Study of the suitability of jetty facilities to the number of vessels on Kutaraja fishing port, Banda Aceh

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Abstract. The jetty of the Kutaraja fishing Port which has been built at this time is not in accordance with the number of fishing vessels currently available, there are still many vessel moored in the Krueng Aceh river basin. The length of the jetty is a basic facility that determines the carrying capacity of the fishing port. The purpose of this research is to assess the suitability of the jetty facilities to the number of fishing vessel moored at Kutaraja fishing port to assess the capacity and determine the suitability of the currently available jetty. This research uses a descriptive method that is survey, namely by making direct observations of objects in the form of jetty and vessel. Based on the calculation of the ideal length of the jetty, the current requirement for the jetty of Kutaraja fishing port based on the calculation of the number of fishing vessels is 1.177 m. The length of the jetty of the Kutaraja fishing port that has been built at this time is not suitable, it is necessary to add a jetty of 836 m. Based on the results of this study, it is highly recommended to arrange a mooring pattern at the mooring jetty so that no more vessel moor in the river basin.

1. Introduction
A fishing port is the center of the economy from the time the fish are landed after being caught from the fishing ground until the fish is marketed at the fishing port, therefore fishing ports have a very important role in marine fishing [1] Fishing vessels are a vital object of fishing operations. Activities carried out by fishing vessels at fishing ports include loading and unloading of fish catches, mooring of vessels, supply of fuel and foodstuffs at sea, as well as coordination of fishing activities to marketing of fish catches [2]. Aceh Province is known for its abundant potential. One of these potentials is the potential for marine and fishing [3]. Aceh has a long coastline that reaches 2,660 km and an area of 295,370 km$^2$ of water. Aceh has an Exclusive Economic Zone (EEZ) sea of 238.807 km$^2$ and territorial waters of 56,563 km$^2$ [4]

The function of a port is as a berth and berth for vessels [5] than with the function of fishing ports, but at fishing ports, it is more specific for fishery activities. The function of fishing ports based on these points includes, among other things, a working environment and berths for vessels for loading and unloading fish [6]. All of the mooring system’s components are determined by vessel type and size, as are other aspects of the project. Nevertheless, Classification Societies vary significantly in how they deal with the operation and design of the mooring system’s components [7]. The harbor pool is
part of the fishing port facilities and facilities in the form of waters that have a depth and are in front of
the jetty [8]. The classification of fishing port pools is landing pools, supply pools, mooring pools and
maneuver pools [9]. The space for the vessel to do movement is called a rotary pool. The area of the
rotary pool is determined by the largest vessel using the port [10]

2. Materials and Methods

2.1. Data Collection
This research was conducted from February to March 2020, the research location is located at the
Kutaraja Fishing Port, Banda Aceh. The method used in this research is a descriptive method which is
a survey. Researchers made direct observations of the object in the form of a mooring jetty at the
Kutaraja Fishing Port.

2.2. Data Analysis
2.2.1. Length of the jetty
The number of bollards available at the port also affects the area of the fishing port pond, the more the
number of bollards the greater the area needed for each fishing vessel to perform maneuvers. The
bollard is a place to tie the vessel's rope when the vessel is docked [6, 7]. The formula for determining
the ideal pier length [8] is as follows:

\[ D = \left( (l+s) \times n \times \alpha \times h \right) / \left( u \times d \right) \] [8]

Where: 
- \( D \) = Length of the jetty (m)
- \( l \) = Length of vessel (m)
- \( s \) = Space vessel (m)
- \( n \) = Number of vessels using the jetty (units / day)
- \( \alpha \) = Vessel weight (ton)
- \( h \) = Length of vessel at the jetty (hour)
- \( u \) = Production per day (ton)
- \( d \) = Length of fishing trip (hours)

2.2.2. Turning basin
Another element of the fishing port pool that affects the area of the pond is the rotary pool. The swivel
pool is used for the movement of the vessel when it is anchored. The area of the rotary pool is
determined based on the largest vessel using the port ([5, 6]. The area for turning a vessel, the radius
of rotation is at least one time the length of the largest vessel [8, 9] is as follows:

\[ L_t = \pi \times r^2 \] [8, 9]
\[ L_t = \pi \times l^2 \]

Where: 
- \( L_t \) = Area of rotary pool (m²); \( \pi = 3.14 \); \( l \) = Largest vessel length (m)

