Analysis on the willingness to pay and ability to pay in determining the fares of Sigli - Banda Aceh toll road

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Abstract. The Sigli - Banda Aceh toll road, which has a length of 75 km, is part of the construction project of the Banda Aceh - Binjai toll road section. This toll road will become the first toll road in Aceh, so it is needed to do the research in order to plan the toll rates. The purpose of this study is to find out the value of ability to pay (ATP) and willingness to pay (WTP) of the community on toll fares. Observation surveys were carried out for two days, which is on Saturday and Sunday. The types of vehicles reviewed are group i vehicles which is light vehicles namely sedans, passenger car, and small buses, group II which is the truck with two axles, group III which is a truck with three axles, group IV which is the truck with four axles, and group V which is the truck with five axles or more. The results of the ability to pay (ATP) fares analysis for each group are as follows: group I (LV) is Rp. 60,193 which is rounded to Rp. 61,000; group IIA (MHV) is Rp. 174,089 which is rounded to Rp. 174,000; and Group IIB (LT & LB) is Rp. 120,579 which rounded to Rp. 121,000. On the other hand, the results of the willingness to pay (WTP) analysis for each group are as follows: group I (LV) is Rp. 52,305 which is rounded to Rp. 53,000; group IIA (MHV) is Rp. 124,655 which is rounded to Rp. 125,000; and group IIB (LT & LB) is Rp. 110,052 which is rounded to Rp. 110,000.

1. Introduction
The development of infrastructure, such as the construction of Banda Aceh-Binjai toll road, is a logical and strategic choice in order to increase Indonesia’s competitiveness. The Aceh toll road consists of four roads with a total length of 455 km, which consists of 75 km for Banda Aceh-Sigli, 135 km for Sigli – Lhokseumawe, 135 km for Lhokseumawe - Langsa, and 110 km for Langsa - Binjai. The construction of this first Aceh toll road started from the Sigli - Banda Aceh Corridor with a length of 75 km. This toll road will become the first toll road in Aceh, so it is needed to do the research in order to plan the toll rates or fares.

Based on the regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia (2018), No 10/PRT/M/2018 [1], the toll road is a public road which is part of the road network system and as the national road; those who use it are required to pay tolls. For toll road users themselves are people who use motorized vehicles by paying the toll. Toll road development will affect economic development, and increase the mobility and accessibility of people and goods.

The purpose of this study is to find out the value of ability to pay (ATP) and willingness to pay (WTP) of the community on toll fares. This research was conducted on the Sigli - Banda Aceh toll road with a length of 75 km. Observation surveys were carried out for two days. The type of vehicles reviewed...
is the group I vehicles which is light vehicles, namely sedans, passenger car, and small buses, group II which is truck with two axles, group III which is a truck with three axles, group IV which is truck with four axles, and group 5 which is a truck with five axles or more. The analysis of vehicles uses Pacific Consultant International method [2].

2. Literature review

2.1. Toll road
The toll road is a public road as part of a road network system and as a national road. The users of this road are required to pay tolls [3]. Toll road users are people who use motorized vehicles by paying tolls. Toll road fare is a certain amount of money that is paid for the use of toll roads [4]. The operation of the toll road itself is intended to realize the development of equality and balance in the region. The development can be achieved by fostering a road network whose funds come from road users.

The technical requirements for toll roads are:

a. Toll roads have a higher level of security and comfort services compared to the general public roads; it can serve long-distance traffic flow with high mobility.

b. Toll roads used for inter-city traffic are designed based on the plan speed of at least 80 km per hour; the toll road in urban areas are designed with a plan speed of at least 60 km per hour.

c. Toll roads are designed to be able to withstand the heaviest axle loads of at least 8 tons.

d. Each toll road segment must be fenced off and equipped with crossing facilities in the form of bridges or tunnels.

e. In sections that can endanger toll road users, they must have security build, which has the strength and the structure that can absorb the impact energy of the vehicles.

f. Toll roads must be equipped with rules and orders which are stated in the form of traffic signs, road marking, or traffic signaling devices.

2.2. Fare
Fare is the price of transportation services that must be paid by the service users, whether through agreement lease, bargaining, and government provisions [4]. The price of transportation services is determined by following the commonly applied fare system. There are no provisions that bind the transport company and owner of goods or passengers except what is set in the fare books.

Several general principles that underlie the fare determination, which is based on [5]:

- The number and characteristics of passengers,
- Characteristics of public transport passengers, and
- Vehicle operational cost.

