basic infrastructure directly threaten the core Measured Fishing Policy process of landing and verifying quota-bound catches, risking delays and data inaccuracies, and ultimately compromising the policy's fundamental control mechanism. Similarly, Cilacap suffers from structural deterioration in revetments and piers. Siltation and overcapacity in its port pond further impair operational efficiency. This undermines the reliable scheduling and execution of landings, which is critical for the monitored and documented flow of catches required by the Measured Fishing Policy system.

Regarding functional facilities, Nizam Zachman possesses 21 out of 22 assessed facilities, whilst Cilacap has 18 amenities. Both ports offer administrative offices, integrated service posts, fish auction sites, fuel facilities, ship docking, financial services, and electrical networks. At Nizam Zachman, the fish auction site is underutilized, the wastewater treatment plant is damaged, and the quality control laboratory is absent. These issues affect market operations, environmental compliance, and post-harvest management. Specifically, the lack of a quality control laboratory impedes the implementation of the quality standards mandated by the Measured Fishing Policy, risking the economic value of the quota-managed catch that the policy aims to optimize. Cilacap presents more severe deficiencies: communication radios are non-functional, and several key facilities such as the surveillance tower, net repair workshop, wastewater treatment plant, and quality laboratory are completely unavailable. This lack of functional support hampers regulatory monitoring, service delivery, and the enforcement of the Measured Fishing Policy principles. The absence of a surveillance tower and non-functional radios, for instance, create blind spots in monitoring, making the port vulnerable to practices, like misreporting catches, that the policy is designed to eliminate.

In the supporting facilities category, both ports achieve similar scores (6 out of 7). However, Nizam Zachman suffers from limited restroom availability, which triggered the emergence of unauthorized private sanitation facilities. Retail outlets are also considered inadequate, reducing service convenience for fishing port users. While both ports lack a fishermen's house, Cilacap demonstrates inclusivity by offering diverse places of worship, including a mosque and a Buddhist temple. Nonetheless, these qualitative aspects indicate that, while infrastructure is nominally "available," it may be insufficient, improvised, or below user standards. These inadequacies in supporting services can lead to operational inefficiencies and low user compliance, indirectly eroding the cooperative environment necessary for the successful adoption of the new Measured Fishing Policy regulations.

Both ports show comparable constraints in their additional facilities that support the Measured Fishing Policy. Refrigerated fishing vessels licensed under the Indonesian flag, crucial for maintaining cold chain integrity for quota-based catch landings, are deficient. CCTV systems are installed; nevertheless, they fail to provide complete coverage of operational hotspots. This represents the most critical gap. Without refrigerated vessels, the cold chain integrity for quota-bound catches is broken, directly undermining the Measured Fishing Policy's goals of traceability and quality assurance. Inadequate CCTV coverage hinders the transparent monitoring of unloading and weighing processes, which is the cornerstone of quota compliance and data validation under the Measured Fishing Policy. These deficiencies indicate that availability without optimization renders these instruments only partially effective for the implementation of the Measured Fishing Policy.

The facility readiness scores for Nizam Zachman Ocean Fishing Port (93 %) and Cilacap Ocean Fishing Port (86 %) reflect a significant degree of infrastructure availability. However, complementary field observations conducted by the research team during site visits revealed notable shortcomings in practical operations that are not captured by the scoring alone. At Nizam Zachman, essential infrastructure, including breakwaters and port highways, was present. Nonetheless, these facilities faced considerable challenges and were often overwhelmed during periods of high tides and wet seasons. The port pond is flooded, and the drainage systems, despite their substantial capacity, are ineffective in preventing inundation. In Cilacap, the stability of revetments and piers is at risk,

while sediment buildup in the port pond obstructs vessel navigation and docking operations. The results indicated that it is essential to reevaluate the availability of infrastructure, focusing on its functionality, maintenance condition, and resilience when subjected to operational stress. Furthermore, the essential facilities also required for the execution of the Measured Fishing Policy, as outlined in two main regulations (Government Regulation No. 11/2023 and Ministerial Regulation No. 28/2023), are either inadequate or completely lacking. Both ports are devoid of Indonesian-flagged refrigerated fishing vessels, which are crucial for guaranteeing traceable, cold-chain-integrated landings. The current CCTV coverage is also insufficient, hindering effective oversight of unloading operations and the use of digital weighing equipment. Infrastructure readiness must be evaluated not just by its existence, but by the effectiveness of its operations, the quality of its maintenance, and the compatibility of each element with the technical specifications and particular execution of the Measured Fishing Policy.

3.3 Assessment of Fishing Port Service Quality

The assessment of service quality indicated that the measurement tools employed adhere to optimal validity and reliability standards. All questionnaire items were validated, with r-count values above the r-table (0.217 at Nizam Zachman and 0.250 at Cilacap) and demonstrated reliability with Cronbach's Alpha values of more than 0.60. The findings indicate that the collected data have a high consistency and reliability in evaluating the five essential elements of fishing port service quality: reliability, responsiveness, and assurance, empathy, and tangibles.

Table 8 CSI score for Nizam Zachman and Cilacap.

