

## Delineation of Urban Center Area Based on Geopgrahic Information System (GIS)

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**Abstract :** *The delineation of urban areas in Indonesia is determined by the government. However, in practice, the boundaries of these city areas do not conform to the existing delineation. The influence of population and economic activity variables sometimes causes urban areas to not conform to the predetermined delineation of city areas, better known as the urban sprawl effect. The purpose of this study is the urban sprawl effect of Makassar City. The methodology used in this study is the Degree of Urbanization (DoU) using a remote sensing data approach. This method uses two main data sets: population data and building data. The results of this study identified the urban center area of Semarang City, which is an expansion due to the urban sprawl effect. It was found that the influence of Makassar City has expanded far beyond the existing urban area delineation.*

**Keywords:** *Urban center, GIS, urban sprawl, population*

### Introduction

The Mamminasata area (Makassar—Maros—Sungguminasa—Takalar—Pangkep) is an important center of economic growth in Indonesia. (Rahman, 2018; Utama et al., 2021). With increasing economic and population growth in this region, the urban center area in the Mamminasata region will likely not only be centered on the city of Makassar. (Rahman, 2023; Surya, Muhibuddin, et al., 2021). An urban center is a growth center area that has a population density of more than 1,500 per km<sup>2</sup>, has a population of 50,000 residents and in its area has a minimum of 50% built-up area. (Statistical Commission European Union, 2020). With the increasing development in the Mamminasata urban area, it is necessary to classify which areas are considered urban and which are rural. One approach to separating urban and rural areas is to use the degree of urbanization approach. (Commission & Eurostat, 2021; Taubenböck et al., 2022). Analysis of the degree of urbanization can be done using a geographic information system approach. (Slimani & Raham, 2023; Živanović et al., 2024). For this reason, this study uses a degree of urbanization approach to classify

urban and rural areas in the Mamminasata urban area using a geographic information system approach.

## Methodology

The primary data used in this study are population and building distribution. Figure 1a shows the population based on sub-district administrative boundaries in the Mamminasata urban area. This data was obtained from the Central Statistics Agency (BPS) in each district/city. Makassar City has the highest population in the Mamminasata urban area. The eastern part of the Mamminasata urban area shows a relatively low population.

Figure 1b shows the distribution of buildings in the Mamminasata urban area. This building distribution data was obtained from Google Open Buildings, an open-source building plot data resource. As can be seen from the image below, the largest building distribution is in Makassar City, extending along the road network in the Mamminasata urban area.

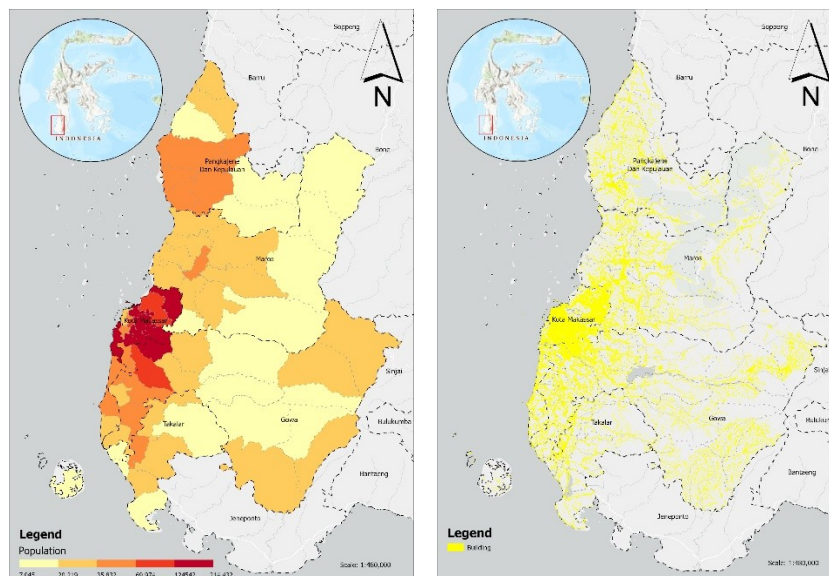


Figure 1 (a) Population maps (b) Building distribution maps

The data collected above was pre-processed by grid-in building distribution data with a size of 100 x 100 m. This building distribution grid data is used as the basis for the distribution of the population in order to obtain a population distribution map with a grid of 100 x 100 m. The flow of this research can be seen in Figure 2. This grid-based population distribution data is used as the main data for analyzing the degree of urbanization to obtain the classification of urban areas.

