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Analysis of clean water demand at the Kutaraja Fishing Port (PPS Kutaraja) Lampulo Banda Aceh

Iwan Musawir[1], Makwiyah A. Chaliluddin[2,3,*], Muhammad Rusdi[4], Aprianty[5]

[1]*Master Study Program, Integrated Coastal Resource Management, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[2]*Fishing Technology Laboratory, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[3]*Fishery Resources Utilization Department, Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[4]*Faculty of Agriculture, Universitas Syiah Kuala, Banda Aceh, Indonesia.*
[5]*Faculty of Science and Technology ,Universitas Al Washliyah Darussalam, Banda Aceh, Indonesia.*

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ABSTRACT

The Kutaraja Fishing Port (PPS Kutaraja) serves as a central hub for the fisheries sector in Aceh Province. Clean water is one of the essential facilities that plays a vital role in supporting port activities. If issues related to clean water supply are not addressed, they are predicted to affect fish quality, reduce user confidence in PPS services, and hinder operations at the port.This study aims to determine the level of clean water demand at PPS Kutaraja, Lampulo, Banda Aceh. The research was conducted from October to November 2024. The method used was a survey approach with purposive sampling techniques. Data analysis employed a quantitative descriptive method by calculating the total clean water demand, which includes clean water needs for fishing activities at sea, for ice factories, and for office use. The results of the analysis showed that the total clean water demand at PPS Kutaraja is 163,522 liters/day, clean water demand for fishing activity is 18,142 liters/day, ice plant requirement is 144,000 liters/day, and office use is 1,380 liters/day. Based on interviews and field observations, fishermen individualy need to purchase clean water from tank trucks agents. Therefore, a strategic policy is needed for clean water management at PPS Kutaraja.

Introduction

A fishing port serves as a docking area for vessels, a site for fish landing, and a hub for facilitating fishing operations, marketing, and the development of fishermen. To maximize this potential, the development of fishing ports aimed at exploring marine fisheries resources will drive regional economic growth, particularly in sectors related to the fisheries and marine industries (Anggawangsa *et al.*, 2022). The presence of a fishing port in a region should be able to stimulate other economic activities, thereby positioning the fishing port as a central hub for the development of the fisheries industry (Arif *et al.*, 2020).

Kutaraja Fishing Port (PPS Kutaraja), the largest fishing port in Aceh is categorized in Class A fishing port. In 2016, the Kutaraja Coastal Fishing Port was upgraded from a class C to a class A fishing port. Later, in 2018, the port's name was officially changed from Lampulo Fishing Port to Kutaraja Fishing Port (Ahadi, 2016; Fajri *et al.*, 2018; Chaliluddin *et al.*, 2019; Sari *et al.*, 2019; Husen *et al.*, 2022). Kutaraja Fishing Port (PPS Kutaraja) serves as the central hub for the fisheries sector in Aceh Province (Aprianty *et al.*, 2019; Salmarika *et al.*, 2019). The Aceh Government has designated Kutaraja Fishing Port (PPS Kutaraja) as one of the economic centers of Aceh (Sahnia *et al.*, 2024).

* Corresponding author.
Email address: chaliluddin@usk.ac.id

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The Lampulo Fishing Port (PPS Lampulo) in Banda Aceh is geographically located at 05°57'63" N and 95°32'30" E. Operationally, it is managed as one of the Technical Implementation Units (UPTD) under the Aceh Marine and Fisheries Office (Rahmah *et al.*, 2018).

Kutaraja Fishing Port (PPS Kutaraja) serves as a vital gateway for landing, trading, and distributing fishery products to many regions. Therefore, the utilization and condition of these facilities must be carefully maintained to ensure the smooth operation of all activities within the fishing port (DKP, 2019).