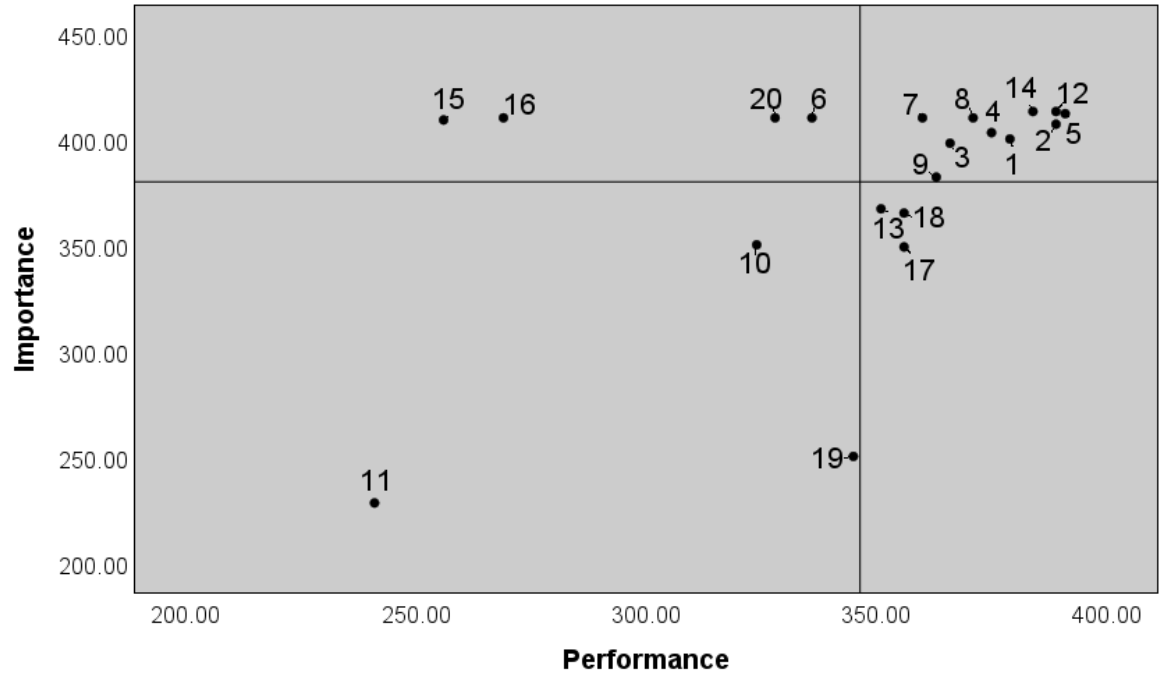
Category	Nizam Zachman (%)	Cilacap (%)
Reliability dimension	75.45	75.15
Responsiveness dimension	72.51	68.55
Assurance dimension	67.00	69.16
Empathy dimension	75.10	74.20
Tangibles dimension	62.92	66.87
Overall score	**66.97**	**70.38**

As presented in **Table 8**, the overall Customer Satisfaction Index (CSI) scores are 66.97 % for Nizam Zachman Ocean Fishing Port and 70.38 % for Cilacap Ocean Fishing Port. Based on established benchmarks (Thai, 2016), these values place both ports in the "Satisfied" category. However, examination of the individual service dimensions shows a distinct performance pattern. The Tangibles dimension scored the lowest at both facilities, suggesting that issues with physical infrastructure are a universal concern. Conversely, the Reliability and Empathy dimensions were consistently the highest-rated, reflecting user confidence in the consistency of core services and the attentiveness of port staff.

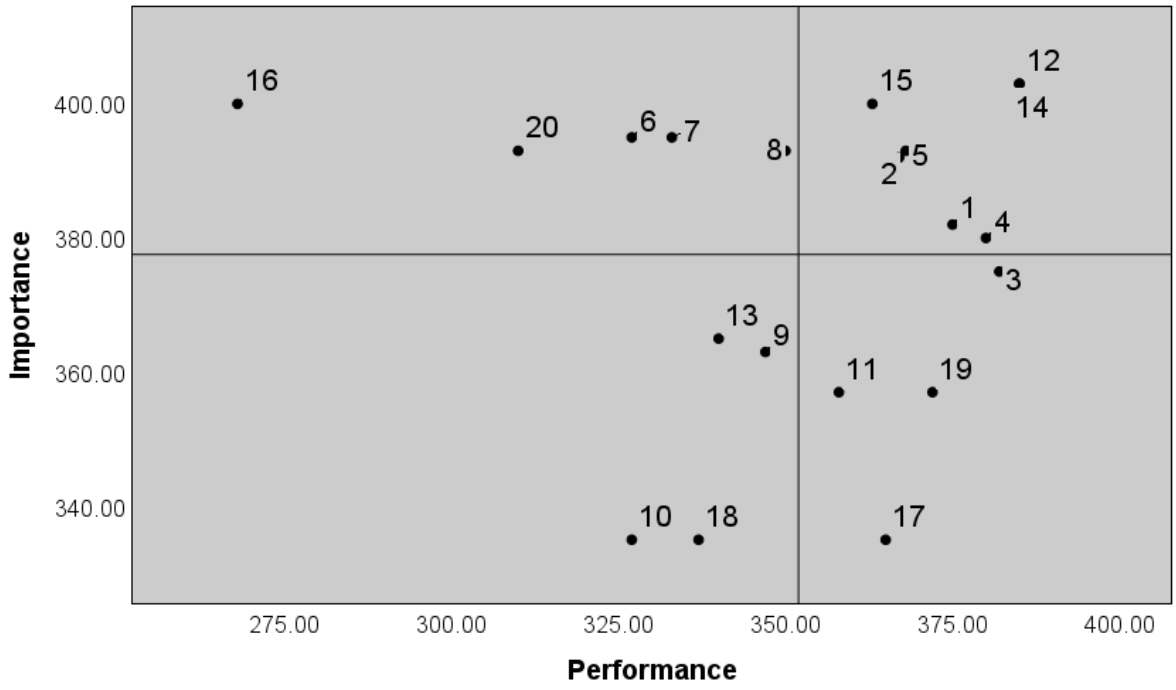
The Importance-Performance Analysis (IPA) revealed that both Nizam Zachman and Cilacap have achieved high conformance to the service standards required under the Measured Fishing Policy. The overall suitability scores reached 90.99 % for Nizam Zachman and 93.20 % for Cilacap (**Table 9**), indicating that most service attributes are perceived as well-aligned with user expectations. However, further examination through the Cartesian diagram highlights clear differences in service improvement priorities between the two ports, reflecting their distinct institutional conditions and operational capacities.