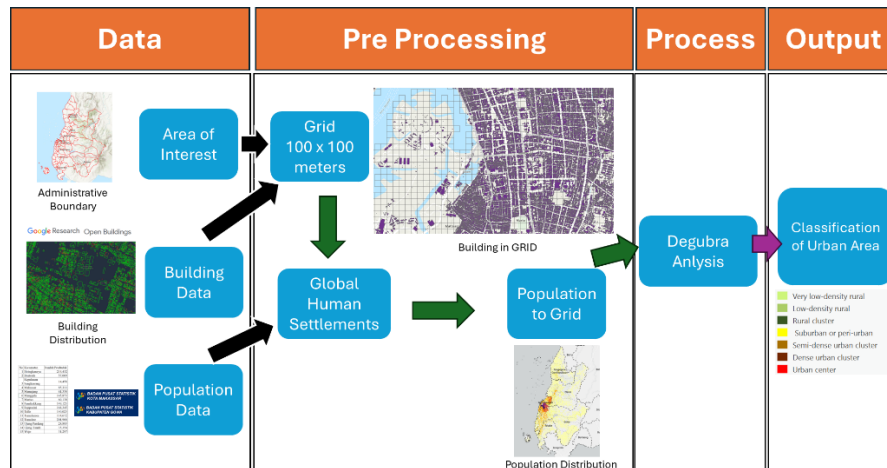


Figure 2. Flowchart of research

## Results and Discussion

### Population Distribution

Based on the building distribution and population data, a population distribution can be generated based on the number of buildings. Figure 2 shows a population distribution map with a spatial resolution of 100 x 100 meters, with the highest population of 298 in the Mamajang District, Makassar City. Population distribution appears to be concentrated in the area around Makassar City, while the population in other city/district areas tends to be smaller.

This study also produced a building density value, derived from the number of buildings on a 100 x 100 meter grid. Figure 2b shows the highest value for the number of buildings, 159, predominantly located in Makassar City. Areas with high building density extend northward, to Biringkanaya, and southward, to Somba Opu and Pallangga.

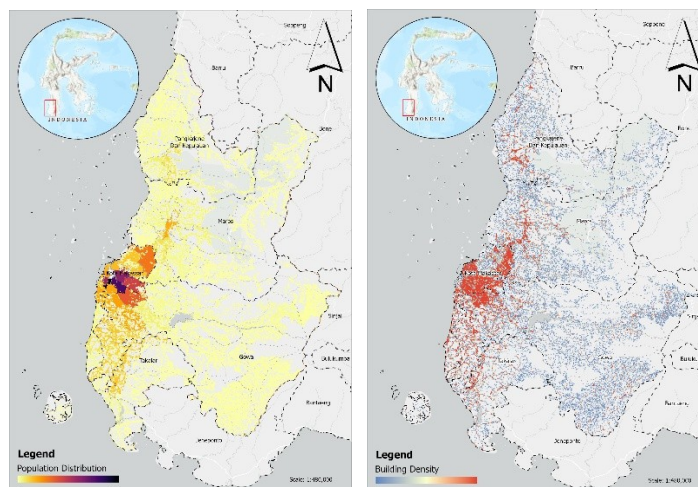


Figure 2. (a) Distribution of Population Maps (b) Distribution of building density

## Degree of Urbanization

The results of the degree of urbanization analysis classify areas into seven classes: urban center, dense urban cluster, semi-dense urban cluster, suburban or peri-urban, rural cluster, low-density rural, and very low-density rural. Figure 3a shows that the dominant urban center is located in Makassar City and Gowa Regency. Suburban or peri-urban areas are located in Pangkajene Kepulauan Regency, Maros Regency, and Takalar Regency.

If analyzed in more detail, the urban center area is spread across 4 sub-districts, namely Gowa Regency, Makasar City, Maros Regency, and Takalar Regency. As seen in Figure 3b, the urban center area in Maros Regency only covers 3 sub-districts, namely Mandai District, Moncongloe District, and Marusu District, while the urban center area of Takalar Regency is only located in North Galesong District. For Gowa Regency, the urban center area is located in Bajeng, Barombong, Bontomarannu, Pallangga, Pattallasang, and Somba Opu Districts. Meanwhile, the urban area in Makasar City covers all sub-districts.

As seen in Figure 4, the urban center area of Makassar City is the largest, accounting for approximately 61% of the total urban center area. After Makassar City, the urban center areas are followed by Gowa Regency (32%), Takalar Regency (4%), and Takalar Regency (3%).

