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RESEARCH ARTICLE

Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia

Herika Muhamad Taki[1,*], Bethany Jaffa Rani[2], Muhammad Dimas Elvin Putra[3]
[1*23] *Department of Urban and Regional Planning, Universitas Trisakti, Grogol Petamburan, Jakarta Barat, Indonesia*

* Corresponding author : herika@trisakti.ac.id
Tel.: +62 812-8820-6699
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Abstract

Setiabudi, a district located in South Jakarta, emerges as one of the significant business centers. Its proximity to other commercial areas makes Setiabudi a primary attraction for human activities. This article delves into Transit Oriented Development (TOD), a city planning development pattern integrated with transportation systems to create an efficient city.

The TOD concept emphasizes high-density development, prioritizes pedestrian-friendly environments, and utilizes diverse land functions. This research adopts a literature review method, detailing the criteria and principles of TOD according to the ITDP TOD Standard 2017.

The Additionally, references from other journal literature are used to analyze the potential development of TOD areas, focusing on radius and distance analyses around the Setiabudi district using Google Maps and Google Earth at specific TOD points that serve as transit hubs. LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station show high potential for Transit-Oriented Development (TOD), while MRT Setiabudi Astra and LRT Kuningan Station exhibit moderate potential.

Rasuna Said LRT Station, however, has a low potential for TOD. Implementing TOD in the high-potential stations can generate significant positive impacts, with room for improvement in MRT Setiabudi Astra and LRT Kuningan Stations. Rasuna Said LRT Station requires further attention to boost its potential for the future.

Keywords: TOD, Integration, Land Use, Transit

1. Introduction

Urban transportation problems generally evolve in tandem with population growth, increases in community income, the availability of motorized vehicles, and the escalation of economic and social activities (Carlton, 2009). The urbanization process and economic growth that have happened in Jakarta resulted into various socioeconomic challenges, including transportation problems such as traffic congestions (Garrin A. N. & Lin, Y., 2022).

Transit-Oriented Development (TOD) aims to reduce dependence on private vehicles and promote sustainable transportation modes such as walking, cycling, and public transportation (Knowles et al., 2020). Implementation of Transit-Oriented Development (TOD) will be of benefit both socially and economically such as reduction of CO2 emissions, prevention of urban sprawl and higher property (real estate) prices (Cervero & Kockelman, 1997; Renne & Wells, 2002). The concept of Transit-Oriented Development (TOD) integrates regional transit networks and complements existing environmental development strategies around transit hubs.

Several studies relating to Transit-Oriented Development (TOD) as a way to help traffic problems showed that TOD improves congestion regionwide (Zhang M., 2010), people living in TOD areas tend to drive less, reducing their vehicle miles travelled (VMT) (Nasri & Zhang L., 2014; Luscher, Daniel R., 1995), and increased usage of public transport (bus) (Hamid et. al., 2020).

In the development of an urban area, intermodal transit facilities and transit zones have become indispensable aspects. The area around transit points is a potential zone for the development of a region. This is related to the ease of access offered by the presence of transit facilities in Transit-Oriented Development (TOD) areas.

The growth of a city is always associated with the growth of its population, which has both positive and negative impacts (Cervero, 2004). Due to its density, South Jakarta faces various urban challenges, such as transportation issues. According to the Central Statistics Agency (BPS) of DKI Jakarta Province, as of the year 2022, the population of South Jakarta has reached 2,244,623 people. Therefore, based on UU No. 26 of 2007, South Jakarta has been classified as a metropolitan city, where a metropolitan city is defined as a city with a minimum population of 1 million people.

The Setiabudi Subdistrict is one of the subdistricts in the South Jakarta Administrative City that houses various economic and business activities. Setiabudi Subdistrict is located in South Jakarta. The several traffic congestion points in South Jakarta include, Blok M - Fatmawati, Antasari Street, Cilandak - Pasar Minggu and Tanjung Barat - Depok (IDN Times, 2015).

Geographically, according to DKI Jakarta Governor Regulation No. 171 of 2007, the area of Setiabudi Subdistrict is 8.85 km2 and comprises 8 sub-districts. This area is one of the most important business and commercial centers in Jakarta.

It has diverse land uses, including residential, business or office spaces for the provision of goods and services, social-cultural activities, religious activities, and more.

2. Research Methodology

2.1 Research Methods

The potential for transit-oriented development is assessed by analyzing the fulfillment of TOD requirements at each transit point, using principles and variables selected from expert literature and previous research (Ibraeva et al., 2023).

The observed stations include two Jakarta MRT Phase 1 stations, namely Setiabudi Astra and Bendungan Hilir, as well as four Jabodebek LRT stations, namely LRT Dukuh Atas, LRT Setiabudi, LRT Rasuna Said, and LRT Kuningan. This research involves weighting the development potential at all transit points within an 800 m radius from the central transit node, employing the Analytical Hierarchy Process (AHP) method. Data collection methods include secondary data collection.

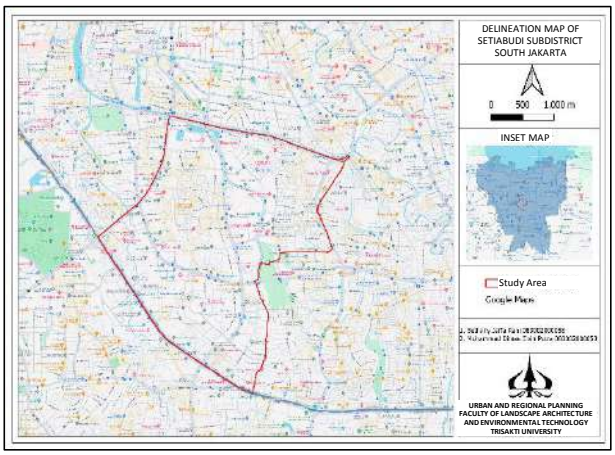

Fig 1. Study Area Delineation Map

2.2 Variable and Unit

The "walk" principle encompasses pedestrian and crossing facility variables, while the "cycle" principle involves cycling facility variables. The establishment of indicators for each variable in the "walk" and "cycle" principles refers to the TOD Standard facility assessment indicators (ITDP, 2017), which have quantitative characteristics to facilitate the assessment.

Tabel 1. Variable and Unit Research

Principle	Variable	Unit
Walk	*Pedestrian Facilities*	*TOD Standards, ITDP 2017*
	Crossing Facilities	*TOD Standards, ITDP 2017*
Cycle	*Cycling Facilities*	*TOD Standards, ITDP 2017*
Transit	*Number of Modes of Transportation*	Number of Transportation Mode Routes
Density	*Population Density*	people/Ha
	Number of Types of Land Use	*Sub Land Use*
Mix	*Residential & Non-Residential Ratio*	*% Residential: % Non-Residential*

In the "transit" principle, the variables focus on the quantity of transportation modes, with assessment indicators being the number of interconnected routes for other mass transportation modes, both within station buildings and interchange stations.

For the "density" principle, the considered variable is population density, while the "mix" principle involves the number of land use types and the ratio of residential to non-residential properties. Assessment indicators include average population density, the number of subtypes of land use, and the ratio of residential to non-residential land area within an 800 m radius from the central transit point.

The scoring assessment for each variable ranges from 0 to 3, derived from assessments of indicators and then converted into total weighting based on calculations using the Analytical Hierarchy Process (AHP) method. Information regarding principles, variables, and score criteria can be referred to in Table 2.

Tabel 2. Variable and Unit Research

Principle	Variable	Unit	Score 0 Low	1 Medium	2 High	3 Very High
Walk	*Pedestrian Facilities* (C1)	*TOD Standards, ITDP 2017*	0	1	2	3
	Crossing Facilities (C2)	*TOD Standards, ITDP 2017*	0	1	2	3
Cycle	*Cycling Facilities* (C3)	*TOD Standards, ITDP 2017*	0	1	2	3
Transit	*Number of Modes of Transportation* (C4)	Number of Transportation Mode Routes	0	1-3	4-6	>6
Density	*Population Density* (C5)	person/Ha	<150	151-200	201-400	>400
	Number of Types of Land Use (C6)	*Sub Land Use*	1-5	6-10	11-15	>15
Mix	*Residential & Non-Residential Ratio* (C7)	*% Residential : % Non-Residential*	>80: <20	61-80: 20-39	41-60: 40-59	20-40: 60-80

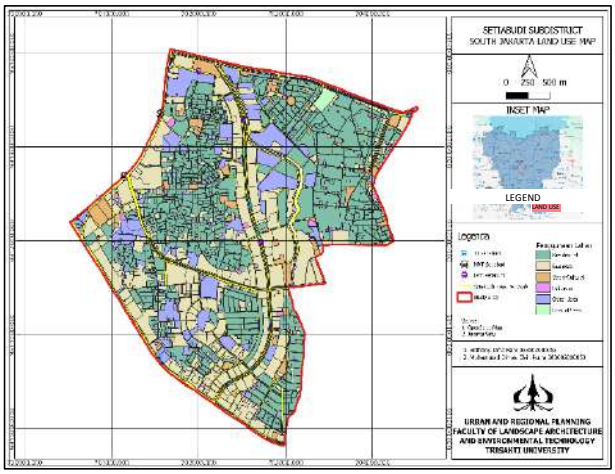

Fig 2. Study Area Land Use Map

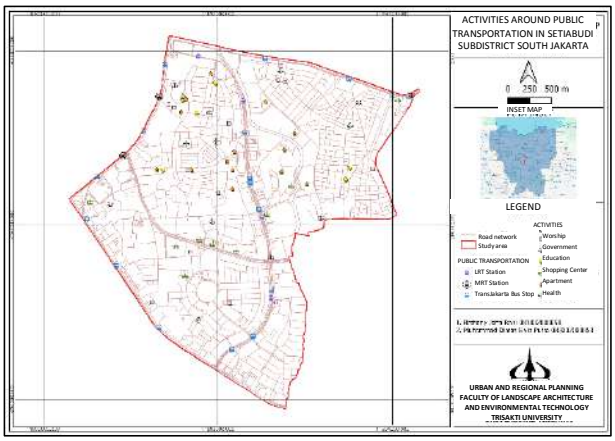

Fig 3. Map of Activities Around Public Transportation

The scoring for pedestrian facility (C1), crossing facility (C2), and cycling facility (C3) variables refers to the standards outlined in TOD Standard (ITDP, 2017), each having three selected assessment indicators. The pedestrian facility standard involves dedicated pedestrian paths on all building fronts, disabled-friendly paths, and pedestrian path lighting. For crossing facilities, the standard involves safe paths with a minimum width of 2 meters, easy access for people with disabilities, and crossing path lighting. Meanwhile, cycling facilities set standards for separated bike routes from motor vehicles, bike parking, and bike carrier routes within buildings. The assessment was conducted through observations at all transit points of MRT and LRT stations.

The establishment of score ranges for the transportation mode quantity variable (C4) is based on rounding down the highest number of mass transportation routes, which is 10 at Dukuh Atas BNI Station. The range is divided into four groups: low group (0), medium group (1-3), high group (4-6), and very high group (>6). The assessment is carried out by calculating the number of connected transportation routes to Jakarta MRT Station using the Jakarta Public Transportation Integration Map, published by the Jakarta Transportation Discussion Forum (FDTJ) in January 2023.

The scoring for the population density variable (C5) follows the population density standards outlined in SNI 03-1733-2004 regarding Procedures for Urban Housing Environmental Planning. These standards include low population density, medium population density, high population density, and very high population density. The assessment is conducted using data from the Central Statistics Agency (BPS), calculating the average population by assuming a proportional ratio of the district's area within an 800 m radius from the central transit point.

The establishment of score ranges for the land use types variable (C6) is based on rounding down the highest number of land subtypes within an 800 m radius from the central transit point, which is a total of 17 at Blok A and Cipete Raya Stations. This number is divided into four groups: low (1-5), medium (6-10), high (11-15), and very high (>15). Furthermore, the determination of scores for the residential and non-residential ratio indicator (C7) follows the standards for residential and non-residential ratios in TODs for cities, sub-cities, and neighborhoods, regulated in the Minister of ATR/BPN Regulation No. 16 of 2017 concerning Guidelines for Transit-Oriented Development. The assessment for both is conducted by calculating the number of land subtypes and the ratio of residential and non-residential land areas within an 800 m radius from the central transit point, available on the Jakarta Land Use Map accessible through the Jakarta Satu website.

3. Results and Discussion

The analysis was conducted by evaluating 7 research variables, namely pedestrian facilities, crossing facilities, cycling facilities, transportation mode quantity, population density, land use types, and residential and non-residential ratio, at all transit points in 2 MRT stations and 4 LRT stations, within an 800 m radius according to the previous assessment scores. The research data, collected through observations and secondary data calculations, were then assessed by assigning scores and converting them into weights based on the AHP calculation results involving five expert sources, including both academics and practitioners in the field of transportation and urban and regional planning. The evaluation of each transit area is detailed in the following section.

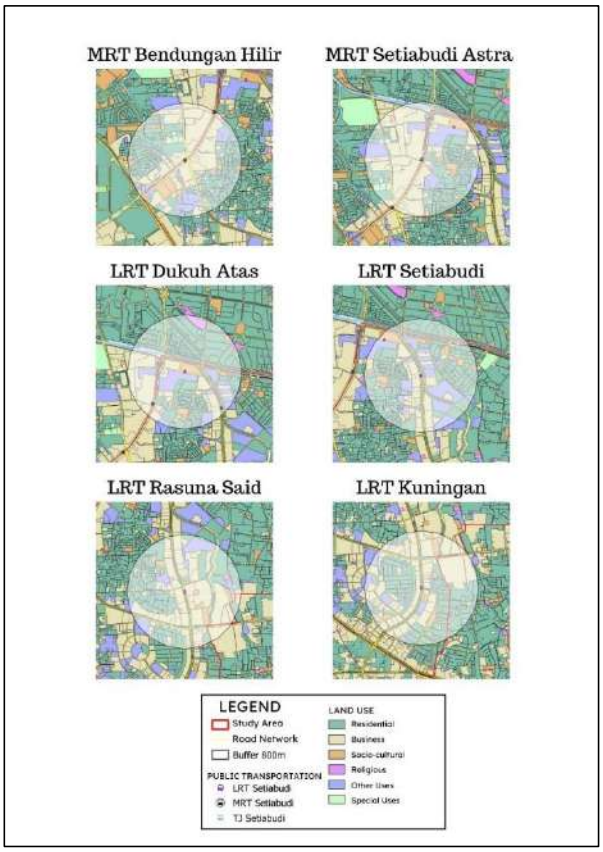

Fig 4. Land Use Map Radius 800 m from MRT and LRT

3.1 Bendungan Hilir MRT Station

Surrounding the Bendungan Hilir MRT Station is an area well-equipped with pedestrian facilities, crossings, and bike lanes. Despite this, the station lacks a direct connection to other mass transportation modes. Situated close to a BRT stop with routes to Blok M-Old Town Station (*Stasiun Kota*), Ragunan Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari, the Bendungan Hilir MRT Station is located in an area adjacent to three districts: Setiabudi (51.08%), Tanah Abang (48.83%), and Kebayoran Baru (0.08%) in Central and South Jakarta.

The region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius

from the transit point, there are 16 types of land subtypes, reflecting a high level of diversity. The residential and non-residential ratio is 38.02%:61.98%, categorized as a very high score, with residential land covering an area of 85.01 hectares and non-residential land covering 138.58 hectares.

