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Analysis of Passenger Terminal Capacity and Bajoe Port Parking Lot, Bone Regency

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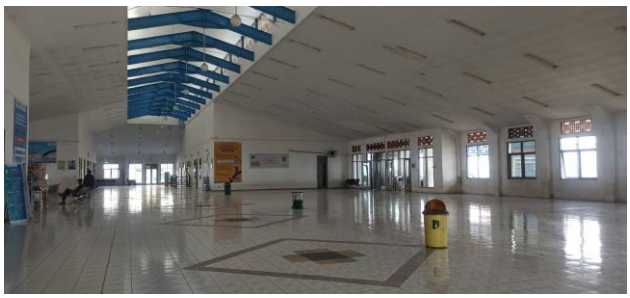
Abstract

Bajoe Port is a ferry port using Ro-Ro type ships that transport passengers, goods and vehicles from several regencies/cities in South Sulawesi to Kolaka Regency, Southeast Sulawesi Province. The purpose of this study is to predict the number of passengers and vehicles that will visit Bajoe Port until 2037 and to determine the need for passenger terminals and parking lots that are currently available are still sufficient until 2037. The method used is regression to predict the flow of passengers and vehicles and the calculation formula for the need for passenger terminals and parking lots in determining capacity. The results of the study are the predicted number of passengers and vehicles that will visit Bajoe Port until 2037 of 498,168 people and 76,038 units. The capacity of the passenger terminal until 2037 is 1,497 m² so that the capacity of the passenger terminal currently available is 1,459 m2 [is] no longer sufficient until 2037 and the passenger terminal capacity needs to be increased. The parking capacity for vehicles that will cross and drop-off/pick-up vehicles until 2037 is 1,771 m² and 839 m2 [so] that the parking capacity for vehicles that will cross and drop-off/pick-up vehicles currently available is 8,980 m2 [and] 2,984 m2 [is] still sufficient until 2037 and there is no need to increase the parking capacity for vehicles that will cross and drop-off/pick-up vehicles.

Keywords: Capacity, Passenger Terminal, and Parking Lot

1. INTRODUCTION

A port is a place consisting of land and surrounding waters with certain boundaries as a place for government activities and economic activities used as a place for ships to dock, anchor, embark and disembark passengers and/or load and unload goods equipped with shipping safety facilities and port support activities as well as a place for intra and inter-mode transportation transfers [1]. Water transportation (river and sea) is one part of the national transportation system that plays an important and strategic role in the mobility of passengers, goods, and services both domestically and to and from abroad [2]. The transportation system organized in Bone Regency consists of land, air, river and sea transportation modes, specifically for sea transportation in Bone Regency there are 8 ports, one of which is Bajoe Port which is a national port, 2 regional ports, namely Pattiro Bajo Port and Tuju-tuju Port, 4 local ports, namely Kading Port, Cenrana Pallime Port, Waetuo Port, and Uloe Port, and 1 people's port, namely Lapangkong Port [3]. Bajoe Port is a ferry port that uses Ro-Ro type ships that transport passengers and goods as well as vehicles such as motorbikes, cars, buses, and trucks and other types of vehicles from several regencies/cities in South Sulawesi to Kolaka Regency, Southeast Sulawesi Province [4]. The number of passengers getting on and off at Bajoe Port has tended to increase in the last 5 years with an average growth rate of 3.75 % . Bajoe Port is a ferry port that has a passenger terminal capacity of 730 people with an area of 1,459 m2 [and] a parking area of 8,980 m2 [5, 6]. Due to the increasing number of passengers to be shipped each year, it is suspected that the available terminal capacity cannot accommodate the number of prospective passengers to be shipped. The increasing number of passengers certainly also affects the increasing number of drop-off and pick-up vehicles so that a parking area is needed that meets the needs. The passenger terminal capacity of Bajoe Port is 730 people with an area of 1,459 m2 , while when compared to the passenger flow in 2022 of 414,349 people, if it is assumed that this will continue, it is suspected that the current passenger terminal capacity cannot accommodate passengers in the future. For this reason, this study aims to analyze the capacity of the passenger terminal and parking lot of Bajoe Port, Bone Regency.



