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Presentation of Green Open Space of Makassar City in WebGIS

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Abstract

Green open space has three basic functions, among others, to function socially, namely as a facility for the public with the functions of recreation, education and sports, as well as establishing communication between city residents; to function physically, namely as the lungs of the city, protecting the water system, soundproofing, fulfilling visual needs, restraining the development of built-up land/as a buffer, and protecting city residents from air pollution; and functions as an aesthetic that is a binder between building elements in the city, a giver of characteristics in shaping the face of the city, and an element in the arrangement of urban architecture. Law No. 26 of 2007 concerning Spatial Planning, it is explained that the spatial planning of the city area must include a plan for the provision and utilization of green open space which covers at least 30% of the city area consisting of 20% public green open space and 10% consisting of private green open space. . But in reality, there are still many big cities that are not difficult to achieve the provisions of the law. This research will identify green open space in Makassar City by utilizing satellite image data and then presenting the green open space in the form of spatial information into a Web GIS so that it can be easily accessed openly. Based on the results of the analysis, the percentage of open green space in Makassar reached 9.08%, consisting of private green open space of 4.07% and public green open space of 5.01%.

Keywords: Green Open Space; Makassar; WebGIS.

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Introduction

Makassar as the capital of South Sulawesi Province, which is also seen as the gateway to Eastern Indonesia, is iconic of the infrastructure development that continues to be carried out to support the activities of its people. In the context of Green Open Space, infrastructure development in Makassar City is not in line with the amount of provision of Green Open Space areas. Infrastructure development plays a role in cutting Green Open Space which results in a decrease in the efficiency of space and land use and the quality of life in the area (Samsudi, 2010). The reduction of green open space in urban areas causes emotional, dimensional, and psychological instability so that people's space for activities and thinking is limited (Zulkarnaen et al., 2016).

The total population in 2020 in urban areas has a percentage of 56.7% and will increase in 2035 to 66.6% (Sinatra et al., 2022). This increase in population causes the need for space to increase. The increasing need for area, especially for housing, then affects the decreasing quantity and quality of green spaces in urban areas (Dollah & Rasmawarni, 2019; Zulkarnaen et al., 2016). Therefore, the need for green spaces in urban areas must be seen quantitatively and qualitatively. Based on Permen PU No. 5/PRT/M/08 concerning Guidelines for the Provision and Utilization of Green Spaces in urban areas, the population and oxygen demand with the availability of green

spaces must be adjusted (Kurnianti & Rahmi, 2020; Devi & Santosa, 2022).

Law No. 26/2007 (BPK, 2007) on Spatial Planning explicitly mandates 30% of the city area to be Green Open Space, 20% public Green Space and 10% private Green Space. This 30% green space allocation is stipulated in the Regional Regulation (Perda) on city Spatial Planning. Spatial Planning as the spatial dimension of urban development is a tool to coordinate urban development in a sustainable manner. In line with the mandate of PR Law No. 26 of 2007 article 3 (BPK, 2007), it is necessary to realize a form of urban area development that harmonizes the natural environment and the artificial environment. Urban areas are areas that have non-agricultural main activities with an arrangement of regional functions as a place for urban settlements, concentration and distribution of government services, social services, and economic activities.

As the center of development, urban areas will attract and increase the population ratio in a region. Increased population growth will have an impact back to increased development for settlements in urban areas. The current development of urban development shows a tendency for unbalanced development activities (Yanti et al., 2023). Based on this, it is deemed necessary to identify Makassar City's green spaces and present them in WebGIS so that they can be accessed directly and openly.

Definition of Green Open Space

Open space is an elongated area in the form of a path or large area that is open or has no buildings. Green Open Space is a vegetated area, such as plants and plants located in urban areas with socio-cultural, aesthetic, and physical functions of the city (Setyani et al., 2017; Abdillah et al., 2021). The existence of green spaces is an important factor in supporting urban ecology. It also affects air comfort which is influenced by humidity and temperature as described in the thermal comfort index. A decrease in air temperature by 5.86% and an increase in humidity by 4% resulted from green spaces in good condition (Prakoso & Herdiansyah, 2019).