3.2 Setiabudi Astra MRT Station

The transit area around Setiabudi Astra MRT Station provides complete pedestrian facilities, crossings, and bike lanes. However, the station is not directly connected to other mass transportation modes. Nevertheless, Setiabudi Astra MRT Station is in close proximity to a BRT stop, covering routes from Blok M to Old Town Station (*Stasiun Kota*), Ragunan-Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari. Situated between three districts, namely Tanah Abang (52.68%), Setiabudi (46.19%), and Menteng (1.13%) in Central and South Jakarta, this area has an average population density of approximately 158 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 29.78%:70.22%, categorized as a very high score, with residential land covering an area of 67.83 hectares and non-residential land covering 159.92 hectares.

3.3 Dukuh Atas LRT Station

The area around Dukuh Atas LRT Station, integrated with KRL Station, is complete with pedestrian facilities and crossing points. Located near BRT Corridor 1 stop, Sudirman KRL Station. This region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 51.09%:69.91%, categorized as a very high score, with residential land covering an area of 97.071 hectares and non-residential land covering 132.829 hectares.

3.4 Setiabudi LRT Station

The vicinity around Setiabudi LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 107 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 64.82%:35.18%, categorized as a very high score, with residential land covering an area of 87.507 hectares and non-residential land covering 47.493 hectares.

3.5 Rasuna Said LRT Station

The area around Rasuna Said LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 137.6 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 39.97%:61.03%, categorized as a very high score, with residential land covering an area of 51,961 hectares and non-residential land covering 79,339 hectares.

3.6 Kuningan LRT Station

The area around Kuningan LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 126.4 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 45.20%:54.80%, categorized as a very high score, with residential land covering an area of 54.24 hectares and non-residential land covering 65.76 hectares.

4 Conclusion

Based on the evaluation of the calculation results, it can be concluded that LRT Dukuh Atas Station, LRT Setiabudi, and Bendungan Hilir MRT Station exhibit high potential for development using the Transit-Oriented Development (TOD) concept. Meanwhile, MRT Setiabudi Astra Station and LRT Kuningan Station demonstrate moderate potential for implementing the TOD concept. Conversely, Rasuna Said LRT Station is assessed to have low potential for development with the TOD approach. Considering these results, it is evident that implementing the TOD concept could yield significant positive impacts in the areas surrounding LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station. The potential for improvement in implementing TOD in MRT Setiabudi Astra and LRT Kuningan Stations suggests room for enhancing their impact. However, for Rasuna Said LRT Station, further attention is needed to develop the concept and boost its potential for the future.

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Penulis : Herika Muhamad Taki, Bethany Jaffa Rani, Muhammad Dimas Elvin Putra

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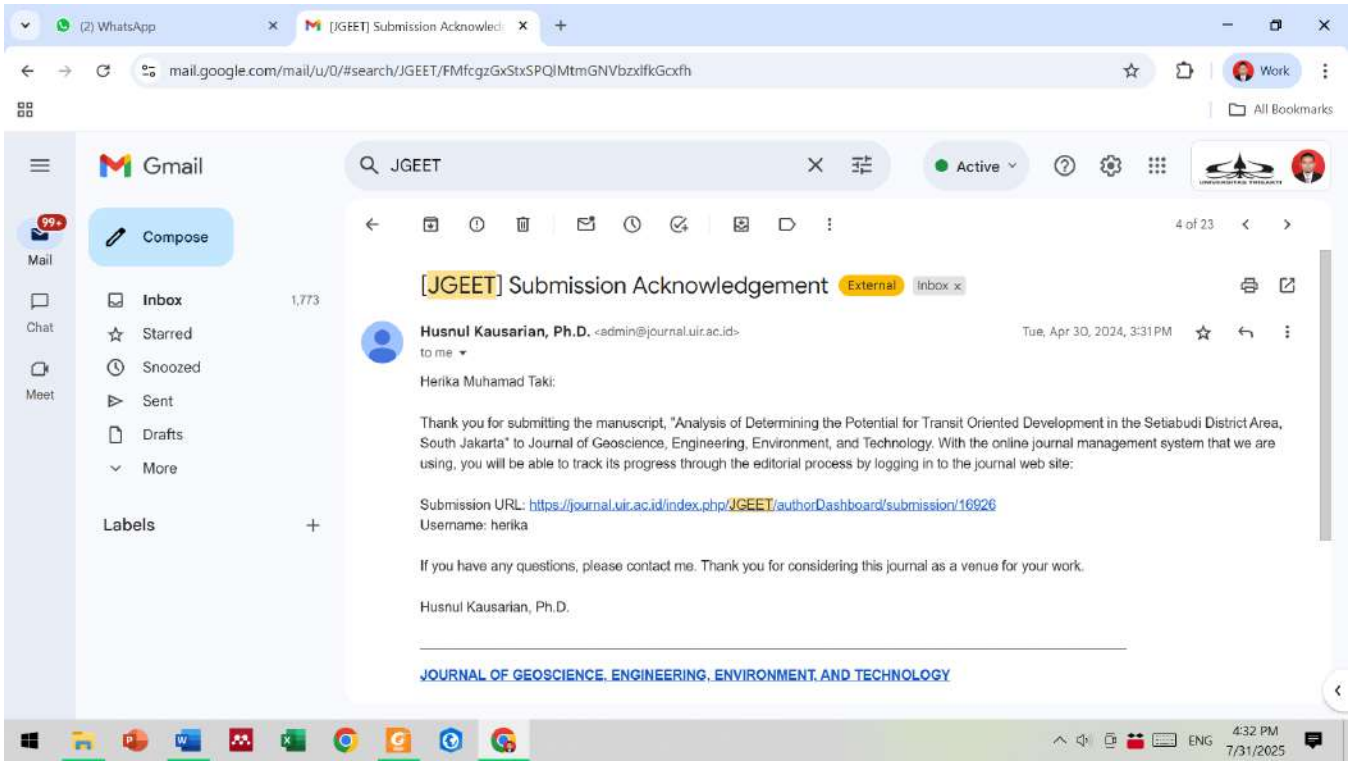

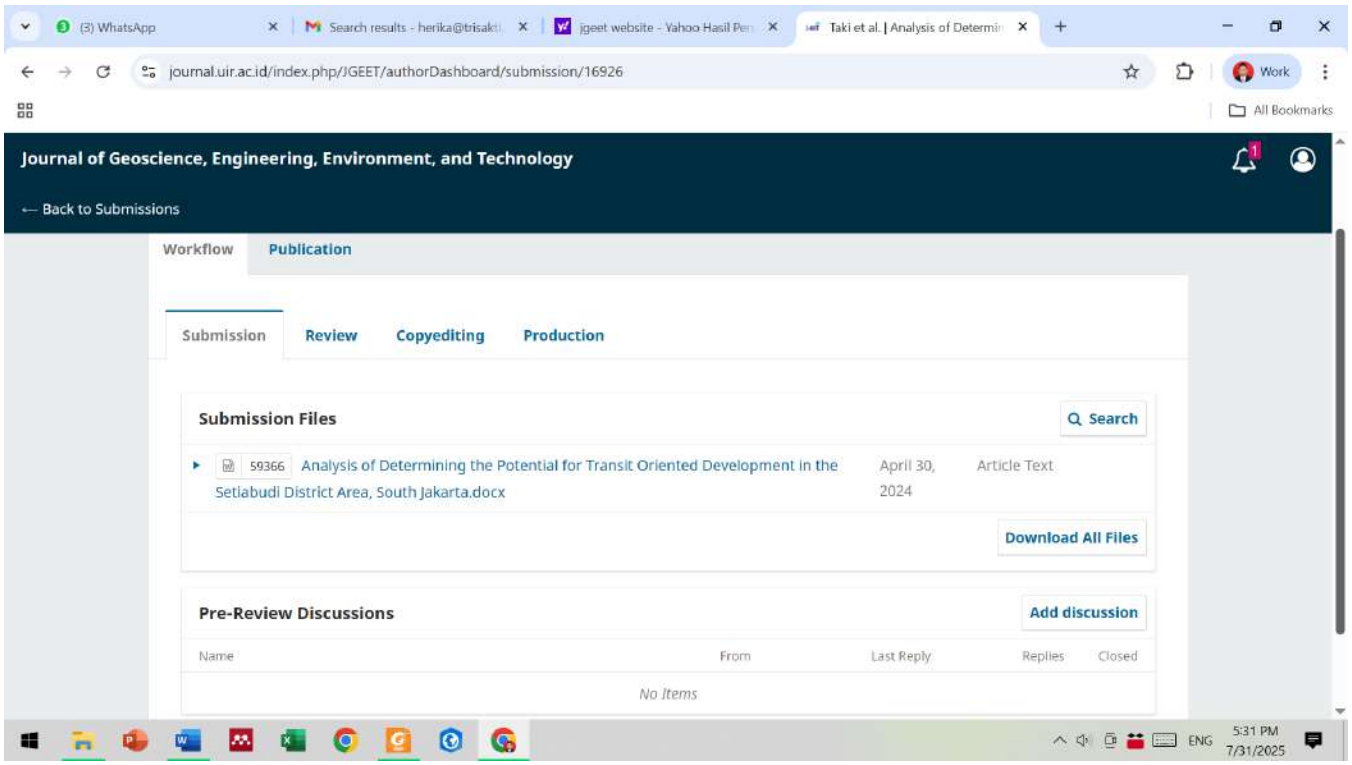
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RESEARCH ARTICLE

Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta

Herika Muhamad Taki[1,*], Bethany Jaffa Rani[2], Muhammad Dimas Elvin Putra[3]

[1*23] Universitas Trisakti, Jakarta Barat, Indonesia,

* Corresponding author : herika@trisakti.ac.id [email of the corresponding author]
Tel.:+6281288206699; fax: +81-72-867-1658 [Tel./fax of the corresponding author]
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1. Introduction

Urban transportation problems generally evolve in tandem with population growth, increases in community income, the availability of motorized vehicles, and the escalation of economic and social activities (Carlton, 2009). The urbanization process and economic growth that have happened in Jakarta resulted into various socioeconomic challenges, including transportation problems such as traffic congestions (Garrin A. N. & Lin, Y., 2022).

Transit-Oriented Development (TOD) aims to reduce dependence on private vehicles and promote sustainable transportation modes such as walking, cycling, and public transportation (Knowles et al., 2020). Implementation of Transit-Oriented Development (TOD) will be of benefit both socially and economically such as reduction of CO2 emissions, prevention of urban sprawl and higher property (real estate) prices (Cervero & Kockelman, 1997; Renne & Wells, 2002). The concept of Transit-Oriented Development (TOD) integrates regional transit networks and complements existing environmental development strategies around transit hubs.

Several studies relating to Transit-Oriented Development (TOD) as a way to help traffic problems showed that TOD improves congestion regionwide (Zhang M., 2010), people living in TOD areas tend to drive less, reducing their vehicle miles travelled (VMT) (Nasri & Zhang L., 2014; Luscher, Daniel R., 1995), and increased usage of public transport (bus) (Hamid et. al., 2020).

In the development of an urban area, intermodal transit facilities and transit zones have become indispensable aspects. The area around transit points is a potential zone for the development of a region. This is related to the ease of access offered by the presence of transit facilities in Transit-Oriented Development (TOD) areas.

The growth of a city is always associated with the growth of its population, which has both positive and negative impacts (Cervero, 2004). Due to its density, South Jakarta faces various urban challenges, such as transportation issues. According to the Central Statistics Agency (BPS) of DKI Jakarta Province, as of the year 2022, the population of South Jakarta has reached 2,244,623 people. Therefore, based on UU No. 26 of 2007, South Jakarta has been classified as a metropolitan city, where a metropolitan city is defined as a city with a minimum population of 1 million people.

The Setiabudi Subdistrict is one of the subdistricts in the South Jakarta Administrative City that houses various economic and business activities. Setiabudi Subdistrict is located in South Jakarta. The several traffic congestion points in South Jakarta include, Blok M - Fatmawati, Antasari Street, Cilandak - Pasar Minggu and Tanjung Barat - Depok (IDN Times, 2015).

Geographically, according to DKI Jakarta Governor Regulation No. 171 of 2007, the area of Setiabudi Subdistrict is 8.85 km2 and comprises 8 sub-districts. This area is one of the most important business and commercial centers in Jakarta.

It has diverse land uses, including residential, business or office spaces for the provision of goods and services, social-cultural activities, religious activities, and more.

2. Research Methodology

2.1 Research Methods

The potential for transit-oriented development is assessed by analyzing the fulfillment of TOD requirements at each transit point, using principles and variables selected from expert literature and previous research (Ibraeva et al., 2023).

The observed stations include two Jakarta MRT Phase 1 stations, namely Setiabudi Astra and Bendungan Hilir, as well as four Jabodebek LRT stations, namely LRT Dukuh Atas, LRT Setiabudi, LRT Rasuna Said, and LRT Kuningan. This research involves weighting the development potential at all transit points within an 800 m radius from the central transit node, employing the Analytical Hierarchy Process (AHP) method. Data collection methods include secondary data collection.

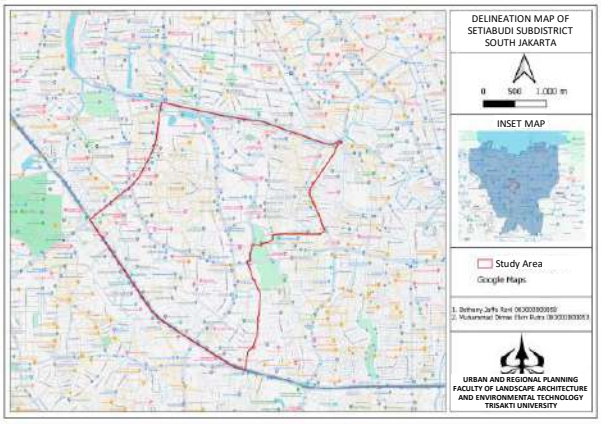

Figure 1. Study Area Delineation Map

2.2 Variable and Unit

The "walk" principle encompasses pedestrian and crossing facility variables, while the "cycle" principle involves cycling facility variables. The establishment of indicators for each variable in the "walk" and "cycle" principles refers to the TOD Standard facility assessment indicators (ITDP, 2017), which have quantitative characteristics to facilitate the assessment.

In the "transit" principle, the variables focus on the quantity of transportation modes, with assessment indicators being the number of interconnected routes for other mass transportation modes, both within station buildings and interchange stations.

For the "density" principle, the considered variable is population density, while the "mix" principle involves the number of land use types and the ratio of residential to non-residential properties. Assessment indicators include average population density, the number of subtypes of land use, and the ratio of residential to non-residential land area within an 800 m radius from the central transit point.

Tabel 1. Variable and Unit Research

Principle	Variable	Unit
Walk	*Pedestrian Facilities*	*TOD Standards, ITDP 2017*
	Crossing Facilities	*TOD Standards, ITDP 2017*
Cycle	*Cycling Facilities*	*TOD Standards, ITDP 2017*
Transit	*Number of Modes of Transportation*	Number of Transportation Mode Routes
Density	*Population Density*	people/Ha
	Number of Types of Land Use	*Sub Land Use*
Mix	*Residential & Non-Residential Ratio*	*% Residential: % Non-Residential*

The scoring assessment for each variable ranges from 0 to 3, derived from assessments of indicators and then converted into total weighting based on calculations using the Analytical Hierarchy Process (AHP) method. Information regarding principles, variables, and score criteria can be referred to in Table 2.