Clean water is one of the essential facilities that plays a vital role in supporting activities at the port. The provision of clean water and its installation infrastructure is a fundamental requirement for any fishing port (Lubis, 2012). Clean water at a fishing port serves four main functions: for drinking and food preparation, for cleaning and washing facilities, as a raw material for processing plants, and as an additive for fish processing industries within the port (Pane, 2005).

Based on field observations, the clean water supply at Kutaraja Fishing Port (PPS Kutaraja) originates from four bore wells located within the port complex. However, only two of these bore wells are currently in active use. The first active well, located beside the main reservoir, has been tested and shows good water quality—clear, fresh, and odorless. It has a discharge rate of 1.20 liters per second and a depth of 200 meters. The well is equipped with a 6-inch galvanized pipe for the first 60 meters and a 3-inch pipe for the remaining 140 meters. The second active well is located in the Fish Auction Center (TPI) area. Although the discharge rate from this well is unknown, the water quality is also considered good—clear, fresh, and odorless. Water from this bore well is used for office needs and operations within the fish auction area.

The challenge of providing clean water at Kutaraja Fishing Port (PPS Kutaraja) is quite complex. This is due to the fact that the Fisheries Industrial Area within the Kutaraja Fishing Port (PPS Kutaraja) Lampulo is experiencing an unreliable clean water supply. As a result, fishermen and fishery industry operators have expressed concerns and complaints regarding the situation.

The PDAM (Regional Water Utility Company) Tirta Daroy pipeline network in Banda Aceh City was installed in November 2015 to support the commemoration of National Archipelago Day. This network channels water from the Krueng Aceh River to meet the clean water needs of PPS Lampulo. The daily clean water demand for the ice plant and cold storage facilities ranges from 60,000 to 70,000 liters. However, the existing pipeline network is no longer sufficient to support fishery industry activities. As a result, fishermen and industry operators are now forced to purchase clean water from PDAM using water tank trucks (Intan *et al.*, 2020).

If the clean water supply issue is not resolved, it is predicted to impact fish quality, reduce port users' confidence in the services provided by PPS, and hinder overall operations at the port (Muninggar *et al.*, 2024). Therefore, it is necessary to conduct an analysis of the clean water demand at Kutaraja Fishing Port (PPS Kutaraja). The objective of this study is to determine the level of clean water demand at PPS Kutaraja. The findings of this research are expected to provide valuable information for the management and future development of the Kutaraja Fishing Port.

Materials and Methods

Location and time of research

This research was conducted from October to November 2024. The study site is located at Kutaraja Fishing Port (PPS Kutaraja) in Lampulo, Kuta Alam District, Banda Aceh City, Aceh Province. The locations for the research can be seen in Figure 1 below.

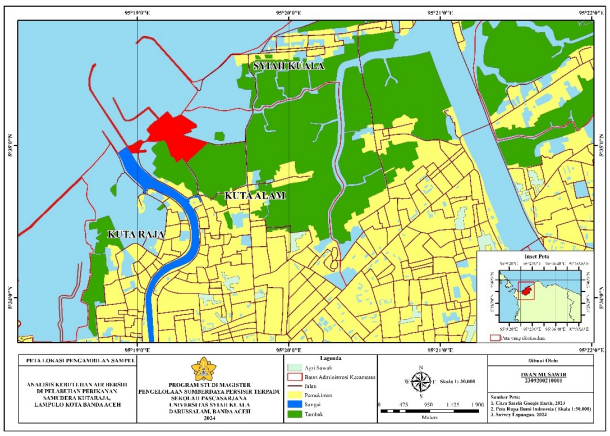

Figure 1. Map of the research locations

Method of collecting data

The data collected in this study consists of primary and secondary data, while the method used is the survey method to systematically collect information from the respondents (Suryabrata, 2006; Nazir, 2009).

The sampling method used in this study is purposive sampling. According to Sugiyono (2015). purposive sampling is a technique in which samples are selected based on specific criteria or considerations in accordance with the objectives of the research.

