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Trans Mamminasata Bus Service Coverage Area in Corridors 2 and 3, Indonesia, using Network Analysis

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Abstract: This study examines issues related to the Trans Mamminasata Bus/Teman Bus, Indonesia, particularly in Corridors 2 and 3. Using primary and secondary data obtained from a survey, this study explores the service coverage area for three facilities (housing facilities, government and educational infrastructures) along the Corridors 2 and 3 using network analysis in Quantum GIS (QGIS). Two variables, pedestrian distance (400 meters) and cyclist distance (2000 meters), were applied in this study. The results showed that Corridor 2 served 86 infrastructures for the pedestrian distance variable and 367 infrastructures for the cyclist distance variable, while Corridor 3 served 89 infrastructures for the pedestrian distance variable and 217 infrastructures for the cyclist distance variable. The study found that the total service coverage area along Corridors 2 and 3 is wider for cyclists than for pedestrians. Moreover, this study highlights the presence of urban sprawl in the regions served by both Corridors.

Keywords: Trans Mamminasata Bus; Teman Bus; network analysis; service area; QGIS.

Introduction

The expansion of urban areas, accompanied by an increase in the number of people, is a common phenomenon in Indonesia's major cities. According to the findings of a study conducted by the United Nations Centre for Human Settlements (UNHCS), by the year 2050, the number of people living in cities will exceed 40% of the total population of the world, with cities accounting for approximately 68 percent of the total population of the world [1].

The presence of the Trans Mamminasata Bus connecting the Mamminasata area (Makassar-Maros-Sungguminasa-Takalar), Indonesia, since 14 November 2021 is one of the solutions in facilitating community mobilization in Makassar City and its three supporting areas. This mass transportation system, known as Teman Bus, serves 4 corridors connecting Sultan Hasanuddin International Airport, Soekarno Hatta Port, Malengkeri Terminal, Campus 2 of Politeknik Negeri Ujung Pandang to Hasanuddin University Engineering Campus in Gowa Regency with its 87 bus fleets. The Trans Mamminasata bus is one of the implementations of Buy The Service (BTS) program from the Ministry of Transportation of the Republic of Indonesia [2], and the concept adopted the Mass Rapid Transportation (MRT).

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Mass transportation is part of the strategic concept of Transportation Demand Management (TDM). The goals is to reduce the use of private vehicles, reduce the rate of traffic accidents, save on transportation and parking costs, efficiency in the use of space and travel time, increase people's mobility, and to help environmental problems in terms of energy conservation and reduction of carbon emissions [3].

For service areas, although the existence of a these 4 corridors indicates the service area, however how wide the service area of each bus stop is not yet explored. Thus, this study attempts to identify Trans Mamminasata Bus service areas, particularly in Corridors 2 and 3.

The mass transportation commonly is used by citizens from housing areas to office and education areas. Therefore, this research will focus on discussing service areas related to housing facilities (as a major of trip generation), and also government and education infrastructures using two variables (400 meters for commonly distance for pedestrian, and 2000 meters for cyclists).

The Geographic Information System (GIS) is a computer-based system designed to collect, manage, manipulate, analyze and display spatial information. One of the advantages of this technology is that it can work with various data formats and integrate these data with maps, satellite images, and CAD drawings [4]. Network analysis is one method of network issues. It is a part of the spatial decision problem' model and used to optimize time and costs associated with the network problem [5].

Study about mass rapid transportation has been developed. The context about this topic relate to

service area [6–8], the characteristic of MRT' user [9]; the shelter accessibility [10]; until the concept MRT in TOD [10]. Mostly these studies used GIS' analysis, either network analysis [6,10,11], or proximity analysis [6–8,11]. In the previous studies, the variables were the pedestrian' distance (400 meter) [6,7,1], and the cyclists' distance (2000 meter) [6]. Unfortunatelly, the research related to Teman Bus Mamminasata using pedestrian' distance and cyclists' distance has not been taken. Thus, this study explores the service area coverage of the Teman Bus Mamminasata/Trans Mamminasata Bus on Corridors 2 and 3 by using 2 variables: the distance variable for pedestrians (400 meters) and the distance variable for bicycle users (2000 meters).