2.2.3. Harbor pool area
The planned port pond area development can be calculated by knowing the number of all fishing
vessels domiciled in the fishing port and the size of the largest vessel domiciled in the related fishing
port as parameters. The ideal fishing port pool development planning [8] is as follows:

\[ L = L_t + (3 \times n \times l \times b) \] [8]

Where: 
- \( L \) = Harbor pond area (m²); \( L_t \) = Area of rotary pool (m²); \( n \) = Total number of fishing vessels (units); \( l \) = The overall length of the largest active vessel (m); \( b \) = Width of the largest active vessel (m)
3. Results and Discussions

3.1. Identification of PPS Kutaraja Jetty

The results of measurements of the length of the Kutaraja PPS jetty that have been built are shown in table 1. There are 2 pools, namely pool A and pool B, the loading jetty is in pool A, while the mooring jetty is in pool A and pool B. The total length of the PPS Kutaraja mooring jetty based on observations and calculations by researchers is 341 m, while the total length of the loading jetty is approximately 234 m.

| No | Measure Object                        | Length (m) |
|----|---------------------------------------|------------|
| 1  | Beach mooring jetty (pool B)          | 101 m      |
| 2  | Jetty / mooring and loading jetty (pool A) | 177 m     |
| 3  | mooring jetty (pool B)                | 63 m       |
| 4  | Sheet pile (pool A)                   | 100 m      |
| 5  | Unloading and mooring jetty divider (pool A) | 42 m     |
| 6  | Unloading jetty (pool A)              | 234 m      |

3.2. Identification of the Accommodating Capacity of the PPS Kutaraja Pond

The capacity of the PPS Kutaraja pond is studied based on two objects, namely the length of the jetty and the area of the port pool. The length of the jetty is a study of the position and layout of the vessel to fill the pool, while the area of the port pool is a study of the land capacity to accommodate vessels regardless of the vessel's position [11]. The loading jetty is calculated based on the number of vessels using the jetty per day while the mooring jetty is calculated based on the number of fishing vessels. The following is a calculation to obtain the ideal length for each jetty for loading and mooring jetty [12].

\[
D = ((28.85 \text{ m} + 1.5 \text{ m}) \times 10 \text{ units} \times 137 \text{ GT} \times 12 \text{ hours}) / (56 \text{ tons} \times 168 \text{ hours}) = 53 \text{ m}
\]

\[
D = ((28.85 \text{ m} + 1.5 \text{ m}) \times (369 \text{ units}) / 5 \times 137 \text{ GT} \times 36 \text{ hours}) / (56 \text{ tons} \times 168 \text{ hours}) = 1.177 \text{ m}
\]

The results of this jetty calculation are then used to find out how many bollards are needed to position the vessel. The number of bollards is calculated by dividing the length of the moorings by the number of vessels plus the space for the vessels [3, 5, 13]. The following is the calculation to obtain the number of mooring jetty bollards:

\[
\text{Number of mooring jetty bollards} = (1.177 \text{ m}) / (28.85 \text{ m} + 1.5 \text{ m}) = 39 \text{ unit}
\]

Other objects that support the capacity of the mooring pool are the length of the jetty and the number of moorings. The function of the jetty is for anchoring and berthing vessels. So the function of the jetty is to arrange the layout and position the vessel [14]. Therefore, the length of the jetty, especially the mooring jetty, greatly affects the suitability of the mooring pool. It states that the length of the jetty is the aspect of the vessel (vessel length, vessel space, vessel weight, length of time the vessel uses the jetty and the number of vessels using the jetty per day) divided by the aspect of loading and unloading the vessel (result production and length of fishing trip) [3, 4, 6]. The distance between vessels (space vessels) in the mooring pool is not there (tight), the researchers added the amount of vessel space by 1.5 m, this addition was made to maintain the distance of each row of vessels [15]. The amount of the figure on the vessel space that the researcher uses refers to the statement of which states that if the jetty has more than 3 moorings, then the size to calculate the pool area is 1.5 LOA (Length Over All). The largest vessel is only calculated in length and width, other dimensions of the vessel such as draft, depth and area of the building on the vessel are ignored [16]. The vessel that was counted was the KM Pusaka Esa vessel because based on the observations of the researcher and the information from the UPTD PPS Kutaraja Syahbandar, KM Pusaka Esa, weighs 137 GT and is the
largest active vessel domiciled in PPS Kutaraja. The length and width of the vessel seen in Pasbesar KM Pusaka Esa, the length of the vessel is 28.85 m and the width of the vessel is 9.32 m. Every day there are 10 vessels carrying out loading and unloading activities at the jetty. The length of time the vessel uses the jetty to unload the catch is 12 hours and 36 hours for the moored boat. Every day fishing activities at PPS Kutaraja can produce 56 tons of fish. The average length of fishing trip for fishing boats in PPS Kutaraja is 168 hours.

