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Analysis of Utilization Levels of Core Facilities Supporting Fish Landing Operations at Cilacap Oceanic Fishing Port

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A B S T R A C T

Cilacap Ocean Fishing Port (COFP), the largest fishing port in Central Java, plays a crucial role in supporting large-scale capture fisheries within Indonesia's Fisheries Management Area (FMA) 573 in the Indian Ocean. Although COFP is equipped with relatively complete infrastructure, there is a mismatch between the capacity of available facilities and their actual utilization levels. Core operational facilities—such as the port basin, landing quay, and the hygienic fish auction facility (FAP)—which are expected to function optimally in facilitating the loading, unloading, and distribution of catches, instead show signs of over or under-utilization. This issue is critical as it directly impacts the economic value of fishery products and the efficiency of the overall supply chain. This study employed direct field measurements and utilization analysis, conducted in September during the peak fishing season. The results indicate that the port basin had a utilization rate of 136.12%, the landing quay 107.84%, and the hygienic FAP building only 22.17%. The basin's utilization rate exceeding 100% suggests overuse and suboptimal operational functionality. Landing quay overcapacity was primarily due to restricted maneuvering space for vessels over 30 GT. Although the FAP's utilization appears low, this does not necessarily reflect inefficiency; instead, it may be influenced by market characteristics that have shifted auction practices away from the facility. These findings underscore the urgency of physical infrastructure upgrades and/or operational system restructuring to optimize facility performance at COFP.

Keywords: Cilacap Oceanic Fishing Port, Facility Utilization Level , Fish Auction Hall, Landing Quay, Port Basin

Introduction

Cilacap Regency is one of the regions with rich and abundant fishery resources, making it highly potential for further development. Capture fisheries production in Cilacap Regency reached 26,029,000 kg with a production value of IDR 673,355,583,000, making it the second largest after Pati. The regency contributed 9.27% of the production and 15.50% of the production value of Central Java's total capture fisheries, which amounted to 280,758,000 kg valued at IDR 4,345,329,102,000 [1]. In addition, Cilacap is the leading producer of tuna and shrimp commodities in Central Java, representing a significant economic potential that needs to be strengthened to support the advancement of the regional fisheries sector. Geographically, the Cilacap Oceanic Fishing Port (COFP) is located in Tegalkamulyan Village, South Cilacap District, Cilacap Regency, Central Java Province. Astronomically, it is positioned at 09°01'18.4" E and 07°43'31.2" S, and it is the only oceanic fishing port located on the southern coast of Java, facing the Indian Ocean (FMA 573), which is known for its abundant fish resources. The port's fisheries potential includes a coastline stretching 197.4 km from the eastern coast of Jetis Village, Nusawungu District, to the western tip of Nusakambangan Island bordering West Java Province (including the Segara Anakan region). The port has a designated fishing area of 5,200 km², supports approximately 17,000 fishers, and 1,004 fishing vessels [2]. Initially established as a regular fishing port, Cilacap was upgraded to an oceanic fishing port based on the approval of the Minister of Administrative Reform through Decree Number 86/M/PAN/4/2001. COFP recorded a total fish landing volume of 19,955,120 kg, valued at IDR 594,889,050,000. Tuna (*Thunnus* spp.) is the dominant commodity, accounting for 8,846,920 kg or 44.33% of the total production [3]. The high volume of tuna production has expanded the marketing area, including distribution to Jakarta and exports to Japan.

The growth of fishing activities at COFP can be seen from the average annual increase in marine fisheries production of 7.96% during the 2018–2022 period. This production can be further increased by developing the fishing fleet, improving exploitation management, and adopting better technology—while maintaining sustainability. This is particularly important considering that the fishing fleet at COFP is dominated by large vessels of 21–30 GT, with a total of 476 units [3]. The variation in vessel sizes affects the demand for port facilities. Existing port infrastructure—including basic, functional, and supporting facilities—must be able to accommodate fishing vessel operations both during landing (for auction and marketing) and departure (for fishing). Future development of the fisheries sector is highly dependent on the capacity and quality of these facilities. Therefore, an evaluation of existing facilities and services is essential to determine the development strategies needed to improve productivity efficiency at COFP and support the growth of the marine fisheries sub-sector.

