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# The Effectiveness of Regulation in Improving the Fishing Port Services

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**Abstract**

Indonesia is a maritime nation with a potential economy in the fishing sector. However, the sustainability of Indonesia's fishing sector is facing many challenges, such as overfishing, illegal fishing activities, and the degradation of marine habitats. The fishing ports play a significant role in overcoming these challenges. Therefore, the government has developed several regulations to ensure the fisheries ports provide a safe and efficient way for fishing activities, an economic center for many coastal communities, and sustainable fishing operations. There is a need to assess the effectiveness of these regulations; hence, this research aims to analyze the effectiveness of regulation in improving the services in the fishing ports. The method of stratified random sampling in proportion was conducted to select 291 participants of administrative offices, fishing companies, and fisherman organizations from 6 fishing ports in east Java Province. This research used structural equation modeling (SEM) as a comprehensive approach to assessing the effectiveness of regulation in fishing ports. The result found that the regulation variable has a significant relationship with port services that = 5.099 (p<0,001). The analysis showed that the regulation variable indirectly affects the port services variable through infrastructure, economy, and social community variables (p<0,001). Furthermore, the result recommended that the regulation will enhance port services by improving the physical infrastructure of the port, boosting the local economy, and benefiting the social community. These findings have significant implications for the fishing industry, as they demonstrate the potential for regulations to improve the efficiency and sustainability of fishing port services.

**Keywords:** *Effective, Fishing port, Regulation, Structural equation modeling, Port services*

## INTRODUCTION

Indonesia's strategic geographical positioning, nestled between two oceans and sprawling across thousands of islands, has inherently made it one of the world's leading maritime nations. Its expansive coastline, which extends for more than 95,000 kilometers, is an undeniable testament to this fact [1]. Further bolstering its maritime identity is the nation's exclusive economic zone (EEZ), which sprawls across an impressive 6.1 million square kilometers, offering abundant marine resources and potential for economic growth [2]. Indonesia's identity as a maritime nation is deeply embedded in its geography, economy, and culture. The urgent and pressing need for sustainable practices in this sector is crucial for the environment and ensures long-term economic growth and food security for its ever-growing population [1]. The fishing port plays a pivotal role in ensuring optimal service activities related to fishing, and productive efficiency is assured when there is an adequate supply of fishing resources [3].

The fisheries sector stands out as one of the pillars of Indonesia's economy [4]. Contributing to approximately 10% of the nation's GDP, it underscores the profound economic importance of the sea to Indonesia [5]. Beyond the statistics, the fisheries sector is a livelihood for over 7 million Indonesians who rely on it for employment [6]. The fishermen who venture into the deep seas, the traders in bustling fish markets, and the workers in processing plants, the ripple effect of the sector is felt across various layers of the economy [7]. The importance of the fishing industry goes beyond just numbers in a nation with a strong maritime history and dependence; it also encompasses culture, tradition, and a way of life. The sea has been intertwined with the daily lives of its people, shaping their customs, folklore, and culinary habits. The fisheries make the thriving fisheries sector not just an economic asset but also a cultural treasure. However, the vastness of Indonesia's marine territory also poses management, conservation, and sustainable utilization challenges. The fisheries sector requires a significant strategy to ensure that the marine ecosystems are not overexploited and

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that future generations can also benefit from the sea [8].

The sustainability of Indonesia's fisheries sectors is facing challenges, and fishing ports play a vital role. Fishing ports are essential for the success of the fishing industry since they are hubs where fishing vessels can dock to unload their catch, refuel and resupply, and undergo maintenance and repairs. Fishing ports also provide various services to the fishing industry, where tons of fresh catch are traded, processed, and transported daily to various parts of the country. From the early morning auction to the late-night cargo shipments, the rhythm of a fishing port is ceaseless. Furthermore, fishing ports play a pivotal role in ensuring the quality and safety of seafood products. With facilities for cold storage, processing, and packaging, they help maintain the freshness of the catch, ensuring that consumers get high-quality seafood products. The government often sets up checkpoints at these ports to ensure that the net meets the standards, contributing to the health and safety of consumers.