The results of the calculations obtained state that ideally the current length of the PPS Kutaraja jetty is 53 m for the unloading jetty, these results are obtained based on the calculation of the number of vessels used at the jetty and 1,177 m for the mooring jetty, these results are obtained based on the number of fishing vessels currently divided by 5 (stated that in 1 row the mooring jetty are used by 5 vessels moored marginally) with the largest average length using the largest vessel, namely KM Pusaka Esa. The required number of bollards is 39 moorings for the mooring jetty.

3.3. Identification of the Ideal Area of the PPS Kutaraja Mooring Pond
The initial step in calculating the area of the mooring pool is to determine the size of the rotary pool area [17]. The area of the rotary pool is obtained from multiplying the area of the circle times the length of the entire vessel. Here is the calculation for the rotary pool area:

\[
\text{Lt} = 3.14 \times (28.85 \text{ m})^2 = 2.613 \text{ m}^2
\]

\[
\text{Pond} = 2.613 \text{ m}^2 + (3 \times 369 \text{ unit} \times 28.85 \text{ m} \times 9.32 \text{ m}) = 300.265 \text{ m}^2
\]

The calculation of the mooring pond area is based on the number of fishing vessels as many as 369 units. The ideal mooring pool formula is a calculation of the vessel aspects (rotary pool, total number of vessels, largest length of vessel and largest vessel width) [18]. The rotary pool is calculated using the formula for the area of a circle where the radius of the circle is replaced by the length of the vessel [7, 8]. The results of the researcher’s calculations of the ideal mooring pond area today are based on the number of fishing vessels. The area of mooring pond required by PPS Kutaraja for now is 300.265 m².

3.4. The Suitability of the Area of the Kutaraja PPS Mooring Pool
The data presented in table 2 is a large comparison of the facilities that have been built with current needs. The difference in numbers in the comparison between the current mooring pool and jetty facilities with the currently required mooring pool and jetty facilities will determine whether or not the mooring pool and jetty facilities have been built currently, if the numbers are for the facilities that have been built greater than the facility requirement figure based on current calculations, the mooring pool and jetty are declared appropriate, and vice versa [19]. Facilities that are not suitable, namely the inadequate length of the mooring jetty, the results of the calculation indicate that there is a need to increase the length of the mooring jetty by 836 m. The area of PPS Kutaraja mooring pond that has been built is 654,550 m², while what is needed now is 300,265 m².

| Information                                      | Length (m) | Large (m²) | Carrying capacity (unit) |
|-------------------------------------------------|------------|------------|--------------------------|
| Unloading jetty                                  | 234        | 654.550    | 2.259                    |
| Mooring Jetty                                   | 341        |            |                          |
| Mooring Pool                                    | 300.265    |            | 369                      |
| Mooring pool                                    |            | 300.265    | 369                      |

Table 2. Suitability of the ideal area of the PPS Kutaraja mooring jetty for fishing vessels.
The PPS Kutaraja mooring pool that has been built for now is adequate with the current number of vessels, but it is necessary to arrange the vessel when mooring. Fishing boats can moor each other in rows parallel to the jetty, so that all fishing vessels can be accommodated and can moor at the existing mooring pond at PPS Kutaraja. The method of mooring a fishing boat at the PPS Kutaraja jetty is a mooring boat parallel to the jetty [20]. Fishing boats that are moored parallel to the jetty have advantages in terms of ease of unloading fish from vessel to jetty, but the disadvantage is that they require a long jetty [4, 5]. Under all kinds of mooring, it is also necessary to take into account factors like vessel type and size, the characteristics and disposition of its mooring system and terminal and, finally, the physical conditions of the port [7, 9].

4. Conclusion
The conclusions obtained from this study is that the current requirement for the mooring pond of PPS Kutaraja based on the calculation of the current number of fishing vessels is 300.265 m² and the need for a jetty to accommodate moored fishing vessels is 1.177 m. The area of the PPS Kutaraja mooring pool that has been built at this time is suitable, while for the mooring jetty that are not yet suitable, it is necessary to add a jetty of 836 m.

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