The facilities available at COFP are utilized to support various operational needs of fishers and fishing vessels, both before, during, and after going to sea. These include port basins, landing quay, fish auction halls (FAP), cold storage, fuel stations, ship repair facilities (dockyards), and administrative services provided by the port authority (*syahbandar*). The presence of these facilities enhances the efficiency of the fishery supply chain, optimizes fleet operations, and supports the economic activities of coastal communities in Cilacap Regency. Optimizing the utilization of port facilities is a key factor in ensuring the sustainability of capture fisheries and improving the welfare of fisheries business stakeholders. Additionally, calculating the utilization rate of facilities serves to determine whether existing infrastructure at COFP needs to be expanded, further developed, or is already adequate to accommodate current and future port activities as part of the port development efforts.

This study focuses on the utilization of the main physical components of the Cilacap Oceanic Fishing Port (COFP) that directly support fishing vessel operations, namely the port basin area, landing quay length, and the area of the fish auction hall (FAP). These three components were selected as they are the most relevant and quantifiable indicators for assessing the extent of port facility usage by the fishing fleet. By limiting the analysis to these facilities, the study aims to assess the effectiveness of port capacity and service functions in supporting capture fisheries activities at COFP. The existing facilities in most fishing ports remain limited in terms of availability, completeness, and capacity. Facility capacity refers to the ratio between installed capacity and its actual utilization, indicating whether the facilities are underutilized, adequately used, or have exceeded their capacity. The completeness of facilities refers to whether the current infrastructure meets, fails to meet, or exceeds the operational needs. Facility analysis can also be conducted by evaluating the layout, i.e., whether it supports, somewhat supports, or does not support the efficiency and effectiveness of activities at the fishing port. Capacity is defined as the limiting ability of a production unit to operate within a certain timeframe, usually expressed in terms of output per unit of time [4]. Capacity planning involves the following steps [5]:

- Forecasting future demand, including the potential impact of competing technologies, and other factors.
- Translating the forecast into physical requirements.
- Developing capacity planning options based on the identified requirements.
- Analyzing economic factors that may influence the selection of a plan.
- Evaluating risks and strategic factors related to each option.
- Making a final decision on the selected plan.

Methods

The material substance of this research is the fisheries facilities at the Cilacap Oceanic Fishing Port. Specifically, the focus is on the utilization level of the port's fishery facilities, including the port basin, landing quay, and the Hygienic Fish Auction Place (FAP). This research was conducted from September to November 2024 using a descriptive method, involving direct observation at COFP and the collection of both primary and secondary data. The descriptive method aims to portray problems as they are. It is a method used to investigate a group of people, objects, a set of conditions, or even a class of events in the present. The purpose of descriptive research is to systematically, factually, and accurately describe the characteristics, facts, and relationships among phenomena [6].

The observations and measurements conducted include:

- Mooring or catch landing activities;
- Marketing or distribution of catches at the Fish Auction Place (FAP);
- Supply distribution activities; and
- The availability and condition of port facilities at PPS Cilacap.

Measurements of port facilities were carried out using a measuring device to determine:

- The area of the port basin at Cilacap Oceanic Fishing Port (COFP);
- The length of the landing quay at COFP; and
- The area of the auction building at COFP.

The data used in this study include both primary and secondary data. Primary data were obtained through direct observation and measurement of the facilities. The observation method was employed to obtain primary data related to the condition of COFP's facilities, operational performance, and port activities. Primary data refer to information collected directly in the field by reviewing the main, functional, and supporting facilities of PPS Cilacap. Secondary data were obtained from records and documents provided by COFP, especially from the One-Stop Integrated Service (OSIS).

Table 1 - Data Collected in the Research

Num.	Data Type	Data	Data Source	Data Collection Method
1.	Primary	- Condition of COFP facilities - Characteristics of the capture fisheries fleet	Direct observation and measurement	Direct observation and measurement
2.	Secondary	- Size, type, and number of fishing vessels in the working area COFP - Safe distance between fishing vessels in the port basin and at the landing quay - Daily production volume of catches - Capacity and dimensions of facilities at COFP - Utilization level of COFP facilities	OSIS of COFP, head of the syahbandar work team, and head of the port pperations work team	Documentation

The method used for facility utilization analysis is a calculation approach based on [7]. Facilities with a defined capacity can have their utilization rate calculated using the following formula:

$$\text{Facility Utilization Rate (\%)} = \frac{\text{Facility Usage}}{\text{Facility Capacity}} \times 100\% \quad (1)$$

The utilization rate is categorized as follows:

- Utilization percentage > 100%: Facility utilization exceeds optimal conditions.
- Utilization percentage = 100%: Facility utilization reaches optimal conditions.
- Utilization percentage < 100%: Facility utilization has not yet reached optimal conditions.

