

# A Concept of Transit Oriented Development for Support of Connectivity Railway and Settlements Development in Maros South Sulawesi

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**Abstract:** *The increase in the number of private vehicles that are not balanced with spatial planning and transportation systems can cause various traffic problems. The existence of the Makassar–Parepare Railway network is expected to reduce traffic density in the Maros Regency. One of the development patterns that can be developed to support the railway system and settlement spread in Maros is the concept of Transit Oriented Development (TOD). The objectives of this study are: Analyzing the feasibility of the Marusu TOD location from the aspect of mixed use ‘demand’ and connectivity with bus transportation and develop the TOD concept as a support function of the Makassar-Parepare-South Sulawesi railway service function. Sources of data come from observations and document of spatial planning, Central Bureau of Statistics, analysis using image map interpretation with ArcGIS application, analyzed based on the presence of service nodes, potential for road and rail network connectivity. The results of the study explain that the feasibility of the TOD location from the demand of mixed use aspect which is projected until 2025 will use the Marusu TOD as a support for the development of the Makassar Parepare railway and settlement development area. Meanwhile, from the aspect of mass transportation connectivity, there are 2 corridors out of 11 Bus Rapid Transit (BRT) corridors that are interconnected in the Marusu District area. The TOD concept that is directed is the TOD Neighborhood scale, with the Green TOD concept, which is set at a location in a mixed use area with the concept of Infill Development*

**Keywords:** *Transit Oriented Development, Railway, Connectivity, Settlement Spread*

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## I. Introduction

The growth number of vehicles continues to experience an increase of traffic movement, especially in the hinterland area of Road Network Makassar–Maros [1]. The increase in the number of private vehicles that are not balanced with spatial planning and transportation systems can cause various traffic problems. The existence of the Makassar–Parepare Railway is expected to reduce traffic density in the Maros Regency area. The development of the railway network needs to be supported by connectivity between modes of transportation, one of which is mass transportation. The pattern of transportation development needs to be supported by mode transfer nodes, including Transit Oriented Development (TOD).

TOD is a strategy for the development of a sustainable area that is transportation friendly, integrated between transportation modes with city/neighborhood service nodes, especially in mixed use areas consisting of residential functions, offices, shopping, education, health and other social facilities [2,3,4,5].

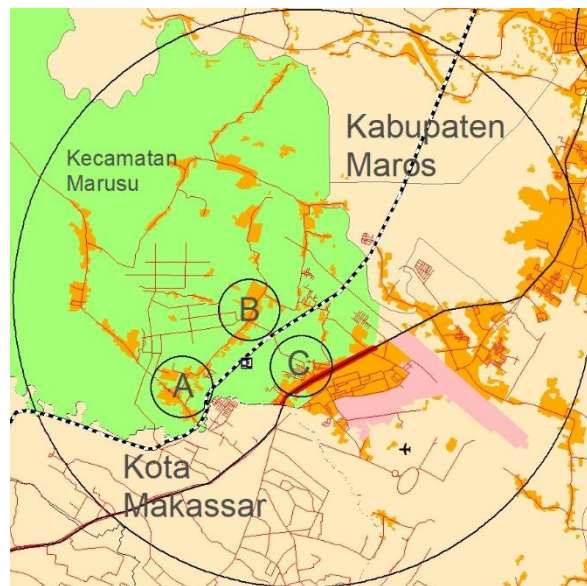
The TOD concept in the hinterland area of Maros Regency is expected to solve Makassar City traffic problems. The TOD concept is one solution to overcome transportation problems resulting from sporadic urban developments to sub-urban areas (urban spirals and urban flogs). The city development system that is equipped with the TOD concept can improve the quality of the living environment, reduce the use of private vehicles, reduce traffic congestion which in turn leads to transportation cost efficiency [6,7]. This is a strategic effort in developing a transit area node that is integrated with a pedestrian and cyclist friendly transportation system [8,9,10]

The objectives of this study are: 1) Analyzing of the Marusu TOD location from the aspect of mixed use ‘demand’ to support the service function of the Makassar-Parepare railway line, 2) analyzing of the Marusu TOD location from the aspect of connectivity with bus transportation lines (BRT Trans Mamminasata) to

support access to the train station (Mandai) across Makassar-Parepare, 3) develop the TOD concept as a support function for the service function of the Makassar-Parepare Railway, South Sulawesi.

## II. Research Methods

This research uses descriptive method with qualitative and quantitative approaches. The location of the research was carried out in Marusu District, Maros Regency, South Sulawesi (see in Figure 1).