Function of Green Open Space

Green Open Space has two functions, which are intrinsic and extrinsic functions. Intrinsic functions consist of ecological functions, while extrinsic functions include social and cultural, economic, and aesthetic functions. In an urban area, these four main functions can be combined according to the needs, interests, and sustainability of the city such as water system protection, ecological balance, and biological conservation.

It can be concluded that basically green open space has three basic functions, including social functions, which are as a public facility with recreational, educational and sports functions, as well as establishing communication between city residents; physically functions, such as part of the air circulation or lungs of the city, protecting water systems, sound absorbers, fulfilling visual needs, regulating the microclimate so that water and air circulation can take place naturally and play a role in producing oxygen; and functions as aesthetics, such as increasing comfort, binding between building elements in the city, giving characteristics in shaping the face of the city, and elements in urban architectural arrangements (Imansari & Khadiyanta, 2015; Zubair et al., 2017).

Types of Green Open Space

Green Open Space can be in the form of urban forests, public cemetery parks, city parks, sports fields, railroad banks, green lanes, highways, and river banks (Noveri et al., 2020). Based on the explanation in the Regulation of the Minister of Public Works No. 5/PRT/M/2008, the division of existing types is in accordance with the typology that can be seen on Figure 1.

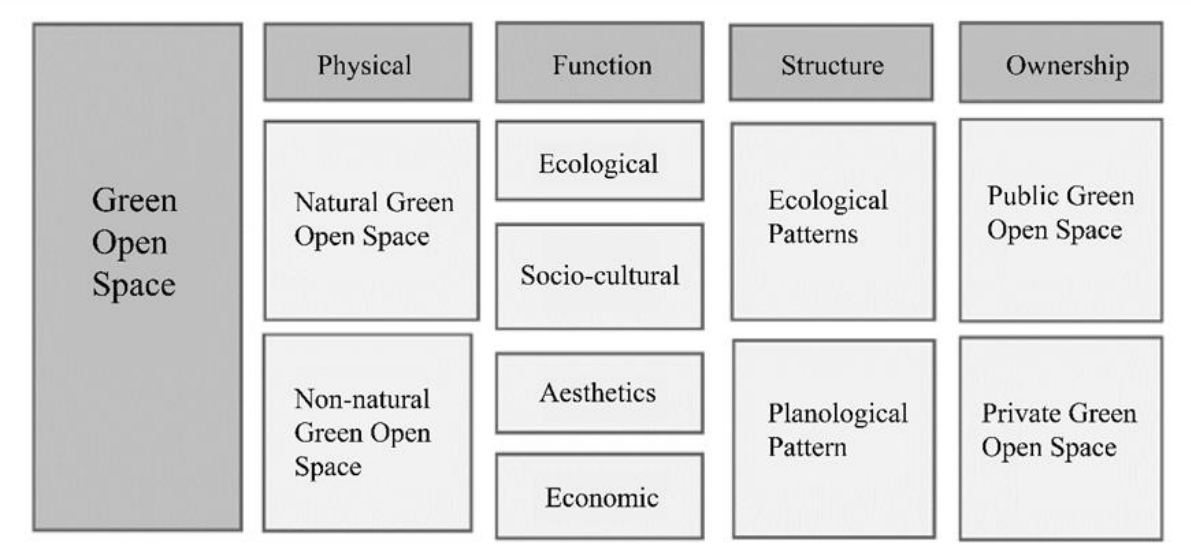

Figure 1. Typology of Green Open Space (Minister of Public Works No. 5, 2008).

In terms of ownership, Green Open Space can be in the form of Public Green Open Space and Private Green Open Space. The following is the characteristic of public and private green spaces (Table 1).

Table 1. Ownership of green space (Minister of Public Works No.5, 2008).