Methods

Research Site

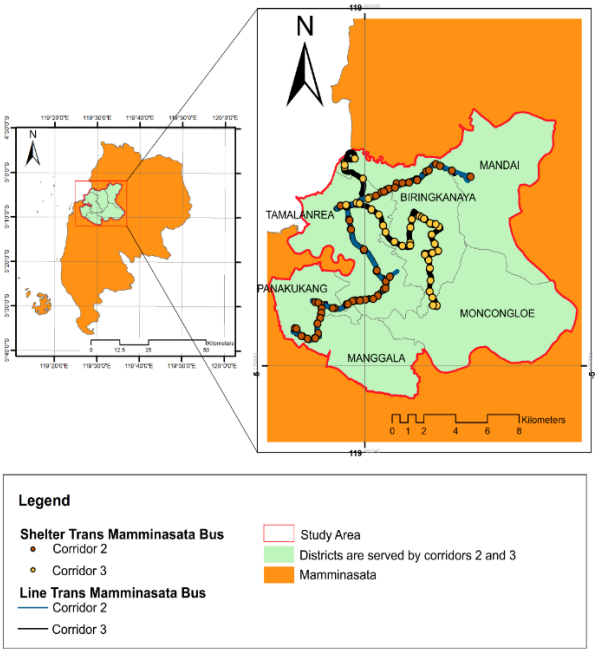

Figure 1. Study Area

This study is located in Mamminasata region. Mamminasata region is located in the South Sulawesi province, Indonesia, and it encompasses several regencies and municipalities including Makassar, Maros, Gowa-Sungguminasa and Takalar. The present study focusses on the cover area in the line of Corridor 2 and 3 Trans Mamminasata Bus (see Figure 1). Corridor 2, with the length of the corridor line is 25.5 km, covers 5 districts (Mandai, Biringkanaya, Tamalanrea, Manggala, and Panakukang), where only Mandai District is a part of Maros regency, and others are Makassar city. While Corridor 3, with the length of the corridor line is 23.5 km, serves 3 districts (Moncongloe, Tamalanrea, and Biringkanaya), where Moncongloe district is a part of Maros regency, and others are Makassar city.

Instrument

The present study collected primary data (line Corridors 2 and 3 of Trans Mamminasata Bus; shelter Corridor 2 and shelter Corridor 3 of Trans Mamminasata Bus and infrastructure around Corridors 2 and 3 related to housing, government and education). This study also used secondary data, consisting of the administrative map and street map of Makassar City and Maros Regency.

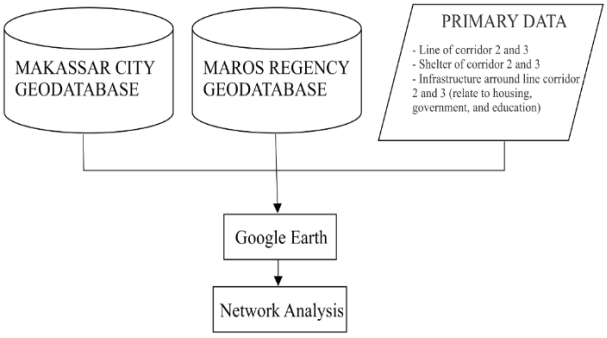

Figure 2. General Data Processing Scheme

In this study, we used Google Earth to confirm the data from a survey and recollect the data. Next, data was processed in QGIS with network analysis' plugin. In the process analysis, we used 2 distance variables, 400 m as the representative distance for pedestrian, and 2000 m as the representative distance for cyclists. To understand the process data handling, please see general data processing scheme (Figure 2)

Results

Figure 3 illustrates the coverage of facilities and infrastructure services in Corridor 2, highlighting the difference in coverage between two different variables. The blue color represents a distance variable of 400 meters, while the orange color represents a distance variable of 2000 meters. The analysis shows that the total coverage of infrastructure services at a distance of 2000 meters is greater than that at a distance of 400 meters.

