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Projection of Main Facility Needs for the Next 8 Years at Beba Fishing Port, Indonesia

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Abstract

This study aims to project catch production; fishing fleets; landing docks and ponds for the next 8 years (2022-2029) to improve the function of the Beba fishing port. This research was conducted at Beba Fishing Port Takalar Regency, South Sulawesi, Indonesia. The method used in this study was a case study. Calculation of the dock and pond area needs for the present and the next 8 years used monthly data such us the catch production, the number and size of fishing fleets; direct measurement of result data such us jetty length, pond depth; and direct observations data such us condition of the dock facilities and port pools. The results show the projection of production volume of catches in 2022 at PPI Beba is 1,473.7 tons and an increase of 3,373.9 tons in 2029. The projection of fishing fleet in 2022 is 426 units and an increase of 823 units in 2029. The projection of length of the required dock is 118 m in 2029. In addition, it is also necessary to increase area of the port pool to 14,558 m^2 and depth pool is -2.36 at the lowest low tide and -3.68 at the highest tide.

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Basic facilities, projections, port development, fishing port, Beba.

Introduction

Fishing ports have a very strategic role in fishery development which contribute to a significant impact on improving fisheries management and plays an important role in fisheries business consequently that their existence will encourage well-managed capture fisheries activities (Puspitasari *et al.*, 2013; Eka *et al.*, 2020).

This happens because the fishing port used as a place to carry out fishing preparation activities such as fishing supplies to landing sites, processing, marketing, and distribution of catches, as well as a center for economic improvement activities for fishing communities from the production aspect (Lubis, 2012; Lubis and Mardiana, 2011; Chen and Lam, 2018), the relationship between these activities are quite strong, then if one activity experiences obstacles, it will be effected another activities (Ariyanto and Sulfitra, 2018).

According to Lubis (2011), 70% of fishing ports in Indonesia do not optimally operate due to inadequate facilities, so this condition is considered one of the inhibiting factors for fishing port activities in Indonesia, thus great efforts are needed to fix this problem. As stated by Rosalia (2018), a well-managed fishing port in terms of facilities and activities will advance the economy in a region and increase local revenue, for that reason fishing ports are very important to develop.

Beba Fishing Port is one of the fishing ports in South Sulawesi, categorize as fishing port type D located in North Galesong, TakalarRegency. According to Salim *et al.*, (2018), PPI Beba has considerable economic

potentials because its activities are crowded and supported by a strategic position. However, the condition of PPI Beba, especially in the volume of catch production is quite high, but this is not followed by adequate facilities, especially in basic facilities such as docks and port ponds that can support other facilities to be developed.

The wharf and pond of the PPI Beba port are inadequate and not properly functioned, thus the landing of the catch is ineffective, fishing boats measuring at <10 GT cannot moor their boats at the dock and have to get off the ship to land their catch on the beach, caused the landing dock is high. The limited facilities available currently obstructed unloading activities at PPI Beba.

The projection of the needs of docks and port ponds for the next 8 years (2022-2029) is very important to anticipate the increasing of catch production volume and growth rate of fishing fleets thus analysis of projected production of catches and fishing vessels are also required.

These projections need to be carried out in order to determine the extent the needs of main port facilities can be developed appropriately and successfully, thus providing information for researchers about the projection of needs for fishing port facilities and providing information to PPI Beba managers in implementing future policies.

Materials and Method

The research was conducted from November 2021 to January 2022 at Beba Fishing Port, Takalar Regency, South Sulawesi Province. The tools and materials used are cameras, writing instruments, questionnaires, and roller meters. The method used was a case study method regarding the need for basic facilities, prediction of catch production, and fishing fleets at PPI Beba.

The data collected in this study were primary data and secondary data. Primary data was obtained through measurements, observations, and interviews in the field. Direct measurement of result data such us jetty length and pond depth.