No.	Types	Public green space	Private green space
1	Yard green space		
	a Residential yards		v
	b Office yards, shops, and business premises		v
	c Roof gardens		v
2	Urban Park and Forest		
	a Neighborhood Park	v	v
	b RW park	v	v
	c Urban Village Park	v	v
	d Sub-district Park	v	v
	e City Park	v	
	f Urban Forest	v	
	g Green belt	v	
3	Road Green Belt		
	a Road island and road median	v	v
	b Pedestrian path	v	v
4	Specific function green space		
	a Railway green belt	v	
	b Green belt of high voltage electricity network	v	
	c Riverside green space	v	
	d Shoreline green space	v	
	e Green space for safeguarding raw water sources	v	
	f Cemetery	v	

According to the Regulation of the Minister of Public Works No. 05/PRT/M/2008 on Table 1, the determination of Green Open Space area based on population is done with the standard of Green Open Space area per capita (Manshur et al., 2020). The table listing the provision of green space based on population can be seen below (Table 2).

Table 2. Provision of green space based on population (Minister of Public Works No.5, 2008).

No.	Environmental unit	Green Space type	Minimum area /Unit (m^2)	Minimum area /Kapita (m^2)	Location
1	250 people	Household garden	250	1,0	In the middle of the neighborhood
2	2500 people	Home garden	1.250	0,5	In the center of RW activities
3	30.000 people	Neighborh ood garden	9.000	0,3	Clustered with school/district center
4	120.000 people	Sub-district park	24.000	0,2	Clustered with school/district center
5	480.000 people	Cemetery	Customized	1,2	Scattered
		City Park	144.000	0,3	In the center of the region/city
		City Forest	Customized	4,0	In/on the periphery
		For certain functions	Customized	12,5	Customized with needs

Geographic Information System

Geographic Information System (GIS) is a system that uses a computer as a base used to manipulate information or store geographically related data (Frizani et al., 2021). This system is designed to be able to analyze, capture, store, organize, and capture all types of existing geographic data. GIS can be used for spatial analysis, such as Green Open Space maps (Manshur et al., 2020; Nugrahanto et al., 2021). The development of existing technology allows GIS technology to be built based on web. WebGIS is a form of website that describes the geographic information of an area, so that it can make it easier for users to find the latest geographic information in the city (Idris & Mustofa, 2021).

Pleiades Imagery

From some of the previous descriptions, the role of green spaces in urban areas is very important, so in the evaluation and direction of Detailed Spatial Planning (Rencana Detail Tata Ruang - RDTR), accurate information is needed to see changes in green spaces that occur. In supporting the monitoring of Green Open Space area, Pleiades imagery is used which has a high spatial resolution of 0.5 meters (Mukhoriyah et al., 2019). The Pleiades high-resolution sensor loads images in panchromatic mode with a resolution of 0.7 meters resampled to 0.5 meters at ground level (LAPAN, 2007).

Research Methods

The location of this research is Makassar city with an area of 17670.31 ha. This research will identify Green Open Space by utilizing high resolution image data, Pleiades.

This research was conducted using the digitization method. Digitization was carried out on Pleiades imagery. Digitization is the process of converting raster data into vector data using GIS software, so digitization is not only limited to the process of converting analog maps into digital maps. It works by interpreting spatial objects and then converting those spatial objects into a collection of x,y coordinates with a certain type of geometry (point, line, polygon).

Results and Discussion

Research related to the presentation of Makassar City Green Open Space in

WebGIS was conducted by identifying Makassar city land cover using high-resolution images. The satellite image used is Pleiades with a resolution of 2 m multispectral and 0.5 m panchromatic (Figure 2). Interpretation to identify Green Open Space is done by analyzing Pleiades images by first identifying land cover in the Makassar city area by considering the Makassar City RTRW map and conducting a survey to the location. After identifying the land cover, then classifying the land cover which includes Green Open Space.

