Analysis of Potential Mass Public Transport Choice Using Geographic Information System (Case Study: Commuter Line Jakarta – Bogor)

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Abstract. Mode choice by travellers is carried out with several considerations. The interesting point is, some public transport users have their private vehicles. No research has described how many travellers can choose the mode and how significant their shift is to mass public transportation. The aim of research was carried out by analysing the potential for selecting mass public transportation by considering the socio-demographic, economic and vehicle ownership characteristics with the variable distance, time and travel costs based on user preferences. According to the special condition, mode choice by rail-based transit mode is called KRL commuter line, bus and private vehicle at Jakarta–Bogor Corridor become research location. Research method of mode choice probability has been developed using Multinomial Logit Model (MLM) by transport cost, time travel and distance variable. A graphical descriptive approach method based on an equation model will then overlay the site to get the results of mode selection pattern using Geographical Information System (GIS). The application of the Transit-Oriented Development (TOD) concept will be more effective if there is a transit-based mass transportation mode such as Rail-based Commuter Line (KRL) as an option, besides travellers also having private vehicles. The Result of this research is described by transport cost, travel distance, and time travel based on the revealed preference survey by 324 respondents. 50% of private car travellers are influenced by trip distance, but probability decreases if time travel increases and they switch to public transport. Users consider choosing a commuter line if the walk distance to the station is about 200 meters. On the other side, increase transport costs makes some travellers choose bus mode.

Keywords: mass public transportation, Geographic Information System (GIS), Transit-Oriented Development (TOD)

1. Introduction

The transport modes selection for the community is decided with several considerations. The first is that there is a possibility that pedestrians, who are assumed to be the users of public transportation, would switch from one public transport to another when they end route to their destination. The second is that there is a possibility that private vehicle users would change to public transportation after they...
park their vehicle at a transit point. The third is that people who use personal vehicles are considered non-absolute factors; since it is predicted that some would switch to public transportation, it is more efficient. The role of these considerations is essential to be identified to map each planned zone's capabilities, which may not always be equally distributed in strength.

The interesting thing is that some people who often use public transportation have a private vehicle. So far, there has been no research that can clarify how many commuters can choose their transport modes and how frequent they shift to public transportation. This research is conducted by analysing the potential of public transport selection by considering socio-demographic characteristics, economy and vehicle ownership (with distance, time and travel cost variables - based on user preferences). The probability of transport mode selection has been developed using the Multinomial Logit Model (MLM) [1,2] between private vehicles, buses, as well as KRL Commuter Line by cost, time and distance variables.

People tend to choose the most profitable transport modes, both in economy and efficiency and the desired level of service [3]. The estimation of passengers' density on public transport will depend on the expectation of seasonal travel - and it will always provide an estimate for random density in a public transportation system [4]. Individual preference towards public transportation can be measured and ranked according to the order of preference. The essential travel attribute is "arrive on time", followed by "easy access to seats", "does not need to switch to other transport modes", "good service", "provided with a protection against the weather when waiting for the transportation" - as well as significantly reduce the stopping/waiting time" [5].

2. Data and Methods

2.1 Locus Description

The study areas are around the rail corridor, highways and toll roads along Jakarta-Bogor, which goes through Kota Bogor, Kabupaten Bogor and Kota Depok - and then continues to Jakarta areas; i.e., Jakarta Selatan-Jakarta Pusat in Tanah Abang. Figure 1 describes the study area.

![Figure 1. Research Location](image-url)
2.2 Revealed Preference Survey

The Revealed Preference Survey is conducted through a direct and online interview. This interview aims to collect data on the tendency of the outlooks of potential users of the Jakarta-Bogor Corridor. The sampling method is done using a simple random sampling method, with the determination of this research location; initiated from the consideration that these locations are in direct contact with potential users of the Jakarta-Bogor Corridor. Questionnaires are also made to ask for public or 'respondents' opinions, which are primarily commuters who are currently on-site at that time, willing to be interviewed, as well as to fill out online questionnaires; considering that Indonesia is still under Community Activities Restrictions Enforcement (PPKM) [6].