Corridor 2 serves a total of 86 infrastructure facilities for a variable distance of 400 meters (for pedestrians), including 47 educational facilities, 8 government facilities, and 31 housing facilities. In comparison, the variable distance of 2000 meters (for cyclists) serves 367 infrastructure facilities, including 157 educational facilities, 44 government facilities, and 166 housing facilities.

Figure 4 shows a graph of the coverage service area of facilities and infrastructure in Corridor 3, illustrating the difference in the amount of coverage of infrastructure services with two different variables. The

blue color represents the 400-meter distance variable, while the orange color represents the 2000-meter distance variable. Compared to Corridor 2, the total coverage of infrastructure services at a distance of 2000 meters (for cyclists) is greater than the variable distance of 400 meters (for pedestrians).

Based on Figure 4, Corridor 3 serves total of 89 infrastructure facilities for a variable distance of 400 meters (for pedestrians), including 36 educational facilities, 11 government facilities, and 42 housing facilities. While, for the 2000-meter distance variable (for cyclists), it serves a total of 217 infrastructure facilities, including 73 educational facilities, 39 government facilities, and 105 housing facilities.

Figures 5 and 6 show the results of the network analysis for Corridor 2, while Figures 7 and 8 show the results of the network analysis for Corridor 3. The network analysis is in a line format, generated from the analysis process by setting the distance from each shelter/bus stop of Trans Mamminasata Bus, as the starting point, represented by the green circle symbol. The distance used is adjusted to the distance variable in this study, with 400 meters for pedestrians (shown in Figures 5 and 7) and 2000 meters for cyclists (shown in Figures 6 and 8). These figures illustrate that the covered area for cyclists is greater than that for pedestrians.

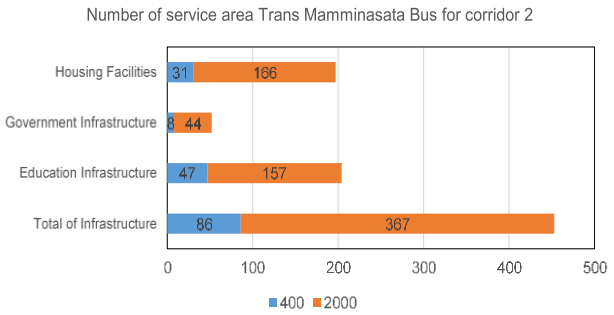

Figure 3. Number of Service Area Trans Mamminasata Bus for Corridor 2 with Network Analysis

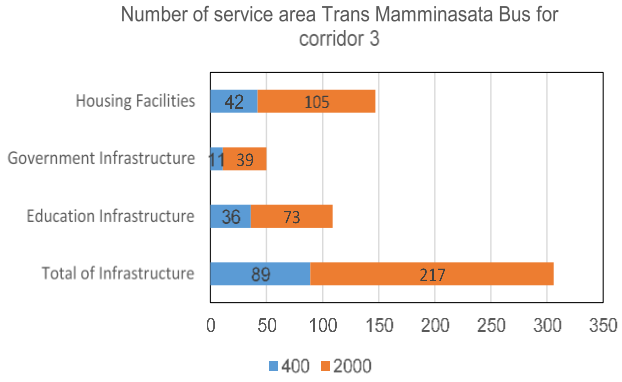

Figure 4. Number of Service Area Trans Mamminasata Bus for Corridor 3 with Network Analysis