Table 9 The suitability of performance and importance criteria of Nizam Zachman and Cilacap.

Dimension	Item	Nizam Zachman (%)	Cilacap (%)
Reliability			
The number of ports officers is adequate	1	94.39	98.25
The harbor master is always on standby	2	95.40	93.62
The meticulousness of inspecting the catch logbook by port officers	3	91.85	101.78
The quality of inspection and monitoring of catch results	4	92.88	100.00
Responsiveness			
Administrative services for fishing vessels	5	94.85	93.64
The speed of processing fishing vessels documents	6	81.76	82.70
The speed of processing the arrival and departure of fishing vessels	7	87.54	84.39
Assurance			
Fish loading and unloading services	8	90.27	88.98
Disaster mitigation	9	94.77	95.41
Guarantee of cleanliness in fishing ports	10	92.17	97.51
Fish auction and the availability of fish auction facilities	11	105.46	100.47
Empathy			
The friendliness and communication of the port officers in providing service	12	93.96	95.45
Strategy for socializing the Measured Fishing Policy	13	95.58	93.15
Communication and coordination of port officers with fishermen and stakeholders	14	92.75	95.45
Tangibles			
Availability of transportation access and supporting facilities	15	62.50	90.83
The suitability of port capacity with the number of vessels	16	65.35	67.08
The number of downstream industries available around the port	17	101.79	108.96
The implementation of monitoring and management technology for fishing in the port area	18	97.27	100.50
Provision of fishing market facilities	19	137.31	104.21
Adequacy of fishing mooring facilities	20	79.64	78.81
Averages		**90.99**	**93.20**



(a)



(b)

Figures 2 Cartesian diagram of Nizam Zachman (a) and Cilacap (b).

Figure 2 presents the IPA Cartesian diagrams for both ports. In this analysis, Quadrant I is defined as high importance but low performance, representing service attributes that require immediate intervention. In Nizam Zachman, four attributes fell into Quadrant I: ship document processing (item 6), vessel arrival and departure handling (item 7), fish loading and unloading services (item 8), and the suitability of port capacity and mooring facilities (items 16 and 20). These attributes represent highly important services with underperforming delivery. Similarly, Cilacap

shows five attributes in Quadrant I: administrative document processing (item 6), arrival and departure handling (item 7), fish loading and unloading services (item 8), port capacity (item 16), and mooring facilities (item 20). This consistent clustering of attributes in both ports indicates shared systemic constraints in responsiveness and infrastructure adequacy, particularly related to vessel management and physical facility support. While Quadrant I represents the highest priority for improvement, other quadrants indicate attributes that are either performing well or are less critical for service delivery. The results emphasize a combination of tangibles (infrastructure, capacity, facilities) and responsiveness (processing speed, operational efficiency) as the dominant gaps. The findings suggest the need for institutional strengthening through digitalization of vessel administration systems, expansion of port and mooring capacity, and improved logistical access. These interventions are expected to reduce operational bottlenecks, improve service delivery, and enhance user satisfaction under the Measured Fishing Policy framework.

4. Discussion

This study evaluated the readiness of fishing ports, focused on the highest-class port category, to support Indonesia's new Measured Fishing Policy. Overall, the fishing ports in this study demonstrate a relatively high level of infrastructure availability, with Nizam Zachman providing about 93 % of required facilities, and Cilacap about 86 %. These figures indicate that most basic physical infrastructures, such as docking areas, auction halls, cold storage, and fuel and water supply, are in place. User satisfaction levels, measured via the CSI, were moderate for both ports: approximately 69.8 % for Nizam Zachman, and 70.4 % for Cilacap. The data indicated that users regard the current services as being at a just satisfactory level. The IPA reveals that each port has numerous service qualities that are critically important yet exhibit inadequate performance levels. The components are situated in the first quadrant. In the first quadrant, substantial defects necessitate prompt adjustment. Simultaneously, numerous traits were categorized in Quadrant II (high importance/high performance), underscoring current strengths that have to be preserved. Consequently, although the ports are predominantly equipped in terms of infrastructure, and provide satisfactory services, there exist certain deficiencies and underperforming sectors that may jeopardize their complete preparedness to execute the quota-based fisheries policy.

A detailed comparative analysis showed distinct strengths and weaknesses of the evaluated fishing ports. Nizam Zachman, a fishing port near the capital, exhibits distinctly superior physical capabilities compared to other Indonesian fishing ports. This is demonstrated by its 110-hectare area, 40-hectare port pool, and role as the nation's primary hub, accommodating more than 1,000 vessels annually (PIPP, 2024). This extensive physical base is reflected in its high facility availability (93 %) and positions it as a specialized port for managing high-volume landings within set limits. The resilient infrastructure of Nizam Zachman offers a significant benefit, supporting the assertion that superior port facilities boost operational efficiency (Utomo et al., 2024). However, this port faces chronic operational disruptions, particularly regular flooding that inundates docking areas, jetties, and port roadways, significantly impeding vessel movement and service reliability. Cilacap is a prominent port located on the southern coast of Java, with facility availability at a significantly lower rate of 86 %. The findings showed that the infrastructure presents certain limitations. Addressing these limitations will be crucial for enhancing Cilacap's role in supporting Measured Fishing Policy effectively. Critically, despite its more constrained infrastructure, Cilacap earned a slightly higher user satisfaction level (CSI of 70.4 at Cilacap, versus 69.8 at Nizam Zachman).