Further classify the level of facility utilization based on its intensity [8]. A utilization rate of:

- 0 – 40% indicates very low utilization;
- 40.01 – 75% indicates moderate utilization; and
- 75.01 – 100% indicates optimal utilization.

To determine the utilization rate and the capacity of each port facility, the following formulas are used [9]:

1) Port Basin

To calculate the required area of the port basin:

$$L = Lt + (3n \times l \times b) \quad (2)$$

Where:

L = Port basin area (m²)

Lt = Turning area for vessels ("πr²"; m²)

3 = Constant

n = Maximum number of vessels at anchor (units)

l = Average vessel length (m)

b = Average vessel width (m)

2) Landing Quay Length

To calculate the required dock length:

$$L = \frac{(l + s)\, n \times a \times h}{u \times d} \quad (3)$$

Where:

L = Landing quay length (m)

l = Average vessel length (m)

s = Distance between vessels (m)

n = Average number of vessels using the landing quay per day

a = Average vessel weight (tons)

h = Average landing duration (hours)

u = Fish production per day (tons)

d = Average fishing trip duration (hours)

3) Auction Hall Area

To determine the required area of the auction hall:

$$S = \frac{N \times P}{r \times a} \quad (4)$$

Where:

S = Auction hall area (m^2)

N = Average daily production (tons)

P = Space requirement per ton (m^2/ton)

r = Auction frequency per day

a = Ratio of auction space to total building area

The calculations above are used to determine the required usage of each facility, while facility capacity figures are obtained from existing data or as stated in the annual report of Cilacap Oceanic Fishing Port. Facility utilization is measured by comparing the actual usage of a facility with its available capacity, then multiplying the result by 100%. The purpose of this calculation is to determine whether the existing facilities need to be expanded, redeveloped, or are already adequate to support current activities. For facilities with undefined capacity, the utilization rate may be estimated subjectively [10].

Results and Discussion

Fisheries Conditions at COFP

Cilacap Oceanic Fishing Port is geographically located in Tegalkamulyan Village, South Cilacap District, Cilacap Regency, Central Java Province, at coordinates 109º 01' 18.4" E and 07º 43' 31.2" S, with a total area of 30.7 hectares. It is the only Oceanic Fishing Port situated on the southern coast of Java, directly facing the Indian Ocean (WPP 573), which is known for its abundant fishery resources. The port has a coastline length of 197.4 km, stretching from the eastern coast of Jetis Village, Nusawungu District, to the western tip of Nusakambangan Island, which borders West Java Province (including the Segara Anakan area). The estimated area of coastal fishing grounds is approximately 5,200 km^2, with a fishing workforce of around 17,000 people.

The geographical boundaries of the Cilacap Oceanic Fishing Port are as follows:

North : Banyumas Regency

East : Indian Ocean

South : Indian Ocean

West : Kedungreja Subdistrict and part of Adipala Subdistrict

The operational activities at the Cilacap Oceanic Fishing Port cover a wide range of aspects, both those managed directly by the port authority and those operated by external institutions within the port area. The vision of the port aims to optimize the implementation of its main duties and functions by providing high-quality services, serving as a reference, and offering inspiration and motivation for improved port performance. In line with the objectives of capture fisheries development, the port seeks to achieve the following goals:

- To increase the production and productivity of capture fisheries through sustainable fish resource management;
- To improve the welfare of fishermen.

The strategic targets for enhancing the port's operations through the construction, development, and maintenance of infrastructure are supported by efforts to improve the quality of human resources at the port. These strategic targets include:

- Increasing fishermen's income at Cilacap Oceanic Fishing Port;

- Improving the economic performance of the capture fisheries sector;
- Enhancing the management of capture fisheries resources;
- Increasing capture fisheries production;
- Upgrading port facilities;
- Promoting competitive and sustainable port management;
- Strengthening the competitiveness of fishing vessel crews;
- Ensuring proper licensing management in accordance with applicable regulations;
- Achieving good governance within the port's operations.

The average daily fish production at COFP is 70.90 tons, as detailed in Table 2.