**Figure 1.** Location Analysis TOD Marusu

**Source:** Developed from Maros Regency Spatial Plan Data

The TOD location analysis map is divided into 3 sites, namely A, B and C. The three sites are determined based on land functions and transportation networks, so that they can be used as samples to analyze their potential and be developed as a development plan for the Marusu TOD area (Figure 1).

Land use data is carried out by direct observation in the field [11] to identify the amount of demand for railway utilization from residential function areas, mixed use functions, and the distance between service nodes. In addition, demographic data for demand projections uses BPS data from Maros Regency. Transportation network data is obtained from the map of the Spatial Plan of Maros Regency (2012-2032) and the Spatial Plan of Mamminasata 2013-2020).

The analytical method to identify the feasibility of the TOD location from the aspect of land use of transportation demand uses image map interpretation for spatial analysis and analysis based on Geographic Information Systems (GIS). The TOD space requirement analysis is based on the projected ownership of the population's transportation mode and the amount of movement [12]. Connectivity of mass transit lines using data analysis of the existing road network and road network according to the direction of the 2012-2020 Mamminasata Spatial Plan.

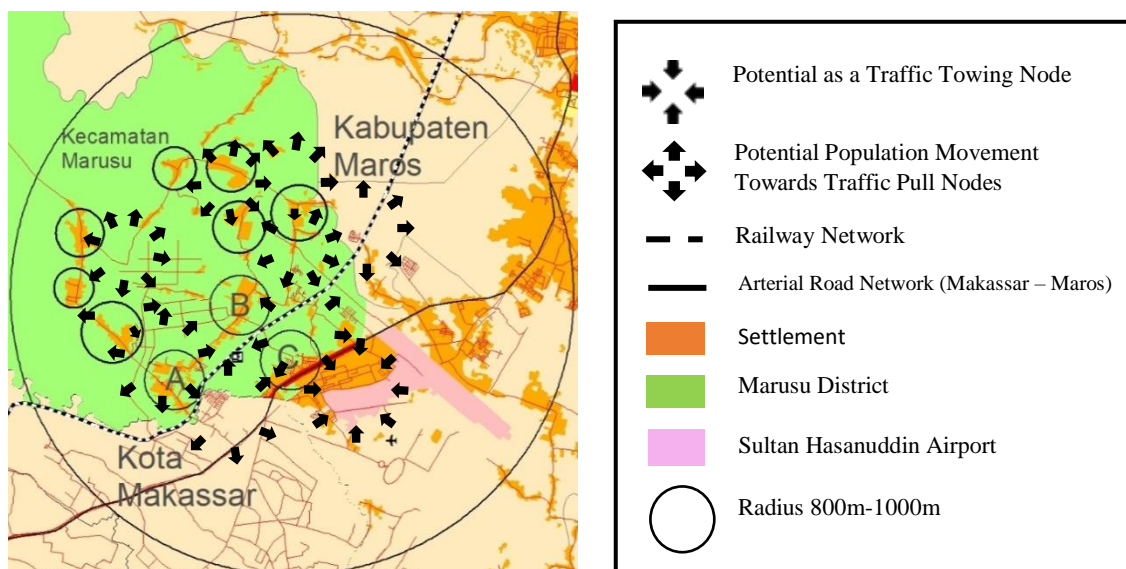
## III. Research Result

### TOD Locations Based Of Demand Aspect

The Makassar-Parepare Railway network traverses one of the Marusu sub-districts in Maros Regency. Land use in the sub-district area has been projected in 5 years 2025 to have a population about 28,000 people and has the potential to cause traffic movements within the area itself and between regions. The development of land use in the Marusu District area is influenced by the expansion for Urban Sprawl of Makassar City which tends to develop in an Urban Flog. Residential clusters with low intensity, spreading and jumping have clusters of 50-100 housing units, while the supporting land use functions of Mixed Land Use such as trade, offices, settlements, tourism and education, and public spaces develop along arterial roads (see in Figure 2).



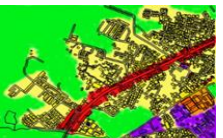
The TOD concept has the potential as a space for connectivity between transportation functions and city, environmental service nodes within a distance of 800-1000 m. The goal is that the potential for traffic attraction can be brought closer to its generation, so that the distance to reach is shorter and can encourage residents' interest in walking. As for distances greater than 1000m-5000m, non-motorized modes and distances greater than 5000m can be served by mass transportation. Therefore, the Marusu sub-district has the potential to

develop TOD which can bind mixed land use functions that develop along arterial roads and at the same time can serve the movement of residents from residential clusters in the Marusu TOD node.



