

# Moda Choice Between Water Moda And Land Moda On Kertapati Station -16 Ilir Palembang Route

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**Abstract:** The congestion that occurs in Palembang City is caused by the number of vehicles that have exceeded the road capacity. One way to reduce congestion in Palembang is by shifting road loads to the Musi River. research will be carried out on prospects service users to switch from the land mode, namely city transportation (public transportation) to river mode, namely water buses on the Kertapati-16 Ilir route, by comparing traveling time and cost between these modes. If the general cost of water buses is cheaper than the general cost of public transportation, the proportion of water bus use can reach 53%. If the general cost of water buses and city transportation has a price value that is comparable or nearly the same or greater, then the proportion of water bus service users ranges from 30-40 percent, so it is possible that the desire of service users to use water buses is possible.

**Index Terms:** Traveling time, general cost, land mode, river mode.

## 1. INTRODUCTION

The congestion that occurs in Palembang City is caused by the number of vehicles that have exceeded the road capacity. Based on data from the Regional Revenue Agency of South Sumatra Province, the number of motorized vehicles in Palembang in 2018 was 1,066,403, while the capacity of protocol roads in Palembang was only 17,679 units of vehicles per hour with an average area of 161,000 protocol roads. This traffic jam can cause longer travel times, increase vehicle operating costs, which causes high transportation costs to be paid by passengers. Congestion causes increased transportation costs and losses for road users (Ritonga, 2015). Fast and cheap transportation is needed by the community. Especially to reach workplaces, schools and fulfillment of daily needs. One way to reduce congestion in Palembang is by shifting road loads to the Musi River. River transportation has many advantages over road transportation, namely that it is cheaper because the infrastructure is available, it can carry loads with a larger capacity and can reduce air pollution. Palembang City is traversed by the Musi River which is the longest river on the island of Sumatra. The city government of Palembang has begun to develop river transportation by building river docks that can be connected to intermodal public transportation, such as city transportation (public transportation) and "Teman Bus mass" transit or better known as Transmusi. In 2011 the Palembang City Government built a river pier in Kertapati, which is used for goods and passenger transportation. The location of this pier is close to Kertapati Station and is connected to other public transportation, so it is very strategic to use by passengers from or to Kertapati Station. However, this pier has not been used as an alternative mode of passenger transportation in Palembang. Congestion on the Kertapati-16 Ilir highway can be reduced by diverting road transport service users to river transportation as an alternative mode of transportation from Kertapati Station to 16 Ilir or vice versa. Currently, alternative transportation from the Kertapati station to 16 Ilir, only served by city transportation (public transportation) and online transportation. So that the large number of public transports that stop or park along the road in front of Kertapati Station causes congestion along the road. On both knots the route has been inbuild a quite representative river pier and it is feasible in terms of infrastructure. Based on the description above, research will

be carried out on prospects service users to switch from the road mode, namely city transportation (public transportation) to river mode, namely water buses on the Kertapati-16 Ilir route, by comparing traveling time and cost between these modes.

## 2 RESEARCH METHODS

### 2.1 Research Variable

The variables used in this study are rates, travel time, access time, progress time, and vehicle waiting time. In this study, several assumptions were simplified on the variables and values determined by the considerations.

### 2.2 Data Processing Methods

#### 2.2.1. Time Value Analysis

There are various methods that can be used to determine the value of travel time. Two of them are the Income Approach and the Mode Choice Approach.

**TABLE 1**  
*Research Variable*

Variable	Mode of Transport	
	Water mode	Land mode
Rates	IDR 4000	IDR 5000
Travel time	5 minutes	30 minutes
Access time	5 minutes	3 minutes
Time of progress	1 minute	1 minute

#### 2.2.2. Income Approach

This method is relatively simple because it only has two factors, namely Gross Regional Domestic Product (GRDP) per person and the amount of working time in a year per person, assuming that this time is what generates the GRDP. The formula of this method can be seen as follows:

$$\lambda = \frac{\text{GRDI/person}}{\text{Total working time a year/person}}$$

Information :

$\lambda$  = Value of time

GRDI = Gross Regional Domestic Income

**2.2.3. Mode Selection Method**

This method seeks to determine the time value of the model to estimate the preferred ratio of a traffic mode. In this model, the choice ratio is assumed to be a function of two variables, namely operating costs and time costs. Time value  $\lambda$  defined as the ratio of the time cost parameters and operating costs. To find out the value of time, you can use the following equation:

$$Y = a_0 + a_1(Ck - C_m) + a_2(Tk - T_m)$$

$$\lambda = a_2/a_1$$

Information :

Y = dependent variable

Ck-Cm = Difference in cost between water and bus mode of City transport.