Table 2 - Fishery Production at Cilacap Oceanic Fishing Port, 2023

Month	Total Production (Tons)
January	790.41
February	535.41
March	1,083.65
April	1,724.61
May	898.11
June	2,839.63
July	2,699.41
August	2,902.60
September	3,261.24
October	3,493.88
November	3,009.84
Desember	2,640.86
Total	25,879.65

Source: [11]

The frequency of fishing vessel visits is presented in table 3. The total number of vessel arrivals in 2023 was 24,922, with a daily average of approximately 68 visits.

Table 3 - Frequency of Fishing Vessel Arrivals at COFP, 2023

Month	Number of Ship Arrivals
January	1,969
February	1,881
March	1,779
April	1,556
May	2,331
June	2,132
July	1,902
Agustus	2,626
September	2,351

October	2,372
November	2,097
Desember	1,926
Total	24,922

Source: [11]

Based on fisheries production data in 2023, the total catch at the Cilacap Oceanic Fishing Port (COFP) reached 25,879.65 tons, with a daily average of approximately 70.90 tons. Meanwhile, the number of vessel visits throughout the year was recorded at 24,922, averaging around 68 visits per day. These figures indicate a high intensity of vessel operations and catch distribution activities at the port. The high frequency of vessel visits necessitates the availability of adequate port basin and quay facilities to ensure that mooring and unloading processes can be carried out efficiently. By applying the formula for estimating the required port basin area and quay length—based on the average vessel length, maximum number of moored vessels, average mooring time, and daily production volume as used in this study—the ideal capacity of these facilities can be quantitatively assessed. Furthermore, considering the daily production volume, the capacity and utilization of the Fish Auction Place (FAP) are also critical. With a daily catch averaging nearly 71 tons, the hygienic FAP area must be adjusted according to the distribution rotation ratio and the required space per ton, as explained in the calculation of FAP facility requirements. If the auction area is undersized or if the rotation of catch distribution is inefficient, it may result in fish accumulation, prolonged distribution times, and a subsequent decline in the quality and market value of the catch. Research on the Kutaraja International Fishing Port revealed that inadequate dock facilities led to long vessel queues, causing delays in unloading catches. Such delays can result in fish spoilage, reducing the quality and market value of the catch. This underscores the importance of aligning facility capacity with operational demands to ensure efficient port operations [12].

Facilities of Cilacap Oceanic Fishing Port

The port facilities at Cilacap Oceanic Fishing Port (COFP) are categorized into three groups: primary, functional, and supporting facilities. Primary facilities refer to basic infrastructure that supports operational activities at the fishing port and are considered the main infrastructure components. These facilities are essential to ensure the safety and smooth movement of vessels when entering, exiting, and berthing within the port area. Functional facilities serve to enhance the utility of the primary facilities and are often referred to as superstructure components. These facilities play a role in supporting the development of capture fisheries activities at the fishing port. Supporting facilities are secondary in nature, indirectly contributing to the port's function and providing convenience for users in conducting various activities within the fishing port area [13].

The current port basin capacity at COFP exceeds 6,000 GT, while the total vessel gross tonnage amounts to 12,674 GT. During bad weather conditions, nearly 90% of the fleet (10,977 GT) typically remains in port. The port basin has a depth of -3 meters, which poses challenges, especially for vessels above 60 GT, in maneuvering, entering, and berthing during low tide conditions. The Fish Auction Place (FAP) facility located at Wharf 3 of COFP is not yet fully functional. Regular fish auctions are not conducted at the port because its primary commodities consist of large pelagic species such as tuna (Thunnus spp.) and skipjack (Katsuwonus pelamis). Landed fish at COFP are distributed to different destinations based on species type. Skipjack (Katsuwonus pelamis) and marlin (Makaira indica) are commonly shipped to Jakarta in frozen or fresh form, while fresh tuna is partially exported to Japan. Approximately 5% of the landed catch is allocated to local markets in Central Java, 25% to East Java, and 65% to Jakarta. Further details regarding existing facilities at COFP and their utilization status in the field can be seen in Table 4.