Tabel 1. Variable and Unit Research

Principle	Variable	Unit	Score			
			0	1	2	3
			Low	Medium	High	Very High
Walk	*Pedestrian Facilities* (C1)	*TOD Standards, ITDP 2017*	0	1	2	3
	Crossing Facilities (C2)	*TOD Standards, ITDP 2017*	0	1	2	3
Cycle	*Cycling Facilities* (C3)	*TOD Standards, ITDP 2017*	0	1	2	3
Transit	*Number of Modes of Transportation* (C4)	Number of Transportation Mode Routes	0	1-3	4-6	>6
Density	*Population Density* (C5)	person/Ha	<150	151-200	201-400	>400
	Number of Types of Land Use (C6)	*Sub Land Use*	1-5	6-10	11-15	>15
Mix	*Residential & Non-Residential Ratio* (C7)	*% Residential: % Non-Residential*	>80:<20	61-80:20-39	41-60:40-59	20-40:60-80

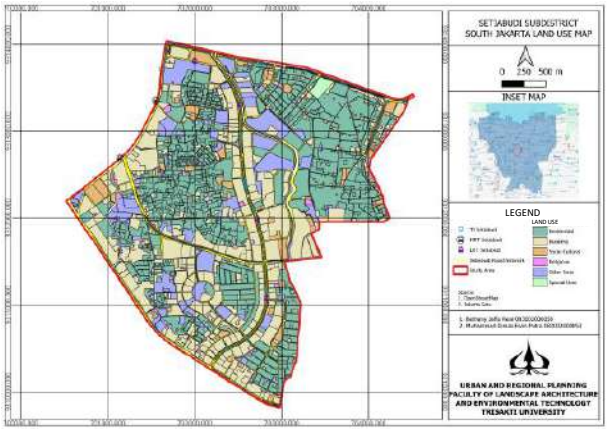

Figure 2. Study Area Land Use Map

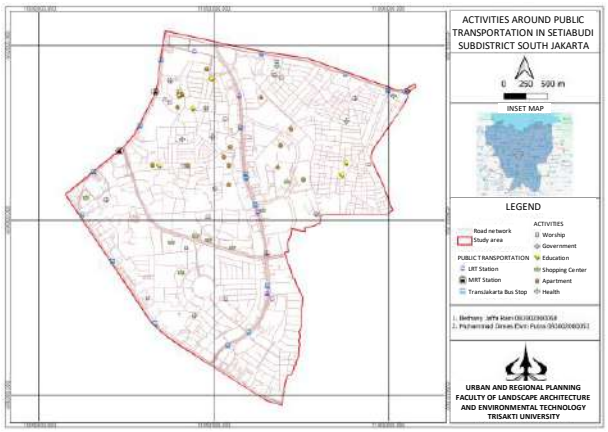

Figure 3. Map of Activities Around Public Transportation

The scoring for pedestrian facility (C1), crossing facility (C2), and cycling facility (C3) variables refers to the standards outlined in TOD Standard (ITDP, 2017), each having three selected assessment indicators. The pedestrian facility standard involves dedicated pedestrian paths on all building fronts, disabled-friendly paths, and pedestrian path lighting. For crossing facilities, the standard involves safe paths with a minimum width of 2 meters, easy access for people with disabilities, and crossing path lighting. Meanwhile, cycling facilities set standards for separated bike routes from motor vehicles, bike parking, and bike carrier routes within buildings. The assessment was conducted through observations at all transit points of MRT and LRT stations.

The establishment of score ranges for the transportation mode quantity variable (C4) is based on rounding down the highest number of mass transportation routes, which is 10 at Dukuh Atas BNI Station. The range is divided into four groups: low group (0), medium group (1-3), high group (4-6), and very high group (>6). The assessment is carried out by calculating the number of connected transportation routes to Jakarta MRT Station using the Jakarta Public Transportation Integration Map, published by the Jakarta Transportation Discussion Forum (FDTJ) in January 2023.

The scoring for the population density variable (C5) follows the population density standards outlined in SNI 03-1733-2004 regarding Procedures for Urban Housing Environmental Planning. These standards include low population density, medium population density, high population density, and very high population density. The assessment is conducted using data from the Central Statistics Agency (BPS), calculating the average population by assuming a proportional ratio of the district's area within an 800 m radius from the central transit point.

The establishment of score ranges for the land use types variable (C6) is based on rounding down the highest number of land subtypes within an 800 m radius from the central transit point, which is a total of 17 at Blok A and Cipete Raya Stations. This number is divided into four groups: low (1-5), medium (6-10), high (11-15), and very high (>15). Furthermore, the determination of scores for the residential and non-residential ratio indicator (C7) follows the standards for residential and non-residential ratios in TODs for cities, sub-cities, and neighborhoods, regulated in the Minister of ATR/BPN Regulation No. 16 of 2017 concerning Guidelines for Transit-Oriented Development. The assessment for both is conducted by calculating the number of land subtypes and the ratio of residential and non-residential land areas within an 800 m radius from the central transit point, available on the Jakarta Land Use Map accessible through the Jakarta Satu website.

3. Results and Discussion

The analysis was conducted by evaluating 7 research variables, namely pedestrian facilities, crossing facilities, cycling facilities, transportation mode quantity, population density, land use types, and residential and non-residential ratio, at all transit points in 2 MRT stations and 4 LRT stations, within an 800 m radius according to the previous assessment scores. The research data, collected through observations and secondary data calculations, were then assessed by assigning scores and converting them into weights based on the AHP calculation results involving five expert sources, including both academics and practitioners in the field of transportation and urban and regional planning. The evaluation of each transit area is detailed in the following section.

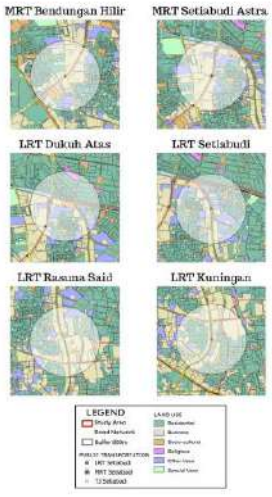

Figure 4. Land Use Map Radius 800 m from MRT and LRT

3.1 Bendungan Hilir MRT Station

Surrounding the Bendungan Hilir MRT Station is an area well-equipped with pedestrian facilities, crossings, and bike lanes. Despite this, the station lacks a direct connection to other mass transportation modes. Situated close to a BRT stop with routes to Blok M-Old Town Station (*Stasiun Kota*), Ragunan Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari, the Bendungan Hilir MRT Station is located in an area adjacent to three districts: Setiabudi (51.08%), Tanah Abang (48.83%), and Kebayoran Baru (0.08%) in Central and South Jakarta.

The region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a high level of diversity. The residential and non-residential ratio is 38.02%:61.98%, categorized as a very high score, with residential land covering an area of 85.01 hectares and non-residential land covering 138.58 hectares.

3.2 Setiabudi Astra MRT Station

The transit area around Setiabudi Astra MRT Station provides complete pedestrian facilities, crossings, and bike lanes. However, the station is not directly connected to other mass transportation modes. Nevertheless, Setiabudi Astra MRT Station is in close proximity to a BRT stop, covering routes from Blok M to Old Town Station (*Stasiun Kota*), Ragunan-Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari. Situated between three districts, namely Tanah Abang (52.68%), Setiabudi (46.19%), and Menteng (1.13%) in Central and South Jakarta, this area has an average population density of approximately 158 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 29.78%:70.22%, categorized as a very high score, with residential land covering an area of 67.83 hectares and non-residential land covering 159.92 hectares.

3.3 Dukuh Atas LRT Station

The area around Dukuh Atas LRT Station, integrated with KRL Station, is complete with pedestrian facilities and crossing points. Located near BRT Corridor 1 stop, Sudirman KRL Station. This region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 51.09%:69.91%, categorized as a very high score, with residential land covering an area of 97.071 hectares and non-residential land covering 132.829 hectares.

3.4 Setiabudi LRT Station

The vicinity around Setiabudi LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 107 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 64.82%:35.18%, categorized as a very high score, with residential land covering an area of 87.507 hectares and non-residential land covering 47.493 hectares.

3.5 Rasuna Said LRT Station

The area around Rasuna Said LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 137.6 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 39.97%:61.03%, categorized as a very high score, with residential land covering an area of 51,961 hectares and non-residential land covering 79,339 hectares.

3.6 Kuningan LRT Station

The area around Kuningan LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 126.4 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 45.20%:54.80%, categorized as a very high score, with residential land covering an area of 54.24 hectares and non-residential land covering 65.76 hectares.

4 Conclusion

Based on the evaluation of the calculation results, it can be concluded that LRT Dukuh Atas Station, LRT Setiabudi, and Bendungan Hilir MRT Station exhibit high potential for development using the Transit-Oriented Development (TOD) concept. Meanwhile, MRT Setiabudi Astra Station and LRT Kuningan Station demonstrate moderate potential for implementing the TOD concept. Conversely, Rasuna Said LRT Station is assessed to have low potential for development with the TOD approach. Considering these results, it is evident that implementing the TOD concept could yield significant positive impacts in the areas surrounding LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station. The potential for improvement in implementing TOD in MRT Setiabudi Astra and LRT Kuningan Stations suggests room for enhancing their impact. However, for Rasuna Said LRT Station, further attention is needed to develop the concept and boost its potential for the future.

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Editor Decision

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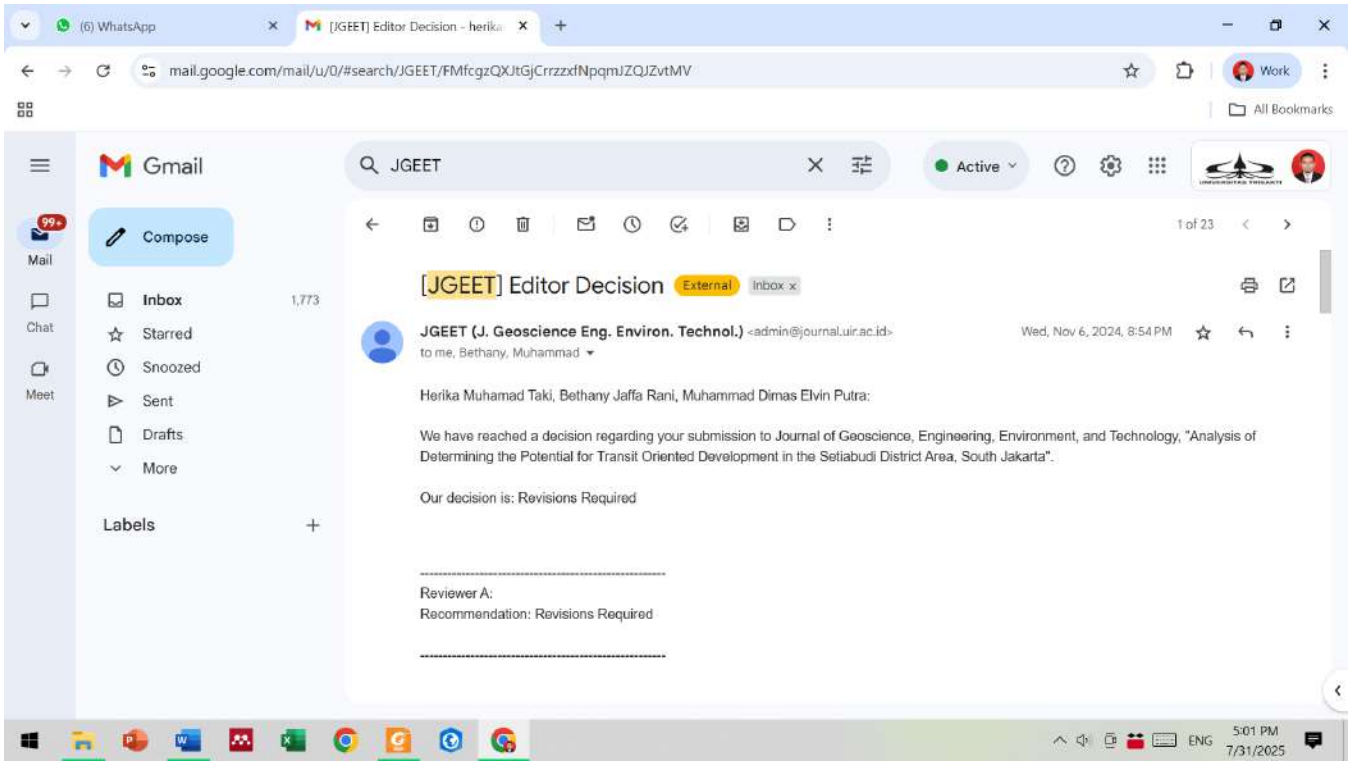

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Paper title reflects the content and purpose of the research.

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4

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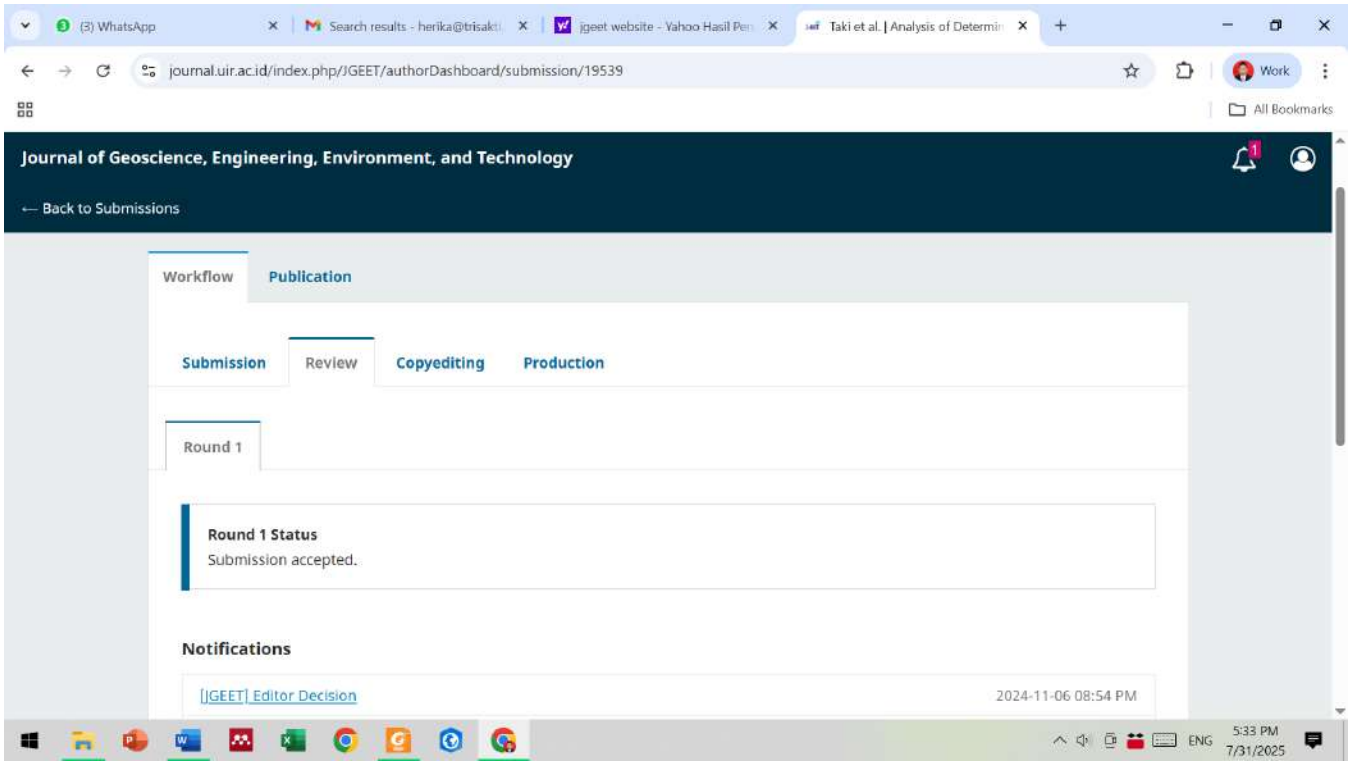