(a) Passenger Terminal

(b) Parking Lot

Figure 1. Bajoe Port Passenger Terminal and Parking Lot

2. METHOD

2.1. Passenger Terminal

Passenger terminal capacity planning consists of several components of activities at the terminal [7], including:

1. The waiting room
2. Canteen
3. Administration
4. Tickets, medical, breastfeeding, toilet, etc.

The calculation formula for passenger terminal capacity requirements is based on the Decree of the Minister of Transportation Number KM 40 of 2022 concerning the Implementation of River and Lake Transportation [8] as follows:

$$A_1 = a.\ n\ .\ N.\ x.\ y \quad (1)$$

Where :

A_1 = area of waiting room (m^2)
A = area required for one person (generally a = 1.2 m 2 / person)
n = number of passengers on one ship
N = number of ships arriving/departing at the same time
x = concentration ratio (1.0 -1.6)
y = average fluctuation (1 ,2)

Waiting Room (A1)

Canteen (A2) = 15% x A1 (2)

Administration (A3) = 15% x A1

Tickets, medical, nursing, toilet, etc.

(A4) = 25% x (A1+A2+A3) (3)

So the area of the terminal building required is:

$$A = A_1 + A_2 + A_3 + A_4 \quad (4)$$

2.2. Parking Lot

The parking area is divided into two, namely parking for vehicles that will cross and vehicles dropping off/picking up passengers [9]. The formula for calculating the need for parking space for vehicles that will cross and drop off/pick up vehicles is based on the Decree of the Minister of Transportation Number KM 40 of 2022 concerning the Implementation of River and Lake Transportation [8] as follows:

1. Parking area for vehicles that will cross:

$$A = an\ N.\ x.\ y \quad (5)$$

Where :

A = total area of the crossing vehicle parking area
a = area required for one vehicle unit (m^2)
8 ton truck : 60 m , ^{2}
4 ton truck : 45 ^{m2}

2 ton truck : 25 ^{m2}
Passenger Vehicles : 25 ^{m2}

n = number of vehicles in one ship
N = number of ships arriving/departing at the same time
x = average utilization (1 ,0)
y = concentration ratio (1.0 – 1.6)

2. Required pick-up/drop-off parking area:

A = a.n1.N.xyz 1/n2 (6)

Where :

A = total area of parking area for pick-up/drop-off vehicles
a = area required for one vehicle unit
n_1 = number of passengers on one ship
n_2 = number of passengers in one vehicle (average 8 people/unit)
x = average utilization (1 ,0)
y = concentration ratio (1.0 – 1.6)
z = average utilization (1 ,0)

2.3. Forecasting Methods

Simple linear regression analysis is a linear relationship between one independent variable (X) and a dependent variable (Y). This analysis is to determine the direction of the relationship between the independent variable and the dependent variable, whether positive or negative, and to predict the value of the dependent variable if the value of the independent variable increases or decreases. The data used is usually on an interval or ratio scale. The simple linear regression equation [10] is as follows:

Y = a + bx 1 (7)

Where :

Y = estimated value for the dependent variable
b = value of independent variable
a = intercept
x = coefficient of n variables

3. RESULTS AND DISCUSSION

3.1. Passenger Flow Prediction for the Next 15 Years

Prediction of the number of passengers and vehicles for the medium term, namely the next 15 years, is the first step to determine the capacity requirements of passenger terminals and parking lots [11]. To predict the flow of passengers for the next 15 years (2023 - 2037) using equation (7), where the predicted variables are the flow of ships in the last 5 years as the dependent variable (y) and the number of residents and PDRB as the independent variables (x). Based on the results of the regression analysis and correlation of the equation model:

Table 1. Passenger Flow Equation Model

Function F(X)	**Regression Model**	***Significance* F**	**R *square***	**Meet/Not Meet**
F(X1,X2)	-337909.09 + 0.152 X1 + 0.002 X2	0.103	0.896	No
F(X1)	467325.37 + (-0.035) X1	0.958	0.001	No
F(X2)	51598.91 + 0.002 X2	0.025	0.851	Fulfil

Based on Table 1 of the three equations above using the regression and correlation methods, F(X2) 51598.91 + 0.002 X2 is selected, namely PDRB as variable X2 by considering the significance value of F, which is 0.025 where the significance value of F determines a model can be used if the value is below 0.05. Then the R square value is 0.851 where R square is a determination value that determines how far the X variable affects the Y variable.