Table 4 - Facilities of Cilacap Oceanic Fishing Port (COFP)

No.	Facility	Size	Condition	Utilization
A. Basic Facilities				
1.	Port Land	Management Right (Industrial Plot) = 12.73 ha; Usage Right = 18.05 ha	Land Reorganization Needed	Utilized
2.	Breakwater	North Side = 760 m; South Side = 371 m	Good	Utilized
3.	Port Basin	Basin A = 3.6 ha; Basin B = 7.4 ha; Basin C = 4.5 ha; Depth = -0.5 to -3 LWS	Expansion Needed	Utilized
4.	Navigation Channel	Length = 760 m; Width = 90 to 110 m; Depth = -2 to -4 LWS	Good	Utilized
5.	Quay	Reporting Quay = 240 m²; Quay A = 171 m² (3 units); Quay B: Quay 1 = 171.2 m² (2 units), Quay 2 = 106.38 m² (8 units);	Poorly Maintained	Utilized

No.	Facility	Size	Condition	Utilization
		Quay C: Quay 1 = 240 m², Quay 2 = 120 m², Quay 3 = 250 m²		
6.	Internal Road	16,565 m²	Good	Utilized
7.	Drainage	3,765 m	Good	Utilized
8.	Revetment	Basin A = 2,528 m; Basin B = 1,120 m; Basin C = 289 m	Repair Needed	Utilized
9.	Bridge	30 m	Good	Utilized
B. Functional Facilities				
1.	Administration Office	940 m²	Good	Utilized
2.	Meeting Hall	540 m²	Good	Utilized
3.	Auction Building	Unloading Hall = 420 m²; Marketing Center = 1,024 m²	Good	Utilized
4.	Fisheries Supervision Office	200 m²	Good	Utilized
5.	Clean Water Installation	90 m³ or 12 L/sec	Good	Utilized
6.	Electricity Installation	457 kVA (3 Units)	Good	Utilized
7.	Generator Set	100 kVA and 125 kVA	Good	Utilized
8.	Navigation Lights	White = 12 miles; Green = 8 miles; Red = 8 miles	Good	Utilized
9.	Refrigerated Trucks	2 Units	Good	Utilized
10.	Wastewater Treatment Plant (WWTP)	140 m³	Repair Needed	Not Utilized
11.	Docking	5 Rails up to 200 GT	Good	Utilized
12.	Workshop	New = 75 m²; Old = 100 m²	Good	Utilized
13.	Fuel Station	SPBU Tank = 95 KL; SPDN Tank = 16 KL	Good	Utilized
14.	Cold Storage	22 Units	Good	Utilized
C. Supporting Facilities				
1.	Fishermen’s Meeting Hall	400 m²	Repair Needed	Not Utilized
2.	Fishermen Shelter	120 m²	Repair Needed	Utilized
3.	Cooperative Store	1,008 m²	Good	Utilized
4.	Prayer Rooms	Auction Hall = 16 m²; Office = 49 m²	Good	Utilized
5.	Business Central Building	190 m²	Repair Needed	Not Utilized

No.	Facility	Size	Condition	Utilization
6.	Fish Processing Facility	644 m²	Good	Utilized
7.	Fish Drying Facility	1,036.8 m²	Good	Utilized
8.	Coastal Kiosk	135 m²	Good	Utilized
9.	Truck Crane	1 Unit	Good	Utilized
10.	Dump Truck	3 Units	Good	Utilized
11.	Public Toilets	66 m²	Good	Utilized
12.	Guest House	124 m²	Good	Utilized
13.	Processing Equipment and Packaging House	1 Unit	Good	Utilized
14.	Security Post	64 m²	Good	Utilized

Source: [11]

To support port operational activities, a fishing port must be equipped with adequate facilities that meet the needs of fishers. In terms of overall port infrastructure, the Cilacap Oceanic Fishing Port (COFP) currently possesses sufficient capacity to support its operational functions. If the facilities or infrastructure of a fishing port are damaged, such conditions can negatively impact port operations. Without appropriate follow-up and maintenance, these deficiencies may disrupt vessel activities within the port. Therefore, evaluating and developing port infrastructure is essential to optimize utility and improve service delivery for the community [14]. COFP, as a Class A fishing port, is primarily designed to serve fishing vessels larger than 60 gross tons (GT) and offshore fishing operations, with landed catches predominantly intended for export markets. The fish auction facility, which operates within the port, is managed by the Mino Saroyo Fisheries Cooperative (KUD Mino Saroyo). Auctions are held biweekly or according to the availability and type of landed fish commodities. The primary marine product auctioned at the FAP of COFP is shrimp. Most buyers are large-scale middlemen targeting international markets, and the auction system employed is an open-bidding format. The suboptimal utilization of the FAP facility at the fishing port is largely attributed to natural factors, such as extreme weather conditions that affect the volume of fish landings. Additionally, many fishers tend to sell their catch directly to agents or traders without going through the FAP, which further contributes to underutilization. This behavior increases the risk of the FAP becoming inactive or functionally ineffective due to the absence of fish supply from fishers [15]. One critical issue faced by COFP is sedimentation caused by material carried by currents from the Kali Yasa River, resulting in the gradual shallowing of port waters. Regular dredging is essential and non-negotiable to address this problem. Based on port authority calculations, approximately 7% (equivalent to around 2 hectares) of the port's land area remains underutilized. Part of this land has been designated for the development of fishery-related industries. COFP faces the Indian Ocean directly, which increases the rate of sedimentation due to strong ocean currents. Severe sedimentation hampers vessel mooring, leading to delays and inefficiencies in fish landing operations. Since its inauguration in 1994, sedimentation in COFP has progressed rapidly, as evidenced by a sounding survey conducted in 1997. Consequently, increasing the capacity of the port basin is considered a viable alternative to effectively address the issue of sediment accumulation [16].