Tk-Tm = Difference in travel time between water and bus mode of City transport

a1..a3 = independent variable

a0 = Constant

= Value of time

**2.2.4. General Cost Analysis**

The combined costs for the movement of public transport can be expressed by the following equation:

$$GC = \Phi + VT_a + VT_b + VT_c + VT_d$$

Information :

GC = Combined costs incurred in one trip by water bus or transportation City transport.

$\Phi$  = Fare for one trip in rupiah

Ta = Travel time from Kertapati Pier-16 ilir Palembang in minutes

Tb = Access time (Time required by service users to reach the dock / terminal) in minutes

Tc = Time of progress (Time required by service users to get to the final destination) in minutes

Td = Time to wait for the vehicle (minutes)

V = Time value per one way trip in rupiah

**2.2.5. Frequency and Descriptive Analysis**

Based on the general cost comparison between water buses and City transport, then it also affects the choice of respondents who will travel from Route Kertapati-16 ilir. Based on the calculation of general cost, it will be obtained the number of respondents either using water buses or using City transport using the SPSS 15.0 program for windows evaluation version based on 2 analyzes, namely the frequency and descriptive analysis which can also be described using the histogram chart on SPSS.

**3 RESULTS OF ANALYSIS AND DISCUSSION**

**3.1. Description of Respondent Characteristics**

The characteristics of the 80 respondents can be seen in Table 2

**TABLE 2**  
**Respondent Characteristics**

No.	Characteristics	Respondents	amount
1	Gender	a. Male b. Women	60 20
2	Age	a. <20 years b. 21-30 years c. 31-40 years d. 41-50 years e. 51-60 years	10 20 42 8 -
3	Profession	a. PNS / TNI b. Private c. entrepreneur d. Student / Student e. Does not work	10 14 41 15 5
4	Income	a. There is no income b. <IDR 3.2 million c. IDR3,2 million-IDR 5 million d. IDR5 million-IDR 10 million e. > IDR10 million	1 11 36 28 -

**3.2. Variable Formation**

**3.2.1. Time Value Analysis**

There are two analysis of the time value, namely: Income Approach Method and Mode Choice Approach Method. The calculation of the time value using the Income Approach method is quite simple, because it only has 2 factors, namely the Gross Regional Domestic Product (PDRB) of each person and the annual working hours of each person. Based on data from BPS, it is known that the per capita income of the population is IDR21,738,146 and the number of workdays 301 days, namely the number of calendar days (365 days) minus the number of holidays (64 days) and the total working minutes of 420 minutes / day, namely the number of work days (7 hours / day) multiplied by 60 minutes / hour. The results of the calculation are as follows:

$$\text{VOT per person} = \frac{\text{IDR}21.738.146}{301\text{days} \times 420\text{minutes}}$$

The time value analysis method used in this study is the Mode Choice Approach method and the required data is based on the difference in travel costs or travel costs and the time difference used. The time value calculation is based on the following formula:

$$Y = a_0 + a_1 (Ck - C_m) + a_2 (Tk - T_m);$$

$$\lambda = a_2 / a_1$$

This equation uses multiple linear regression, for Y is the dependent variable, (Ck-Cm) is the first independent variable (X1), (TK-Tm) is the second independent variable (X2), a0 is a constant, a1 is the coefficient of the independent variable first, and a2 is the coefficient of the second independent variable. This equation is obtained from the results of reduction and is an option offered to respondents in Table 3.

**TABLE 3**  
*Respondents' Choice of Alternatives*

No.	Fare Difference (Rp / trip)	Time Difference (minutes / trip)
1	-1000	+2
2	-1500	+10
3	+1500	-2
4	+1000	+10

By using multiple linear regression, the parameters for the multi linear regression equation are:

$$Y = 238.37874 - 0.00658.X1 - 0.77575.X2$$

So that the time value is obtained,  $\lambda = a2 / a1$  and the total time value  $\lambda = \text{IDR}117.92929 / \text{minute} / \text{person}$ .

### 3.2.2. Time Value Analysis Based on Respondent Characteristics Segmentation

The calculation of the time value is based on segmentation, namely gender, age, occupation and income, which is calculated the same as the total analysis of the total respondents' choices. Based on the above equation, the time value can be found, namely by using the formula  $\lambda = a2 / a1$ .