Direct observations data such us condition of the dock facilities and port pools. Interviews related to duration of time loading supplies and landing, the size of the fleet, the condition of the dock, the port pond, and the maximum draft of the largest ship. Secondary data was obtained through literature studies. The types of secondary data used time series data catch production for each month, quantity and size of the fishing fleet for each month, area and depth of current port ponds obtained from local authority (UPTD) PPI Beba and the Department of Marine Affairs and Fisheries of South Sulawesi Province. Respondents were determined by purposive sampling conducted on 5 management of Beba fishing port, 12 fishermen, and 3 fishmonger.

Data Analysis

Projection of volume of fish production and fishing fleets at PPI Beba for the next 8 years (2022-2029)

The projection of volume of fish production and the quantity of fishing fleets for the next 8 years in the period 2021-2029 can be calculated using the combined model estimation method (Dajan, 1973). The stages are as follows:

Create actual data in time functions;

Carry out the process of moving averages with a RB of 11 months, in order to obtain the form of a model equation with the smallest error and the largest correlation coefficient to the observation data. On the process used catch production volume data and the monthly fleet in PPI Beba in 2018-2021.

Calculate the influence of trends, seasonal variations and cyclic variations before making predictions.

Perform trend equations with the following regression model:

$$\hat{Y}i = a + b\,Xi$$

Description

a = Constant

b = Constant regression coefficient

$\hat{Y}i$= Predicted catch production

Xi= Time index (month)

Pearson correlation coefficient $r_{xy\ count}$

$$r_{xy\ count} = \frac{(n\sum xy)-(\sum x\sum y)}{\sqrt{\{\sum(n\sum x^2)-(\sum x)^2\}\{(n\sum y^2)-(\sum y)^2\}}}$$

Hypothesis

H0:r_{xy} =0 if there is no correlation between variable x catchs production volume and variable y time (month, year)

H0:$r_{xy} \neq 0$ if there is a correlation between variable x and variable y

Trend tendency: (*Ti*) = $\hat{Y}i$

Effect of seasonal variation (*Si*): *Si=Yi/RBi*

Effect of cyclic variation (*Ci*): *Ci=RBi/Ti*

Determine the estimate value:

$\hat{Y}i$ = *TsixSi x Ci,* or

Understanding the development:

$\hat{Y}i$ = *(Tsi x Si x Ci) +FPi*

Error (*Ei*):

Ei = Yi/$\hat{Y}i$

Analyze the accuracy of projections using Standard Error Estimated (SEE) analysis.

$$SEE = \sqrt{\frac{\sum_{i}^{n}(Yi-\hat{Y}i)^2}{n}}$$

Percentage of SEE to the actual data average:

Percentage SEE (%) = *(SEE/*$\hat{Y}$*) x 100%* Description:

Yi = Actual data on month - i

$\hat{Y}i$ = Data projection results on month- i

I = Month - i of the calculate deviation data

N = Total observations (timeindex month- i; i=1,2,3,...,n)

$\bar{Y}$ = Average of actual data

Projection of Main Facility Needsat PPI Beba for the next 8 years (2022-2029)

Projection offish landing dock need of Beba PPI for next 8 years (2022-2029) can be calculated using the approach of the production volume of the catch landed based on the following formula (Pane, 2016):

$$Dp = \frac{VPT.(L+s)-s+2j}{VPU.HPR.FP}$$

Keterangan

Dp = Length of landing dock with the approach of the landed catch production volume (m)

VPT= Production volume of landed caught at fishing ports in a year (tons/year)

L = LOA of the longest vessel (m)

s= Distance between 2 fishing vessels

(5-15 m)
J = Distance of the bow/stern of the ship to the end dock (25 m)

VPU=Average production volume of landed caught per unit of ships landing at fishing ports (tons/landing).