In this sampling, \( N \) is the population size obtained from the number of passengers commuting through the Jakarta-Bogor Corridor each day. The \( N \) value is 364,127 people/day during the November 2020 pandemic. The number of samples is determined using a 5% - 10% error margin, with a 90% to 95% reliability level, with a normal value of 1.645-1.960 for the variable (\( Z \)) [7]. Based on the load factor, the proportion of the population used is 70% of the calculated population. Based on the calculation using the above formula, it is possible to calculate the sample size taken in this research. Equation 1 describes the calculation of the sample size which would be used:

\[
n = \frac{(NZ^2 P(1 - P))/Nd^2 + Z^2 P(1 - P)}{(1)}
\]

\[N_{(95\%)} = \frac{(364.127 (1,960)^2 70\% (1-70\%)) / 364.127 (5\%)^2+(1,960)^2 70\%(1-70\%)}{364.127 (10\%)^2+(1,645)^2 70\%(1-70\%)} = 322.35
\]

\[N_{(90\%)} = \frac{(364.127 (1,645)^2 70\% (1-70\%))/364.127(10\%)^2+(1,645)^2 70\%(1-70\%)} = 80.64
\]

Based on the above calculation, one can take a minimum of 323 samples to obtain a 95% reliability rate. Three hundred and fifty-one questionnaires were distributed with a random sampling method and returned, from which twenty-seven responses were excluded for further analysis process due to incompleteness. It is somewhat surprising that respondents did not show the sign of response contamination, so that in answering the questions asked, they merely answered according to what they wanted. The sign of response contamination can usually be seen in the interview. For instance, the respondent is not answering the questions asked by showing their behaviour. They consider lots of public opinions related to the questionnaire's topic.

2.3 Data

From Figure 2, it can be seen that of the 324 respondents, 71% prefer to commute through Jakarta-Bogor Corridor using KRL Commuter Line, 17% prefer to use a private vehicle, and only 12% prefer to use a bus. Figure 2 shows that KRL Commuter Line is quite preferred - based on vehicle ownership and respondents' economic level.

![Figure 2. Mode Choice Proportion](image-url)
From Figure 3, it can be seen that there are 63% of respondents own private vehicle(s), while the remaining respondents (i.e., 37%) do not. Respondents’ vehicle ownership varies when it comes to the amount and type. The consideration of mode selection is based on three constraint variables: cost, time, and distance. However, those variables are described in terms of transport cost, travel time, privacy, travel distance, and safety. There are two subjective variables, which are privacy and safety. These are used as qualitative variables to get a more objective function. The following is the proportion of mode choice considerations:

![Vehicle Ownership Proportion](image)

**Figure 3. Vehicle Ownership Proportion**

2.4 **Method**

Mode selection is essential in transportation planning. The use of public transportation modes is macro-economically more efficient. Furthermore, if people switch to public transportation modes, private vehicles will benefit from improved service levels due to the increase in this mode. All private vehicles can't be contained on a city's road network system since it needs an enormous road space, including parking lots. Therefore, transport modes selection is the most crucial stage in various transportation planning and policies [8]. This concerns the mobility’s efficiency in urban areas, the space provided by a city to be used as a means of transportation, and the choices of transportation modes the community can choose.

Multimodal is an important issue that must be carefully considered in Indonesia for the future (Figure 4). The process in a station (bus', trains, etc.) is the most critical factor which needs that This is shown in Figure 5, Multimodal structure: (a) N-way structure; (b) Modification Structure; (c) Hierarchical structure, which shows the structure of mode selection model which is more than two (multimodal). The N-way structure is very popular in non-aggregate modelling. However, since it is assumed that all alternatives weigh the same, a problem emerged. That problem is 'some choices are similar to 'another' [1,2]. The development of this research is approached with a hierarchical structure.
Multimodal selection model using Multinomial Logit Model (MLM) approach is described using Equation 2 [9]:

$$ P(i) = \frac{e^{u(i)}}{\sum_{i=1}^{3} e^{u(i)}} $$

Where:

- $P(i)$ = Choice Probability of Mode (i)
- $u(i)$ = $f(x1,x2,x3,x4,x5,x6,x7)$
- $x1$ = Transport Cost
- $x2$ = Travel Time
- $x3$ = Distance
- $x4$ = Parking Time
- $x5$ = Transfer Number
- $x6$ = Insurance
- $x7$ = Waiting Time