Table 2. Projection of Passenger Flow for the Next 15 Years

Year	Passenger Flow Data N/T (Person)
2023	341,869
2027	386,526
2030	420,018
2033	453,511
2037	498,168

Based on table 2, the passenger flow projection for the next 15 years, in 2023 the passenger flow will be 341,869 people until 2037 the passenger flow will be 498,168 people, experiencing a significant increase and will affect the facilities and services at Bajoe port.

3.2. Vehicle Predictions for the Next 15 Years

Prediction using the method in equation (7) , where the predicted variables are the previous year's vehicle flow as the dependent variable (y) and the number of residents and PDRB as the independent variables (x). Based on the results of the regression and correlation analysis, the equation model is obtained :

Table 3. Vehicle Flow Equation Model

Function F(X)	Regression Model	*Significance* F	R *square*	Meet/Not Meet
F(X1,X2)	- 60824.11 + 0.030 X1 + 0.00 03 X2	0.133	0.866	No
F(X1)	46031.82 + 0.005 X1	0.950	0.001	No
F(X2)	17198.98 + 0 .0002 X2	0.033	0.824	Fulfil

Based on Table 3 of the three equations above using the regression and correlation methods, F(X2) 17198.98 + 0.0002 X2 is selected, namely PDRB as variable X2 by considering the significance value of F, which is 0.033, the significance value of F determines that a model can be used if its value is below 0.05. Then R square is 0.824 where R square is a determination value that determines how far the X variable affects the Y variable.

Table 4. Projection of Vehicle Flow for the Next 15 Years

Year	Vehicle Flow Data N/T (Person)
2023	55,445
2027	61,329
2030	65,742
2033	70.154
2037	76,038

Based on table 4, the projection of vehicle flow for the next 15 years, in 2023 the vehicle flow will be 55,455 units until 2037 the vehicle flow will be 76,038 units, experiencing a significant increase and will affect the facilities and services at Bajoe port.

3.3. Passenger Terminal Requirements

The current passenger terminal capacity is 1,459 m^2 . The passenger terminal consists of a waiting room, canteen, administration, and other rooms including (tickets, medical, nursing, toilets, etc.). The calculation of the waiting room capacity requirements is known where the area required for one person (a) is 1.2 m2 ' the number of passengers on one ship (n) is taken from the number of passengers per year/number of ships per year, the number of ships departing or arriving at the same time (N) is assumed to be 1 ship and the concentration ratio (x) is 1.6 and the average fluctuation (y) is 1.2. Then the calculation of the canteen capacity requirements is known to be 15% of the waiting room, and the administration capacity requirements are known to be 15% of the waiting room and the capacity requirements for other rooms (tickets, medical, nursing, toilets, etc.) are known to be 25% of the waiting room, canteen and administration. So that the total capacity requirements for the passenger terminal are obtained from the waiting room capacity, canteen

capacity, administration capacity and other room capacities (tickets, medical, nursing, toilets, etc.). So the calculation of the passenger terminal capacity in 2023 is obtained as follows.

1. The waiting room

A1 = an N. x. y
A1 = 1 .2 m^2 x 363 x 1 x 1.6 x 1.2
A1 = 836 m^2

2. Canteen

A2 = 15% x A1
A2 = 15% x 836
A2 = 125 m^2

3. Administration

A3 = 15% x A1
A3 = 15% x 836
A3 = 125 m^2

4. Tickets, medical, nursing, toilet, etc.

A4 = 25% x (A1 + A2 + A3)
A4 = 25% x (836 + 125 + 125)
A4 = 272 m^2

So the passenger terminal capacity required is:

A = A1 + A2 + A3 + A4
A = 836 + 125 + 125 + 272
A = 1,358 m^2

So from this equation, the passenger terminal capacity requirements from 2023 to 2037 are obtained as follows.