In order to handle the fare policies, any purposes that have been made in the end will be made as the decision that consider two things: first, fare rates are the amount charged and has a range from rates of free until the fare rates charged to make a profit for the service; second, the fare rate structure is calculated and the procedure of payment is decided.

2.3. Ability to pay (ATP)

Ability to pay (ATP) is a person’s ability to pay for services he or she receives based on ideal income. The method used in the ATP analysis is based on the cost allocation for transportation from the routine income. In other words, ATP is the ability of the community to pay the cost of their trip [5]. The calculation of ATP is done by using these following formulas:

\[
ATP = \frac{I_x \cdot P_p \cdot P_t}{T_t}
\]  

Information:
ATP : Ability to pay, Rp;
I_x : Respondent income per month, Rp;
Pp : Cost transportation per month, percentage of the total income;
Pt : Allocation percentage cost transportation for toll, %; and
Fr : Frequency of respondent travel time.

2.4. Willingness to pay (WTP)
Willingness to Pay (WTP) is the willingness of service users to pay the fares for the services they obtain. The approach used was based on the perception of the fares of the transportation service [3]. The purpose of WTP is to obtain the optimum and realistic amount of toll fares based on the community's willingness to pay, but still attract investors to invest.

Factors that influence the amount of willingness to pay:
- Products offered or provided by transportation service operators;
- Provided quality and quantity services;
- Users utility for transportation services;
- User characteristics.

The value of WTP is obtained by averaging selected fares perception for each type of work, namely:

\[
WTP_{\text{type of works}} = \frac{\sum (\text{selected fares} \times \text{number of respondent})}{\text{the total number of respondents for each type of work}}
\]  
(2)

\[
WTP_{\text{all works categories}} = \frac{\sum (WTP_{\text{type of works}})}{\text{number of work categories}}
\]  
(3)

2.5. The relation between ATP and WTP
In order to determine the fares obstacles between the value of ATP and WTP, these conditions are then illustrated as follows:

a. ATP greater than WTP
   This condition indicates that the ability to pay is greater than the willingness to pay. It occurs when users have a relatively high income, but utility or the needs on services are relatively low.

b. ATP lower than WTP
   This condition shows that the willingness of users to pay the services is greater than the ability to pay. Maybe it occurs because the users have a relatively lower income, but the utility or the needs on service is relatively high so that the user has no options. The willingness of users to pay for these services tends to be influenced by the utility or the high dependency.

c. ATP equal with WTP
   This condition shows that the ability and willingness to pay are equal. This condition occurs when the balance of users' utility with the services cost charge happens.

3. The methodology of the research

3.1. Surveyor and equipment
In this research, several surveyors are in charge of the following jobs:
   a) Recording traffic volume.
   b) Distributing questionnaires.

The equipment used in this research are:
   a) Wristwatch, which is used to review the time in order to record traffic volume.
   b) Traffic volume survey form, which is used to record the number of vehicles that passed the Sigli - Banda Aceh road.
   c) The questionnaire, which will be filled by passengers.
d) Stationery, which helps both the respondents to fill out the questionnaires and surveyor to fill out the survey form.

3.2. Data collecting method

The data collected in this research are the primary and secondary data. Primary data is the data that directly obtained by surveying the research location, while secondary data is the data obtained in order to support the research. The secondary data is obtained through relevant agencies.

A. Primary data

Primary data includes:

1. Traffic volume that obtained from traffic surveys based on the regulation of Minister of Public Works and Public Housing of the Republic of Indonesia (2007), No. 370/KPTS/M/2007, about the determination of the vehicles type on the operating toll road and the amount of toll fares on the several toll road sections, which are as follows:
   - Group I Vehicles (LV): sedans, jeep, pick up, small bus, small truck, and medium bus;
   - Group II Vehicles (MHV): truck with two axles;
   - Group III Vehicles (LT dan LB): truck with three axles;
   - Group IV Vehicles (LT dan LB): truck with four axles; and
   - Group V Vehicles (LT dan LB): truck with five or more axles.

2. Questionnaire

B. Secondary Data

Secondary data covers:

1. Data of prices and material for vehicle operational cost calculation, including:
   - Premium fuel, in the unit price (Rp/liter);
   - Diesel, in the unit price (Rp/liter);
   - Oil for premium fuel engines, in the unit price (Rp/liter);
   - Oil for diesel fuel engines, in the unit price (Rp/liter);
   - New tire prices;
   - New vehicle prices;
   - Depreciating vehicle prices;
   - Insurance; and
   - Interest rate.