This method collects information about people's desires for some choices. It can also be used to estimate the level of their need for new modes. The utility attribute variables, which will be used as observation variables, are in accordance with the observation of 'commuters' preferences, which are transport cost, travel time, privacy, distance and safety. The probability level is made in such a way as to form a selection scale according to the survey data. If the Private Vehicle selection is ($P(1)=0,0$) then the Bus selection is ($P(2)=0,0$), and the Commuter Line selection is ($P(3)=0,0$); and vice versa, meaning if the Commuter Line selection is ($P(3)=1,0$), then the Bus selection is ($P(2)=0,0$), and the Private vehicle selection is ($P(1)=0,0$). This value is the dependent variable. With a linear approach, the utility function can be explained by Equation 2:

$$ U(i) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_0 $$

Where $\beta_0$ is the Intercept Coefficient, and $\beta_1$ to $\beta_7$ is the Variable Coefficient.
3. Results and Discussion

3.1 Statistical Analysis

The questionnaire data are processed with the help of Microsoft Excel, with \( Y \) = mode selection preference (0 for not selecting and 1 for selecting) and \( X \) = variables that affect mode selection (x1 to x7). The data are processed for each respondent characteristic - which affects mode selection. The Statistical Analysis is shown in Table 1 to Table 6.

**Table 1. Statistics Summaries of Private Vehicle Utility Function \( u(1) \)**

| Regression Statistics | Value          |
|------------------------|----------------|
| Multiple R             | 0.867743312    |
| R Square               | 0.752978455    |
| Adjusted R Square      | 0.747506458    |
| Standard Error         | 0.251397279    |
| Observations           | 324            |

From Table 1, it can be seen that the \( R^2 \) is 0.752, meaning that 75% of the data collected have formed a utility equation for private vehicle mode selection.

**Table 2. Variable Coefficients of Private Vehicle Utility Function \( u(1) \)**

| Variable | Coefficient | Standard Error |
|----------|-------------|----------------|
| Intercept| 0.321742778 | 0.050153801    |
| X1       | 4.71241E-06 | 9.21135E-07    |
| X2       | -0.001943998| 0.013660249    |
| X3       | 0.000250828 | 0.000958925    |
| X4       | 0.094677428 | 0.009509002    |
| X5       | -0.018352509| 0.009635913    |
| X6       | 0.002551713 | 0.000249091    |
| X7       | -0.010662229| 0.000997997    |

Table 2 shows the variable coefficients which form the utility equation for private vehicle mode selection with variable coefficient 1, which is the cost variable, for \( \beta_1 = 4.71E-06 \); the coefficient variable 2, which is the time variable, for \( \beta_2 = -0.00194 \); the variable coefficient 3, which is the distance variable, for \( \beta_3 = 0.00025 \); the coefficient variable 4, which is the parking variable, for \( \beta_4 = 0.09468 \); the coefficient variable 5; which is the transfer variable, for \( \beta_5 = -0.01835 \); the coefficient variable 6, which is the insurance variable; for \( \beta_6 = 0.00255 \); and the coefficient variable 7, which is the waiting time variable, for \( \beta_7 = -0.01066 \). The intercept coefficient is \( \beta_0 = 0.32174 \), with the equation 5:

\[
U(\text{PC}) = 4.71E^{-06}x_1 - 0.00194x_2 + 0.00025x_3 + 0.095x_4 - 0.018x_5 + 0.003x_6 + 0.017x_7 + 0.322 \quad (5)
\]

The Standard Error for all variables is \( \alpha \leq 0.05 \) or 5%. This value makes the utility equation to be in accordance with the sampling expectation in Equation \( (1) \).
Table 3. Statistics Summaries of Bus Utility Function \( u (2) \)

| Regression Statistics | Value |
|-----------------------|-------|
| Multiple R            | 0.703046396 |
| R Square              | 0.494274235 |
| Adjusted R Square     | 0.483071449 |
| Standard Error        | 0.360017332 |
| Observations          | 324 |

From Table 3, it can be seen that the \( R^2 \) is 0.494, meaning that 49% of the data collected have formed a utility equation for bus selection.