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**MATERIAL AND METHOD**

The research aims to analyze the relationship between regulation and its impact on port services, the social community, the economy, infrastructures, and the environment using structural equation modeling (SEM) analysis. Structural equation modeling (SEM) has become a dominant multivariate method increasingly utilized in academic studies to test and evaluate multivariate causal relationships [12]. However, SEM is a statistical method used to test and validate complex relationships between variables, and it has been applied in various fields, including social sciences, economics, and engineering. Therefore, SEM can be used to analyze the relationship between regulation and its relationship to port services, the social community, the economy, infrastructures, and the environment. The research can use SEM to test and validate the complex relationships between the variables and provide insights into the impact of regulation on the different aspects of the port industry [13].

**Data Collection**

The data collection was conducted from Mei to September 2023. The research utilized survey techniques and descriptive-analytical approaches to lessen measurement [14]. The method of stratified random sampling in proportion was conducted to select 291 participants of administrative offices, fishing companies, and fisherman organizations from 6 fishing ports in east Java Province. This study incorporated both primary and secondary data [15]. A methodical questionnaire assessed the port's functions and infrastructure, while comprehensive discussions with essential contributors and regular port service users provided primary information [16]. The data was sourced from the administrative and harbor managers offices of the Marine and Fisheries Department of East Java Province, PPN Prigi, PPN Brondong, UPT Pondok Dadap, UPT Mayangan, UPT Puger, UPT Tamperan. Additional secondary information came from reports of associated fishing organizations, companies, and institutions among those fishing ports.

The assessment of the effectiveness of the regulations in enhancing port services following the method by Aini et al. [17]. The specifics are a total of 31 indicator statements (Qi) segmented into three categories: 5 indicators for port services, 5 for functional social communities, 5 for economics, 5 for infrastructure and facilities, 5 for environments, and 5 for regulations. These statements were completed by 291 participants (St), with their evaluations spanning a scale from 1 to 5 (ranging from very poor to very good) for each statement (as shown in Table 1).

**Table 1.** Measuring users' response by Likert scale

| Answer scale | Scale value |
|---|---|
| Strongly disagree | 1 |
| Disagree | 2 |
| Doubtful | 3 |
| Agree | 4 |
| Strongly agree | 5 |

Source : (21)

The research variable and detailed indicator are represented in Table 2.

**Table 2.** Instrument research

| Variable | Indicator dan Code |
|---|---|
| Economy (Eco) | Economic Growth (Eco_1) |
| | Investment (Eco_2) |
| | Job Creation (Eco_3) |
| | Trade Balance (Eco_4) |
| | Consumer Confidence (Eco_5) |
| Environmental (Env) | Sustainable Fishing (Env_1) |
| | Waste Management (Env_2) |
| | Biodiversity Protection (Env_3) |
| | Eco-friendly Infrastructure (Env_4) |
| | Habitat Protection (Env_5) |
| Infrastructure and facilities (Inf) | Standardization and Upgrades (Inf_1) |
| | Safety and Security (Inf_2) |
| | Sustainability (Inf_3) |
| | Capacity Building (Inf_4) |
| | Technological Integration (Inf_5) |
| Port services (Port) | Standard Compliance (Port_1) |
| | Safety Measures (Port_2) |
| | Efficiency (Port_3) |
| | Sustainability Services (Port_4) |
| | Technological Integration (Port_5) |
| Regulation (Reg) | Sustainability Standards (Reg_1) |
| | Safety Protocols (Reg_2) |
| | Quality Control (Reg_3) |
| | Waste Management (Reg_4) |
| | Infrastructure Standards (Reg_5) |
| | Operational Protocols (Reg_6) |

**Research site**

The research was conducted in the Marine and Fisheries Department of East Java Province and fishing ports in East Java province: PPN Prigi in Trenggalek Regency, PPN Brondong in Lamongan Regency, UPT Pondok Dadap in Malang Regency, UPT Mayangan in Probolinggo regency, UPT Puger in Jember regency, UPT Tamperan in Pacitan regency.