The criteria or considerations for selecting the respondents were stakeholders who have authority and responsibility in the management of the fishing port. The selection was based on their respective areas of authority, including the Head of the Ocean Fishing Port of Kutaraja (UPTD), the Section Head of Governance, Facilities and Infrastructure, and Business Services, as well as the Section Head of Port Operations and Harbor Master Services. Once all data sources were gathered, an evaluation was conducted, followed by data analysis using a descriptive-quantitative method to assess the clean water demand.

Data analysis

Data analysis was carried out using a descriptive-quantitative method to calculate the number of clean water users and their daily water demand. The analysis covered all activities at the fishing port that require clean water for their operations.

The clean water demand at the Kutaraja Fishing Port (PPS Kutaraja) is calculated based on three aspects: clean water demand for fishing/provisioning, clean water demand for office use, and clean water demand for the ice plant. The calculation of clean water needs for fishing activities is based on factors that influence the amount of water required during a fishing trip, such as the duration of fishing operations (days/trip) and the number of crew members. In addition, the theoretical calculation of clean water demand includes a coefficient value of $\alpha = 0.5$, which represents the reserve freshwater coefficient on board, and the daily freshwater requirement per crew member (A), which is 50 liters/person/day for motor vessels and 3 liters/person/day for motorized boats with outboard engines (Pane, 2005).

The clean water demand at the fishing port is calculated in detail using a specific formula Pane (2011).

$$KAPP = (KAM + KAE + KAB)$$

Information:
KAPP : Water demand at the fishing port (liters/day);
KAM : Clean water demand for fishing trips (liters/day);
KAE : Clean water demand for the ice plant (liters/day);
KAB : Clean water demand for office use (liters/day).

The above elements are further analyzed using a formula :

KAM (Clean water demand for fishing trips) :

$$KAM = KM \times I \times N \left[\frac{1+\alpha}{360}\right] \times A$$

Information:
KM : The number of vessels planned to purchase fishing trip supplies at the Fishing Port (units)
I : Average number of fishing operation days per year per vessel for all vessels planned at the port (days/year))
N : Average number of crew members per vessel planned at the port (people/unit)
A : 50 liters/person/day for motor vessels, 3 liters/person/day for motorized boats with outboard engines
α : Coefficient of freshwater reserve on the vessel (0.5)

KAE (Clean water demand for the ice plant):

$$KAE = \gamma \times K$$

Information:
K : Ice plant capacity per day (tons/day)
γ : Coefficient of clean water demand for the ice plant (1.1 – 1.3)

KAB (Clean water demand for office use):

$$KAB = FKB \times \frac{O}{L}$$

Information:
FKB : Conversion factor for clean water demand in office use at the port (30 liters/day/person or 2.81 m^3 per floor area)
O : Total number of workers in all port offices (people)
L : Floor area of office spaces at the port

Results

The analysis of clean water demand at the Kutaraja Fishing Port (PPS Kutaraja) includes clean water demand for fishing trips, clean water demand for the ice plant, and clean water demand for office use. The analysis covers all activities at the fishing port that require clean water for their operations.

Clean water demand for fishing (KAM)

The clean water demand for fishing trips is determined by the duration of fishing operations (days/trip) and the number of crew members (people). The fishing fleet at the Kutaraja Fishing Port (PPS Kutaraja) uses motor vessels (KM), such as purse seines and fishing boats. The calculation of clean water demand is classified based on the vessel size (GT), as each vessel size has a different number of crew members and operation duration. The total water demand for fishing trips can be seen in Table 1.

Table 1. Clean water demand for fishing activities (KAM) at Kutaraja Fishing Port (PPS Kutaraja)

Vessel Size (GT)	KM (Unit)	KAM (liter/day)
<5	10	287
6-10	213	6.113
11-20	158	4.535
21-30	76	2.181
31-50	47	1.349
51-60	109	3.128
61-100	12	344
>100	5	205
Total	**630**	**18.142**

Based on Table 1, it can be seen that the clean water demand for vessels under 5 GT is 287 liters/day, or an average of 28.7 liters/day per unit for boats equipped with outboard motors. Meanwhile, the water demand for vessels ranging from 6 to 100 GT is 17,855 liters/day, resulting in a total accumulated clean water demand for fishing activities of 18,142 liters/day.