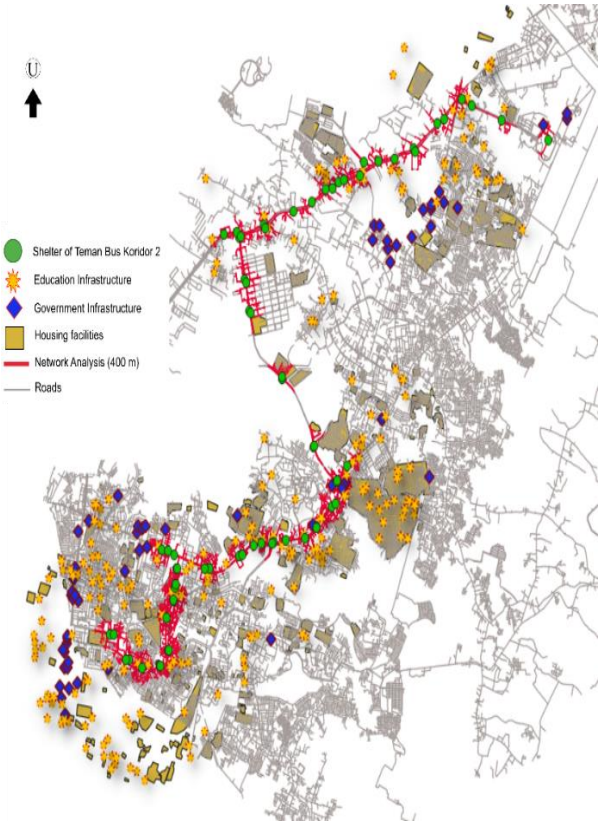

Figure 5. Network Analysis in Corridor 2 (for Distance 400 m)

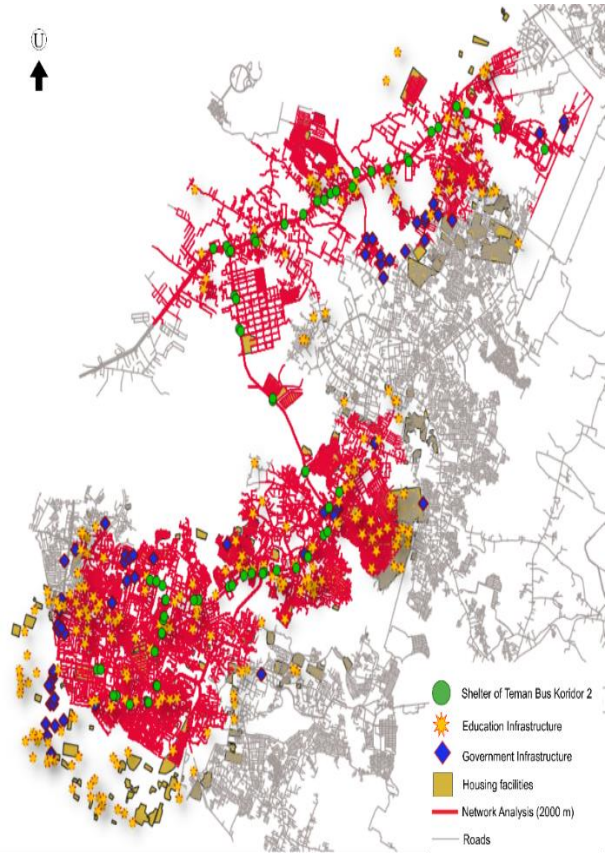

Figure 6. Network Analysis in Corridor 2 (for Distance 2000 m)

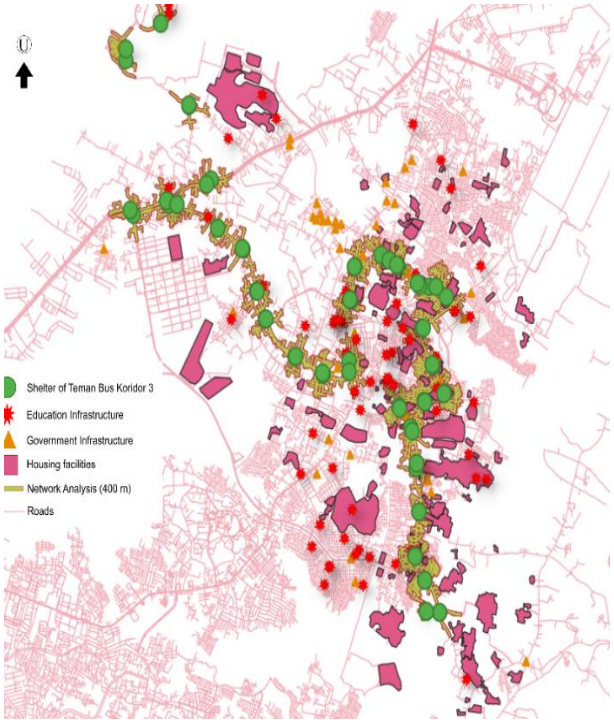

Figure 7. Network Analysis in Corridor 3 (for Distance 400 m)