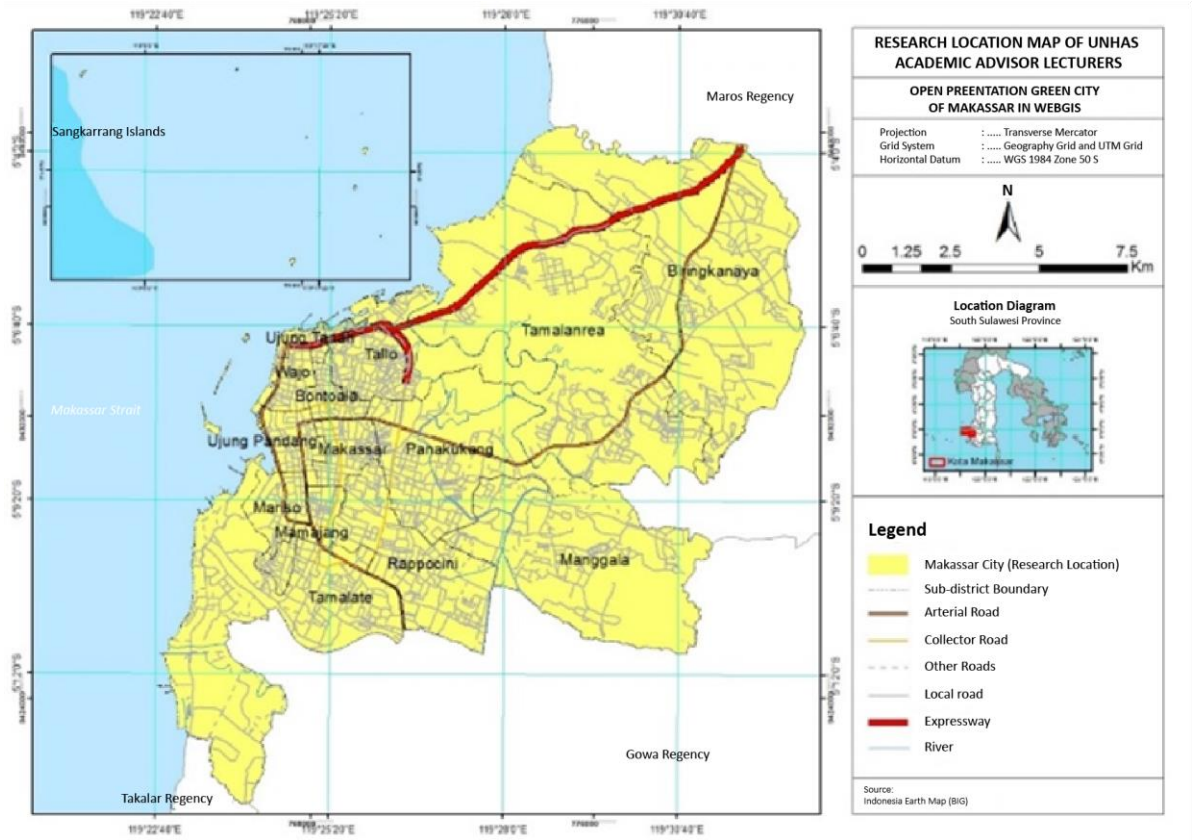

Figure 2. Makassar City Administration Map.

Identification of land cover was carried out by digitizing images using ArcGIS software. Based on the results of the Pleades image interpretation in 2021, 28 types of land cover were detected in Makassar City (Table 2), where the distribution of the area is presented in Figure 3. The land cover in question includes: lakes, docks, sports facilities, urban forests, mangrove huta, industry, roads, greenways, ponds, commercial, fields, vacant land, fields, tombs, sand, ports, settlements, education, offices, swamps, rice fields, shrubs, river borders, rivers, landfills, parks and ponds.