The amount of clean water required for fishing activities is influenced by the clean water needs of each vessel per fishing trip and the number of vessels that refill water. The clean water carried by the vessels is used for drinking, cooking, bathing, and other activities that require water (Darmawaty and Mesrawaty, 2023).

Clean water demand for the ice plant (KAE)

The clean water demand for the ice plant at the fishing port is crucial, as water is the main raw material in ice production used to preserve the fish catch. The amount of clean water required for the ice plant at PPS Kutaraja can be seen in Table 2.

Table 2. Clean water demand for the ice plant (KAE) at Kutaraja Fishing Port (PPS Kutaraja)

Ice Plant	Produksi (Ton/day)	Water Demand (liter/day)
Pabrik Es A	50	60.000
Pabrik Es B	70	84.000
Total		144.000

The analysis results of the clean water demand for the ice plant at PPS Kutaraja show a total requirement of 144,000 liters per day. There are two ice plants, with individual water demands of 60,000 liters per day for a production capacity of 50 tons/day, and 84,000 liters per day for a production capacity of 70 tons/day.

The quality and quantity of water must meet standards to ensure that the ice produced is hygienic and safe for fishery products. The amount of ice carried during fishing operations directly affects the quality of the catch, helping to preserve the freshness of the fish and thereby increasing its market value.

Clean water demand for office use (KAB)

The use of clean water in the office units at PPS Kutaraja is intended to meet various daily needs, such as those of employees and staff, including washing or cleaning work tools and restroom facilities. The clean water demand for office use at PPS Kutaraja can be seen in Table 3.

Table 3. Clean water demand for office use (KAB) at Kutaraja Fishing Port (PPS Kutaraja)

Office	Conversion Factor for Water Demand (FKB)	Workforce (O)	KAB (Liter/Hari)
Syahbandar	30	46	1.380

Based on Table 3, it can be seen that the clean water demand for the Harbor Master's office at PPS Kutaraja is 1,380 liters/day. The total clean water demand is determined by the number of workers and the clean water demand conversion factor of 30 liters/person/day.

Water demand at the fishing port (KAPP)

The calculation of clean water demand at Kutaraja Fishing Port (PPS Kutaraja) is based on three main components: demand for fishing activities (KAM), the ice plant (KAE), and office use (KAB). The total

clean water demand at Kutaraja Fishing Port can be seen in Table 4.

Table 4. Total clean water demand (KAPP) at Kutaraja Fishing Port (PPS Kutaraja)

No	Activity Unit	Water Demand (Liters/Day)	Precentage (%)
1	Fishing Activities (KAM)	18.142	11,09
2	Ice Plant (KAE)	144.000	88,06
3	Office Use (KAB)	1.380	0,84
	Total KAPP	163.522	

Based on Table 4, it can be seen that the total clean water demand at PPS Kutaraja is 163,522 liters/day or 163.522 tons/day. The highest percentage of water usage is for the ice plant, accounting for 88.06%, while the lowest water demand is for the office unit, which represents 0.84% of the total water demand at PPS Kutaraja (Figure 2).