Utilization Rate of Cilacap Oceanic Fishing Port Facilities

The calculation of utilization rates is necessary to assess the extent of optimization and the effective use of the existing facilities at the Cilacap Oceanic Fishing Port (COFP). This calculation also serves to determine whether additional or improved facilities are required to accommodate greater port activities. However, among all the facilities, only three have been analyzed for their utilization rates: the port basin area, the length of the quay, and the fish marketing facility. A detailed analysis of the utilization rates for each of these facilities is provided in Table 5.

Table 5 - Utilization Rate of the Cilacap Oceanic Fishing Port Facilities

Num.	Facility Type	Unit	Facility Capacity	Facility Usage	Utilization Rate (%)	Category
1.	Port Basin					
a.	Basin Area	m²	155,000	210,995.12	136.12	Exceeds Optimal Condition
b.	Vessel Capacity	Vessel Units	410	757	184.63	Exceeds Optimal condition
2.	Quay Length					

a.	Length	m	678	732.58	107.92	Exceeds Optimal Condition
b.	Vessel Capacity	Vessel Units	357	385	107.84	Exceeds Optimal Condition
3.	Hygienic Fish Auction Facility	m²	1,024	227.06	22.17	Suboptimal

1) Port Basin

The port basin functions as a space to accommodate vessels entering the port, where it serves as an area for maneuvering vessels and conducting various activities. The Cilacap Oceanic Fishing Port (COFP) is equipped with a port basin covering an area of 15.5 hectares, with a depth ranging from -1 to -3 meters below Low Water Spring (LWS). The results of the port basin facility needs calculation indicate that the required basin area, based on the latest data, is 210,955.12 m² or 21.1 hectares, with a vessel capacity of 410 units. This data is then assumed to reflect the facility usage for calculating the utilization rate of the facility. The calculation results show that the utilization rate of the port basin area is 136.12%, while the basin's vessel capacity utilization is 184.63%. Both of these utilization conditions fall under the category of overutilization. This can be interpreted to mean that the current condition of the port basin is no longer optimal. A value greater than 100% reflects overcapacity, rather than simply high efficiency. The facility utilization figures above are not based on peak season calculations. During peak seasons, it is possible that the COFP port basin can accommodate more fishing vessels.

Fishing Season Index (FSI) in the Indonesian Fisheries Management Area (FMA) 573, report that from 2013 to 2016, the peak fishing season for madidihang tuna occurred from January to February and May to July. The intermediate season occurred from March to April and August to November, while the lean season occurred in December [17]. The proximity of the Cilacap Oceanic Fishing Port Basin B to the hygienic fish auction facility causes the basin to be used for landing high-value fish species such as tuna, with peak fishing seasons occurring from January to February and May to July, with the highest peak in June. The intermediate season is from March to April and August to November, and the lean season occurs in December [18]. The Fishing Season Index (FSI) for yellowfin tuna (*Thunnus albacares*) in FMA 573 over the 2018–2022 period shows that the peak season for yellowfin tuna occurs from April to July, albacore tuna (*Thunnus alalunga*) from June to October, bigeye tuna (*Thunnus obesus*) from April to July, baby tuna from December to April, skipjack tuna (*Katsuwonus pelamis*) from February, May to August, and November, while the peak season for frigate tuna (*Auxis thazard*) occurs in February, June, August, and October. A decrease in fish catch production is observed during the western monsoon (December to February) due to unfavorable weather conditions. The differences in fishing season patterns are likely influenced by climate change factors [19]. The peak fishing season for sailfish in the Cilacap waters and surrounding areas occurs from April to November. This period corresponds to the eastern monsoon, characterized by calm waters and moderate winds. This season is ideal for fishermen to engage in fishing activities [20]. The Fishery Season Index (FSI) is calculated using the moving average method. The shrimp fishing season at the Cilacap Oceanic Fishing Port (COFP) occurs over five months: June, September, October, November, and December. In general, there are four seasonal groups based on the wind direction in Indonesia: the western monsoon (December, January, February), first transition season (March, April, May), eastern monsoon (June, July, August), and second transition season (September, October, November) [21].