**SEM analysis**

There are five main steps of structural equation modeling (SEM):

1) Model specification: This step involves developing a theoretical model of the relationships between the variables of interest. The model should be based on existing research and theory, and it should be specified in terms of the hypothesized relationships between the constructs and their measures.
2) Measurement model assessment: This step involves assessing the convergent and discriminant validity of the measurement model. Concurrent validity refers to the extent to which the measures of a construct are correlated with each other. Discriminant validity

refers to the time in which the actions of one construct are not associated with the efforts of different constructs.

3) Confirmatory factor analysis: This step involves using confirmatory factor analysis (CFA) to test the measurement model. CFA is a statistical technique that allows researchers to assess the fit of their model to the data.
4) Structural model estimation: This step involves using CFA to estimate the structural model coefficients. The structural model coefficients represent the direct and indirect effects of the independent variables on the dependent variables.
5) Mediation analysis: This step involves testing for mediation effects. Mediation occurs when a third variable mediates the impact of one variable on another variable.

**Validity, reliability, and composite reliability analysis**

Construct validity refers to the extent to which a measurement tool or instrument accurately measures the construct it is intended to measure. Structural equation modeling (SEM) is a statistical method that can test the construct validity of a measurement tool or instrument. SEM can be used to develop a model that represents the hypothesized relationships between variables, and statistical techniques can be used to test the model's fit to the data. SEM can analyze observed and latent variables and incorporate measurement errors into the model. Overall, SEM is a powerful tool for studying complex relationships between variables and can provide valuable insights into the construct validity of a measurement tool or instrument [18].

Reliability is a statistical concept that refers to the consistency and stability of a measurement tool or instrument over time and across different samples. In the research context, reliability is important because it ensures that the results obtained from a study are consistent and accurate. There are various types of reliability, including internal consistency, test-retest, and inter-rater reliability. Cronbach's alpha is a commonly used measure of internal consistency reliability, which assesses the extent to which the items in a scale or instrument measure the same construct. Cronbach's alpha values range from 0 to 1, with higher values indicating greater internal consistency reliability. A Cronbach's alpha value of 0.7 or higher is generally considered acceptable for research purposes, although some researchers may prefer higher values depending on the context of their study [19].

Composite reliability (CR) is another measure commonly used in structural equation modeling (SEM). CR assesses the extent to which the latent variables in a model are reliable indicators of the underlying construct. CR values range from 0 to 1, with higher values indicating more excellent reliability. A CR value of 0.7 or higher is generally acceptable for research purposes, although some researchers may prefer higher values depending on the context of their study. In summary, both Cronbach's alpha and composite reliability are measures of reliability that assess the consistency and stability of a measurement tool or instrument. A Cronbach's alpha value of 0.7 or higher and a CR value of 0.7 or higher are generally considered acceptable for research purposes [11].

**Path analysis**

Path analysis is a statistical method used to examine the relationships between variables in a model. Path coefficients (β values) represent the strength and direction of the relationships between variables in the model. The significance levels of the path coefficients are typically obtained through bootstrapping, which involves resampling the data to estimate the sampling distribution of the path coefficients. T-values are then calculated based on the estimated sampling distribution and used to test the null hypothesis that the path coefficient is equal to zero [20].

R-squared values are used to assess the model's goodness of fit and represent the proportion of variance in the endogenous constructs explained by the exogenous constructs in the model. Effect sizes (f2 values) are used to assess the practical significance of the relationships between variables in the model and represent the proportion of variance in the endogenous constructs explained by the exogenous constructs after controlling for the effects of other variables in the model [21].