HPR=Total number of real landing days caught per year each ship; as a guideline (day/year)

FP=Frequencies number of dock usage periods per day at fishing ports

Projection of port pond area need of PPI Beba uses the formula of the Directorate General of Fisheries (1981) as follows:

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

Descriptions

L = Port pond area (m^2)

Lt = Area for rotating the vessel (πr^2) (m)

= 3.14 × the longest ship size ^{2}

3 = Constant

n = Number of max ships docked (units)

l = average ship length (m)

b = average ship width (m)

Projection of port pond depth need of PPI Beba uses the formula of the Directorate General of Fisheries (1981) as follows:

$$D = d + \frac{1}{2} H + S + C$$

Description

D = Port pool depth (m)

d = Draft of the largest ship with a full load (m)

H = Maximum wave height (m)

S = Height of the oncoming ship (0.1 - 0.3 m)

C = Safe distance from the ship's keel to the bottom of the water (0.25 - 1 m).

Results and Discussion

Projection of volume of fish production at PPI Beba for the next 8 years (2022-2029)

The production of catches at fishing ports is one of the benchmarks for the success of management in a fishing port, especially at PPI Beba, so that according to (Lubis and Sumiati, 2011; Yuspardianto, 2006) it is necessary to project production volumes in order to see the potential for developing basic facilities in order to attract investors for investing in fishing ports operations.

Initial steps taken to project catch production are data cleaning and calculation of the 11 month moving average (RB; moving average) with the aim to obtaine the best trend equation (smallest error and largest correlation coefficient).

The calculation result of the regression trend equation is y = 1.756x + 49.739. It means that each additional x = 1 month will increase the volume of catch production by y = 1,756 tons. The relationship between the time index variable (x) and the production volume (y) obtained is very strong, indicated by the value of R2 = 0.871 with an error value (SEE) of 22.7%. To determine results of the projection volume of production landed at PPI Beba in 2018-2021 also calculate the effect of seasonal variations and cyclic variations (Table 1).

Calculation results Table 1 of the effect of seasonal variations on the production volume of caught fish landed at PPI Beba in 2018-2021 are in the range of 40.12%-180.32% with an average of 112.18% per month (Table 1). Likewise, the average effect of cyclic variation is 82.11% with a range of 68.43% - 96.64%. This calculation then used in calculating the projection of volume of fish production caught at PPI Beba in 2022-2028 (Figure 1).

Figure 1 shows the results of trends, seasonal variations, and cyclic variations calculations which produce graphs and equations the projection of volume of fish landed caught production at PPI Beba in 2022-2029.

Regression equation obtained is y = 247.248x + 1288.313. It means that each additional x = 1 year will increase the volume of catch production by y = 247.248 tons. The relationship between the time index variable (x) and the production volume (y) obtained is very strong, indicated by the value of R^2 = 0.951 and SEE = 14,0%. The projection results are used to project the production volume at PPI Beba in 2022-2029 (Table 2).

Table 2 shows the projection of results of total production volume of catches which shows an increase in production volume every year with an average increase of 13.2% per year with the maximum volume occurring in 2029, where in 2022 the total production volume at PPI Beba reaches 1,473.7 tons/year or 122.8 tons/month, increased to 3,373.9 tons/year or 281.2 tons/month in 2029.

The projection of volume of fish production in 2022-2029 tends to experience an increasing trend with the assumption that the stock of fish resources is sufficient, regulations for the use of fishing gear are not changed and the quantity of fishing fleets remains stable. The results use to bea basis for calculating the needs for PPI Beba's main facilities in the future.

The same result was also obtained by Rosalia *et al.*, (2018) that the prediction volume of fish production is important to determine the needs for main facilities for dock and port ponds can be developed. This is in line with Lubis and Pujiono (2020) that the increasing volume of catch production must be balanced with an increase in main facilities so that fishing activities in ports can take place properly.