This counterintuitive finding can be critically interpreted through both contextual factors and supporting research. While Nizam Zachman has superior facilities, its operational effectiveness is compromised by persistent flooding that disrupts basic port access and vessel operations. In contrast, Cilacap's available facilities, though fewer in number, remain consistently operational and unimpeded by such major disruptions. This phenomenon finds strong parallel in Nur et al. (2023)'s study of Belitung Island fishing ports, which similarly documented adequate service quality perceptions

despite significant facility limitations. Both cases demonstrate that reliable access to functional basic facilities may outweigh the value of extensive but disruption-prone infrastructure.

The quality of service is a crucial factor influencing port user satisfaction. Research indicates that both technical and functional dimensions of service delivery substantially influence satisfaction levels (Ugboma et al., 2009). The SERVQUAL model and Customer Satisfaction Index have been employed to assess service quality and satisfaction, indicating that enhanced service quality results in increased user satisfaction (Ugboma et al., 2009). Moreover, effective management approaches are crucial for improving service standards and quality. This is particularly true for addressing the administrative bottlenecks identified in the IPA results of the present study, where enhanced management focusing on process streamlining and staff training could directly improve the speed of document processing and vessel clearance. Moreover, government decisions and reforms significantly influence port performance and user satisfaction (Brooks & Pallis, 2008). The higher satisfaction at Cilacap suggests that its service quality and management could represent a comparative advantage, potentially providing more efficient or user-friendly services despite having fewer facilities. Field observations revealed a unique socio-economic dynamic that may contribute to this efficiency: the active involvement of women as vessel managers, who play a crucial role in handling administrative documents and facilitating communication between vessel owners and port authorities. This inclusive practice potentially streamlines the administrative process, directly addressing the kind of bureaucratic bottlenecks identified in the IPA results, while also promoting gender inclusivity in fisheries governance. This supports the emerging understanding that service reliability and consistent operations may be more valued by users than facility quantity, particularly when basic needs are adequately met.

The study indicates both fishing ports, Nizam Zahman and Cilacap, have several high-priority weaknesses in Quadrant I, though their natures differ. The IPA results of the two ports show similar challenges in terms of administrative speed and port capacity, but Cilacap has additional challenges related to facilities concerning loading and unloading services. These differences underscore that Nizam Zachman's strength lies in its infrastructure, while Cilacap's strength lies in its service delivery;, each port's weakness is the other's strength. Such comparative insights are valuable for tailored improvements at each site. This study aligns with extensive studies on fishing port performance, emphasizing that both infrastructure and service quality are essential for port readiness in relation to new fisheries policies, such as the Measured Fishing Policy. Robust physical facilities are crucial and, therefore, improvement of port infrastructure through integration with technological innovations can significantly boost operational efficiency, safety, and sustainability. Investments in modern landing equipment, cold storage, and waste management systems significantly improve the efficiency and quality of fish handling. This ensures that port operations adhere to sustainability principles (Dirman et al., 2024). The notable facility score of 93 % for Nizam Zachman demonstrates that the port has successfully developed the essential infrastructure. However, the IPA results clearly demonstrate that this infrastructure, by itself, is insufficient to ensure policy readiness, as evidenced by critical service attributes like 'speed of document processing' and 'port capacity' falling into Quadrant I (high importance, low performance). The quality of service substantially influences the efficiency of port operations (Chang & Thai, 2016). In fishing port management, service quality encompasses the efficiency of vessel clearance, the equity and transparency of the auction process, the provision of timely information, and the professionalism of port personnel. A study of a similar Indonesian fishing port in Belitung indicated that several critical port services were considered important by users but demonstrated insufficient performance, yielding an overall facilities-and-services score of around 60 % (categorized as "moderate") (Nur et al., 2023). This scenario illustrates that, despite the establishment of required infrastructure, deficiencies in services, such as sluggish fish auction transactions, insufficient ice supply, or inadequate cleanliness, can hinder the effectiveness of port operations. Tijan et al. (2021) also highlighted the essential function of port

authorities in managing port community systems to improve efficiency, sustainability, and overall growth.

Insufficient infrastructure and lack of collaboration among stakeholders were significant obstacles hindering efficiency. The IPA analyses for both Nizam Zachman and Cilacap pinpointed specific shortcomings that require management attention, such as the potential need for better port ICT systems or more integrated services, despite being the ports being rated as having a generally "good" performance. Therefore, it is essential to address the interconnectedness of infrastructure readiness and service quality. Strong infrastructure is fundamental to port operations; however, effective, user-focused service delivery and skilled port management are crucial for transforming that capacity into positive outcomes for port users and improving fisheries production. Based on this study, it is argued there is a need to improve any subpar service processes, achievable such as by streamlining bureaucracy or enhancing training, alongside closing infrastructure gaps. Such improvements will not only increase satisfaction but also ensure the ports can function as reliable support hubs under the new quota-based management regime.

The readiness of the selected ports significantly influences the successful implementation of Indonesia's quota-based fisheries strategy. In a quota system, fishing ports function as essential hubs for the oversight and administration of catch limits, and verification of total allowable catch (TAC) regulations within output-control fisheries management systems. The experiences of New Zealand's Quota Management System (QMS) and the European Union's Common Fisheries Policy (CFP) are particularly instructive here, offering complementary lessons on the critical role of ports. These ports serve as essential control centers, where scientific devices and regulatory frameworks converge to oversee fish populations and ensure long-term sustainability. In New Zealand, ports are pivotal control points where compliance is monitored, and crucial data for stock assessments is collected through detailed catch reporting systems and observer schemes (Livingston et al., 2015; Aranda & Christensen, 2009). This role transforms ports from passive landing sites into active nodes of governance and data collection. Similarly, the EU's CFP underscores the role of ports as enforcement gateways. Ports in the EU are mandated to implement the Landing Obligation, requiring infrastructure to handle all catches and serving as points for rigorous inspections and catch documentation to combat illegal fishing (Catchpole et al., 2017; Tsamenyi et al., 2010). This EU model highlights that port readiness is as much about physical infrastructure for compliance (e.g., sorting and processing unwanted catches) as it is about surveillance and administrative control.