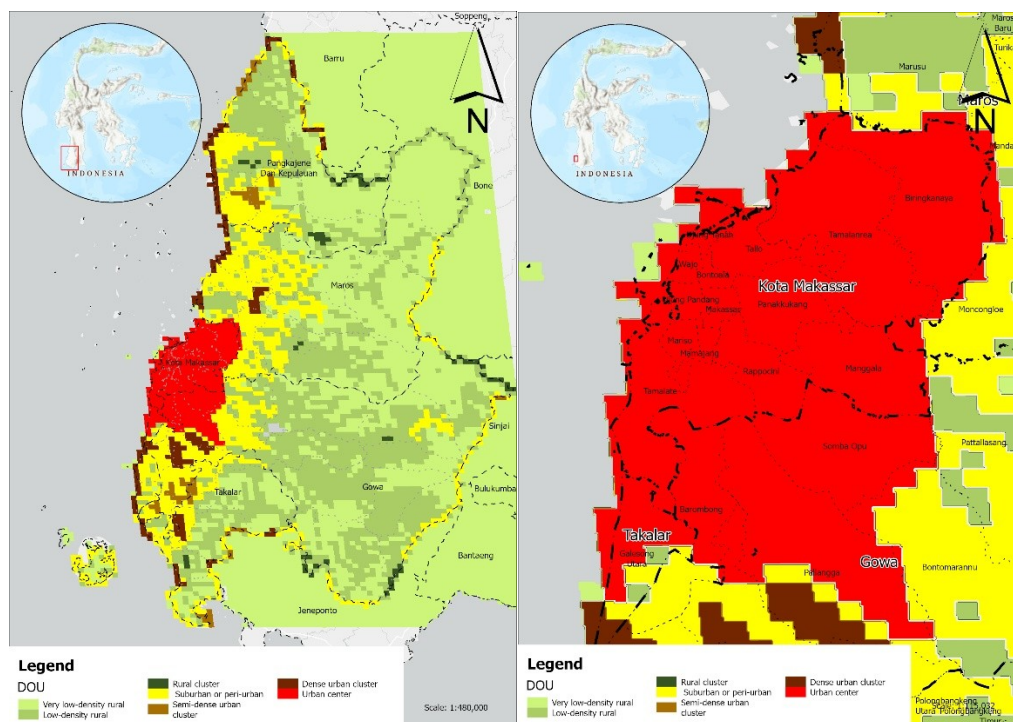


Figure 3. Degree of Urbanization Maps

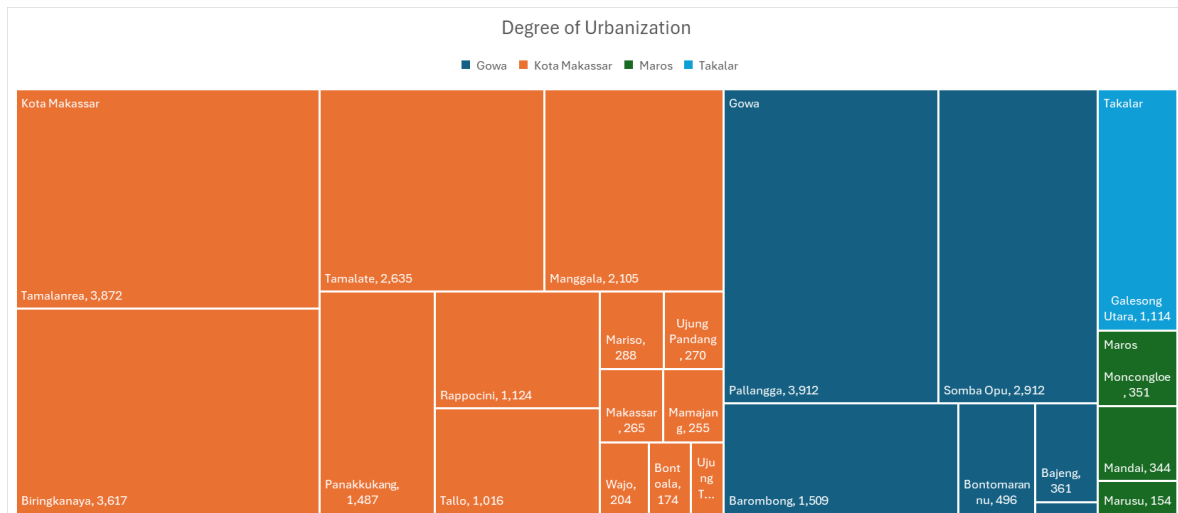


Figure 4. Urban center.