Table.1 Calculation of seasonal variations and cyclic variations of catch production volumes at PPI Beba in 2018-2021

Year	Time Index (month; x or i)	Seasonal Variation (Si;%)	Cyclic Variation (Ci;%)
2018-2021	1-48	-	-
Averages		112.18	82.11
Range	Min	40.12	68.43
	Max	180.32	96.64

Table.2 Projection of production volume of caught fish landed at PPI Beba year 2022-2029

Year	Time Index (Month; x ori)	Projection of Production Volume of Catches		
		(ton/year)	(ton/month)	Percentage growth (%)
2022	49-60	1,473.7	122.8	-
2023	61-72	1,781.2	148.4	20.9
2024	73-84	2,222.5	185.2	24.8
2025	85-96	2,099.4	174.9	-5.5
2026	97-108	2,651.6	221.0	26.3
2027	109-120	2,768.5	230.7	4.4
2028	121-132	2,836.7	236.4	2.5
2029	133-144	3,373.9	281.2	18.9
Average/year		2,400.9	200.1	13.2
Range	Min	1,473.7	122.8	-5.5
	Max	3,373.9	281.2	26.3

Table.3 The number projection of ships at PPI Beba in 2022-2029

Year (*x*)	Prediction of the fishing fleets number y = 56.7x +142.5	
	(Unit)	Percentage growth(%)
2022	426	-
2023	483	13.3
2024	539	11.7
2025	596	10.5
2026	653	9.5
2027	710	8.7
2028	766	8.0
2029	823	7.4
Average/Year	624	9.9
Range Min	426	7.4
Max	823	13.3

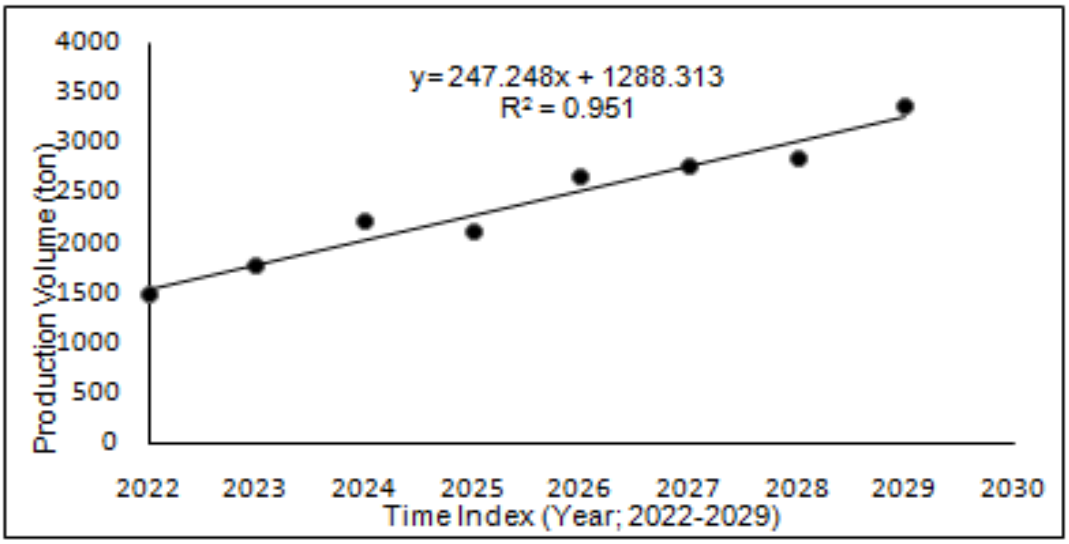
Table.4 Calculation projection of landing dock needs at PPI Bebain 2022 until 2029

Year	Fish production volumes (ton/vessel)	Projection of needs for dock length (m)	Current length of the dock (m)	Difference (m)
2022	1,473.7	51.6	68.5	16.9
2025	2,099.4	73.5		-5.2
2029	3,373.9	118.0		-49.7

Table.5 Calculation projection of area port pond needs at PPI Bebain 2022 until 2029