Table 4. Variable Coefficients of Bus Utility Function \( u (2) \)

| Variable | Coefficient | Standard Error |
|----------|-------------|----------------|
| Intercept| 0.756556108 | 0.069246033    |
| X1       | -7.23019E-06| 1.38322E-06    |
| X2       | 0.024017611 | 0.019615175    |
| X3       | 9.32139E-05 | 0.001413551    |
| X4       | -0.146029955| 0.013303443    |
| X5       | 0.04095647  | 0.013183974    |
| X6       | 0.000563488 | 0.000367027    |
| X7       | -0.006328326| 0.001327277    |

Table 4 shows the variable coefficients which form the utility equation for Bus selection with variable coefficient 1, which is the cost variable, for \( \beta_1 = -7.23 \times 10^{-06} \); the coefficient variable 2, which is the time variable, for \( \beta_2 = 0.024 \); the coefficient variable 3, which is the distance variable, for \( \beta_3 = 9.23 \times 10^{-05} \); the coefficient variable 4, which is the parking variable, for \( \beta_4 = 0.146 \); the coefficient variable 5, which is the transfer variable, for \( \beta_5 = 0.041 \); the coefficient variable 6, which is the insurance variable, for \( \beta_6 = 0.0006 \); and the coefficient variable 7, which is the waiting time variable, for \( \beta_7 = 0.0063 \). The intercept coefficient is \( \beta_0 = 0.757 \), with the following equation:

\[
U(\text{bus}) = -7.23 \times 10^{-06} x_1 + 0.024 x_2 - 9.24 \times 10^{-05} x_3 + 0.146 x_4 - 0.0041 x_5 + 0.0006 x_6 + 0.006 x_7 + 0.757(6)
\]

The Standard Error for all variables is \( \alpha \leq 0.05 \) or 5%. This value makes the utility equation to be in accordance with the sampling expectation in Equation (1). From Table 5, it can be seen that the \( R^2 \) is 0.483, meaning that 48% of the data collected have formed a utility equation for KRL Commuter Line selection.

Table 5. Statistics Summaries of Commuter Line Utility Function \( u (3) \)

| Regression Statistics | Value   |
|-----------------------|---------|
| Multiple R            | 0.695684982 |
| R Square              | 0.483977594 |
| Adjusted R Square     | 0.472546718 |
| Standard Error        | 0.340435578 |
| Observations          | 324     |
Table 6. Variable Coefficients of Commuter Line Utility Function \( u(3) \)

| Variable   | Coefficient          | Standard Error  |
|------------|----------------------|-----------------|
| Intercept  | 0.185450616          | 0.06518144     |
| X1         | 2,29514E-06          | 1,3014E-06     |
| X2         | 0.005830187          | 0.01807736     |
| X3         | 0.000348393          | 0.001308021    |
| X4         | -0.078088631         | 0.011834345    |
| X5         | 0.087457433          | 0.012655236    |
| X6         | 0.002395764          | 0.000344551    |
| X7         | -0.006902296         | 0.001282797    |

Table 6 shows the variable coefficients which form the utility equation for KRL commuter line selection with variable coefficient 1, which is the cost variable, for \( \beta_1 = 2.29E-06 \); the coefficient variable 2, which is the time variable, for \( \beta_2 = 0.006 \); the coefficient variable 3, which is the distance variable, for \( \beta_3 = 0.00035 \); the coefficient variable 4, which is the parking variable, for \( \beta_4 = 0.078 \); the coefficient variable 5, which is the transfer variable, for \( \beta_5 = 0.087 \); the coefficient variable 6, which is the insurance variable, for \( \beta_6 = 0.0024 \); and the coefficient variable 7, which is the waiting time variable, for \( \beta_7 = 0.0069 \). The intercept coefficient is \( \beta_0 = 0.185 \), with the following equation:

\[
U(CL) = -2.29E^{-06}x_1 + 0.006x_2 + 0.00035x_3 + 0.078x_4 - 0.087x_5 + 0.0024x_6 + 0.007x_7 + 0.185
\]

The Standard Error for all variables is \( \alpha \leq 0.05 \) or 5%. This value makes the utility equation to be in accordance with the sampling expectation in Equation (1).

3.2 Mode Choice Model Analysis

After getting Equation (5), Equation (6) and Equation (7) as the utility function equation for mode selection, the next step is to build a mode selection model based on the Multinomial Logit Model (MLM) according to Equation (2), so that a new equation can be obtained and used as a mode selection function.