Predictive relevance is assessed using Q2 values, representing the variance proportion in the endogenous constructs the model predicts after cross-validation. Q2 values are used to evaluate the model's predictive validity and determine whether the model is likely to generalize to new samples. Overall, path analysis is a powerful tool for examining the relationships between variables in a model and can provide valuable insights into the strength and direction of these relationships and their practical and predictive significance [22]. All hypotheses were supported for H1, which posited a negative relationship between regulation perception and port service, social community, economy, infrastructure, and environment [19]. Bootstrapping was conducted with 1,000 samples, and the 95% confidence intervals for path coefficients did not include zero, confirming their statistical significance [23].

## RESULT

### General characteristics of the study

The participants were categorized into four groups: 65.3% fishing port administrators, 13.1% private sector employees, 8.9% fishers, and 15 others. Regarding work duration, 52.9% had worked 10-15 years, 30.9% had worked 5-10 years, and 12.4% had worked more than 15 years. The majority of participants were of working age. [24].

### Content validity

The SEM analyses both observed and latent variables. Based on Table 3, Cronbach's alpha values range from 0 to 1, with higher values indicating more excellent internal consistency reliability. A Cronbach's alpha value of 0.7. Generally, an α above 0.7 is acceptable, above 0.8 is good, and above 0.9 might suggest that the items are too similar and some could be redundant. The rho A value in Table 1 ranges from 0.873 to 0.906, indicating that the model was reliable. The composite reliability (CR) assesses the extent to which the latent variables in a model are reliable indicators of the underlying construct. The CR values range from 0.904 to 0.927, with values higher than 0.7 indicating greater reliability [11]. The variables in this research, as shown in Table 3, have a content validity index ranging between 0.654 and 0.705 and the scale-level content validity index/AVE > 0.50, indicating adequate content validity.

**Table 3.** Construct Reliability and Validity

| Variable | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|---|---|---|---|---|
| Economic | 0,868 | 0,873 | 0,904 | 0,654 |
| Environmental | 0,891 | 0,891 | 0,920 | 0,696 |
| Infrastructure and Facilities | 0,895 | 0,896 | 0,923 | 0,705 |
| Port Service | 0,885 | 0,885 | 0,916 | 0,685 |
| Regulation | 0,905 | 0,906 | 0,927 | 0,678 |
| Social Community | 0,881 | 0,883 | 0,913 | 0,678 |

### Structural analysis of the effective fishing port regulation model

Wicaksono et al. [25] reveal numerous strategies and methods for assessing fishing port performance, and the approach is especially relevant to the assessment model appropriate for fishing ports in Indonesia. Three distinct parts categorize the fishing port assessment model into (1) eco, (2) fishing, and (3) port. This classification is beneficial because it underscores how structures influence processes, subsequently impacting outcomes. The relationship structure set out in Figure 1 shows the following characteristics: the design includes variables that were affected by the regulation, such as social community, economic, infrastructures, port services, and environmental aspects. The process of fishing port services provided anchoring locations for fishing vessels, fish landing stations, distribution centers, and marketing [26].