2) Quay Length

The Cilacap Oceanic Fishing Port (COFP) has four quay locations with a total length of 678.8 meters. These quays are directly connected to the port basin. In practice, Quay I is located on the Kaliyasa River and is typically used for vessels under 10 GT for loading and unloading activities. Quay II at COFP is situated near the hygienic fish auction facility and accommodates a significant number of vessels. Activities conducted at Quay II include unloading, resupplying for fishing trips, docking for maintenance and repairs, and vessels managing their sailing permits. Meanwhile, Quay III is used for unloading and loading activities of vessels greater than 20 GT, and the final quay, located next to the Integrated One-Stop Service (PTSA) office, is used for reporting and is frequently used by motor vessels for anchoring. The reporting quay at Quay II is predominantly used by local fishermen with tremmel nets and shrimp catch, engaging in one-day fishing trips.

The utilization rate of the quay at the Cilacap Oceanic Fishing Port (COFP) has reached 108%, indicating an overload condition or exceeding the optimal capacity that the quay facilities are designed to accommodate. This figure not only reflects the high number of vessels docking, but also illustrates inefficient docking patterns, where vessels often dock in multiple layers (double layer) along the quay. This issue arises because the number of vessels performing unloading activities at COFP, especially during the intermediate season such as in September, exceeds the actual quay capacity. With the limited quay length and the absence of quay function separation based on vessel types or commodities, all types of vessels—both large-scale fishing vessels and small local fishing boats—access the same area simultaneously, leading to high congestion, long docking queues, and reduced operational efficiency at the quay. The prolonged docking time, which is disproportionate to the unloading process speed, exacerbates congestion. Many vessels wait for their turn to unload or for access to the FAP gate, resulting in longer dwell times than necessary. This directly impacts the increase in utilization values, as these vessels continue to occupy quay space even though they are not actively engaged in productive activities.

The quay facility utilization rate at the Nusantara Fishing Port (PPN) Pelabuhanratu has been greater than 100% over the past five years, indicating that the facility's capacity exceeds the ideal condition. Therefore, facility capacity needs to be increased. If the capacity is limited, unloading activities may be hindered, and the quality of fish catches may decline. The quay utilization rate is related to its function as a place for unloading catch, loading and unloading operations, as well as a docking and mooring area for fishing vessels. The quay capacity at a fishing port influences the allocation of measured

fish catch quotas, in line with Article 9 of the Minister of Maritime Affairs and Fisheries Regulation No. 28 of 2023, which states that the distribution of the fish catch quota considers the capacity of the base port. A similarly high quay utilization rate also occurs at the Kwadang PPN, with utilization reaching 392%, indicating that it has surpassed its optimal utilization limits. The high activity levels at the quay, when compared to the small quay size, result in vessel congestion. This vessel congestion leads to a quay utilization rate exceeding 100% [22].

3) FAP

The fish auction hall is an essential facility that must be available at a fishing port. The Cilacap Oceanic Fishing Port (COFP) has a hygienic FAP with an area of 1,024 m². This building is provided to facilitate the regular and documented distribution and marketing of fish catch. The existence of the FAP not only supports economic aspects but also plays a crucial role in quality control, production statistics recording, and serves as a source of regional income. The effectiveness of this facility is highly dependent on its utilization by service users, particularly fishermen and business operators. The hygienic FAP at COFP does not implement an auction system, but it still performs the distribution function of the fish catch through a direct selling system. In this case, parameter R (activity frequency) refers to the number of transaction rotations or the use of the production space per day. Therefore, the calculation of the production space capacity (P) can still be performed using the same formula, adjusted for the functional context of the space. The unloading and loading times at the FAP COFP are from 07:30 Western Indonesian Time (WIB) to 22:00 WIB, with a total of 3 gates as access control from the quay to the FAP building. Gate 1 is used for frozen fish and exports, gate 2 serves as a backup, and gate 3 is designated for fish such as skipjack, mackerel, squid, and other fish species. The average unloading time for vessels ranging from 10 to 30 GT is 2.29 hours, and for vessels over 30 GT, it takes approximately 2.60 to 3 hours, the unloading rotation occurs 8 to 15 times per day [23].