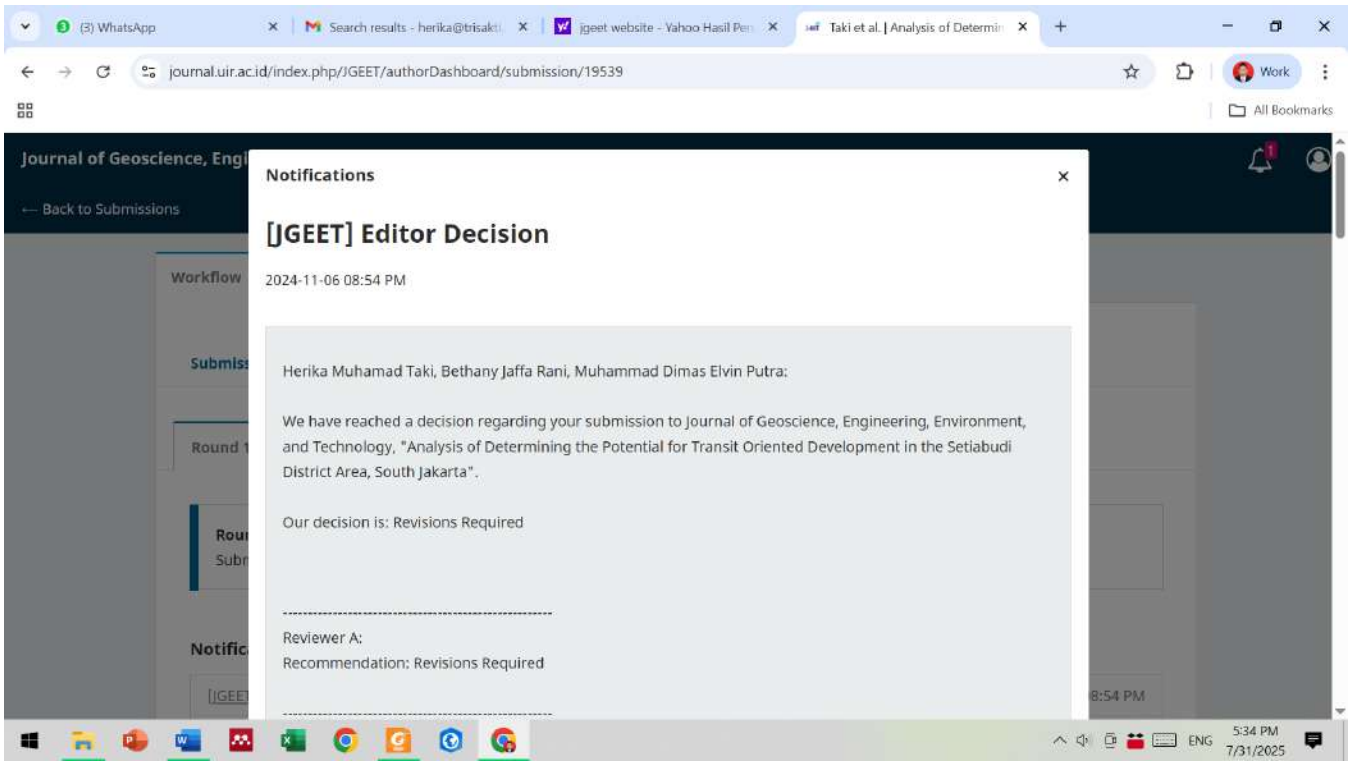
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Recommendation: Revisions Required

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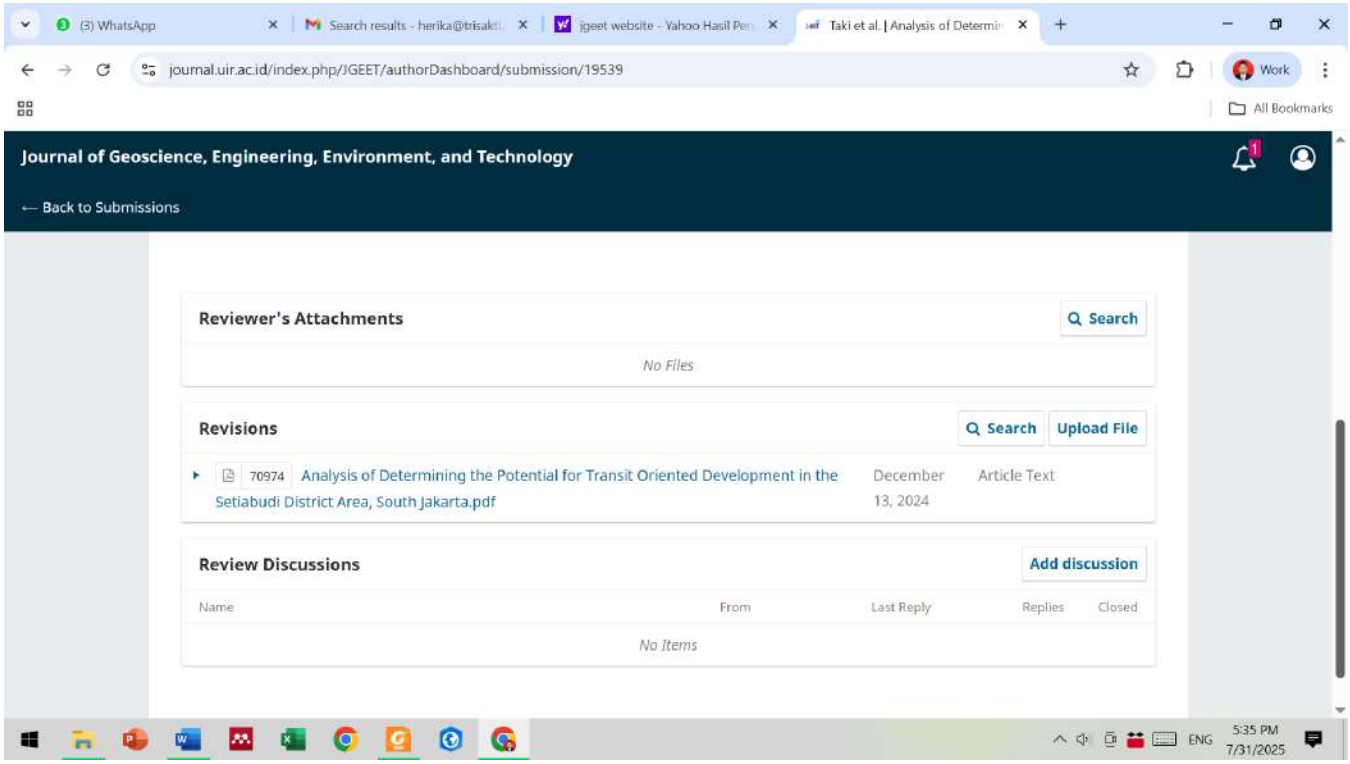

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RESEARCH ARTICLE

Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia

Herika Muhamad Taki[1,*], Bethany Jaffa Rani[2], Muhammad Dimas Elvin Putra[3]

[1*23] *Universitas Trisakti, Jl. Letjen S. Parman, Grogol Petamburan, Jakarta Barat, Indonesia*

* Corresponding author : herika@trisakti.ac.id
Tel.: +62 812-8820-6699
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Abstract

Setiabudi, a district located in South Jakarta, emerges as one of the significant business centers. Its proximity to other commercial areas makes Setiabudi a primary attraction for human activities. This article delves into Transit Oriented Development (TOD), a city planning development pattern integrated with transportation systems to create an efficient city.

The TOD concept emphasizes high-density development, prioritizes pedestrian-friendly environments, and utilizes diverse land functions. This research adopts a literature review method, detailing the criteria and principles of TOD according to the ITDP TOD Standard 2017.

The Additionally, references from other journal literature are used to analyze the potential development of TOD areas, focusing on radius and distance analyses around the Setiabudi district using Google Maps and Google Earth at specific TOD points that serve as transit hubs. LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station show high potential for Transit-Oriented Development (TOD), while MRT Setiabudi Astra and LRT Kuningan Station exhibit moderate potential.

Rasuna Said LRT Station, however, has a low potential for TOD. Implementing TOD in the high-potential stations can generate significant positive impacts, with room for improvement in MRT Setiabudi Astra and LRT Kuningan Stations. Rasuna Said LRT Station requires further attention to boost its potential for the future.

Keywords: TOD, Integration, Land Use, Transit

1. Introduction

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The observed stations include two Jakarta MRT Phase 1 stations, namely Setiabudi Astra and Bendungan Hilir, as well as four Jabodebek LRT stations, namely LRT Dukuh Atas, LRT Setiabudi, LRT Rasuna Said, and LRT Kuningan. This research involves weighting the development potential at all transit points within an 800 m radius from the central transit node, employing the Analytical Hierarchy Process (AHP) method. Data collection methods include secondary data collection.

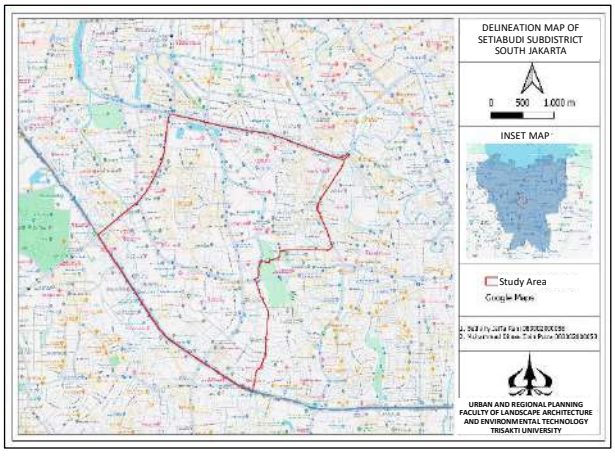

Fig 1. Study Area Delineation Map

2.2 Variable and Unit

The “walk” principle encompasses pedestrian and crossing facility variables, while the “cycle” principle involves cycling facility variables. The establishment of indicators for each variable in the “walk” and “cycle” principles refers to the TOD Standard facility assessment indicators (ITDP, 2017), which have quantitative characteristics to facilitate the assessment.

Tabel 1. Variable and Unit Research

Principle	Variable	Unit
Walk	*Pedestrian Facilities*	*TOD Standards, ITDP 2017*
	Crossing Facilities	*TOD Standards, ITDP 2017*
Cycle	*Cycling Facilities*	*TOD Standards, ITDP 2017*
Transit	*Number of Modes of Transportation*	Number of Transportation Mode Routes
Density	*Population Density*	people/Ha
	Number of Types of Land Use	*Sub Land Use*
Mix	*Residential & Non-Residential Ratio*	*% Residential: % Non-Residential*

In the “transit” principle, the variables focus on the quantity of transportation modes, with assessment indicators being the number of interconnected routes for other mass transportation modes, both within station buildings and interchange stations.

For the “density” principle, the considered variable is population density, while the “mix” principle involves the number of land use types and the ratio of residential to non-residential properties. Assessment indicators include average population density, the number of subtypes of land use, and the ratio of residential to non-residential land area within an 800 m radius from the central transit point.

The scoring assessment for each variable ranges from 0 to 3, derived from assessments of indicators and then converted into total weighting based on calculations using the Analytical Hierarchy Process (AHP) method. Information regarding principles, variables, and score criteria can be referred to in Table 2.

Tabel 2. Variable and Unit Research

Principle	Variable	Unit	Score 0 Low	1 Medium	2 High	3 Very High
Walk	*Pedestrian Facilities* (C1)	*TOD Standards, ITDP 2017*	0	1	2	3
	Crossing Facilities (C2)	*TOD Standards, ITDP 2017*	0	1	2	3
Cycle	*Cycling Facilities* (C3)	*TOD Standards, ITDP 2017*	0	1	2	3
Transit	*Number of Modes of Transportation*	Number of Transportation Mode Routes	0	1-3	4-6	>6

	(C4)					
Density	*Population Density* (C5)	person/Ha	<150	151-200	201-400	>400
	Number of Types of Land Use (C6)	*Sub Land Use*	1-5	6-10	11-15	>15
Mix	*Residential & Non-Residential Ratio* (C7)	*% Residential: % Non-Residential*	>80:<20	61-80:20-39	41-60:40-59	20-40:60-80

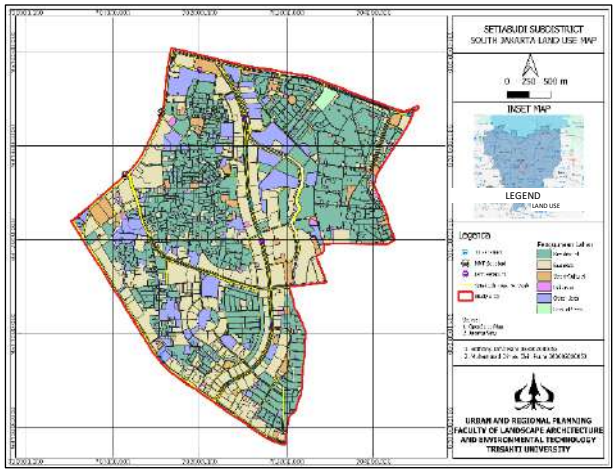

Fig 2. Study Area Land Use Map

The scoring for pedestrian facility (C1), crossing facility (C2), and cycling facility (C3) variables refers to the standards outlined in TOD Standard (ITDP, 2017), each having three selected assessment indicators. The pedestrian facility standard involves dedicated pedestrian paths on all building fronts, disabled-friendly paths, and pedestrian path lighting. For crossing facilities, the standard involves safe paths with a minimum width of 2 meters, easy access for people with disabilities, and crossing path lighting. Meanwhile, cycling facilities set standards for separated bike routes from motor vehicles, bike parking, and bike carrier routes within buildings. The assessment was conducted through observations at all transit points of MRT and LRT stations.

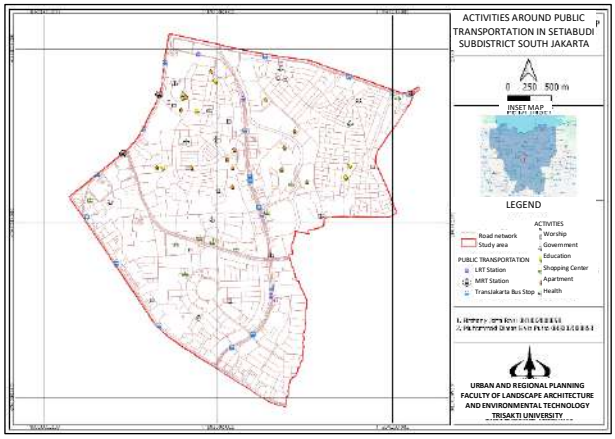

Fig 3. Map of Activities Around Public Transportation

The establishment of score ranges for the transportation mode quantity variable (C4) is based on rounding down the highest number of mass transportation routes, which is 10 at Dukuh Atas BNI Station. The range is divided into four groups: low group (0), medium group (1-3), high group (4-6), and very high group (>6). The assessment is carried out by calculating the number of connected transportation routes to Jakarta MRT Station using the Jakarta Public Transportation Integration Map, published by the Jakarta Transportation Discussion Forum (FDTJ) in January 2023.

The scoring for the population density variable (C5) follows the population density standards outlined in SNI 03-1733-2004 regarding Procedures for Urban Housing Environmental Planning. These standards include low population density, medium population density, high population density, and very high population density. The assessment is conducted using data from the Central Statistics Agency (BPS), calculating the average population by assuming a proportional ratio of the district's area within an 800 m radius from the central transit point.