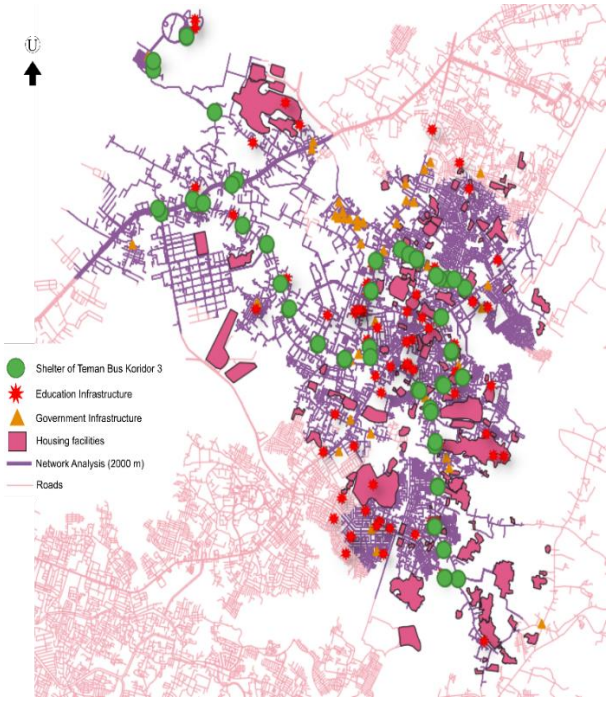

Figure 8. Network Analysis in Corridor 3 (for Distance 2000 m)

Discussion and Conclusion

Generally, the present study explores the number of service coverage area for facilities/infrastructure (housing, government, and education) along Corridor 2 and Corridor 3 of Teman Bus Mamminasata/Trans Mamminasata Bus. The findings allow the following conclusions through analysis in QGIS:

1. The total service coverage area for all three facilities, both along Corridor 2 and Corridor 3, is wider for cyclists than for pedestrians. This is reasonable because the distance for cyclists (2000 m) is longer than for pedestrians (400 m).
2. Corridor 2 has a total length of 25.5 km, which is longer than Corridor 3 (23.5 km). The results show that the total number of facilities covered by Corridor 2 is higher than in Corridor 3. However, for housing facilities with a cyclist distance, Corridor 3 (42 housing facilities) has a greater coverage area than Corridor 2 (31 housing facilities). These findings imply that most of the housing in the region is served by Corridor 3, which is located near the road. This is reasonnable because Corridor 2 runs along the arterial road of Makassar city, while Corridor 3 is mostly on local roads. Furthermore, the present study explores both corridors with the cyclist' distance (2000 m), the higher facilities that coverage is the housing facilities (Corridor 2 with 166, and Corridor 3 with 105), indicating the presence of housing clusters or urban sprawl in the regions served by both corridors. This is in line with Ridwan and Hasanuddin's description of urban sprawl in two districts in Makassar (Tamalanrea and Biringkanaya), which are the regions served by both corridors. Housing clusters are located side by side with each other and around eastern Biringkanaya and southern Tamalanrea [12].

The present study acknowledges a few notable limitations. First, the secondary data, especially the existing road data, is not up to date. In the preliminary study, we used road data from RBI. Due to a lack of data and after comparing it with the street map, we found the street map to be more accurate. However, after the survey, we discovered that even the street map data was not up to date. Therefore, in the next study, more up-to-date data should be used. Second, this study focused only on three facilities/infrastructures (housing, government, and education), so more empirical studies should be conducted and expanded in different focuses.

Disclaimer

The authors declare no conflict of interest.

Acknowledgments

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