### 3.2.3. General cost analysis

In general, there are two main components that are needed in calculating the general cost of the entire trip, namely the transportation operating costs that are charged to service users in the form of tariffs, value of travel time, transportation travel time, and service frequency. The formula is as follows:

$$GC = \Phi + VTa + VTb + VTc + VTd$$

How to calculate general cost is obtained by the following calculations:

Water Moda

Travel Fares ( $\Phi$ ) = IDR4000

Time Value (VoT) = IDR118

VTa = IDR118 x 5 minutes = IDR590

VTb = IDR118 x 5 minutes = IDR590

VTc = IDR118 x 1 minute = IDR118

VTd = IDR118 x 15 minutes = IDR1,770

Total general cost of service users water bus are as follows:

$$\begin{aligned} GC &= \Phi + VTa + VTb + VTc + VTd \\ &= \text{IDR}4000 + \text{IDR}590 + \text{IDR}590 + \text{IDR}118 + \text{IDR}1,770 \\ &= \text{IDR}7088, - \end{aligned}$$

Land Moda

Travel Fares ( $\Phi$ ) = IDR5000

Time Value (VoT) = IDR118

VTa = IDR118 x 30 minutes = IDR3,540

VTb = IDR118 x 3 minutes = IDR354

VTc = IDR118 x 1 minute = IDR118

VTd = IDR118 x 5 minutes = IDR590

The total general cost of city transportation car service users is as follows:

$$\begin{aligned} GC &= \Phi + VTa + VTb + VTc + VTd \\ &= \text{IDR}5000 + \text{IDR}3,540 + \text{IDR}354 + \text{IDR}118 + \text{IDR}590 \\ &= \text{IDR}9.602, - \end{aligned}$$

### 3.3. Scenario Formation

Scenario formation is carried out to determine the various effects or changes in probability that occur in each alternative if there is a change in the variable. The scenario formation is made by tiering several changes in tariffs, length of travel time, and waiting time which are classified into one general cost. Scenario one is considered as the current condition, while scenario two to seven is the basis for the model scenario used.

#### 3.3.1. Scenario One

Water Bus Fares IDR 4000, the travel time is 5 minutes, and the waiting time is 15 minutes, while the public transportation fare is IDR 5000, the travel time is 30 minutes, and the waiting time is 5 minutes, so the total general cost on the water bus is IDR 7,068, while for public transportation the amount of IDR 9,602.

#### 3.3.2. Scenario Two

The water bus fare is IDR 5,000, the travel time is 3 minutes and the waiting time is 30 minutes, while the public transportation fare is IDR 5,000, the travel time is 30 minutes, and the waiting time is 5 minutes, so that the total general cost on the water bus is IDR 8,602, while for public transportation it is IDR 9,602.

#### 3.3.3. Scenario Three

The water bus fare is IDR 4000, the travel time is 5 minutes, and the waiting time is 15 minutes, while the public transportation fare is IDR5000, the travel time is 25 minutes, and the waiting time is 6.7 minutes, so we get the total general cost on the water bus amounting to IDR 7,068, while for public transportation the amount of IDR 8,212.6.

#### 3.3.4. Scenario Four

Water bus boat fare IDR 4,500, the travel time is 5 minutes and the waiting time is 15 minutes, while the public transportation fare is IDR5000, the travel time is 20 minutes, and the waiting time is 10 minutes, so we get the total general cost on the water bus amounting to IDR7,568, while for public transportation the amount of IDR7,012.

#### 3.3.5 Scenario Five

The water bus fare is IDR5,000, the travel time is 10 minutes and the waiting time is 10 minutes, while the public transportation fare is IDR5000, the travel time is 35 minutes, and the waiting time is 4.3 minutes, so that the total general

cost on the Water Bus Ship is IDR10,068, while for public transportation, it is IDR11,609.4.

### 3.3.6. Scenario Six

Water bus boat fare IDR8,000, the travel time is 15 minutes and the waiting time is 7.5 minutes, while the public transportation fare is IDR5000, the travel time is 40 minutes, and the waiting time is 3.75 minutes, so we get the total general cost on the water bus amounting to IDR11,363, while for public transportation the amount of IDR11,134.5.