The findings of the present study, however, reveal critical gaps in the Indonesian context when measured against these international benchmarks. The high facility availability scores (93 % at Nizam Zachman, 86 % at Cilacap) suggest a foundational level of physical readiness. However, the IPA results identified "the speed of processing fishing vessel documents" as a high-priority failure (Quadrant I) at both Indonesian ports. This administrative bottleneck directly impedes the ports' ability to function as efficient data collection and verification points, a cornerstone of New Zealand's successful QMS, and undermines the swift enforcement and documentation required by the EU's CFP. Furthermore, the EU's struggle with the Landing Obligation due to a "lack of such infrastructure" in some ports (Gamaza et al., 2020) serves as a cautionary tale for Indonesia; high percentage availability does not guarantee that facilities are fit-for-purpose for specific policy demands like the Measured Fishing Policy. Moreover, the success of both the NZ and EU systems is bolstered by collaborative frameworks and technological integration, such as New Zealand's involvement of fishers in data collection (Starr, 2010) and the EU's use of Electronic Monitoring (EM) systems (Plet-Hansen et al., 2019). This contrasts with the evolving state of such integrated, tech-enabled collaboration in Indonesia.

Ports regularly evaluate catch reports to verify compliance with reporting regulations (Kindt-Larsen et al., 2011). Port staff and fisheries observers collect critical data concerning species composition, catch volume, gear type, and fishing effort. This information is crucial for informing management decisions and maintaining the sustainability of fish stocks. Through the analysis of these

data points, regulatory authorities can enact targeted interventions to mitigate overfishing and safeguard at-risk species, thereby promoting a balanced marine ecosystem. This information improves stock assessment models and supports science-based fisheries governance (Stanley et al., 2009; Kritzer, 2020).

The findings of this study show that each port has some underperforming areas via the IPA signaling where such vulnerabilities might lie. For instance, if cold chain facilities or auction processes were identified as Quadrant I issues, these must be improved to prevent bottlenecks or losses once quotas are enforced. A robust institutional support and effective governance structures are essential for the success of fisheries initiatives aimed at output management. Although New Zealand's QMS is often recognized as an innovative and profitable system (Jeffs & Liyanage, 2005; Aranda & Christensen, 2009), and the EU's CFP represents a comprehensive regulatory framework, their successes are deeply rooted in supportive ecosystems that Indonesia must consciously build. The EU's experience, for instance, shows that, even with strong regulations, challenges like non-compliance and insufficient port infrastructure can persist (Kraak, 2023; Carpenter, 2016). Other nations also adopted this strategy, even though it has proven to be ineffective, as illustrated by the case in China (Jiang et al., 2024). The initiative in China to implement an individual transferable quota system in a specific province failed primarily because of a lack of strong commitment from local government and an insufficient legal framework to clearly define and enforce fishing rights. The Indonesian context, as revealed by this study, shows a promising yet challenging picture; the physical infrastructure at major ports is largely adequate, but the critical soft infrastructure of efficient administration, tailored compliance facilities, and integrated data management is lacking. Therefore, addressing issues such as local management capabilities, legal structures, and socio-economic considerations with biological and ecological objectives is needed (Calvo-Ugarteburu et al., 2016; Hill, 2018). The effectiveness of these systems depends on strong legislative frameworks, scientific knowledge, stakeholder participation, and institutional enforcement mechanisms (Marchal et al., 2016).

Based on the combined insights from both ports, a focused, actionable strategy is proposed. The immediate priority should be the digitalization of administrative services through a single online platform for vessel clearance and catch reporting, directly addressing the critical bottleneck of slow document processing identified in the IPA results. Concurrently, targeted infrastructure investments are essential: Nizam Zachman requires urgent flood mitigation to resolve its chronic operational disruptions, while Cilacap needs focused upgrades to its loading/unloading and mooring facilities. To ensure the success of these interventions, mandatory, practical training for port officers on the new digital systems and Measured Fishing Policy procedures must be implemented. Finally, achieving these goals necessitates a strategic reallocation of port budgets, shifting funds from less critical areas to finance these specific digital and physical priorities. By executing this evidence-based plan, the ports can be transformed into reliable and efficient hubs for the Measured Fishing Policy.

5. Conclusions

This study demonstrates that the government is not yet fully prepared to implement the Measured Fishing Policy, a conclusion clearly evidenced by the high-priority deficiencies identified in the Importance-Performance Analysis (IPA). While ports like Nizam Zachman and Cilacap possess adequate basic infrastructure, critical failures in administrative speed, port capacity, and information and communication technology (ICT) systems reveal a significant operational readiness gap that threatens to undermine the policy's enforcement and sustainability.

This research moves the body of science forward by providing a crucial "reality check" on quota system implementation. Successful models rely on efficient data collection and compliance monitoring at ports, and it is precisely the functions of our IPA finding that still underperforming. Thus, this study breaks new ground by shifting the implementation discourse from biological quota-

setting to the operational readiness of landing sites, offering a diagnostic framework to identify these bottlenecks before a policy is launched.

For the Measured Fishing Policy to succeed, the government's strategy must extend beyond setting catch limits. It requires an urgent, targeted intervention to fix the specific shortcomings mapped in this study: digitalizing document processing, mitigating flooding at Nizam Zachman, upgrading loading/unloading facilities at Cilacap, and investing in human resource training. Without this foundational work, Indonesia risks replicating the implementation failures seen in other nations, rather than the success of global leaders.