![Figure 6. Mode Choice Probability Model Based on Transport Cost (Rp) Consideration](image-url)
The three equations for each mode are graphed based on the changes in transport cost, travel time and distance variables to represent potential changes in mode selection, whether from private vehicle to public transportation or vice versa. Figure 6 above shows a probability graph of the transport mode selection with travel cost as the consideration. The greater it is, the more guaranteed KRL Commuter Line and private vehicle selection would increase while the bus selection would decrease.

When it comes to finding out the potential changes in mode selection based on travel time as the consideration, one can see in Figure 7 below that the longer it is. The private vehicle use would decrease - while public transportation (i.e., Bus and KRL Commuter Line would increase).

![Figure 7. Mode Choice Probability Model Based on Journey Time (Minute) Consideration](image)

The most important mode selection model in the graphical presentation principle in a geographic information system is the mode selection based on the distance (how long it takes to travel from one's house or office to the nearest shelter or station). This consideration is so strong since there is a possibility that pedestrians, who are assumed to be the users of public transportation, would switch from one public transportation mode to another when they are en route to their destination. Moreover, private vehicle users are considered a non-absolute factor, which means that the private vehicle mode selection is not considered - since it is predicted that some of them would switch to public transportation, considering it is more efficient. If examined deeper, it appears that commuters are still considering using their main choice, which is KRL Commuter Line, if the station is only 150 meters away. Therefore, the farther the shelter or station is, the greater the use of a private vehicle.

Moreover, the bus selection becomes the lowest when compared to the KRL Commuter Line selection. If probability equality is to be made at the same value, namely 30% for Bus and Commuter Line selection, then the distance of 1000 meters to a commuter station is equal to 200 meters to a bus shelter. For more details, it can be seen in Figure 8.
Transport mode selection analysis based on Walk Distance considerations can be presented in the form of a geographic information system, with the provision that the travel distance to the public transportation's shelter or station can affect commuters in selecting public transportation, whether it is KRL Commuter Line or Bus. The description is graphically set as follows:

a. The potential for using KRL Commuter Line is huge if the distance from one's house or office to the station is only 150 m.

b. The potential use of the KRL Commuter Line and Bus as public transportation has an equal mode selection of up to 30%; if the distance of the KRL Commuter Line station is 1000 meters equivalent to the distance of the bus shelter/station 200 meters from one's house or office.

c. The private vehicle selection becomes the main choice for a distance like 1050 meters and above - since the potential selection is already above 50%.

The representation of the mode selection model in the geographic information system is constructed from primary data in the form of a regional map with building attributes, area, and maps of the road network, train network and train station. These three maps are obtained from the latest open-source of Open Street Map (OSM) and Google MAP.

After overlaying the map based on the characteristic of the prior selection, the graphical result of the mode selection can be seen in Figure 9, which shows that graphically, it is clear that the service for transportation demand is still dominated by road network availability. Toll roads have made the road-based transportation service to be preferable compared to the rail-based ones.

Furthermore, based on an overlay of 1000 meters around the station, further analysis is conducted in housing distribution and road network density at each analysed station, starting from Bogor Station to Tanah Abang Station. The same thing is conducted in the 5000-meter overlay condition around the access to the toll road network, which is parallel to the KRL Commuter Line Corridor; therefore, one can see that bus use and KRL Commuter Line is having a similar proportion of selection.
Figure 9. Road scatter Pattern Based on 5000-meter buffer Coverage area from Toll Access (Left side) and 1000 meter buffer Coverage area from Station Point (Right Side)

Table 7. Road Density Pattern Based on 1000 meter buffer Coverage area from Station Point

| Station       | Sum of Road scatter Pattern (meter) | Road Density (km/km²) |
|---------------|-------------------------------------|-----------------------|
| Bogor         | 91863                               | 29                    |
| Bojonggede    | 68267                               | 22                    |
| Cawang        | 83914                               | 27                    |
| Cilebut       | 53496                               | 17                    |
| Citayam       | 78782                               | 25                    |
| Depok         | 59548                               | 19                    |
| Depokbaru     | 67476                               | 21                    |
| Duren Kalibata| 86687                               | 28                    |
| Lenteng Agung | 68388                               | 22                    |
| Manggarai     | 73873                               | 24                    |
| Pasar Minggu  | 73706                               | 23                    |
| PondokCina    | 66926                               | 21                    |
| Sudirman      | 82092                               | 26                    |
| Tanahabang    | 87187                               | 28                    |
| Tanjung Barat | 77899                               | 25                    |
| Tebet         | 89162                               | 28                    |
| UI            | 60925                               | 19                    |
| Grand Total   | 1270191                             | 24                    |
As shown in Table 7 above, the road network's density is varied. High density exists around Bogor Station (29 km/km$^2$) - and around Tanah Abang, Duren Kalibata, and Tebet Station (28 km/km$^2$ each). Meanwhile, low density exists in the Cilebut station (17 km/km$^2$). The overlay of building distribution is also conducted on the map based on the characteristic of the prior mode selection. The graphical result of building distribution around the KRL Commuter Line Corridor can be seen in Figure 10.