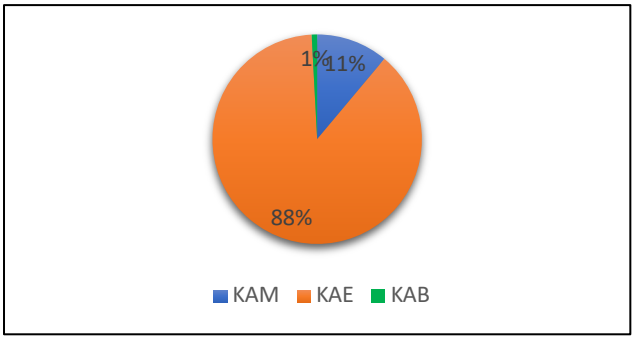

Figure 2. Clean water demand at Kutaraja Fishing Port (PPS Kutaraja)

Discussion

The clean water demand at Kutaraja Fishing Port (PPS Kutaraja) is analyzed based on three aspects: clean water demand for fishing activities or fishing trips (KAM), clean water demand for the ice plant (KAE), and clean water demand for office use (KAB). The analysis covers all activities at the fishing port that require clean water for their operations.

The clean water demand for fishing activities is based on factors that influence the amount of water required during fishing trips, such as the duration of fishing operations (days/trip) and the number of crew members (ABK). According to the Ministry of Home Affairs Regulation PER.23/MEN/2006 on Technical Guidelines and Procedures for Setting Drinking Water Tariffs for Regional Drinking Water Companies, Article 1 (8) states that the standard basic drinking water requirement is 10 cubic meters per household per month, or 60 liters per person per day, or other volume units as further determined by the Minister responsible for water resource management (Permendagri, 2006). Clean water plays a crucial role in supporting the smooth operation of activities at the fishing port. Even Lubis (2006) mentioned that clean water and its supply installation are considered one of the "essential" facilities that must be present at the fishing port.

According to Pane (2005) the clean water demand for fishing vessels in Indonesia currently does not follow theoretical guidelines. This is due to various factors, including the fact that some fishing fleets in Indonesia engage in one-day fishing activities with a duration of just one day, which does not require a clean water allocation for bathing and washing. If they do bathe, they use seawater, which is then rinsed with fresh water, or sometimes they bathe by plunging into the sea after hauling, such as in purse seine fishing in the Java Sea.

The analysis of clean water demand for fishing activities (KAM) at Kutaraja Fishing Port (PPS Kutaraja) shows a total requirement of 18,142 liters/day. The clean water demand for fishing trips is determined by the duration of the fishing operation (days/trip) and the number of crew members (persons). The fishing fleet at PPS Kutaraja uses motor vessels (KM) such as purse seine (ring net) and fishing boats. The clean water demand calculation is classified based on the size of the vessel (GT) because each vessel size has different crew numbers and operational durations. This aligns with previous research, which found that the clean water demand for fishing (KAM) on motor vessels compared to motorized boats is influenced by the number of crew members (ABK) and the duration of the fishing trip (Mattrutty *et al.*, 2017; Astarini *et al.*, 2020; Rizwan *et al.*, 2020; Fazri, *et al.*, 2021; Shafira *et al.*, 2021; Amelia *et al.*, 2021; Darmawaty and Mesrawaty, 2023).

The production of ice in the ice plant highly depends on the availability of clean water as the primary raw material. The demand for ice is essential for the completeness and success of fishing operations. This is closely related to maintaining the quality of the catch to ensure a high market value (Diniah *et al.*, 2012).

The demand for ice at PPS Kutaraja comes from two ice plants located within the port area, namely the Karya Nusa Jaya Ice Plant and PT. Aceh Lampulo Jaya Bahari (Yunanda *et al.*, 2018). The analysis of clean water demand for the ice plant (KAE) at PPS Kutaraja shows a total requirement of 144,000 liters/day, with a total block ice production of 120 tons/day.