CRediT author statement

Seruni Salsabila Putri Basoeki: Conceptualization; Methodology; Investigation; Formal analysis; Visualization; Data curation; Writing - Original Draft. **Suadi**: Conceptualization; Methodology; Supervision; Funding acquisition; Writing - Review & Editing. **Djumanto**: Methodology; Supervision; Writing - Review & Editing.

References

Afriliani, W., Anna, Z., Handaka, A. A., & Khan, A. M. A. (2020). Typology of skipjack (*Katsuwonus pelamis*) fisheries at Nizam Zachman oceanic fishing port, Jakarta, Indonesia. *Asian Journal of Fisheries and Aquatic Research, 7*(2), 39-50. https://doi.org/10.9734/ajfar/2020/v7i230115

Akar, Ö., & Demirci, A. (2023). Risk analysis, assessment and management for local fishing ports in north-eastern mediterranean, Türkiye. *Marine Science and Technology Bulletin, 12*(2), 201-211. https://doi.org/10.33714/masteb.1241126

Alfianto, N., Suherman, A., Suryanti, S., & Hernuryadin, Y. (2023). Strategy for implementation of seaworthiness of large pelagic purse seine at Nizam Zachman Ocean fishing port. *Sustainability, 15*(18), 13713. https://doi.org/10.3390/su151813713

Anderson, S. C., Flemming, J., Watson, R., & Lotze, H. (2011). Rapid global expansion of invertebrate fisheries: Trends, drivers, and ecosystem effects. *PLoS One, 6*(3), e14735. https://doi.org/10.1371/journal.pone.0014735

Aranda, M., & Christensen, A. (2009). The New Zealand's quota management system (QMS) and its complementary mechanisms. In: Hauge, K., & Wilson, D. (Eds.). *Comparative evaluations of innovative fisheries management* (pp. 19-41). Dordrecht: Springer. https://doi.org/10.1007/978-90-481-2663-7_2

Brooks, M. R., & Pallis, A. A. (2008). Assessing port governance models: Process and performance components. *Maritime Policy & Management, 35*(4), 411-432. https://doi.org/10.1080/03088830802215060

Brown, C. J., Desbiens, A., Campbell, M. D., Game, E. T., Gilman, E., Hamilton, R. J., Heberer, C., Itano, D., & Pollock, K. (2021). Electronic monitoring for improved accountability in Western Pacific tuna longline fisheries. *Marine Policy, 132*, 204664. https://doi.org/10.1016/j.marpol.2021.104664

Calvo-Ugarteburu, G., Raemaekers, S., & Halling, C. (2016). Rehabilitating mussel beds in Coffee Bay, South Africa: Towards fostering cooperative small-scale fisheries governance and enabling community upliftment. *Ambio*, *46*(2), 214-226. https://doi.org/10.1007/s13280-016-0823-4

Catchpole, T. L., Ribeiro-Santos, A., Mangi, S. C., Hedley, C., & Gray, T. S. (2017). The challenges of the landing obligation in EU fisheries. *Marine Policy, 82*, 76-86. https://doi.org/10.1016/j.marpol.2017.05.001

Chang, C., & Thai, V. V. (2016). Do port security quality and service quality influence customer satisfaction and loyalty? *Maritime Policy & Management, 43*(6), 720-736. https://doi.org/10.1080/03088839.2016.1151086

Cheung, W., Pauly, D., & Sumaila, U. R. (2025). Hope or despair revisited: assessing progress and new challenges in global fisheries. *Fish and Fisheries, 26*(2), 257-269. https://doi.org/10.1111/faf.12877

Dirman, E. N., Harahab, N., Semedi, B., & Rachmansyah, A. (2024). Analysing factors influenced the sustainable fishing port model in East Java Province, Indonesia. *Journal of Water and Land Development, 62*(7-9), 139-149. https://doi.org/10.24425/jwld.2024.151561

Fernandes, P. G., & Cook, R. M. (2013). Reversal of fish stock decline in the Northeast Atlantic. *Current Biology, 23*(15), 1432-1437. https://doi.org/10.1016/j.cub.2013.06.016

Gamaza, M., Torres, M. A., Acosta, J. J., Erzini, K., & Sobrino, I. (2020). Are we ready to implement a discard ban in the gulf of Cádiz? Stakeholders' perceptions. *Marine Policy*, *116*, 103711. https://doi.org/10.1016/j.marpol.2019.103711

Ganguly, K. K., & Shankar, S. (2018). Evaluating the key performance indicators for supply chain information system implementation using IPA model. *Benchmarking: An International Journal, 25*(6), 1844-1863. https://doi.org/10.1108/bij-03-2017-0041

Garlock, T., Anderson, J., Asche, F., Smith, M., Camp, E., Chu, J., Lorenzen, K., & Vannuccini, S. (2022). Global insights on managing fishery systems for the three pillars of sustainability. *Fish and Fisheries, 23*(4), 899-909. https://doi.org/10.1111/faf.12660

Gebremedhin, S., Bruneei, S., Getahun, A., Anteneh, W., & Goethals, P. (2021). Scientific methods to understand fish population dynamics and support sustainable fisheries management. *Water, 13*(4), 574. https://doi.org/10.3390/w13040574

Ha, M. H., Yang, Z., & Lam, J. S. L. (2019). Port performance in container transport logistics: A multi-stakeholder perspective. *Transport Policy, 73*, 25-40. https://doi.org/10.1016/j.tranpol.2018.09.021

Hill, N. J., Peatman, T., Wakefield, C. B., Newman, S. J., Halafihi, T., Kinch, J., Edwards, C. T. T., Nicol, S. J., & Williams, A. J. (2018). Improving guidelines for implementing harvest strategies in capacity-limited fisheries - lessons from Tonga's deepwater line fishery. *Marine Policy, 98*, 85-91. https://doi.org/10.1016/j.marpol.2018.09.015

Hua, J., & Chen, W. (2019). Prioritizing urban rivers' ecosystem services: An importance-performance analysis. *Cities, 94*, 11-23. https://doi.org/10.1016/j.cities.2019.05.014

Hunter, W. (2011). *Fisheries management and conservation*. Florida: Apple Academic Press.