The establishment of score ranges for the land use types variable (C6) is based on rounding down the highest number of land subtypes within an 800 m radius from the central transit point, which is a total of 17 at Blok A and Cipete Raya Stations. This number is divided into four groups: low (1-5), medium (6-10), high (11-15), and very high (>15). Furthermore, the determination of scores for the residential and non-residential ratio indicator (C7) follows the standards for residential and non-residential ratios in TODs for cities, sub-cities, and neighborhoods, regulated in the Minister of ATR/BPN Regulation No. 16 of 2017 concerning Guidelines for Transit-Oriented Development. The assessment for both is conducted by calculating the number of land subtypes and the ratio of residential and non-residential land areas within an 800 m radius from the central transit point, available on the Jakarta Land Use Map accessible through the Jakarta Satu website.

3. Results and Discussion

The analysis was conducted by evaluating 7 research variables, namely pedestrian facilities,

crossing facilities, cycling facilities, transportation mode quantity, population density, land use types, and residential and non-residential ratio, at all transit points in 2 MRT stations and 4 LRT stations, within an 800 m radius according to the previous assessment scores. The research data, collected through observations and secondary data calculations, were then assessed by assigning scores and converting them into weights based on the AHP calculation results involving five expert sources, including both academics and practitioners in the field of transportation and urban and regional planning. The evaluation of each transit area is detailed in the following section.

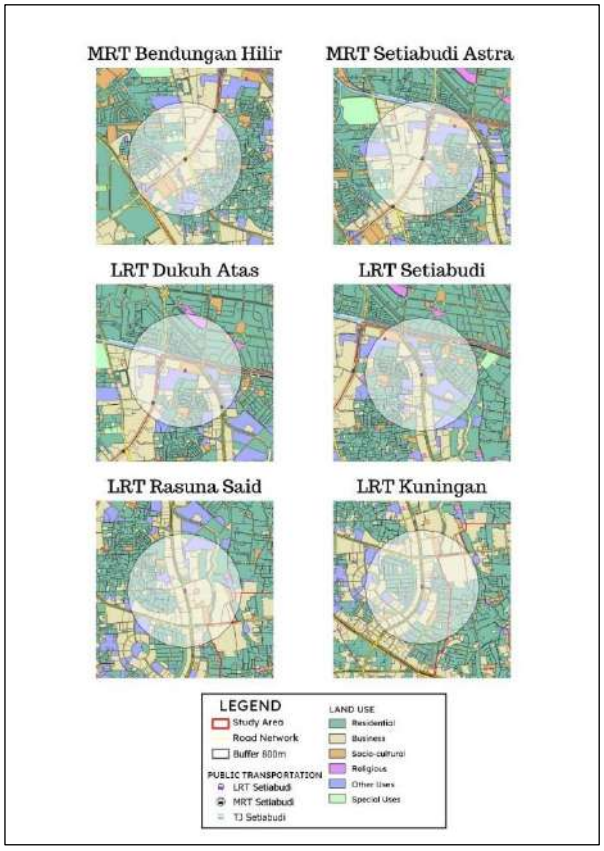

Fig 4. Land Use Map Radius 800 m from MRT and LRT

3.1 Bendungan Hilir MRT Station

Surrounding the Bendungan Hilir MRT Station is an area well-equipped with pedestrian facilities, crossings, and bike lanes. Despite this, the station lacks a direct connection to other mass transportation modes. Situated close to a BRT stop with routes to Blok M-Old Town Station (*Stasiun Kota*), Ragunan Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari, the Bendungan Hilir MRT Station is located in an area adjacent to three districts: Setiabudi (51.08%), Tanah Abang (48.83%), and Kebayoran Baru (0.08%) in Central and South Jakarta.

The region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a high level of diversity. The residential and non-residential ratio is 38.02%:61.98%, categorized as a very high score, with residential land covering an area of 85.01 hectares and non-residential land covering 138.58 hectares.

3.2 Setiabudi Astra MRT Station

The transit area around Setiabudi Astra MRT Station provides complete pedestrian facilities, crossings, and bike lanes. However, the station is not directly connected to other mass transportation modes. Nevertheless, Setiabudi Astra MRT Station is in close proximity to a BRT stop, covering routes from Blok M to Old Town Station (*Stasiun Kota*), Ragunan-Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari. Situated between three districts, namely Tanah Abang (52.68%), Setiabudi (46.19%), and Menteng (1.13%) in Central and South Jakarta, this area has an average population density of approximately 158 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 29.78%:70.22%, categorized as a very high score, with residential land covering an area of 67.83 hectares and non-residential land covering 159.92 hectares.

3.3 Dukuh Atas LRT Station

The area around Dukuh Atas LRT Station, integrated with KRL Station, is complete with pedestrian facilities and crossing points. Located near BRT Corridor 1 stop, Sudirman KRL Station. This region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 51.09%:69.91%, categorized as a very high score, with residential land covering an area of 97.071 hectares and non-residential land covering 132.829 hectares.

3.4 Setiabudi LRT Station

The vicinity around Setiabudi LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 107 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 64.82%:35.18%, categorized as a very high score, with residential land covering an area of 87.507 hectares and non-residential land covering 47.493 hectares.

3.5 Rasuna Said LRT Station

The area around Rasuna Said LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 137.6 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-

residential ratio is 39.97%:61.03%, categorized as a very high score, with residential land covering an area of 51,961 hectares and non-residential land covering 79,339 hectares.

3.6 Kuningan LRT Station

The area around Kuningan LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 126.4 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 45.20%:54.80%, categorized as a very high score, with residential land covering an area of 54.24 hectares and non-residential land covering 65.76 hectares.

4 Conclusion

Based on the evaluation of the calculation results, it can be concluded that LRT Dukuh Atas Station, LRT Setiabudi, and Bendungan Hilir MRT Station exhibit high potential for development using the Transit-Oriented Development (TOD) concept. Meanwhile, MRT Setiabudi Astra Station and LRT Kuningan Station demonstrate moderate potential for implementing the TOD concept. Conversely, Rasuna Said LRT Station is assessed to have low potential for development with the TOD approach. Considering these results, it is evident that implementing the TOD concept could yield significant positive impacts in the areas surrounding LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station. The potential for improvement in implementing TOD in MRT Setiabudi Astra and LRT Kuningan Stations suggests room for enhancing their impact. However, for Rasuna Said LRT Station, further attention is needed to develop the concept and boost its potential for the future.

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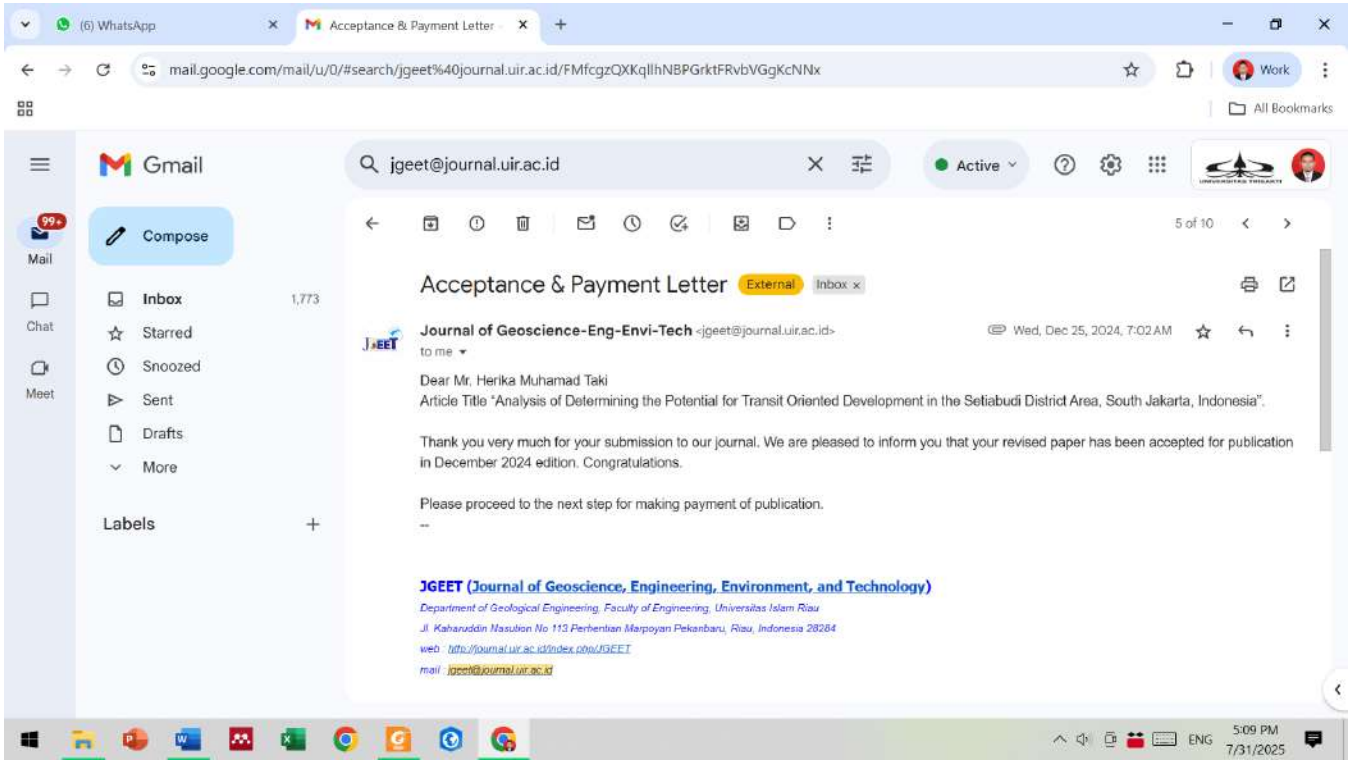

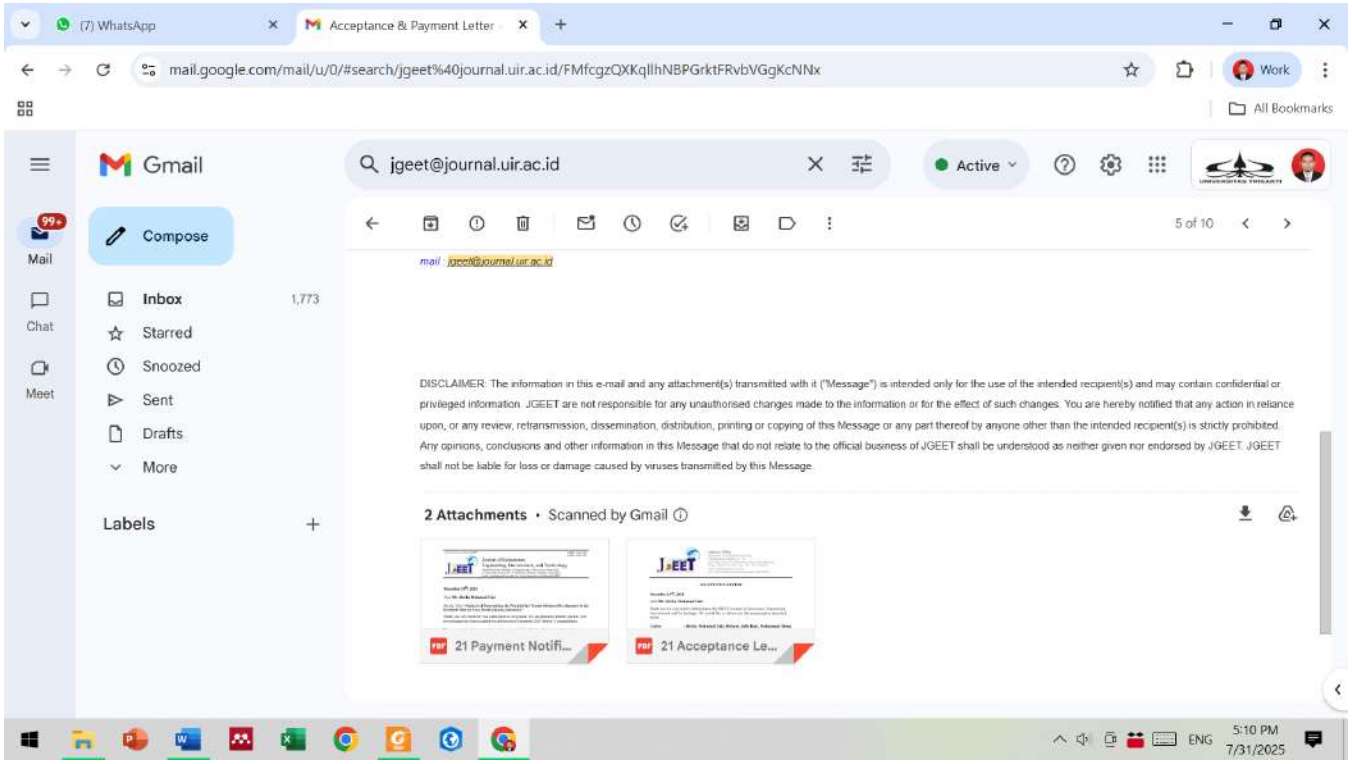

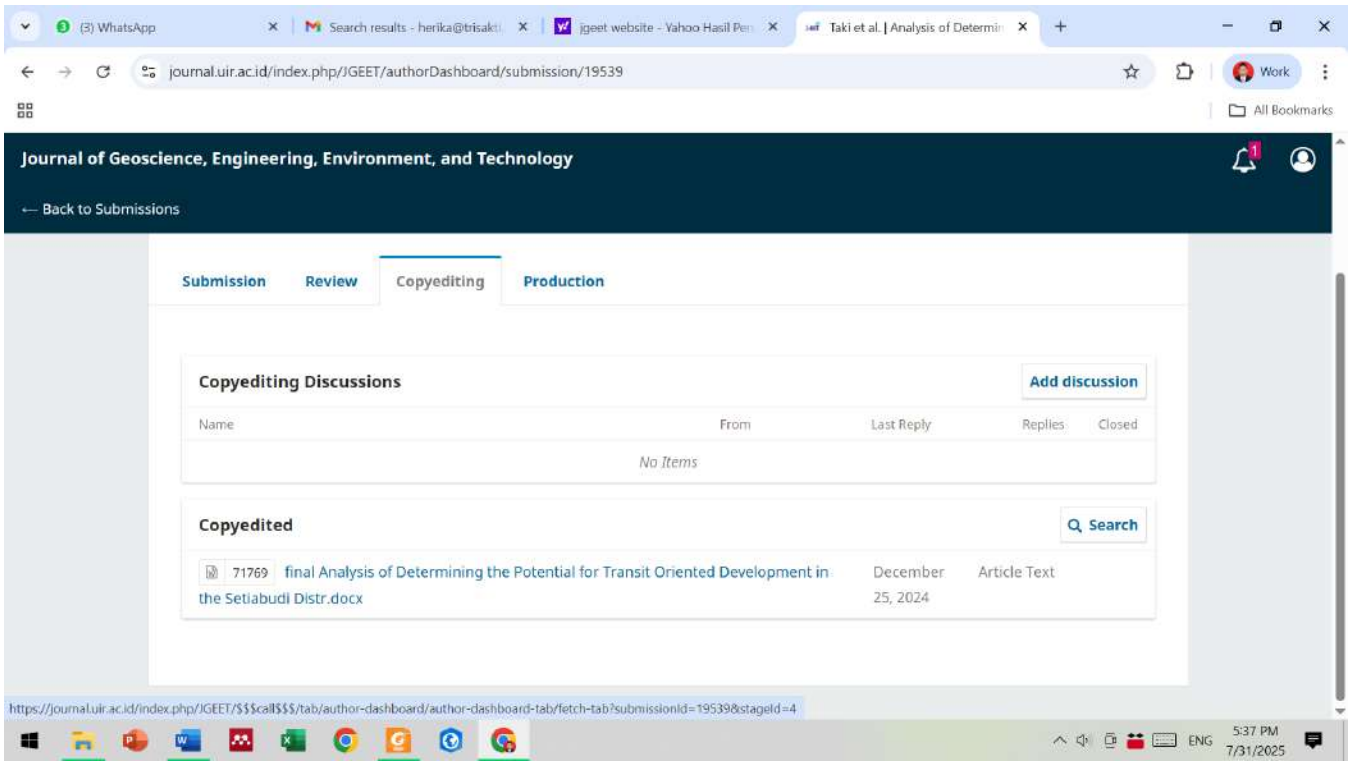
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Thank you for your article submission to the JGEET (Journal of Geoscience, Engineering, Environment, and Technology). We would like to inform you that manuscript as described below:

Author : **Herika Muhamad Taki, Bethany Jaffa Rani, Muhammad Dimas Elvin Putra.**

Title : **"Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia".**

Status : **ACCEPTED**

This manuscript has successfully met the criteria and peer review process, and will be published on **Vol. 09 No. 04 in December 2024**.