The clean water demand for the ice plant at PPS Kutaraja is the highest, as there are two ice plants operating within the PPS Kutaraja area. Clean water is used as the raw material for block ice production and also for other purposes such as cleaning, drinking, bathing, and WC facilities. The clean water demand at the ice plant highly depends on the production capacity and the number of employees. This is in line with the situation at the ice plant in PPS Kendari, where the daily ice production still depends on the amount of water supplied by the port authorities (Ridwan *et al.*, 2017). According to Mattrutty et al. (2017), the lowest level of clean water demand is found in ice factory activities, at 0.28%. This is influenced by customer demand, particularly from fishermen and boat owners. The fishing season affects the amount of ice requested for use as provisions at sea, resulting in minimal demand. The policy adopted by the ice factory is to adjust production levels according to the demand. In addition to ice production, water is also used for cleaning, consumption, bathing, and sanitation facilities, all of which must be considered in the planning and management of water resources at the ice plant (Permenkes, 2023).

There are two offices (agencies) located within the PPS Kutaraja area, namely the Syahbandar Office and the UPTD Samudera Kutaraja Fishing Port Office, with a total of 46 employees and workers. The clean water demand for the offices (KAB) at PPS Kutaraja is 1,380 liters/day. These office units utilize the clean water services from the port to meet various daily needs. Even Pane (2005) the clean water demand for the offices is only a supplementary need for the existing infrastructure. The average clean water usage in the offices is for purposes such as restrooms/WC, cleaning of restrooms, floor cleaning, cleaning equipment, and the needs of employees and workers.

The total clean water demand (KAPP) at PPS Kutaraja is 163,522 liters/day, consisting of clean water for fishing activities (KAM) of 18,142 liters/day, clean water for the ice plant (KAE) of 144,000 liters/day, and clean water for the offices (KAB) of 1,380 liters/day. Based on interviews and field observations regarding the clean water supply, especially for fishing activities, the supply still does not meet the required standards. Fishermen do not receive clean water according to the port's standards due to the absence of government policies on clean water distribution. The insufficient clean water supply forces fishermen to purchase water from tankers, which increases operational costs. This is in line with the research by Intan *et al.*, (2020) for the clean water demand for fishing activities, the water supply at PPS Kutaraja only meets 33% of the required clean water. The clean water supply at PPS Kutaraja is solely from the PDAM and bore wells, which are utilized as efficiently as possible. The issue of insufficient clean water availability at the port has a negative impact on the fishing industry area. The lack of clean water supply forces investors or fishing industry players to purchase clean water from PDAM using tanker trucks.

The assessment of clean water supply parameters at PPS Kutaraja received a score of 1, indicating that the clean water supply does not meet the needs at the port. The clean water supply at PPS Kutaraja is only 200 m^3 per day. The clean water demand at PPS Kutaraja is divided for ship provisioning, industry, and port staff/users, totaling 221,093 m^3 per year (606 m^3 per day). There is a need to add clean water storage facilities from PDAM, ranging from 500 to 1,000 m^3 per day, as well as the installation of longer and more directed pipeline connections to water storage centers in each area (UPTD PPS Kutaraja, 2021; Wahyuni *et al.*, 2022).

Based on the results of this study, a clean water management strategy is needed at PPS Kutaraja to ensure that the clean water needs, especially for fishermen, are fulfilled without having to purchase water from agents. Several strategies were derived from interviews with stakeholders that are including the provision of water storage facilities, optimizing the clean water treatment installations from local sources, and strengthening coordination between the port management and relevant agencies to ensure the sustainable availability of clean water. In addition, empowering fishermen's groups through training in water management and maintenance of clean water distribution infrastructure is also important so that fishermen can independently manage their water needs. With these steps, it is expected that dependence on third parties for clean water procurement can be reduced, while also improving efficiency and the welfare of fishermen in the PPS Kutaraja area.

Conclusion

The clean water demand (KAPP) at PPS Kutaraja is 163,522 liters/day, consisting of clean water needs for fishing activities (KAM) of 18,142 liters/day, clean water for ice plants (KAE) of 144,000 liters/day, and clean water for office use (KAB) of 1,380 liters/day. A clean water management strategy is required at PPS Kutaraja to ensure that the clean water needs, especially for fishermen, are met

without having to purchase water through agents or PDAM via tankers.

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