### 3.3.7. Scenario Seven

Water bus boat fare IDR11,000, the travel time is 20 minutes, and the waiting time is 6 minutes, while the public transportation fares are IDR5000 travel time for 45 minutes, and waiting time for 3.3 minutes, so you get the total general cost on the Water Bus Ship amounting to IDR14,776, while for public transportation the amount of IDR11,671.4. Based on the scenario results, the overall percentage of respondents in choosing the mode to be used can be seen in table 3.3 of the following stated preference questionnaire results: the proportion of water mode and land mode service users will be obtained as shown in Table 4 below:

**TABLE 4**  
*Proportion of Service Users to Mode Selection*

No	Passenger		Proportion of Passengers	
	Water Mode	Land Mode	Water Mode	Land Mode
1	93	65	0.63	0.37
2	85	73	0.53	0.47
3	56	102	0.35	0.65
4	48	110	0.30	0.70
5	70	88	0.44	0.56
6	56	102	0.35	0.65
7	52	106	0.33	0.67

### 3.5. Analysis of the Effect of Overall Costs on Mode

The effect of the overall cost (general cost) on the choice of water bus and public transportation modes on the Kertapati-16 Ilir Palembang route can be seen in Table 5.

**TABLE 5**  
*Results of Calculation of Water Bus Proportions and City Transportation (public transportation)*

### 3.6. Analysis Discussion

Based on the results of the analysis described above and looking at the results of the analysis discussed in this study, there are several things that need to be used as a rationale for achieving the expected output in this study, namely:

- General cost, for the two transport modes analyzed; that the GC water bus per person is IDR7,068 and public transportation is Rp 9,602.
- If we consider the public's willingness to pay the price of transportation and the ability to pay transportation service users, there are several options that are expected by users of transportation services, which are as follows:

- The first scenario, where the water bus fare is IDR4000, travel time is 5 minutes, waiting time is 15 minutes and public transportation fare is IDR5000, average waiting time is 5 minutes, travel time is 30 minutes; where GC Transmusi is IDR9,602, and GC water bus is IDR7,068, from this scenario it shows that water buses are cheaper than public transportation.
  - The second scenario is that the water bus fare is IDR5000; Transmission is also IDR5,000, so the general cost (GC) of water buses is around IDR1,000 cheaper and this indicates that water buses have more opportunities to be implemented because they are generally cheaper.
  - The opportunity is the same for scenarios 3 and 4, from the point of view of general cost (GC) analysis, but proportionally public transportation is preferred over water buses (above 50%) because the price of a water bus ticket is still comparable to the price offered by public transportation water buses are still quite adequate to choose from.
- c. Identify the proportion of options based on water bus and public transportation fares that the options for river transportation are as follows:
- If the general cost of water buses is IDR 5068 and GC public transportation is IDR 8,000; use of water buses can reach 53%.
  - If general cost has a price value that is comparable or nearly the same or greater, then the proportion of water bus service users ranges from 30-40 percent; meaning that it is still possible to attract the desire of river transport service users to encourage greater use or choice of this mode; This performance is analyzed on scenario 3 to scenario 7, where the generalize cost of water buses is still comparable to that of public transportation.

## 4 CONCLUSION

Based on the research analysis, it can be concluded as follows:

- The proportion of water bus service users is as follows:
  - If the general cost of water buses is cheaper than the general cost of public transportation, the proportion of water bus use can reach 53%.

No.	GC		Proportion	
	Water Bus	Public transportation	Water Bus	Public transportation
1	IDR 5,068	IDR 8,102	0.53	0.47
2	IDR 5,602	IDR 8,102	0.47	0.53
3	IDR 5,068	IDR 6,712.6	0.35	0.65
4	IDR 5,068	IDR 5,512	0.30	0.70
5	IDR 8,068	IDR 11,609.4	0.44	0.56
6	IDR 11,363	IDR 15,134.5	0.35	0.65
7	IDR 14,776	IDR 18,671.4	0.33	0.67

- If the general cost of water buses and city transportation has a price value that is comparable or

nearly the same or greater, then the proportion of water bus service users ranges from 30-40 percent, so it is possible that the desire of service users to use water buses is possible.

- b. Efforts that must be made so that river transportation is more desirable than city transportation (public transportation) are as follows:
- 1) Fares must be lower than road freight.
  - 2) The waiting time for transportation is shortened.
  - 3) Shortened travel time.
  - 4) River transportation convenience is prioritized.
  - 5) Improved transit service convenience .
  - 6) Increase socialization efforts that are more comprehensive and effective.

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