Year	Projection number of vessel moored and docked (nt; unit/day)	Vessel length (l; m)	Vessel width (b; m)	Projection port pool area needs (L ; m^2)
2022	66	14	3.5	9,695
2025	80	14	3.5	11,778
2029	99	14	3.5	14,558

Fig.1 Graph of the projection volume of landed catches production at PPI Beba in 2022-2028 taking into account trends, seasonal variations, and cyclical variations



Projection of the number of fishing fleets at PPI Beba for the next 8 Years (2022-2029)

The projection of number calculation of fishing fleets in 2022-2029 is obtained by using time series data for the fishing fleet at PPI Beba for the last 4 years, during 2018-2021 which shows the increase of the ships number every year an increase starting from 198 unit in 2018 and then continuing increased to reach 376 units in 2021.

Calculation results of the regression trend equation are y = 56.7x + 142.5. The equation illustrates that for every additional x = 1 year, thus fishing fleets increases by y = 57 units of ships. The relationship between time index variable (x) and fishing fleet (y) obtained is very strong which is expressed by the value of $R^2 = 0.979$.

Furthermore, projection of number fishing fleets in 2022-2029 is carried out which is obtained from the application of regression in the previous 4 years (2018-2021). The following table shows the projection of number fishing fleets at PPI Beba for 2022-2029 (Table 3). Table 3 shows the results of the number of fishing fleets projection with an average growth of 9.9% with a minimum number of ships is 426 units in 2022 and then increases every year to reach 823 units in 2029.

The projection number of fishing fleets in 2022-2029 tends to experience an increasing trend with the assumption that port facilities are adequate, there is no sedimentation in aquatic ponds, there is no change in regulations for the use of fishing gear, and stock of fish resources in fishing areas is sufficient. This indicates that the main facilities of PPI Beba need to be improved in order to anticipate the needs of port users in the future. In line with (Lubis and Pujiono, 2020; Syahputra *et al.*, 2018), the increase number of fishing fleets at fishing ports should also be balanced with the development of main facilities, especially docks and port ponds.

Projection of landing dock and port pond needs at PPI Beba for the next 8 Years (2022-2029)

The landing docks and port ponds are important facilities needed by fishing ports thus port activities can run well. However, according to Lubis and Pujiono (2020) the minimum length of the dock, width, and depth of the port pool can hinder the process of landing the caught had impact on ships entering the port area, consequently projections of landing dock and port pool need to be carried out to predict whether the dock and the current port pool is able to accommodate the number of ships for the next few years. Calculation projection of landing dock and port pond in Table 4 and Table 5.

Table 4 shows the current required length of the dock (in 2022) is 51.6 m while the current length of the landing dock is 68.5 m. This indicates that the landing dock is still sufficient today. However, the result of the projection length of the landing dock required for the next 8 years (in 2029) is 118 m. It means that it is necessary to add a 49.7 m dock longer.

Table 5 shows the currently required port pool area (in 2022) which is 9,695 m^2 and the currently available port pool area is 8.160 m^2, thus current port pool area is still sufficient. However, the results of the projection area of port pool requirements needed for the next 8 years (2029) are 14,558 m^2, then it is necessary to add a port pool is 6,398 m^2. The depth of the harbor pool currently reaches -1.7 m, but a depth of -2.36 at the lowest low tide and -3.68 at the highest tide is required to accommodate fishing fleets for the next few years. In line with (Simanjuntak *et al.*, 2012; Irawan *et al.*, 2018), in calculating the depth pool of fishing port, it is necessary to look at the tidal conditions of the sea.

According to Ilham *et al.*, (2016), the difference in numbers the comparison between dock facilities and port pools that have been built at this time with the needs for dock facilities and port pools based on the projection results will be a determinant of whether or not the dock facilities and port pools that have been built are appropriate. Currently, if the figure for the facilities that have been built is greater than the number of facility needs based on the projection results, then the facility is declared feasible, and otherwise.

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