**Figure 2.** Potential TOD Locations Based on Demand Aspects  
**Source:** Developed from Maros Regency Spatial Plan Data

**Table 1.** Potential of TOD Development Areas

No.	SITE	Existing
1.	<b>Site A</b> <b>Temppadaue village</b> 	<ul style="list-style-type: none"> <li>• Land Use:                             <ul style="list-style-type: none"> <li><input type="checkbox"/> Most of the settlements are clustered and spread out</li> <li><input type="checkbox"/> There are many warehousing located around the settlement</li> <li><input type="checkbox"/> Trade is along collector roads</li> </ul> </li> <li>• Located on the track of the railway network                              1.5 km from the arterial road (Makassar – Maros)</li> </ul>
2.	<b>Site B</b> <b>Temmapadaue village</b> 	<ul style="list-style-type: none"> <li>• Land Use:                             <ul style="list-style-type: none"> <li><input type="checkbox"/> Settlements spread pattern with low intensity</li> <li><input type="checkbox"/> Warehousing located in the middle of the settlement</li> <li><input type="checkbox"/> Most of it is vacant land and plantation</li> </ul> </li> <li>• Located ±200 meters from the railway network                              It is 2 km from the arterial road (Makassar-Maros)</li> </ul>
3.	<b>Site C</b> <b>Marumpa village</b> 	<ul style="list-style-type: none"> <li>• Land Use:                             <ul style="list-style-type: none"> <li><input type="checkbox"/> Settlements develop along arterial roads</li> <li><input type="checkbox"/> There are offices and services</li> <li><input type="checkbox"/> Commercial located along arterial roads</li> </ul> </li> <li>• Borders the railway network development (±400m)</li> <li>• Located on the arterial road corridor (Axis Makassar-Maros)</li> </ul>

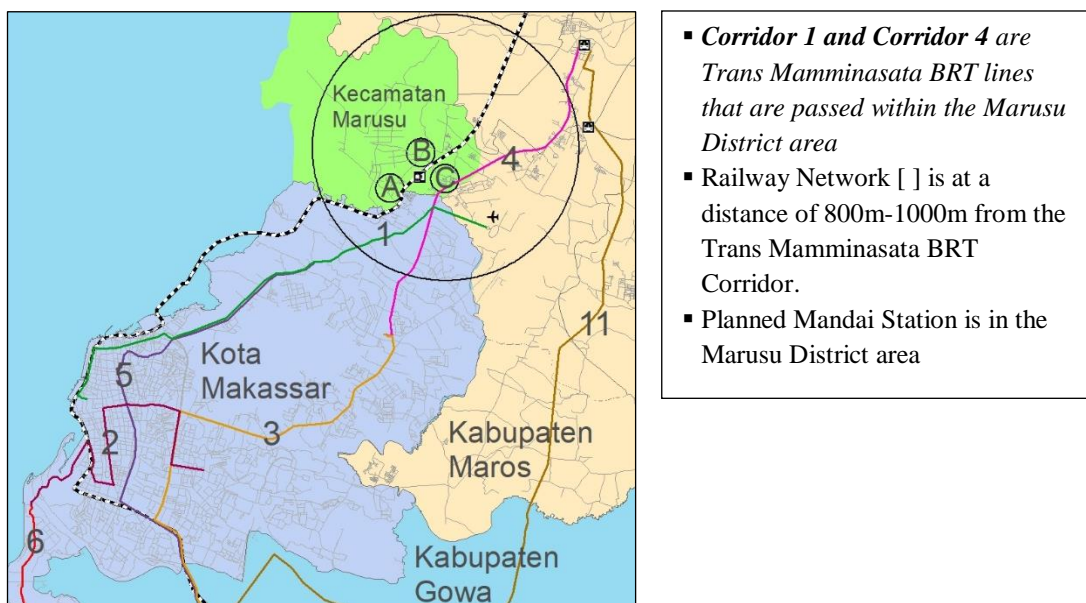
**Source:** Analysis Results, 2021

### TOD Location Based Of Transport Connectivity

The railway network across the Sulawesi Province was established in order to develop interconnection with the National Region, Sulawesi Island and South Sulawesi Province line network system [13]. Most of the service centers in Makassar City and Maros Regency are located in the Makassar - Parepare Railway network service corridor, so that it can facilitate access. Marusu TOD planning is needed so that there is connectivity between long distance modes (Maros - Makassar) which can be served by transportation modes such as trains and BRT, while short distances are expected by walking or non-motorized modes

Bus Rapid Transit or known by the abbreviation BRT Trans Mamminasata in Makassar City is a public service in the field of transportation to solve transportation problems in Makassar City. The Trans Mamminasata BRT operates on 11 corridors in Makassar City, Gowa Regency, Takalar Regency and Maros Regency which have connectivity with activity centers located in these cities and districts.