Based on the imagery used, almost half of Makassar City has been covered by settlements covering an area of 8393.65 Ha (47.50%), where the largest settlements are in Biringkanaya District (1747.0933 ha), Manggala (1144.7717 ha) and Tamalate covering an area of 1076.0592 (ha). Land cover in the form of settlements has the greatest influence on changes in green open space areas, so it is very important to tighten the rules to leave 30% green open space in residential areas, both in the form of thematic parks and residential parks themselves.

In addition, industry uses a large amount of land, which is 996.96 ha or about 5.64%. As a land use that can increase pollution, the industrial area must contribute land division that takes into account the

availability of green space in each industrial land.

Currently there is still a large amount of land left for land uses such as rice fields covering 2907.40 ha or 16.45%, ponds covering 1337.61 ha (7.6%) and fields covering 1360.85 ha (7.70%). However, these three types of land use always experience land conversion related to the fulfillment of needs for settlements or other public facilities, so it cannot guarantee to maintain its contribution in the provision of green spaces in the city of Makassar.

Land uses that can be maintained to contribute to the increase of Green Open Space in Makassar City are urban forest (55.77 ha), mangrove forest (55.25 ha), sports facilities (67.51 ha), field (8456 ha), cemetery (73.65 ha) and park (73.76 ha). The green belt covering an area of 52.56 ha can be improved as a green space through planting trees that have a long life with deep roots, so that the possibility of damaging the road, or falling can be avoided for a long time. The distribution of land use types is presented in Figure 3.