Best Regards,
Prof. Husnul Kausarian, Ph.D

Editor in chief of JGEET
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Article Title **"Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia".**

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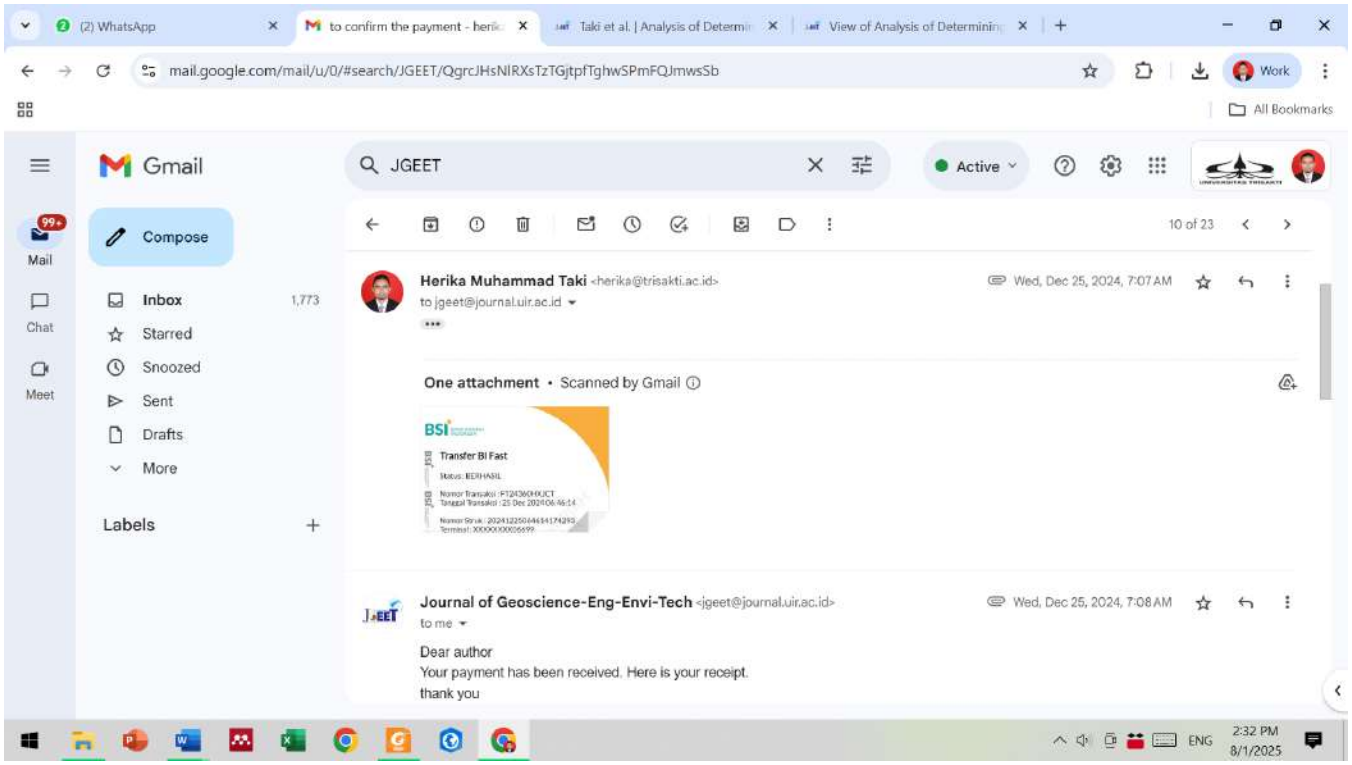

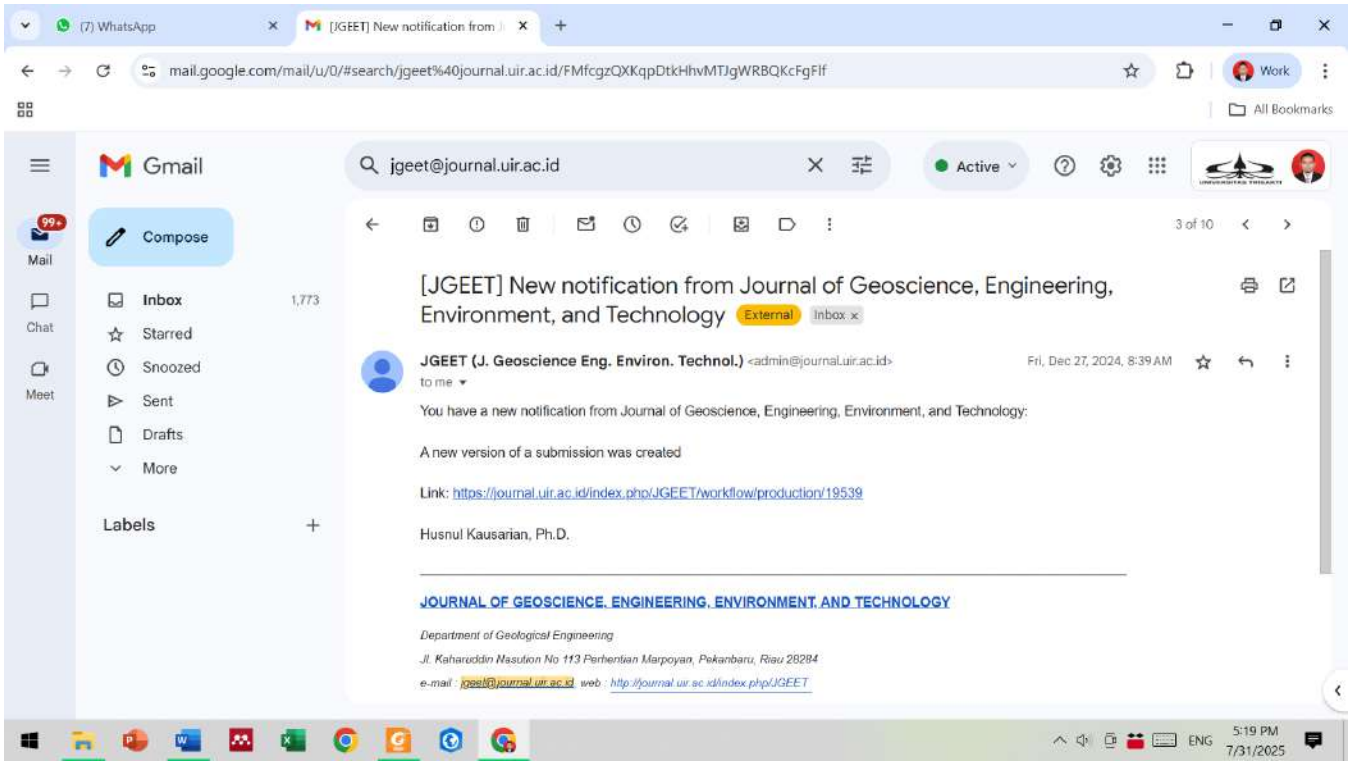

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RESEARCH ARTICLE

Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia

Herika Muhamad Taki[1,*], Bethany Jaffa Rani[2], Muhammad Dimas Elvin Putra[3]

[1*23] *Department of Urban and Regional Planning, Universitas Trisakti, Grogol Petamburan, Jakarta Barat, Indonesia*

* Corresponding author : herika@trisakti.ac.id
Tel.: +62 812-8820-6699
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Abstract

Setiabudi, a district located in South Jakarta, emerges as one of the significant business centers. Its proximity to other commercial areas makes Setiabudi a primary attraction for human activities. This article delves into Transit Oriented Development (TOD), a city planning development pattern integrated with transportation systems to create an efficient city.

The TOD concept emphasizes high-density development, prioritizes pedestrian-friendly environments, and utilizes diverse land functions. This research adopts a literature review method, detailing the criteria and principles of TOD according to the ITDP TOD Standard 2017.

The Additionally, references from other journal literature are used to analyze the potential development of TOD areas, focusing on radius and distance analyses around the Setiabudi district using Google Maps and Google Earth at specific TOD points that serve as transit hubs. LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station show high potential for Transit-Oriented Development (TOD), while MRT Setiabudi Astra and LRT Kuningan Station exhibit moderate potential.

Rasuna Said LRT Station, however, has a low potential for TOD. Implementing TOD in the high-potential stations can generate significant positive impacts, with room for improvement in MRT Setiabudi Astra and LRT Kuningan Stations. Rasuna Said LRT Station requires further attention to boost its potential for the future.

Keywords: TOD, Integration, Land Use, Transit

1. Introduction

Urban transportation problems generally evolve in tandem with population growth, increases in community income, the availability of motorized vehicles, and the escalation of economic and social activities (Carlton, 2009). The urbanization process and economic growth that have happened in Jakarta resulted into various socioeconomic challenges, including transportation problems such as traffic congestions (Garrin A. N. & Lin, Y., 2022).

Transit-Oriented Development (TOD) aims to reduce dependence on private vehicles and promote sustainable transportation modes such as walking, cycling, and public transportation (Knowles et al., 2020). Implementation of Transit-Oriented Development (TOD) will be of benefit both socially and economically such as reduction of CO2 emissions, prevention of urban sprawl and higher property (real estate) prices (Cervero & Kockelman, 1997; Renne & Wells, 2002). The concept of Transit-Oriented Development (TOD) integrates regional transit networks and complements existing environmental development strategies around transit hubs.

Several studies relating to Transit-Oriented Development (TOD) as a way to help traffic problems showed that TOD improves congestion regionwide (Zhang M., 2010), people living in TOD areas tend to drive less, reducing their vehicle miles travelled (VMT) (Nasri & Zhang L., 2014; Luscher, Daniel R., 1995), and increased usage of public transport (bus) (Hamid et. al., 2020).

In the development of an urban area, intermodal transit facilities and transit zones have become indispensable aspects. The area around transit points is a potential zone for the development of a region. This is related to the ease of access offered by the presence of transit facilities in Transit-Oriented Development (TOD) areas.

The growth of a city is always associated with the growth of its population, which has both positive and negative impacts (Cervero, 2004). Due to its density, South Jakarta faces various urban challenges, such as transportation issues. According to the Central Statistics Agency (BPS) of DKI Jakarta Province, as of the year 2022, the population of South Jakarta has reached 2,244,623 people. Therefore, based on UU No. 26 of 2007, South Jakarta has been classified as a metropolitan city, where a metropolitan city is defined as a city with a minimum population of 1 million people.

The Setiabudi Subdistrict is one of the subdistricts in the South Jakarta Administrative City that houses various economic and business activities. Setiabudi Subdistrict is located in South Jakarta. The several traffic congestion points in South Jakarta include, Blok M - Fatmawati, Antasari Street, Cilandak - Pasar Minggu and Tanjung Barat - Depok (IDN Times, 2015).

Geographically, according to DKI Jakarta Governor Regulation No. 171 of 2007, the area of Setiabudi Subdistrict is 8.85 km2 and comprises 8 sub-districts. This area is one of the most important business and commercial centers in Jakarta.

It has diverse land uses, including residential, business or office spaces for the provision of goods and services, social-cultural activities, religious activities, and more.

2. Research Methodology

2.1 Research Methods

The potential for transit-oriented development is assessed by analyzing the fulfillment of TOD requirements at each transit point, using principles and variables selected from expert literature and previous research (Ibraeva et al., 2023).

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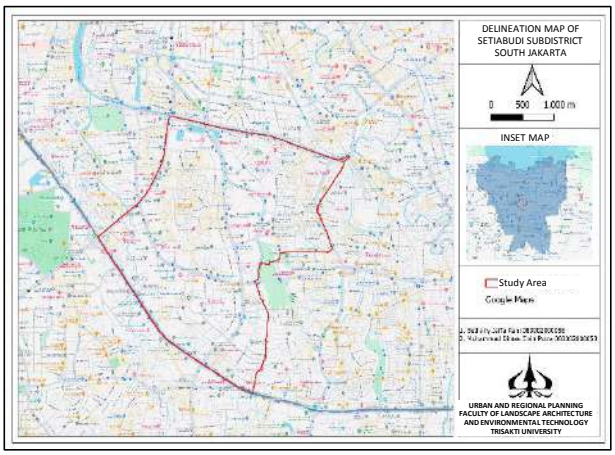

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Mix	*Residential & Non-Residential Ratio*	*% Residential: % Non-Residential*

In the "transit" principle, the variables focus on the quantity of transportation modes, with assessment indicators being the number of interconnected routes for other mass transportation modes, both within station buildings and interchange stations.

For the "density" principle, the considered variable is population density, while the "mix" principle involves the number of land use types and the ratio of residential to non-residential properties. Assessment indicators include average population density, the number of subtypes of land use, and the ratio of residential to non-residential land area within an 800 m radius from the central transit point.

The scoring assessment for each variable ranges from 0 to 3, derived from assessments of indicators and then converted into total weighting based on calculations using the Analytical Hierarchy Process (AHP) method. Information regarding principles, variables, and score criteria can be referred to in Table 2.

Tabel 2. Variable and Unit Research

Principle	Variable	Unit	Score			
			0	1	2	3
			Low	Medium	High	Very High
Walk	*Pedestrian Facilities* (C1)	*TOD Standards, ITDP 2017*	0	1	2	3
	Crossing Facilities (C2)	*TOD Standards, ITDP 2017*	0	1	2	3
Cycle	*Cycling Facilities* (C3)	*TOD Standards, ITDP 2017*	0	1	2	3
Transit	*Number of Modes of Transportation* (C4)	Number of Transportation Mode Routes	0	1-3	4-6	>6
Density	*Population Density* (C5)	person/Ha	<150	151-200	201-400	>400
	Number of Types of Land Use (C6)	*Sub Land Use*	1-5	6-10	11-15	>15
Mix	*Residential & Non-Residential Ratio* (C7)	*% Residential : % Non-Residential*	>80: <20	61-80: 20-39	41-60: 40-59	20-40: 60-80

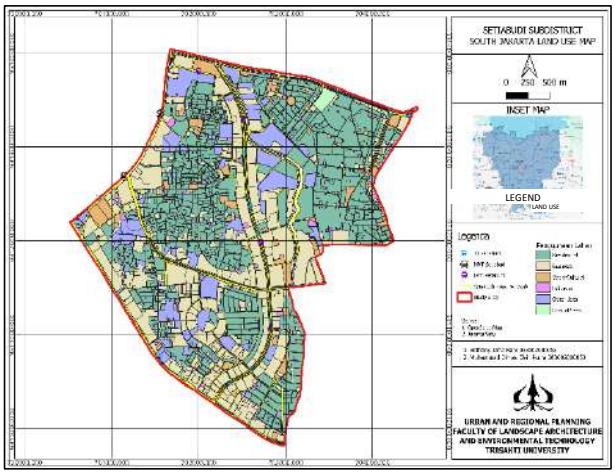

Fig 2. Study Area Land Use Map

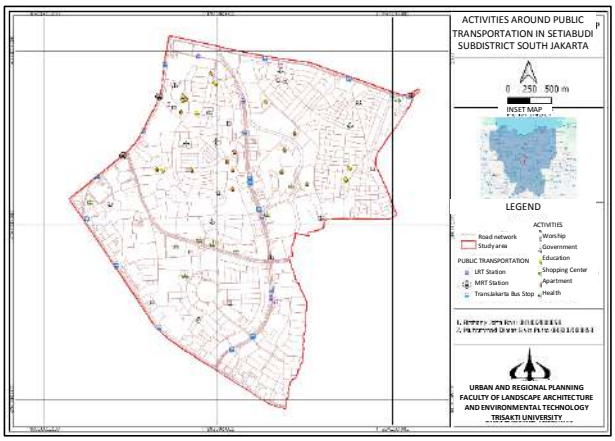

Fig 3. Map of Activities Around Public Transportation

The scoring for pedestrian facility (C1), crossing facility (C2), and cycling facility (C3) variables refers to the standards outlined in TOD Standard (ITDP, 2017), each having three selected assessment indicators. The pedestrian facility standard involves dedicated pedestrian paths on all building fronts, disabled-friendly paths, and pedestrian path lighting. For crossing facilities, the standard involves safe paths with a minimum width of 2 meters, easy access for people with disabilities, and crossing path lighting. Meanwhile, cycling facilities set standards for separated bike routes from motor vehicles, bike parking, and bike carrier routes within buildings. The assessment was conducted through observations at all transit points of MRT and LRT stations.