The value of 22.17% indicates the utilization ratio of the hygienic FAP COFP relative to the total area of the FAP building that is actually used for fish catch distribution activities. This utilization rate suggests that the FAP building is underutilized, not due to a lack of activity, but rather due to the shifting functions and transaction systems. The strategy needed for the management of the FAP at the Cilacap Oceanic Fishing Port (COFP) includes reorganizing the unloading process at the quay and developing facilities outside the FAP building, such as the unloading quay. Although the utilization rate of 22.17% of the hygienic FAP COFP's area based on daily volume and capacity may appear low, it does not necessarily imply underperformance. Several factors influence this value, such as market characteristics. The main fish catch commodities at the hygienic FAP COFP are tuna and mackerel, which generally have regular buyers or direct contracts. This means that transactions do not take place within the FAP, but rather through direct loading into company cold storage or transport vehicles. In the context of operations and a non-auction business model, this utilization rate remains within a reasonable range and does not fully indicate underutilization. This implies that as long as the distribution process remains efficient and does not disrupt port circulation, expanding the FAP building is not a top priority. Expanding the FAP at COFP does not necessarily solve the apparent low utilization issue. More relevant strategies, such as reorganizing the FAP layout to make certain areas more flexible for grading or initial handling of catches, should be considered. The FAP at the PPS Kendari is merely used as a fish landing site and does not conduct fish auctions as intended. Fish landed by fishermen are directly supplied to fish processing companies around the port. Most vessel owners have their own agreements or contracts with fish processing industry entrepreneurs at the port, and some fishermen also have their own buyers for selling their catch. As a result, the FAP at PPS Kendari is only used for weighing the catch and marketing it. From this fact, it can be concluded that the FAP facility utilization rate at PPS Kendari is 114% [24].

Conclusion

Based on the analysis of existing infrastructure conditions at the Cilacap Oceanic Fishing Port (COFP), the utilization rates for the port basin area and capacity were found to be 136.12% and 184.63%, respectively, indicating significant overutilization beyond optimal thresholds. The quay length showed a utilization rate of 108%, likewise exceeding optimal capacity. In contrast, the Fish Auction Place (FAP) recorded a utilization rate of only 22.17%, reflecting underutilization. The high utilization rates, particularly for the port basin and quay, suggest the occurrence of vessel congestion, which may discourage potential port visits and reduce the volume of landed catches at the COFP. These findings highlight the urgent need for capacity adjustments to port infrastructure, particularly to support the operational demands of vessels exceeding 30 GT. Enhancing infrastructure efficiency is essential to improve traffic flow, reduce operational bottlenecks, and preserve the quality of high-value fish commodities, such as tuna.

Suggestions

In order to support the development of the Cilacap Oceanic Fishing Port (COFP), close collaboration between port authorities, relevant agencies such as the Ministry of Marine Affairs and Fisheries, the Regional Office of Marine Affairs and Fisheries, as well as other stakeholders, is essential. This collaboration is crucial to ensure that the proposed development strategies are effective and meet the operational needs of the port, particularly in enhancing the capacity and efficiency of existing facilities. Based on the findings of this study, several strategic recommendations for advancing COFP and strengthening the fisheries sector in the Cilacap region include the expansion of the port basin capacity and quay length to accommodate larger vessels and reduce queuing times, particularly for vessels larger than 30 GT. This involves dredging the port basin to appropriate depths and extending the quay according to the projected increase in vessel traffic. In addition to infrastructure expansion and modernization, evaluating the spatial planning and operational management of the Fish Auction Place (FAP) to improve utilization is also necessary, especially for high-value species such as tuna, by enhancing hygienic standards and market segmentation. Furthermore, increased investment in critical infrastructure through national development programs or public-private partnerships is needed. Additionally, it is important to review and revise relevant regulations that may hinder the smooth operation of the port or infrastructure development. Finally, integrating sustainability principles and resilience planning into the development strategy, such as green port initiatives, is essential to support long-term fisheries productivity and coastal ecosystem health.

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