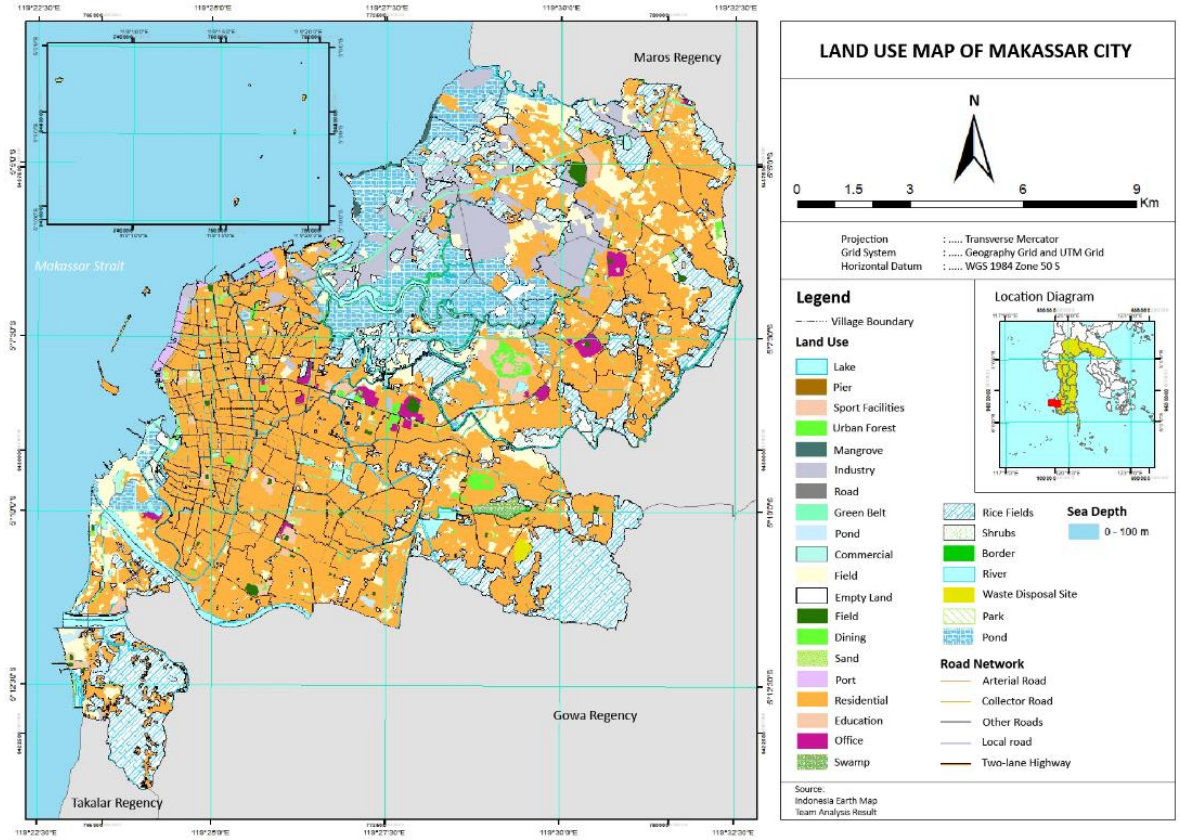

Figure 3. Makassar City Land-use Map.

One concept of providing green open space in an area is based on the area itself. In this case, the open space area must be able to meet the standard of open space area needed in a city. This open space can be in the form of public and private green spaces. According to Law No. 26 of 2007 on Spatial Planning (BPK, 2007), it is stated that each region is required to allocate at least 30% of its space or area for Green Open Space, where 20% is reserved for public Green Space which is green open space owned and managed by the city government and used for the benefit of the community in general, and 10% is reserved for private Green Space on lands owned by the private sector or the community. Public and private green spaces have several main functions such as ecological functions as well as additional functions, namely socio-cultural, economic, aesthetic/ architectural. Especially for green spaces with social

functions such as rest areas, sports facilities and or play areas, these green spaces must have good accessibility for everyone, including accessibility for people with disabilities.

Table 3. Area and Percentage of Private and Public Green Spaces in Makassar City Detailed by Sub-districts.

District	Private green space (Ha)	Public green space (Ha)	Total area (Ha)
Biringkanaya	164.052	154.273	318.325
Bontoala	2.533	9.005	11.538
Kep. Sangkarrang	0.813	4.136	4.949
Makassar	20.628	3.668	24.296
Mamajang	9.013	6.283	15.296
Manggala	198.938	70.306	269.245
Mariso	9.595	30.199	39.795
Panakukang	94.029	97.177	191.206
Rappocini	39.288	29.889	69.177
Tallo	31.481	63.137	94.617
Tamalanrea	74.207	329.302	403.509
Tamalate	46.563	59.745	106.309
Ujung Pandang	10.507	22.757	33.264
Ujung Tanah	13.520	2.394	15.914
Wajo	4.065	2.372	6.437
Green Space Total	**719.233**	**884.643**	**1603.876**
Area of Makassar City (Ha)		**17670.000**	
Percentage of Green Space (%)	**4.07**	**5.01**	**9.08**