Table 5. Passenger Terminal Capacity Requirements

No.	Year	Passenger (Person)	Call Ship (Unit)	Number of Passengers on One Ship (n)	A1 (m^2)	A2 (m^2)	A3 (m^2)	A4 (m^2)	A (m^2)
1	2023	341,869	942	363	836	125	125	272	1,358
2	2027	386,526	1,029	376	865	130	130	281	1,406
3	2030	420,018	1,094	384	884	133	133	287	1,437
4	2033	453,511	1.159	391	901	135	135	293	1,465
5	2037	498,168	1.246	400	921	138	138	299	1,497

Based on Table 5, it shows that from 2023 to 2037, the need for passenger terminal capacity will increase from 1,358 m2 to 1,497 m2 , so that the current passenger terminal capacity of 1,459 is no longer able to serve the needs until 2037.

3.4. Parking Capacity Requirements for Vehicles Crossing

current capacity of the vehicle parking lot that will cross is 8,980 m^2 . To calculate the parking capacity requirements for vehicles that will cross, the area required for one vehicle unit is known (a) based on the parking space unit (SRP) where for groups I, II, & III it is 1.5 m2 , group V is 15 m2 , group V is 42.5 m2 , and groups VI, VII, VIII, & IX are 42.5 m2 . The number of vehicles on one ship (n) is the number of vehicles per year/number of ship visits per year x percentage of existing data on vehicle visits over the past 5 years based on group, namely 46% for groups. I, II, & III 20% for groups. IV 10% for goals. V and 24% for goals. VI, VII, VIII, & IX. Then the number of ships departing/arriving at the same time (N) is assumed to be 1 ship and the average utilization (x) is 1 and the concentration ratio (y) is 1.0 – 1.6. Then the calculation of the parking capacity requirements for vehicles that will cross in 2023 is obtained as follows.

1. Number of class I, II, and III vehicles on one ship (n)

= Number of vehicles per year / number of ship visits per year x % of vehicles based on groups I, II, and III
= 55,445 units / 942 x 46%
= 27 units .

2. Number of class IV vehicles in one ship (n)
= Number of vehicles per year / number of ship visits per year x % of vehicles based on class IV
= 55,445 units / 942 x 20%
= 12 units
3. Number of class V vehicles in one ship (n)
= Number of vehicles per year / number of ship visits per year x % of vehicles based on class V
= 55,445 units / 942 x 10%
= 6 units
4. Number of class VI, VII, VIII, and IX vehicles in one ship (n)
= Number of vehicles per year / number of ship visits per year x % of vehicles based on groups VI, VII, VIII, and IX
= 55,445 units / 942 x 24%
= 14 units

So the parking capacity required for vehicles crossing is:
A = ((27 x 1 .5 m^2) + (12 x 15 m^2) + (6 x 42.5 m^2) + (14 x 42.5 m^2)) x 1 x 1.0 x 1, 6
A = 1,708 m^2
So from this equation, the parking capacity requirements for vehicles that will cross from 2023 to 2037 are obtained as follows.

Table 6. Parking Capacity Requirements for Vehicles Crossing

No.	Year	Vehicle (Unit)	Call Ship (Unit)	Number of Passengers on One Ship (n)	Goal I, II, III (Unit)	Goal IV (Unit)	Goal V (Unit)	Group VI, VII, VIII, IX (Unit)	Parking Lot Requirement (m2)
1	2023	55,445	942	59	27	12	6	14	1,708
2	2027	61,329	1,029	60	27	12	6	14	1,730
3	2030	65,742	1,094	60	28	12	6	14	1,744
4	2033	70.154	1.159	61	28	12	6	15	1,756
5	2037	76,038	1.246	61	28	12	6	15	1,771

Based on table 6, it shows that from 2023 to 2037, the need for parking capacity for vehicles crossing will increase from 1,708 m2 to 1,771 m2 , so that the current parking capacity of 8,980 m2 is still able to serve the needs until 2037.