The establishment of score ranges for the transportation mode quantity variable (C4) is based on rounding down the highest number of mass transportation routes, which is 10 at Dukuh Atas BNI Station. The range is divided into four groups: low group (0), medium group (1-3), high group (4-6), and very high group (>6). The assessment is carried out by calculating the number of connected transportation routes to Jakarta MRT Station using the Jakarta Public Transportation Integration Map, published by the Jakarta Transportation Discussion Forum (FDTJ) in January 2023.

The scoring for the population density variable (C5) follows the population density standards outlined in SNI 03-1733-2004 regarding Procedures for Urban Housing Environmental Planning. These standards include low population density, medium population density, high population density, and very high population density. The assessment is conducted using data from the Central Statistics Agency (BPS), calculating the average population by assuming a proportional ratio of the district's area within an 800 m radius from the central transit point.

The establishment of score ranges for the land use types variable (C6) is based on rounding down the highest number of land subtypes within an 800 m radius from the central transit point, which is a total of 17 at Blok A and Cipete Raya Stations. This number is divided into four groups: low (1-5), medium (6-10), high (11-15), and very high (>15). Furthermore, the determination of scores for the residential and non-residential ratio indicator (C7) follows the standards for residential and non-residential ratios in TODs for cities, sub-cities, and neighborhoods, regulated in the Minister of ATR/BPN Regulation No. 16 of 2017 concerning Guidelines for Transit-Oriented Development. The assessment for both is conducted by calculating the number of land subtypes and the ratio of residential and non-residential land areas within an 800 m radius from the central transit point, available on the Jakarta Land Use Map accessible through the Jakarta Satu website.

3. Results and Discussion

The analysis was conducted by evaluating 7 research variables, namely pedestrian facilities, crossing facilities, cycling facilities, transportation mode quantity, population density, land use types, and residential and non-residential ratio, at all transit points in 2 MRT stations and 4 LRT stations, within an 800 m radius according to the previous assessment scores. The research data, collected through observations and secondary data calculations, were then assessed by assigning scores and converting them into weights based on the AHP calculation results involving five expert sources, including both academics and practitioners in the field of transportation and urban and regional planning. The evaluation of each transit area is detailed in the following section.

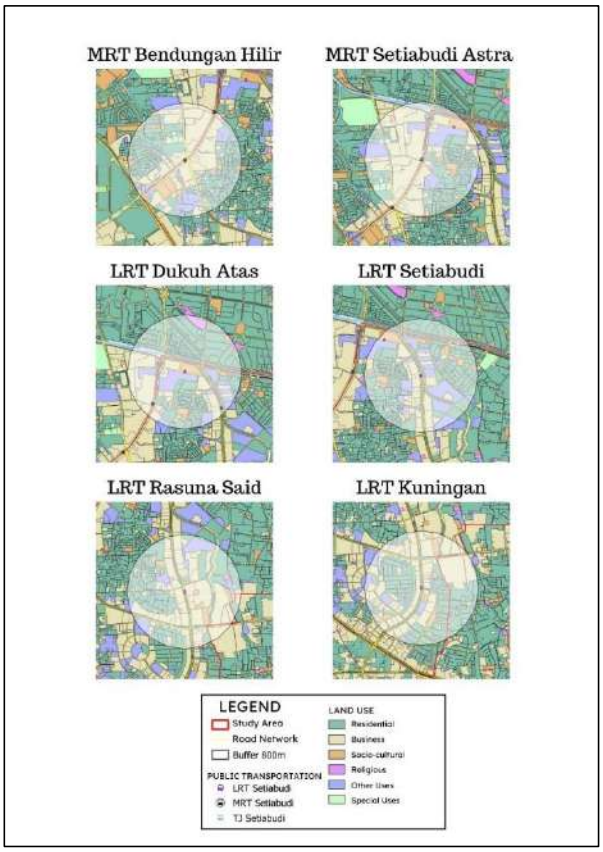

Fig 4. Land Use Map Radius 800 m from MRT and LRT

3.1 Bendungan Hilir MRT Station

Surrounding the Bendungan Hilir MRT Station is an area well-equipped with pedestrian facilities, crossings, and bike lanes. Despite this, the station lacks a direct connection to other mass transportation modes. Situated close to a BRT stop with routes to Blok M-Old Town Station (*Stasiun Kota*), Ragunan Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari, the Bendungan Hilir MRT Station is located in an area adjacent to three districts: Setiabudi (51.08%), Tanah Abang (48.83%), and Kebayoran Baru (0.08%) in Central and South Jakarta.

The region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius

from the transit point, there are 16 types of land subtypes, reflecting a high level of diversity. The residential and non-residential ratio is 38.02%:61.98%, categorized as a very high score, with residential land covering an area of 85.01 hectares and non-residential land covering 138.58 hectares.

3.2 Setiabudi Astra MRT Station

The transit area around Setiabudi Astra MRT Station provides complete pedestrian facilities, crossings, and bike lanes. However, the station is not directly connected to other mass transportation modes. Nevertheless, Setiabudi Astra MRT Station is in close proximity to a BRT stop, covering routes from Blok M to Old Town Station (*Stasiun Kota*), Ragunan-Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari. Situated between three districts, namely Tanah Abang (52.68%), Setiabudi (46.19%), and Menteng (1.13%) in Central and South Jakarta, this area has an average population density of approximately 158 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 29.78%:70.22%, categorized as a very high score, with residential land covering an area of 67.83 hectares and non-residential land covering 159.92 hectares.

3.3 Dukuh Atas LRT Station

The area around Dukuh Atas LRT Station, integrated with KRL Station, is complete with pedestrian facilities and crossing points. Located near BRT Corridor 1 stop, Sudirman KRL Station. This region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 51.09%:69.91%, categorized as a very high score, with residential land covering an area of 97.071 hectares and non-residential land covering 132.829 hectares.

3.4 Setiabudi LRT Station

The vicinity around Setiabudi LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 107 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 64.82%:35.18%, categorized as a very high score, with residential land covering an area of 87.507 hectares and non-residential land covering 47.493 hectares.

3.5 Rasuna Said LRT Station

The area around Rasuna Said LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 137.6 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 39.97%:61.03%, categorized as a very high score, with residential land covering an area of 51,961 hectares and non-residential land covering 79,339 hectares.

3.6 Kuningan LRT Station

The area around Kuningan LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 126.4 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 45.20%:54.80%, categorized as a very high score, with residential land covering an area of 54.24 hectares and non-residential land covering 65.76 hectares.

4 Conclusion

Based on the evaluation of the calculation results, it can be concluded that LRT Dukuh Atas Station, LRT Setiabudi, and Bendungan Hilir MRT Station exhibit high potential for development using the Transit-Oriented Development (TOD) concept. Meanwhile, MRT Setiabudi Astra Station and LRT Kuningan Station demonstrate moderate potential for implementing the TOD concept. Conversely, Rasuna Said LRT Station is assessed to have low potential for development with the TOD approach. Considering these results, it is evident that implementing the TOD concept could yield significant positive impacts in the areas surrounding LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station. The potential for improvement in implementing TOD in MRT Setiabudi Astra and LRT Kuningan Stations suggests room for enhancing their impact. However, for Rasuna Said LRT Station, further attention is needed to develop the concept and boost its potential for the future.

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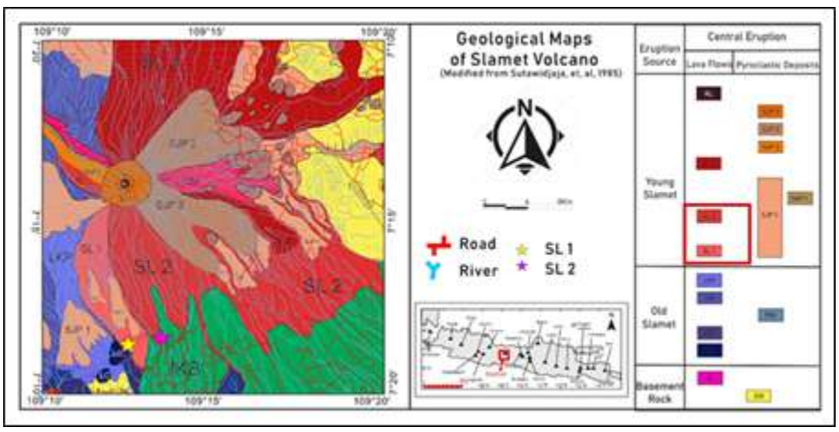

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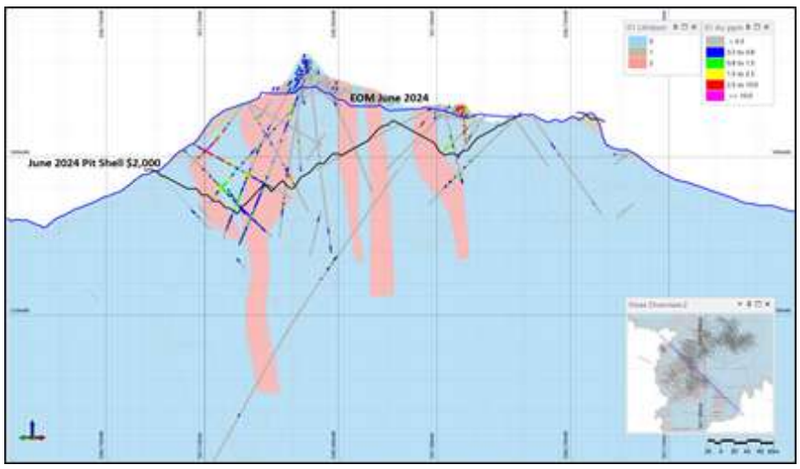

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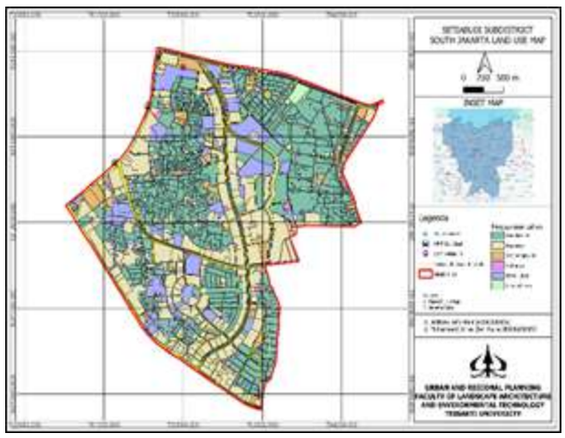

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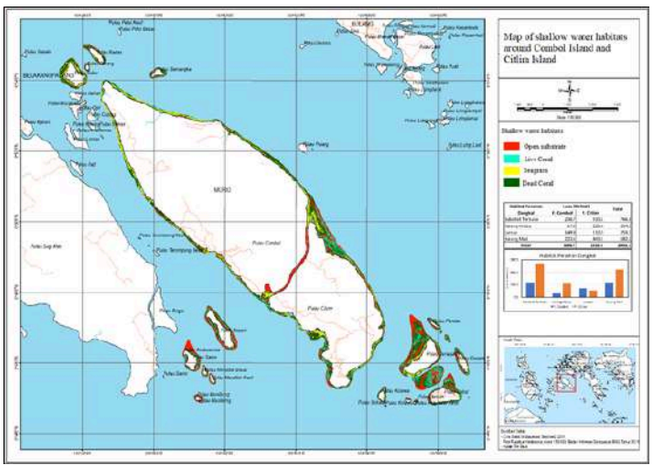

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RESEARCH ARTICLE

Analysis of Determining the Potential for Transit Oriented Development in the Setiabudi District Area, South Jakarta, Indonesia

Herika Muhamad Taki[1,*], Bethany Jaffa Rani[2], Muhammad Dimas Elvin Putra[3]

[1*23] *Department of Urban and Regional Planning, Universitas Trisakti, Grogol Petamburan, Jakarta Barat, Indonesia*

* Corresponding author : herika@trisakti.ac.id
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Abstract

Setiabudi, a district located in South Jakarta, emerges as one of the significant business centers. Its proximity to other commercial areas makes Setiabudi a primary attraction for human activities. This article delves into Transit Oriented Development (TOD), a city planning development pattern integrated with transportation systems to create an efficient city.

The TOD concept emphasizes high-density development, prioritizes pedestrian-friendly environments, and utilizes diverse land functions. This research adopts a literature review method, detailing the criteria and principles of TOD according to the ITDP TOD Standard 2017.

The Additionally, references from other journal literature are used to analyze the potential development of TOD areas, focusing on radius and distance analyses around the Setiabudi district using Google Maps and Google Earth at specific TOD points that serve as transit hubs. LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station show high potential for Transit-Oriented Development (TOD), while MRT Setiabudi Astra and LRT Kuningan Station exhibit moderate potential.

Rasuna Said LRT Station, however, has a low potential for TOD. Implementing TOD in the high-potential stations can generate significant positive impacts, with room for improvement in MRT Setiabudi Astra and LRT Kuningan Stations. Rasuna Said LRT Station requires further attention to boost its potential for the future.

Keywords: TOD, Integration, Land Use, Transit

1. Introduction

Urban transportation problems generally evolve in tandem with population growth, increases in community income, the availability of motorized vehicles, and the escalation of economic and social activities (Carlton, 2009). The urbanization process and economic growth that have happened in Jakarta resulted into various socioeconomic challenges, including transportation problems such as traffic congestions (Garrin A. N. & Lin, Y., 2022).

Transit-Oriented Development (TOD) aims to reduce dependence on private vehicles and promote sustainable transportation modes such as walking, cycling, and public transportation (Knowles et al., 2020). Implementation of Transit-Oriented Development (TOD) will be of benefit both socially and economically such as reduction of CO2 emissions, prevention of urban sprawl and higher property (real estate) prices (Cervero & Kockelman, 1997; Renne & Wells, 2002). The concept of Transit-Oriented Development (TOD) integrates regional transit networks and complements existing environmental development strategies around transit hubs.

Several studies relating to Transit-Oriented Development (TOD) as a way to help traffic problems showed that TOD improves congestion regionwide (Zhang M., 2010), people living in TOD areas tend to drive less, reducing their vehicle miles travelled (VMT) (Nasri & Zhang L., 2014; Luscher, Daniel R., 1995), and increased usage of public transport (bus) (Hamid et. al., 2020).