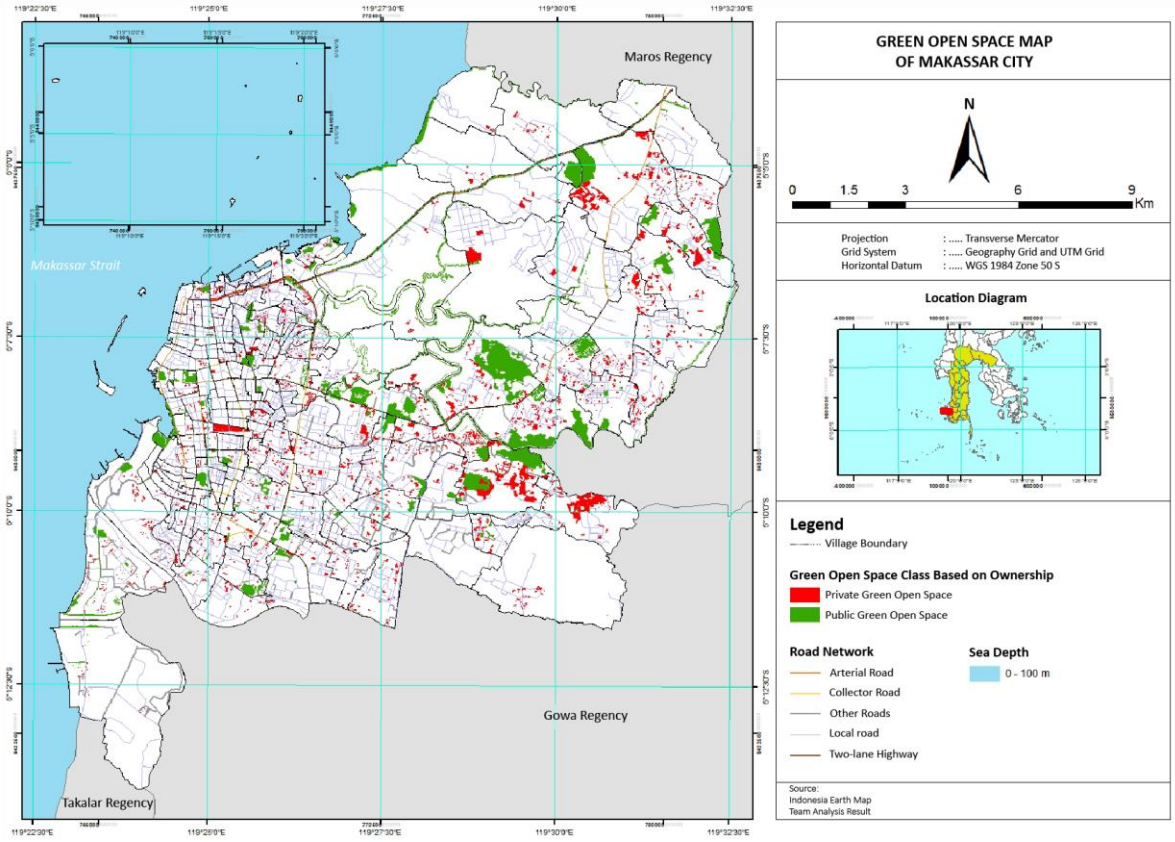

Figure 4. Map of Public and Private Green Space Distribution in Makassar City.

The area of private green spaces in Makassar City reached 719,233 ha (4.07%) and the area of public green spaces was 884,643 (5.01%). Based on this, the

percentage of green spaces in Makassar City reached 9.08% of the total area of Makassar City (Table 3). The largest private green spaces is located in four sub-districts, which are: Biringkanaya, Manggala, Panakukang, and Tamalanrea, where these four sub-districts cover the largest area among the other 15 sub-districts. The largest public green space is in Tamalanrea sub-district with an area of 329,302 ha, followed by Biringkanaya sub-district with an area of 154,273 ha and Panakukang sub-district with an area of 97,177 ha. The largest private green spaces is in Manggala sub-district with an area of 198,938, followed by Biringkanaya sub-district with an area of 164,052 ha. The four sub-districts contributed the most to the percentage of green spaces area in Makassar city. However, the sub-districts with the highest percentage of green spaces in their area are Mariso at 13.65%, Panakukang at 12.32% and Manggala at 11.76%. The distribution in each ward is presented in Table 3 and Figure 4.

The results of the above identification are then presented in a WebGIS so that they can be accessed openly, here is the WebGIS display (Figure 5):