## Conclusion and Recommendation

The results show that the urban center of the Mamminasata urban area is located in Makassar City. However, an interesting phenomenon is the urban sprawl phenomenon that causes the urban area to expand north and south. The data shows that the urban area is expanding towards Gowa Regency, as evidenced by the percentage of Gowa Regency's urban area within the Mamminasata urban area, which is approximately 32%. This is also reflected in the building density in Gowa Regency, which begins in the Somba Opu and Pallangga sub-districts. Given this situation, it is necessary to anticipate the spread of urban centers around Makassar City. (Surya, Rasyidi, et al., 2021). Seeing the population growth of Gowa Regency of 8.6%, and economic growth of 5.8% in 2024, it is not impossible that the urban center will expand towards Gowa Regency (Rasyidi et al., 2024; Surya et al., 2020). Therefore, regional planners in the Mamminasata region need to pay attention, as Gowa Regency rapidly grows into a new urban center. Makassar City must maintain its sustainability as an urban center in the Mamminasata region, ensuring it does not exceed its capacity and remains sustainable as an urban center in the Mamminasata region.

## References

- Commission, E., & Eurostat. (2021). *Applying the degree of urbanisation – A methodological manual to define cities, towns and rural areas for international comparisons – 2021 edition*. Publications Office of the European Union. <https://doi.org/doi/10.2785/706535>
- Rahman, Z. (2018). Analysis of the effect of economic growth toward the center of the overflow area and hinterland in determining nodal centre of new growth on the area of Mamminasata in South Sulawesi. *Indonesia Prime*, 2(1), 68–76. <https://doi.org/10.29209/id.v2i1.19>



- Rahman, Z. (2023). Analysis of Leading Sector Basic Sectors and Economic Sector Shifts in the Mamminasata Area. *Journal of Social Research*, 2(10), 3371–3392. <https://doi.org/10.55324/josr.v2i10.1402>
- Rasyidi, E. S., Jumadil, Syafri, Rahman, R., Rusneni, Hamsinah, & Jibrani, M. K. (2024). Study of Urban Growth Center Development Factors and Simulation The Mamminasata Urban Area. *Jurnal Penelitian Pendidikan IPA*, 10(4), 1976–1988. <https://doi.org/10.29303/jppipa.v10i4.6380>
- Slimani, N., & Raham, D. (2023). Urban Growth Analysis Using Remote Sensing and Gis Techniques To Support Decision-Making in Algeria—the Case of the City of Setif. *Journal of the Geographical Institute Jovan Cvijic SASA*, 73(1), 17–32. <https://doi.org/10.2298/IJGI2301017S>
- Statistical Commission European Union. (2020). A Recommendation on the Method to Delineate Cities, Urban, and Rural Areas for International Statistical Comparisons. *Statistical Commission*, 3(March), 1–33.
- Surya, B., Ahmad, D. N. A., Sakti, H. H., & Sahban, H. (2020). Land Use Change, Spatial Interaction, and Sustainable Development in the Metropolitan Urban Areas, South Sulawesi Province, Indonesia. *Land*, 9(3). <https://doi.org/10.3390/land9030095>
- Surya, B., Muhibuddin, A., Suriani, S., Rasyidi, E. S., Baharuddin, B., Fitriyah, A. T., & Abubakar, H. (2021). Economic Evaluation, Use of Renewable Energy, and Sustainable Urban Development Mamminasata Metropolitan, Indonesia. *Sustainability*, 13(3). <https://doi.org/10.3390/su13031165>
- Surya, B., Rasyidi, E. S., Abubakar, H., & Idris, M. (2021). Population mobility and sustainable development in the Mamminasata Metropolitan South Sulawesi, Indonesia. *Human Geographies*, 15(2), 229–260. <https://doi.org/10.5719/hgeo.2021.152.6>
- Taubenböck, H., Droin, A., Standfuß, I., Dosch, F., Sander, N., Milbert, A., Eichfuss, S., & Wurm, M. (2022). To be, or not to be ‘urban’? A multi-modal method for the differentiated measurement of the degree of urbanization. *Computers, Environment and Urban Systems*, 95, 101830. <https://doi.org/https://doi.org/10.1016/j.compenvurbsys.2022.101830>
- Utama, A. G., Ramli, I., & Dwiarmoko, H. (2021). Study on the Readiness of the Regional Government of South Sulawesi for the Mamminasata Urban Railway Project with Non-State Budget/Regional Budget Financing. *IOP Conference Series: Earth and Environmental Science*, 841(1), 12012. <https://doi.org/10.1088/1755-1315/841/1/012012>
- Živanović, Z., Tošić, B., & Popović, V. (2024). Different Measurement Methods of the Degree of Urbanization: a Case Study of Serbia. *Географски Разгледу-Geographical Reviews*, 56–57(October), 43–63. <https://doi.org/10.37658/gr2456-57043zh>