Jeffs, A., & Liyanage, S. (2005). Raw material access and sustainability as a principal driver for innovation in the New Zealand seafood industry. *International Journal of Learning and Change, 1*(1), 80-95. https://doi.org/10.1504/IJLC.2005.007999

Hua, J., & Chen, W. (2019). Prioritizing urban rivers' ecosystem services: An importance-performance analysis. *Cities, 94*, 11-23. https://doi.org/10.1016/j.cities.2019.05.014

Jiang, Y., Qu, Z., Hao, H., & Wang, S. (2024). Rethink of individual transferable quota fishery management system in China: A case study in Zhejiang Province, China. *International Journal of the Commons, 18*(1), 635-648. https://doi.org/10.5334/ijc.1338

Kindt-Larsen, L., Kirkegaard, E., & Dalskov, J. (2011). Fully documented fishery: A tool to support a catch quota management system. *ICES Journal of Marine Science, 68*(8), 1606-1610. https://doi.org/10.1093/icesjms/fsr065

Kraak, S. B. M. (2023). Evolution of EU technical measures for the avoidance of unwanted catch in the light of scientific evaluation and advice from the STECF: The good, the bad, and the ugly. *ICES Journal of Marine Science, 80*(3), 635-646. https://doi.org/10.1093/icesjms/fsac037

Kritzer, J. P. (2020). Influences of at-sea fishery monitoring on science, management, and fleet dynamics. *Aquaculture and Fisheries, 5*(3), 107-112. https://doi.org/10.1016/j.aaf.2019.11.005

Lee, P. T. W., & Hu, K. C. (2012). Evaluation of the service quality of container ports by importance-performance analysis. *International Journal of Shipping and Transport Logistics, 4*(3), 197-211. https://doi.org/10.1504/IJSTL.2012.047479

Livingston, M. E, Hurst, R. J., O'Driscoll, R. L., Mckenzie, A., Ballara, S. L., & Horn, P. L. (2015). Biology and fisheries of New Zealand hoki (*Macruronus novaezelandiae*). In: Hakes, H., & Arancibia (Eds.). *Biology and exploitation* (pp. 263-293). https://doi.org/10.1002/9781118568262.ch10

Luthfia, S.S. (2023). Mengupas tata kelola perikanan nasional melalui PP No. 11 tahun 2023 tentang penangkapan ikan terukur demi mewujudkan blue economy. *Jurnal Rechts Vinding: Media Pembinaan Hukum Nasional, 12*(3), 483-501.

Mahendra, M. O., & Djuneydi, M. (2025). Satisfaction and determinants of the decision to switch from private vehicles to commuter trains in Merak-Rangkasbitung. *UKaRsT*, *9*(1), 78-92. https://doi.org/10.30737/ukarst.v9i1.6629

Marchal, P., Andersen, J. L., Aranda, M., Fitzpatrick, M., Goti, L., Guyader, O., Haraldsson, G., Hatcher, A., Hegland, T. J., Le Floch, P., Macher, C., Malvarosa, L., Maravelias, C. D., Mardle, S., Murillas, A., Nielsen, J. R., Sabatella, R., Smith, A. D. M., Stokes, K., Thoegersen, T., & Ulrich, C. (2016). A comparative review of fisheries management experiences in the European union and in other countries worldwide: Iceland, Australia, and New Zealand. *Fish and Fisheries, 17*(3), 803-824. https://doi.org/10.1111/faf.12147

Martilla, J. A., & James, J. C. 1977. Importance-performance analysis. *Journal of Marketing, 41*(1), 77-79. https://doi.org/10.1177/002224297704100112

Malhotra, N. K., & Dash, S. (2016). *Marketing research: An applied orientation*. Delhi: Pearson India Education.

Muninggar, R., Lubis, E., Iskandar, B. H., & Haluan, J. (2016). Significant environmental aspects at Jakarta Nizam Zachman fishing port. *Marine Fisheries: Journal of Marine Fisheries Technology and Management, 7*(2), 203-210. https://doi.org/10.29244/jmf.7.2.203-210

Nur, F. S., Suadi., & Partosuwiryo, S. (2023). Enhancing fishing port services quality to support fish supply chains of the island fisheries at the Belitung Island. *Jurnal Perikanan Universitas Gadjah Mada, 25*(1), 31-40. https://doi.org/10.22146/jfs.82811

Nurlaela, E. (2023). Penangkapan ikan terukur: Tantangan dan penerapan. In: Amri, K., Latuconsina, H., & Triyanti, R. (Eds.). *Pengelolaan Sumber Daya Perikanan Laut Berkelanjutan* (pp. 267-314). Penerbit BRIN. https://doi.org/10.55981/brin.908.c759

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing, 49*(4), 41-50. https://doi.org/10.2307/1251430

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing, 64*(1), 12-40.