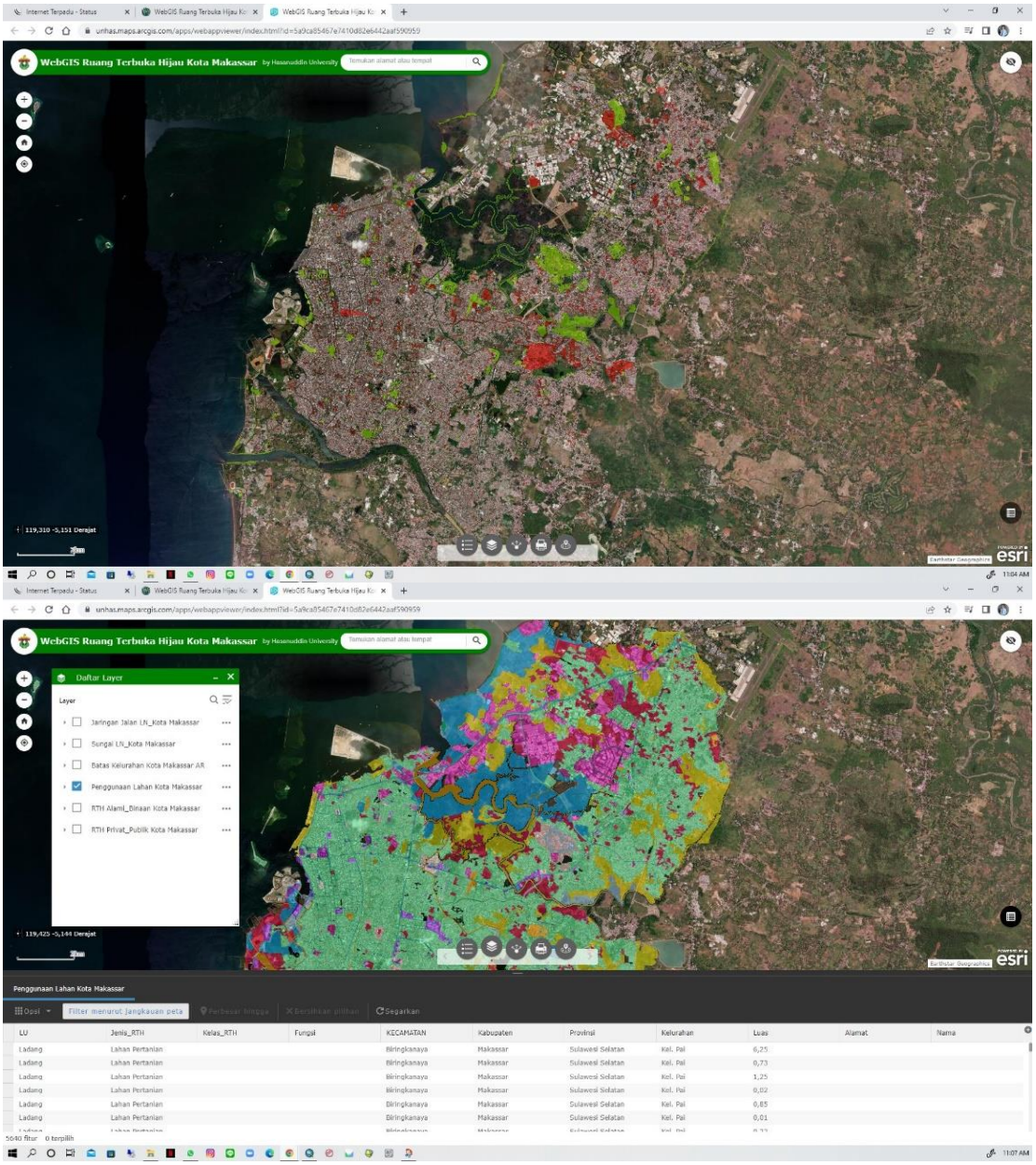

Figure 5. Web View of Makassar City Green Space GIS.

Conclusions

Based on the identification results using Pleiades imagery, the total area of green spaces in Makassar city reached 1603.876 hectares consisting of 719.233 ha of private green spaces and 884.643 ha of public green spaces and based on the identification results, it is known that the Makassar city green space area is 9.08% of the Makassar city area consisting of 4.07% private green space and 5.01% public green space.

Author Contribution

Samsu Arif formulated the title and objectives of the research and made a map of the green open space of Makassar city in the form of webgis. Aswar Syafnur edited, revised the journal, and created a green open space distribution map for Makassar city. Imran Ismail created a research location map and land use map. And the last Aza azzahra and Wikal looked for references and assisted Aswar Syafnur in revising and editing the research results.

Conflict of Interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work.

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