In the development of an urban area, intermodal transit facilities and transit zones have become indispensable aspects. The area around transit points is a potential zone for the development of a region. This is related to the ease of access offered by the presence of transit facilities in Transit-Oriented Development (TOD) areas.

The growth of a city is always associated with the growth of its population, which has both positive and negative impacts (Cervero, 2004). Due to its density, South Jakarta faces various urban challenges, such as transportation issues. According to the Central Statistics Agency (BPS) of DKI Jakarta Province, as of the year 2022, the population of South Jakarta has reached 2,244,623 people. Therefore, based on UU No. 26 of 2007, South Jakarta has been classified as a metropolitan city, where a metropolitan city is defined as a city with a minimum population of 1 million people.

The Setiabudi Subdistrict is one of the subdistricts in the South Jakarta Administrative City that houses various economic and business activities. Setiabudi Subdistrict is located in South Jakarta. The several traffic congestion points in South Jakarta include, Blok M - Fatmawati, Antasari Street, Cilandak - Pasar Minggu and Tanjung Barat - Depok (IDN Times, 2015).

Geographically, according to DKI Jakarta Governor Regulation No. 171 of 2007, the area of Setiabudi Subdistrict is 8.85 km2 and comprises 8 sub-districts. This area is one of the most important business and commercial centers in Jakarta.

It has diverse land uses, including residential, business or office spaces for the provision of goods and services, social-cultural activities, religious activities, and more.

2. Research Methodology

2.1 Research Methods

The potential for transit-oriented development is assessed by analyzing the fulfillment of TOD requirements at each transit point, using principles and variables selected from expert literature and previous research (Ibraeva et al., 2023).

The observed stations include two Jakarta MRT Phase 1 stations, namely Setiabudi Astra and Bendungan Hilir, as well as four Jabodebek LRT stations, namely LRT Dukuh Atas, LRT Setiabudi, LRT Rasuna Said, and LRT Kuningan. This research involves weighting the development potential at all transit points within an 800 m radius from the central transit node, employing the Analytical Hierarchy Process (AHP) method. Data collection methods include secondary data collection.

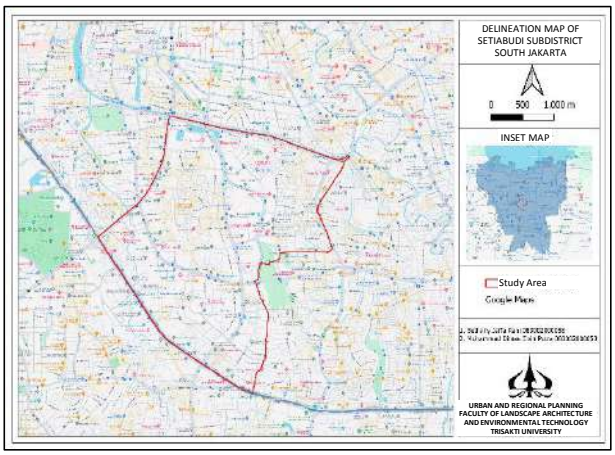

Fig 1. Study Area Delineation Map

2.2 Variable and Unit

The "walk" principle encompasses pedestrian and crossing facility variables, while the "cycle" principle involves cycling facility variables. The establishment of indicators for each variable in the "walk" and "cycle" principles refers to the TOD Standard facility assessment indicators (ITDP, 2017), which have quantitative characteristics to facilitate the assessment.

Tabel 1. Variable and Unit Research

Principle	Variable	Unit
Walk	*Pedestrian Facilities*	*TOD Standards, ITDP 2017*
	Crossing Facilities	*TOD Standards, ITDP 2017*
Cycle	*Cycling Facilities*	*TOD Standards, ITDP 2017*
Transit	*Number of Modes of Transportation*	Number of Transportation Mode Routes
Density	*Population Density*	people/Ha
	Number of Types of Land Use	*Sub Land Use*
Mix	*Residential & Non-Residential Ratio*	*% Residential: % Non-Residential*

In the "transit" principle, the variables focus on the quantity of transportation modes, with assessment indicators being the number of interconnected routes for other mass transportation modes, both within station buildings and interchange stations.

For the "density" principle, the considered variable is population density, while the "mix" principle involves the number of land use types and the ratio of residential to non-residential properties. Assessment indicators include average population density, the number of subtypes of land use, and the ratio of residential to non-residential land area within an 800 m radius from the central transit point.

The scoring assessment for each variable ranges from 0 to 3, derived from assessments of indicators and then converted into total weighting based on calculations using the Analytical Hierarchy Process (AHP) method. Information regarding principles, variables, and score criteria can be referred to in Table 2.

Tabel 2. Variable and Unit Research

Principle	Variable	Unit	Score			
			0	1	2	3
			Low	Medium	High	Very High
Walk	*Pedestrian Facilities* (C1)	*TOD Standards, ITDP 2017*	0	1	2	3
	Crossing Facilities (C2)	*TOD Standards, ITDP 2017*	0	1	2	3
Cycle	*Cycling Facilities* (C3)	*TOD Standards, ITDP 2017*	0	1	2	3
Transit	*Number of Modes of Transportation* (C4)	Number of Transportation Mode Routes	0	1-3	4-6	>6
Density	*Population Density* (C5)	person/Ha	<150	151-200	201-400	>400
	Number of Types of Land Use (C6)	*Sub Land Use*	1-5	6-10	11-15	>15
Mix	*Residential & Non-Residential Ratio* (C7)	*% Residential : % Non-Residential*	>80: <20	61-80: 20-39	41-60: 40-59	20-40: 60-80

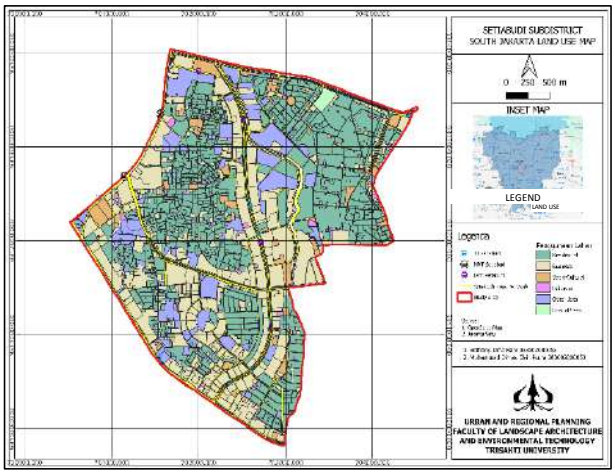

Fig 2. Study Area Land Use Map

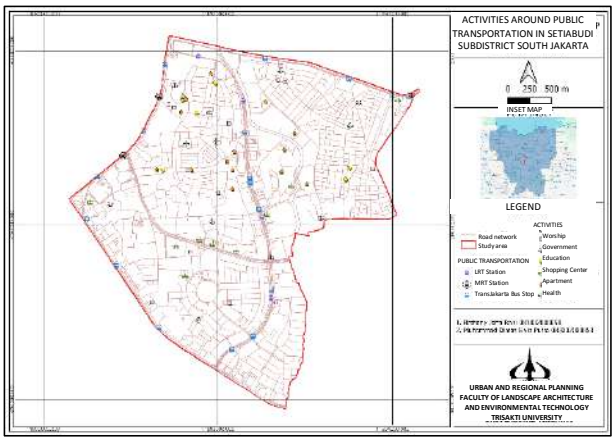

Fig 3. Map of Activities Around Public Transportation

The scoring for pedestrian facility (C1), crossing facility (C2), and cycling facility (C3) variables refers to the standards outlined in TOD Standard (ITDP, 2017), each having three selected assessment indicators. The pedestrian facility standard involves dedicated pedestrian paths on all building fronts, disabled-friendly paths, and pedestrian path lighting. For crossing facilities, the standard involves safe paths with a minimum width of 2 meters, easy access for people with disabilities, and crossing path lighting. Meanwhile, cycling facilities set standards for separated bike routes from motor vehicles, bike parking, and bike carrier routes within buildings. The assessment was conducted through observations at all transit points of MRT and LRT stations.

The establishment of score ranges for the transportation mode quantity variable (C4) is based on rounding down the highest number of mass transportation routes, which is 10 at Dukuh Atas BNI Station. The range is divided into four groups: low group (0), medium group (1-3), high group (4-6), and very high group (>6). The assessment is carried out by calculating the number of connected transportation routes to Jakarta MRT Station using the Jakarta Public Transportation Integration Map, published by the Jakarta Transportation Discussion Forum (FDTJ) in January 2023.

The scoring for the population density variable (C5) follows the population density standards outlined in SNI 03-1733-2004 regarding Procedures for Urban Housing Environmental Planning. These standards include low population density, medium population density, high population density, and very high population density. The assessment is conducted using data from the Central Statistics Agency (BPS), calculating the average population by assuming a proportional ratio of the district's area within an 800 m radius from the central transit point.

The establishment of score ranges for the land use types variable (C6) is based on rounding down the highest number of land subtypes within an 800 m radius from the central transit point, which is a total of 17 at Blok A and Cipete Raya Stations. This number is divided into four groups: low (1-5), medium (6-10), high (11-15), and very high (>15). Furthermore, the determination of scores for the residential and non-residential ratio indicator (C7) follows the standards for residential and non-residential ratios in TODs for cities, sub-cities, and neighborhoods, regulated in the Minister of ATR/BPN Regulation No. 16 of 2017 concerning Guidelines for Transit-Oriented Development. The assessment for both is conducted by calculating the number of land subtypes and the ratio of residential and non-residential land areas within an 800 m radius from the central transit point, available on the Jakarta Land Use Map accessible through the Jakarta Satu website.

3. Results and Discussion

The analysis was conducted by evaluating 7 research variables, namely pedestrian facilities, crossing facilities, cycling facilities, transportation mode quantity, population density, land use types, and residential and non-residential ratio, at all transit points in 2 MRT stations and 4 LRT stations, within an 800 m radius according to the previous assessment scores. The research data, collected through observations and secondary data calculations, were then assessed by assigning scores and converting them into weights based on the AHP calculation results involving five expert sources, including both academics and practitioners in the field of transportation and urban and regional planning. The evaluation of each transit area is detailed in the following section.

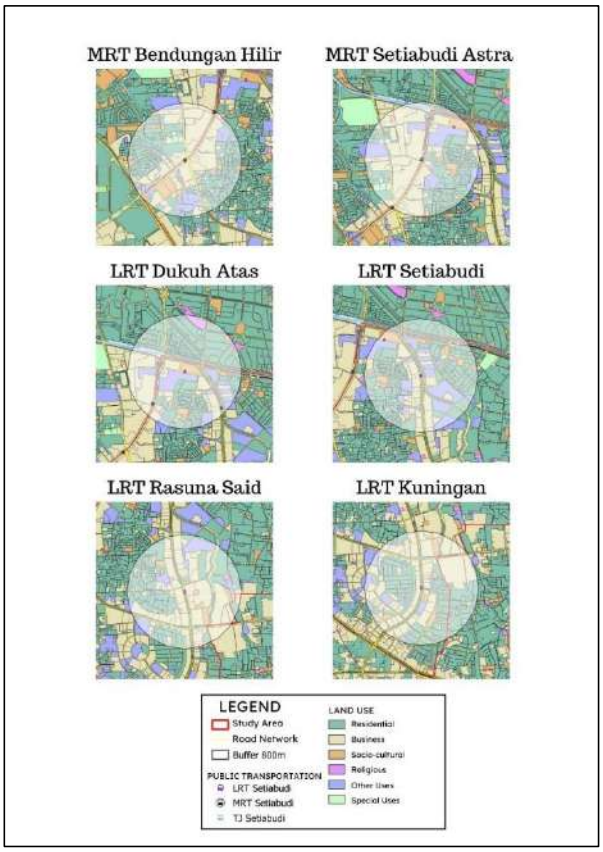

Fig 4. Land Use Map Radius 800 m from MRT and LRT

3.1 Bendungan Hilir MRT Station

Surrounding the Bendungan Hilir MRT Station is an area well-equipped with pedestrian facilities, crossings, and bike lanes. Despite this, the station lacks a direct connection to other mass transportation modes. Situated close to a BRT stop with routes to Blok M-Old Town Station (*Stasiun Kota*), Ragunan Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari, the Bendungan Hilir MRT Station is located in an area adjacent to three districts: Setiabudi (51.08%), Tanah Abang (48.83%), and Kebayoran Baru (0.08%) in Central and South Jakarta.

The region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius

from the transit point, there are 16 types of land subtypes, reflecting a high level of diversity. The residential and non-residential ratio is 38.02%:61.98%, categorized as a very high score, with residential land covering an area of 85.01 hectares and non-residential land covering 138.58 hectares.

3.2 Setiabudi Astra MRT Station

The transit area around Setiabudi Astra MRT Station provides complete pedestrian facilities, crossings, and bike lanes. However, the station is not directly connected to other mass transportation modes. Nevertheless, Setiabudi Astra MRT Station is in close proximity to a BRT stop, covering routes from Blok M to Old Town Station (*Stasiun Kota*), Ragunan-Monas via Semanggi, Pinang Ranti- Old Town Station (*Stasiun Kota*), and Puri Beta Tosari. Situated between three districts, namely Tanah Abang (52.68%), Setiabudi (46.19%), and Menteng (1.13%) in Central and South Jakarta, this area has an average population density of approximately 158 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 29.78%:70.22%, categorized as a very high score, with residential land covering an area of 67.83 hectares and non-residential land covering 159.92 hectares.

3.3 Dukuh Atas LRT Station

The area around Dukuh Atas LRT Station, integrated with KRL Station, is complete with pedestrian facilities and crossing points. Located near BRT Corridor 1 stop, Sudirman KRL Station. This region has an average population density of approximately 156 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 51.09%:69.91%, categorized as a very high score, with residential land covering an area of 97.071 hectares and non-residential land covering 132.829 hectares.

3.4 Setiabudi LRT Station

The vicinity around Setiabudi LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 107 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, reflecting a very high level of diversity. The residential and non-residential ratio is 64.82%:35.18%, categorized as a very high score, with residential land covering an area of 87.507 hectares and non-residential land covering 47.493 hectares.

3.5 Rasuna Said LRT Station

The area around Rasuna Said LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 137.6 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 39.97%:61.03%, categorized as a very high score, with residential land covering an area of 51,961 hectares and non-residential land covering 79,339 hectares.

3.6 Kuningan LRT Station

The area around Kuningan LRT Station is equipped with pedestrian facilities and crossing points. Its location is close to BRT Corridor 6 stop. The population density in this area averages around 126.4 people per hectare, falling within the moderate density category. Within an 800-meter radius from the transit point, there are 16 types of land subtypes, indicating a very high level of diversity. The residential and non-residential ratio is 45.20%:54.80%, categorized as a very high score, with residential land covering an area of 54.24 hectares and non-residential land covering 65.76 hectares.

4 Conclusion

Based on the evaluation of the calculation results, it can be concluded that LRT Dukuh Atas Station, LRT Setiabudi, and Bendungan Hilir MRT Station exhibit high potential for development using the Transit-Oriented Development (TOD) concept. Meanwhile, MRT Setiabudi Astra Station and LRT Kuningan Station demonstrate moderate potential for implementing the TOD concept. Conversely, Rasuna Said LRT Station is assessed to have low potential for development with the TOD approach. Considering these results, it is evident that implementing the TOD concept could yield significant positive impacts in the areas surrounding LRT Dukuh Atas, LRT Setiabudi, and Bendungan Hilir MRT Station. The potential for improvement in implementing TOD in MRT Setiabudi Astra and LRT Kuningan Stations suggests room for enhancing their impact. However, for Rasuna Said LRT Station, further attention is needed to develop the concept and boost its potential for the future.

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