Pauly, D., & Zeller, D. (2016). Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining. *Nature Communications, 7*, 10244. https://doi.org/10.1038/ncomms10244

Phadermrod, B., Crowder, R., & Wills, G. (2019). Importance-performance analysis based SWOT analysis. *International Journal of Information Management, 44*, 194-203. https://doi.org/10.1016/j.ijinfomgt.2016.03.009

Phuong, T. V., & Hang, D. T. (2023). Effectiveness of vessel monitoring systems in managing and monitoring fishing vessels in Ca Mau province, Vietnam. *IOP Conference Series: Earth and Environmental Science, 1278*, 012009. https://doi.org/10.1088/1755-1315/1278/1/012009

PIPP (Pusat Informasi Pelabuhan Perikanan). (2024). *Minister of Marine Affairs and Fisheries*. Retrieved from https://pipp.kkp.go.id

Putera, I. G. S. A., Suadi, S., & Budhiyanti, S. A. (2022). User's satisfaction levels toward sadeng coastal fishing port service at gunungkidul regency. *Marine Fisheries: Journal of Marine*

Fisheries Technology and Management, 13(2), 149-160. https://doi.org/10.29244/jmf.v13i2.41020

Ramdhani, N. M., Sondita, M. F. A., & Nurani, T. W. (2022). Strategi pengembangan sistem pemantauan kuota penangkapan pada perikanan Indonesia. *Marine Fisheries, 13*(1), 15-29. https://doi.org/10.29244/jmf.v13i1.36354

Sembiring, M. G., & Rahayu, G. (2019). Verifying the moderating role of satisfaction on service quality and students' accomplishment in ODL perspective. *Asian Association of Open Universities Journal, 15*(1), 1-12. https://doi.org/10.1108/aaouj-08-2019-0035

Stanley, R. D., Olsen, N., & Fedoruk, A. (2009). Independent validation of the accuracy of yelloweye rockfish catch estimates from the Canadian groundfish integration pilot project. *Marine and Coastal Fisheries, 1*(1), 354-362. https://doi.org/10.1577/C09-005.1

Starr, P. (2010). Fisher-collected sampling data: Lessons from the New Zealand experience. *Marine and Coastal Fisheries, 2*(1), 47-59. https://doi.org/10.1577/C08-030.1

Sudjana, N. (2005). *Metode Statistika*. Bandung: Tarsito.

Sulistiyono, S., Muksin., & Iskandar, R. (2023). Measuring the customer satisfaction to improve the product quality of premium seeds produced by Bintang Asia based on the customer satisfaction index (CSI) and importance performance analysis (IPA). *E3S Web of Conferences, 454*, 03001. https://doi.org/10.1051/e3sconf/202345403001

Swink, M., & Jacobs, B. W. (2012). Six sigma adoption: operating performance impacts and contextual drivers of success. *Journal of Operations Management, 30*(6), 437-453. https://doi.org/10.1016/j.jom.2012.05.001

Syahrianda, D. A., Suadi, & Djumanto. (2025). Service excellence at sea: User satisfaction with Belawan Samudera Fishing Port, Indonesia. *Maritime Technology and Research, 7*(1), 270067. https://doi.org/10.33175/mtr.2025.270067

Thai, V. (2016) The impact of port service quality on customer satisfaction: The case of Singapore. *Maritime Economics & Logistic, 18*, 458-475. https://doi.org/10.1057/mel.2015.19

Tijan, E., Marija, J. M., Panjako, A., & Žgaljić, D. (2021). The role of port authority in port governance and port community system implementation. *Sustainability, 13*(5), 2795. https://doi.org/10.3390/su13052795

Trenggono, S. W. (2023). Penangkapan ikan terukur berbasis kuota untuk keberlanjutan sumber daya perikanan di Indonesia. *Jurnal Kelautan dan Perikanan Terapan, 1*, 1-8. http://dx.doi.org/10.15578/jkpt.v1i0.12057

Ugboma, C., Ugboma, O., & Damachi, B. (2009). A comparative assessment of service quality perspectives and satisfaction in ports: Evidence from Nigeria. *International Journal of Shipping and Transport Logistics, 1*(2), 172-193. https://doi.org/10.1504/IJSTL.2009.024494

Utami, A. R., Widigdo, B., Sulistiono, S., Samosir, A., Riani, E., & Ervinia, A. (2025). Pollution status and water carrying capacity for intensive vaname shrimp cultivation on the cilacap coast, central java. *IOP Conference Series: Earth and Environmental Science, 1508*(1), 012004. https://doi.org/10.1088/1755-1315/1508/1/012004

Utomo, P. B., Mustaruddin, Mulyono, & Muninggar, R. (2024). Measuring the fish logistics performance index in the Indonesian fisheries supply chains (a study case of Poumako fishing port of Mimika, Central Papua). *BIO Web of Conferences, 92*, 01029. https://doi.org/10.1051/bioconf/20249201029

Wicaksono, A., Yanuwiadi, B., & Dwiyanto, A. (2019). *Eco-fishing port assessment model as an environmental management tool on coastal fishing port 'Pondokdadap' - Indonesia*. In Proceedings of the 11th Asia Pacific Transportation and the Environment Conference. Atlantis Press. https://doi.org/10.2991/apte-18.2019.22

Willse, N., Ober, C., Chang, H., Harlisa, H., Ernawati, T., Kembaren, D., Szuwalski, C., Wilberg, M. J., & Kleisner, K. M. (2024). Linking crustacean life history to fishery management controls and reference points. *Fisheries Management and Ecology, 31*(4), e12691. https://doi.org/10.1111/fme.12691

Zhang, K., Li, J., Hou, G., Huang, Z., Shi, D., Chen, Z., & Qiu, Y. (2021). Length-based assessment of fish stocks in a data-poor, jointly exploited (China and Vietnam) fishing ground, Northern South China Sea. *Frontiers in Marine Science, 8*, 718052. https://doi.org/10.3389/fmars.2021.718052