The building density around the Bogor-Jakarta corridor is analysed afterwards. The buildings observed are hospitals, hotels, houses, mosques, offices, residential, retail, school, and universities. The closer it gets to Jakarta, the building distribution gets denser and more varied. As shown in Table 8, the value of building density is described in two indicators based on the amount and area of the buildings. High density exists around Bogor Station (29 km/km$^2$) and Tanah Abang, Duren Kalibata and Tebet Station (28 km/km$^2$ each). Meanwhile, low density exists in the Cilebut station (17 km/km$^2$).

Both building density and its index provide significant information related to the utility value of TOD-based public transportation. For instance, Sudirman Station has a relatively small index (i.e., 34) but high density (i.e., 40685). These values indicate that the area around Sudirman Station is sufficient. Meanwhile, Cilembut Station has an index of 495 and a building density of 22552m$^2$/km$^2$. Therefore, arrangement for the area around it is essential for the KRL Commuter Line to be utilised better.
Table 8. Building Density Pattern Based on 1000 meter buffer Coverage area from Station Point

| Station      | Count of Building (number) | Sum Area Building (meter square) | Building Density Index (building/km²) | Building Density (m²/km²) |
|--------------|---------------------------|----------------------------------|---------------------------------------|--------------------------|
| Bogor        | 1030                      | 248583                           | 328                                   | 79167                    |
| Bojonggede   | 27                        | 2678                             | 30                                    | 853                      |
| Cawang       | 104                       | 69619                            | 33                                    | 22172                    |
| Cilebut      | 1545                      | 70814                            | 494                                   | 22552                    |
| Citayam      | 33                        | 3574                             | 40                                    | 1138                     |
| Depok        | 120                       | 11199                            | 38                                    | 3567                     |
| Depokbaru    | 94                        | 16438                            | 30                                    | 5235                     |
| Duren Kalibata | 99                    | 59818                            | 32                                    | 19050                    |
| Lenteng Agung | 56                     | 44088                            | 18                                    | 14041                    |
| Manggarai    | 119                       | 55149                            | 38                                    | 17563                    |
| Pasar Minggu | 94                        | 42469                            | 30                                    | 13525                    |
| PondokCina   | 67                        | 41258                            | 21                                    | 13139                    |
| Sudirman     | 105                       | 127752                           | 34                                    | 40685                    |
| Tanahabang   | 116                       | 57073                            | 37                                    | 18176                    |
| Tanjung Barat | 56                     | 27608                            | 18                                    | 8792                     |
| Tebet        | 176                       | 63579                            | 56                                    | 20248                    |
| UI           | 49                        | 27137                            | 16                                    | 8642                     |
| Grand Total  | 3850                      | 968836                           | 72                                    | 18150                    |

4. Conclusion

This research is done by making some stages in the analysis; hence, there will be some differences compared to the previous research [6]. The initial stage is a study of mode selection in the observed area to determine the mode selection characteristic and potential by creating a mode selection model. The next stage is the presentation of the modelling result. It is presented in a geographic information system to analyse further the size distribution based on the road and building network density. A more considerable amount of buildings does not necessarily indicate that the potential for KRL Commuter Line selection is higher.

On the other hand, road network density makes it easier to have access to public transportation. However, the farther it is to the station, the KRL Commuter Line selection will undoubtedly be weaker. Facilities provided for pedestrians are sufficient to provide convenience for them considering the distance to the nearest station is essential in choosing a transport mode. This research will continue to reduce bias and sharpen even deeper aims and objectives - of course, while still taking into account the current state of the COVID-19 pandemic.

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