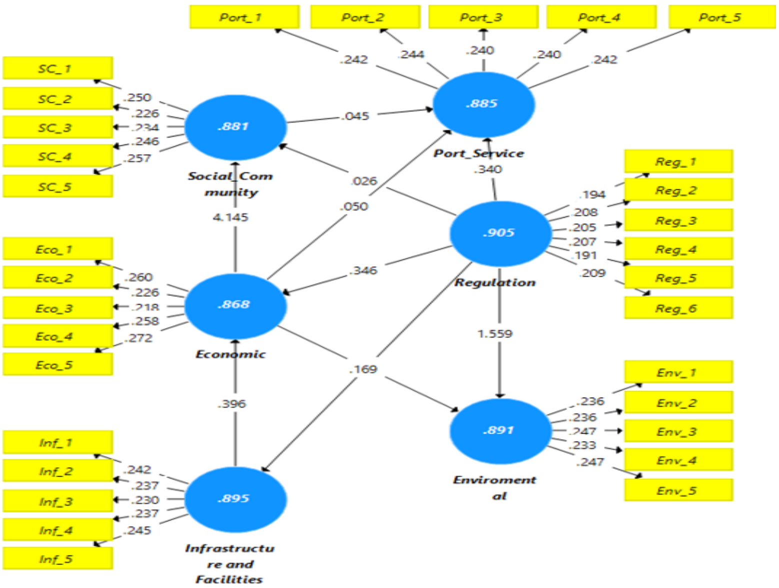


**Figure 1.** Structural model of research
Source : (result study, 2023)

**Table 4** shows the R square value of the model, which indicates the adequacy of the estimation model.

**Table 4**. R Square

| Variable | R Square |
|---|---|
| Economic | 0,634 |
| Environmental | 0,827 |
| Infrastructure and Facilities | 0,327 |
| Port Service | 0,806 |
| Social Community | 0,901 |

Source: result study, 2023

The result of the path analysis in Table 5 found that regulation has a significant relationship with port services with tstat = 5.099 ($p<0,001$).

| Variables | Standard Deviation (STDEV) | T Statistics (\|O/STDEV\|) | P Values |
|---|---|---|---|
| Economic -> Environmental | 0,059 | 4,034 | 0,000 |
| Economic -> Port_Service | 0,097 | 3,229 | 0,001 |
| Economic -> Social_Community | 0,027 | 33,677 | 0,000 |
| Infrastructure and Facilities -> Economic | 0,072 | 6,427 | 0,000 |
| Regulation -> Economic | 0,073 | 5,984 | 0,000 |
| Regulation -> Environmental | 0,056 | 13,064 | 0,000 |
| Regulation -> Infrastructure and Facilities | 0,056 | 10,205 | 0,000 |
| Regulation -> Port_Service | 0,071 | 5,099 | 0,000 |
| Regulation -> Social_Community | 0,033 | 2,118 | 0,002 |
| Social_Community -> Port_Service | 0,092 | 3,226 | 0,001 |

Source : (result study, 2023).

## DISCUSSION

The government has developed regulations to ensure sustainable fishing, protect marine ecosystems, and reduce the impacts of climate change [27]. The following research results briefly discuss the effectiveness of regulation in improving the service in fishing ports using Structural Equation Modelling (SEM) [23].

### Relationship between regulation variable and port services

Ports offer several services to ships, broadly categorized into cargo and vessel services, as outlined by Notteboom et al. [28]. In fishing ports, specific services are adapted to the handling of fishery products, encompassing tasks such as loading, unloading, and storage for the fish catch [29]; on the other hand, vessel services are dedicated to ensuring the safe and timely maneuvering and positioning of vessels, both at sea and within harbor channels. Examples of vessel services include pilotage, towage, and (un-)mooring. Nikghadan [30]. The port services in the fishing port of Indonesia were managed by the Ministry of Maritime Affairs and Fisheries (KKP).

Scholars, such as N' Souvi [31], have extensively explored both fishing handling services and vessel services in port operations, seeking to understand, measure, and enhance overall port performance. The literature underscores the significance of cooperation in improving the efficiency of ports in delivering these services [30]. However, existing research has predominantly focused on port performance among facilities, with limited attention given to the role of regulation in managing the services. Therefore, our primary focus is on the relationship between regulation and port services; it is important to briefly review relevant literature on fishing ports to elucidate the implications of regulation in enhancing port services.

The study showed a significant relationship between regulation variables and port services indicators. The regulation significantly influenced the port services, which were measured by 5 indicators: standard compliance (Port_1), safety measures (Port_2), efficiency (Port_3), sustainability services (Port_4), and technology integration (Port_5). The relationship between a regulation variable and port services is expressed briefly in Figure 2.

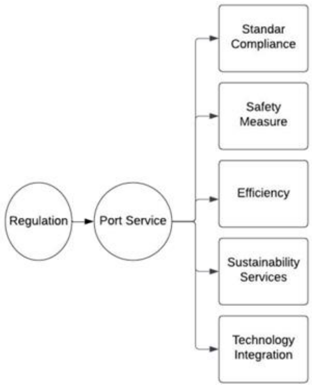


**Figure 2.** Relationship between regulation and port services.
Source: result study, 2023

Furthermore, the following discussion will explore the relationship between regulation and port services.