Corridors 1 and 4 are Trans Mamminasata BRT lines located in the Marusu District area. The corridor also passes through Site C which is on the arterial road network Makassar – Maros. In addition to the Trans Mamminasata BRT line, the Makassar Parepare Railway Network is also located at a distance of about 400 meters from site C (in Table 1).



**Figure 3.** Mamminasata BRT Line Analysis  
**Source:** Developed from Spatial Plan of Mamminasata

The location of the Maros Regency Railway station is planned in Marusu District. The function of the train station is to serve up and down activities for passengers and goods. Station users need connectivity modes as well as mode transfer space as a connecting point between the rail system and other transportation modes such as land, air and sea transportation. One alternative for inter-transport mode transfer space is TOD.

**Transit Oriented Development Concept**

Based on the analysis of 3 sample sites, Site C (Figure 1) has the potential to bind mixed land use functions that develop along arterial roads and at the same time serve the movement of residents from residential clusters into the TOD Marusu node. In addition, in terms of connectivity, Site C can be served by the Transmamminasata BRT line in Corridors 1 and 4 and is at a distance of 800m-1000m from the Train station in Mandai.

In the TOD area within the Marusu District area, this can be done by developing an undeveloped space, namely the development of vacant or abandoned land in the form of moor and plantations in the radius of the development of the TOD area in Figure 1 [14]. The plan for the Train Station Mandai which is located at a radius of about 1000m from the arterial road can be developed with the TOD Neighborhood concept which is equipped with public facilities such as offices, commercial and residential which are also in accordance with TOD principles [2,15,16].

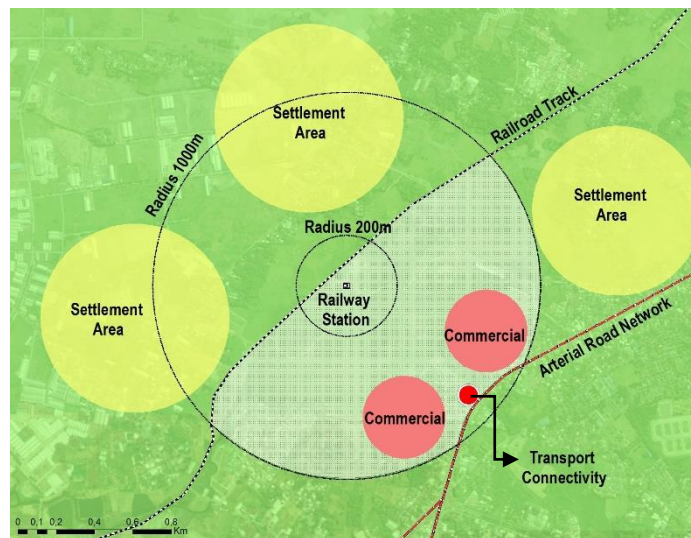
After analyzing the potential area of Site C for the development of TOD Marusu, the next thing that can be developed is the use of space according to standards floor and base coefficient of building namely BBC and BFC, and can realize the development of Green TOD (Table 2) [15,17].

**Table 2.** Potential of the Marusu TOD Area

TOD . Planned Area	Planned Area TOD Marusu (Ha)	Projected Existing Population (2025)	Space Utilization Based on Standard			Development Strategy	Information
			BBC (60%)	BFC	GBC (40%)		
Marusu District	24	28.000	14 Ha	8	6 Ha	Infill Development Site	Potential

**Source:** Analysis Results, 2021

In accordance with the established strategy in Infill Development, the illustration of the Marusu TOD development concept can be seen in Figure 4.



**Figure 4,** Marusu TOD Delimitation Concept Map  
**Source:** Developed from Spatial Mamminasata

In addition to the proposed provision of areas based on aspects of demand for Mixed Land Use and connectivity of Railway and BRT networks, other things that need to be considered are the principles of Transit Oriented Development by accommodating facilities for walking, cycling, connecting, public transport, mix and compact [16].

#### IV. Conclusion

The results of the study explain that the feasibility of the TOD location from the demand for mixed use aspect which until 2025 there are about 28,000 people with a distance of 800m-1000m who will use the Marusu TOD as a support for the development of the Makassar Parepare railway. Meanwhile, from the aspect of mass transportation connectivity, there are 2 corridors out of 11 Bus Rapid Transit (BRT) corridors that are interconnected. The TOD concept that is directed is the TOD Neighborhood scale, with the Green TOD concept, which is set at a location in a mixed use area with the concept of Infill Development.

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