2. Population data and gross regional domestic product data issued by the Central Agency Statistic of Aceh Province in 2018;

3. Planned toll road data and figures of detail engineering drawing (DED);

4. Road geometric data.

3.3. Population and sample

The population taken in this research is the population of Banda Aceh, Aceh Besar, and Pidie, which is in total 564,911 people. There are eight age categories divided in this research, namely: 20 – 24, 25 – 29, 30 – 34, 35 – 39, 40 – 44, 45 – 49, 50 – 54, and 55 – 59. Based on the Slovin Formulas [6], by using 10% error tolerance, the number of samples taken is 100 samples.

3.4. Data processing method

After data from in the field is obtained, the data then being processed based on the formulas that have been stated in section 2. The data was processed by using software Microsoft office excel with MKJI [3] and vehicle operational cost based on the PCI method [2]. From these data, the researcher will plan four scenarios. Then, ATP was analyzed by using the income allocation method, whereas WTP was analyzed using Microsoft excel.
4. Results and discussions

4.1. Respondents characteristics

The most significant percentage for respondents' gender was male (91%); the rest, female, was 9%. The highest percentage of respondents' age is 25-29 years (18%), and the lowest one is 40 - 59 years and 55 - 59 years, each of which is 6%. Then, the highest percentage of respondents’ last education is high school (68%), while the lowest percentage of respondents last education is S2 (1%) and junior high school (1%). The most significant percentage of respondent jobs is the driver (40%), whereas the lowest percentage is for the director and notary public, each of which is 1%.

For travel purposes, the largest percentage is the group of people who go for work or business (52%), whereas the group having the smallest percentage is people who go for other activities (1%). For the dependency, respondents who have the most dependence are the person having two family members, with a percentage of 36%, while the smallest percentage is for the family with five members, which is 55%. For the frequency of passing the road, the most dominant group is who passes the existing road route one to two times (81%) and the most minority group is who passes the existing road route more than three times (23%). Regarding the dependents family, the majority group is who have five dependents family (5%).

4.2. Fares scenario

Based on the results of the research, higher the fares proposed in the questionnaire, fewer respondents agree with the fares, and so vice versa. The following is a graph showing the number of respondents who agree and disagree with the fares based on the fares scenario.

![Graph showing the number of respondents who agree and disagree with the fares based on the fares scenario.]

**Figure 1.** The distribution of respondents based on the reason for choosing the planned toll fares.

4.3. Fare analysis based on ability to pay (ATP)

**Table 1.** Ability to pay (ATP) for every group of vehicles.

| Job            | Number of respondents | Average income / month (Rp) | Percentage of transportation cost/month | Percentage of toll cost/month | Travel frequency | ATP for each type of jobs (Rp) |
|----------------|-----------------------|-----------------------------|-----------------------------------------|-----------------------------|------------------|--------------------------------|
| Group I        | 129                   | 2,800,000                   | 26%                                     | 25%                         | 3.00             | 60,193                        |
| Group IIA      | 32                    | 9,050,000                   | 26%                                     | 26%                         | 3.44             | 174,089                       |
| Group IIB      | 39                    | 7,012,821                   | 28%                                     | 24%                         | 3.82             | 120,579                       |
| **Total**      | **200**               |                             |                                         |                             |                  |                                |
Table 2. Recapitulation of ability to pay (ATP) for every group of vehicles.

| Job       | Number of respondents | ATP for each type of job | Rounded  |
|-----------|-----------------------|--------------------------|----------|
| Group I   | 129                   | Rp. 60,193               | Rp. 61,000 |
| Group IIA | 32                    | Rp. 174,089              | Rp. 174,000 |
| Group IIB | 39                    | Rp. 120,579              | Rp. 121,000 |
| Total     | 200                   |                          |          |

4.4. Analysis of willingness to pay (WTP)

Table 3. Value of willingness to pay (WTP) each group for vehicle group I (LV).

| Type of work         | Type WTP of work (Rp) | WTP throughout job categories (Rp) | Rounded up |
|----------------------|-----------------------|-----------------------------------|------------|
| Retirement           | 59,233                |                                   |            |
| Businessman          | 46,763                |                                   |            |
| Student              | 34,293                |                                   |            |
| Government Employees | 81,055                |                                   |            |
| Staff/ Private       | 40,875                |                                   |            |
| Supervisor           | 49,881                |                                   |            |
| Driver               | 54,037                |                                   |            |