1. **Standard compliance (Port_1)**

The fishing port offers various services to comply with the needs of fishermen and related industries. The fishing ports are designed to facilitate various fishing activities, ranging from vessel services to fresh fish markets and storage solutions while ensuring harmony with the environment and the local community. Thus, the operation of the fishing port must be governed by regulations to ensure it functions efficiently without harming the environment. Table 5 shows a significant relationship between the regulation and port service variables. Key to this relationship are regulations that set standards for port infrastructure and various services at the port, ensuring operations are safe and efficient and covering aspects like dock construction, waste management, and the appropriate handling of catches [32].

2. **Safety measures (Port_2)**

Furthermore, regulations measure which vessels are permitted to access ports, and decisions are influenced by vessel size, equipment type, and commitment to sustainable fishing methods. This access control plays a pivotal role in averting overcapacity and guarantees that the port services serve the vessels practicing sustainable fishing. Additionally, regulations often govern the quality of services encompassing fish handling, storage, and processing. Regulation in port ensures these services are of a high standard; wastage is minimized, the quality of the catch is maintained, and the workers. Equally critical are regulations to reduce the environmental impact of illegal fishing activities. The waste management guidelines mandate preventing fuel spillages and proper waste management [33].

3. **Efficiency (Port_3).**

The immediate effect of some regulations might escalate costs due to enhanced infrastructure or practices services since the services conduct sustainable fishing and ensure a superior catch quality. The Efficiency indicator might mean more inspections, better-trained staff, and specific protocols to ensure safety and quality standards. Regulations focused on the quality of fish and seafood products can influence services like inspection, grading, and certification of catches. Some rules aim to improve the efficiency of port services by ensuring faster customs clearance services, efficient berthing practices, and timely offloading of pitfalls.

**4. Sustainability services (Port_3)**

Environmental regulations may lead to services like waste treatment and disposal, eco-friendly infrastructure, recycling facilities, and biodiversity protection in sustainable fishing practices [33]. Rules often set quotas or limits to prevent overfishing, ensuring fish stocks' long-term viability and marine ecosystems' health. Furthermore, fishing port regulations can mandate the proper disposal and treatment of waste, preventing pollutants from entering the marine environment. The regulation variable includes waste from fish processing and other operational refuse. The Regulations might restrict fishing during specific seasons to protect breeding fish or endangered species, ensuring the biodiversity of marine ecosystems [10]. The Regulations can encourage ports to adopt green infrastructure, such as renewable energy sources, rainwater harvesting, or eco-friendly building materials. Regulations might prohibit certain developments or activities in areas that are crucial habitats for marine species, like mangroves, seagrass beds, or coral reefs [9].

**5. Technology integration (Port_5).**

The most recent advancements in information technologies enable individuals engaged in interaction to collaborate within a unified information environment, ensuring shared information's currency, completeness, and coherence [34]. Regulations encouraging or mandating modern technology can influence services such as real-time catch monitoring, electronic documentation, and advanced vessel communication systems.

## CONCLUSION

This study comprehensively explains the relationships between regulation, port services, social community, infrastructure, economy, and environment. Furthermore, the regulation variable significantly improves port services by measuring standard compliance, safety measures, efficiency, sustainability services, and technology integration.

Standard compliance helps ensure that port services are provided safely, efficiently, and sustainably. Safety measures help to protect workers and the environment from harm. Efficiency measures help to reduce costs and improve the speed and quality of port services. Sustainability services help to reduce the environmental impact of port operations. Technology integration helps to enhance the efficiency and effectiveness of port services.

This study will help the researchers to determine the critical variable of services in fishing ports. Furthermore, by identifying these significant variables, the government can develop strategies to develop regulations and implement them to ensure the improvement of the port services. This research will also serve future studies aiming to understand the fishing port services and their impact on local economies and communities.

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