3.5. Parking Area Requirements for Delivery/Pick-up Vehicles

The current available passenger drop-off/pick-up parking capacity is 2,984 m^2 . To determine the capacity requirements for the drop-off/pick-up parking lot, the number of passengers on one ship (n1) must first be known, taken from the number of passengers per year/number of ship visits per year, then 50% of passengers are taken using motorbikes and 50% use cars. For (n2) the number of passengers in one vehicle where for motorbikes 2 people per unit and cars 8 people per unit. (N) is the number of ships departing at the same time using 1 ship. The area required for one vehicle unit (a) in this case for motorbikes is 1.5 m2 and for cars 15 m2 , the average utilization (y) where all passengers arrive at the terminal is 1 unit and the concentration ratio (x) is 1.0 - 1.6 and the average utilization (z) where all passengers leave the terminal is 1 unit. Then the calculation of the parking capacity for drop-off/pick-up vehicles in 2023 is obtained as follows.

1. For motor vehicles

Amotor = a.n1.Nxyz1/n2
= 1.5 x (363 x 50%) x 1 x 1 x 1.6 x 1 x 1/2
= 218 m^2

2. For car vehicles

Immobility = a.n1.Nxyz1/n2

= 1.5 x (363 x 50%) x 1 x 1 x 1.6 x 1 x 1/8

= 544 m^2

So the parking capacity required for delivery/pick-up vehicles is:

A = Amotor + Amobil

= 218 m^2 + 544 m^2

= 762 m^2

Based on this equation, the parking capacity requirements for delivery/pick-up vehicles from 2023 to 2037 are as follows.

Table 7. Parking Capacity Requirements for Delivery/Pick-up Vehicles

No.	Year	Passenger (Person)	Call Ship (Unit)	Number of Passengers on One Ship (n)	Motor (m^2)	Car (m^2)	Parking Lot Area (m^2)
1	2023	341,869	942	363	218	544	762
2	2027	386,526	1,029	376	225	563	789
3	2030	420,018	1,094	384	230	576	806
4	2033	453,511	1.159	391	235	587	821
5	2037	498,168	1.246	400	240	600	839

Based on Table 7, it shows that from 2023 to 2037, the need for parking capacity for delivery/pick-up vehicles will increase from 762 m2 to 839 m2 · so that the current available parking capacity for delivery/pick-up vehicles is 2,984 m2 · Still capable serve need until year 2037.

4. CONCLUSION

1. The predicted number of passengers and vehicles is:
   a. The number of passengers visiting Bajoe Port with the equation model Y = 51,598.91 + 0.002 X2, the number of passengers until 2037 was 498,168 people.
   b. The number of vehicles visiting Bajoe Port with the equation model Y = 17,198.98 + 0.0002 X2, the number of vehicles until 2037 is 76,038 units.
2. The capacity of the Passenger Terminal and Parking Lot is:
   a. The current passenger terminal capacity of Bajoe Port is 1,459 m2 from the analysis of passenger terminal capacity requirements until 2037 is 1,497 m2 so that the current passenger terminal capacity is not sufficient until the planned year 2037 and it is necessary to add 38 m2 of passenger terminal capacity to meet the passenger terminal needs at Bajoe Port until the planned year 2037.
   b. parking capacity of Bajoe Port for vehicles that will cross that is currently available is 8,980 m2 and the delivery/pickup vehicles that are currently available are 2,984 m2 · From the results of the analysis of the need for parking capacity for vehicles that will cross and delivery/pickup vehicles until the plan year 2037 is 1,771 m2 and 839 m2 so that the parking capacity of vehicles that will cross and delivery/pickup vehicles that are currently available is still sufficient until the plan year 2037 and there is no need to add parking capacity for vehicles that will cross and delivery/pickup vehicles.

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