Table 4. Value of willingness to pay (WTP) each group for vehicle group IIA (MHV).

| Type of work         | Type WTP of work (Rp) | WTP throughout job categories (Rp) | Rounded up |
|----------------------|-----------------------|-----------------------------------|------------|
| Retirement           | 141,166               |                                   |            |
| Businessman          | 111,447               |                                   |            |
| Student              | 81,728                |                                   |            |
| Government Employees | 193,174               |                                   |            |
| Staff/ Private       | 97,413                |                                   |            |
| Supervisor           | 118,877               |                                   |            |
| Driver               | 128,783               |                                   |            |

Table 5. Value of willingness to pay (WTP) each group for vehicle group IIB (LB & LT).

| Type of work         | Type WTP of work (Rp) | WTP throughout job categories (Rp) | Rounded up |
|----------------------|-----------------------|-----------------------------------|------------|
| Retirement           | 124,628               |                                   |            |
| Businessman          | 98,391                |                                   |            |
| Student              | 72,153                |                                   |            |
| Government Employees | 170,543               |                                   |            |
| Staff/ Private       | 86,001                |                                   |            |
| Supervisor           | 104,950               |                                   |            |
| Driver               | 113,695               |                                   |            |

4.5. Analysis of ability to pay (ATP) and willingness to pay (WTP)

Based on the fare of willingness to pay (WTP) of Sigli - Banda Aceh toll road, the fare for vehicles group I is Rp. 53,000, group IIA is Rp. 125,000, and group IIB is Rp. 110,000. The comparison of fares analysis based on a maximum of 70% of the profit of vehicle operational cost, ability to pay (ATP), and willingness to pay (WTP) can be seen on the fares recapitulation on the following table.
Table 6. Recapitulation of the groups II of vehicle fares.

| Type of fares                                      | Group I (LV)  | Group IIA (MHV) | Group IIB (LT & LB) |
|----------------------------------------------------|---------------|-----------------|---------------------|
| Based on the maximum 70% of the profit from vehicle operational cost | Rp. 87,290    | Rp. 208,033     | Rp. 183,661         |
| Based on ATP approach                              | Rp. 60,193    | Rp. 174,089     | Rp. 120,579         |
| Based on WTP approach                              | Rp. 52,305    | Rp. 124,655     | Rp. 110,052         |

Table 7. Recapitulation of the II groups of vehicle fares for a distance of 75 km.

| Type of Fares                                      | Plan rates for 75 km (Rp) |
|----------------------------------------------------|---------------------------|
| Group I (LV)                                       | Group IIA (MHV)           | Group IIB (LT & LB)  |
| Based on the maximum 70% of the profit from vehicle operational cost | Rp. 1,164 ≈ 1,200 /1 km  | Rp. 2,774 ≈ 3,000 /1 km | Rp. 2,449 ≈ 2,500/1KM |
| Based on ATP approach                              | Rp. 803 ≈ 800 /1 km      | Rp. 2,321 ≈ 2,300 /1 km | Rp. 1,608 ≈ 1,600/1KM |
| Based on WTP approach                              | Rp. 697 ≈ 700 /1 km      | Rp. 1,662 ≈ 1,700 /1 km | Rp. 1,467 ≈ 1,500/1KM |

5. Conclusions and recommendations

The conclusions, which can be taken in determining vehicle operational cost for Sigli - Banda Aceh toll road fares based on the 70% maximum of the profit from vehicle operational cost, is as follows:

1. The results of the ability to pay (ATP) fares analysis for each group are Group I (LV) is Rp. 60,193, which is rounded to Rp. 61,000, group IIA (MHV) is Rp. 174,089, which is rounded to Rp. 174,000, and group IIB (LT & LB) is Rp. 120,579, which is rounded to Rp. 121,000.

2. The results of the willingness to pay (WTP) analysis for each group are the group I (LV) is Rp. 52,305, which is rounded to Rp. 53,000, group IIA (MHV) is Rp. 124,655, which is rounded to Rp. 125,000, group IIB (LT & LB) is Rp. 110,052, which is rounded to Rp. 110,000.

The suggestions proposed based on this research are as follows:

1. It is recommended to conduct financial investment/financial analysis and economic value to determine the fares of Sigli - Banda Aceh toll road.

2. It is hoped that this research can be a reference and consideration for authorities involved in determining the fares for the Sigli - Banda Aceh toll road.

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