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MORALITY BEFORE KNOWLEDGE

Availability of green open space in jakarta using GIS analysis

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ABSTRACT

Background: Green Open Space is one of the important elements in sustainable urban development, especially in big cities like Jakarta that are experiencing rapid urbanization growth. This study analyzes the availability of green spaces in Jakarta and evaluates how far the minimum target of 30% of the city area mandated by Law No. 26/2007 on Spatial Planning has been achieved. **Methods**: The analysis was conducted using spatial data and green space maps, as well as literature review related to the concept of green space and environmental sustainability. **Findings:** The results showed that the availability of green open space in Jakarta is still far from the set target, with most of the city area dominated by residential and commercial areas. In addition, the planning and management of green open space still faces various challenges, such as land limitations, conflicts of interest in space use, and low public awareness of the importance of green open space. **Conclusion**: This research concludes with policy recommendations to increase the amount and quality of green spaces through a collaborative approach between the government, community, and private sector, in order to realize a greener and more sustainable city. **Novelty/Originality of this article:** The novelty of this research lies in its focused evaluation of Jakarta's Green Open Space availability using both spatial data analysis and regulatory benchmarks, particularly the 30% target mandated by Law No. 26/2007 on Spatial Planning.

KEYWORDS: green open space; Jakarta; spatial planning

1. Introduction

Every year the population in the Special Region of Jakarta continues to grow, according to data obtained from the DKI Jakarta Provincial Statistics Agency. In 2023, the population of DKI Jakarta recorded at the DKI Jakarta Provincial BPS amounted to 10,672,100 people. This figure has increased the population from 2021 which amounted to 10,605,437 people to 10,640,007 people in 2022 and then increased again to 10,672,100 people in 2023. This means that the number of people living and settling in the DKI Jakarta area has continued to increase in the last 2 years, namely by 0.63% or an increase of 66,663 people. If calculated on average, the increase in the number of DKI Jakarta residents every day increases by around 182 people or an increase of 7 people every hour (BPS, 2023). Population growth is usually accompanied by increased needs in ecological, economic, and social aspects. City development is often is characterized by the physical expansion of the region, which includes the development of infrastructure such as housing, transportation facilities, public services, and commercial areas to meet the increasingly complex needs of the community. This brings significant impacts to urban spatial planning, where land that should be

allocated for Green Open Space is often displaced by development projects. On the other hand, people's needs for recreational space, clean air quality, and mitigation of environmental risks such as flooding and pollution are increasingly urgent as urban activities increase. Therefore, the balance between physical development and environmental sustainability is a major challenge in sustainable urban planning.

DKI Jakarta Province has 6 cities/regencies consisting of Kepulauan Seribu, South Jakarta, East Jakarta, Central Jakarta, West Jakarta, and North Jakarta (BPS, 2023). The city with the largest population in DKI Jakarta Province is East Jakarta City with a population of 3,079,618 people, while the city with the smallest population is Kepulauan Seribu with a population of 28,523 people.

Green open space in DKI Jakarta, based on data from the DKI Jakarta City Planning Agency, is divided into six types, namely urban parks and forests, green lanes along roads, parks in public buildings, water banks, recreational parks, and cemetery green open space. Of the various forms of green open space, parks and urban forests are the most dominant types and are spread across various areas of Jakarta. This type of green open space plays an important role in providing green space that is accessible to the community and serves as the lungs of the city. In addition, parks and urban forests contribute significantly to mitigating environmental impacts such as air pollution and rising urban temperatures. However, despite being the largest in number, the overall area of green space in DKI Jakarta is still insufficient to meet the minimum standard of 30% of the total area mandated by law, so the development of other forms of green space also needs to be improved. Based on data obtained from the DKI Jakarta Provincial Government, in 2023 the DKI Jakarta area only has green spaces with an area of 33.33 million square meters. This area is equivalent to 5.18% of the total area of DKI Jakarta as a whole. This figure is still far from the minimum standard of green space required by law.

The availability of green open space in Jakarta is still an important question that needs to be analyzed further. Jakarta's achievement in meeting the 30% green space target set by Law No. 26/2007 needs to be evaluated in depth. The main challenges faced in planning and managing green spaces in Jakarta need to be clearly identified and understood. Finally, effective solutions are needed to increase the amount and quality of green spaces in Jakarta to support sustainable spatial planning. The purpose of the following paper is to analyze the availability of green spaces in Jakarta based on existing spatial data. In addition, this research also aims to evaluate the achievement of the minimum target of 30% of green space as stipulated in the regulation.

1.1 Literature review

According to Parris (2016), in her book entitled Ecology of Urban Environment, greening policies in cities need to be improved and strengthened, especially for urban areas that face rapid urbanization rates but are not supported by the availability of green open spaces in them, because in several studies that have been conducted before, it has been proven that green areas can show a correlation with improving the mental and physical health of residents who live in the area. Planting trees in urban areas not only supports the creation of biodiversity in flora and fauna, but has also been proven to improve the comfort of life of its citizens, especially in the face of climate change due to increasing temperatures. Through innovative reforestation programs such as roadside tree planting, vertical garden construction, rooftop utilization, land utilization around the house area, not only increase the beauty but also support carbon sequestration so as to reduce the impact of urban heat island, one of the contributing factors is the lack of tree planting in urban areas due to limited land because it has been filled with buildings and housing.

According to (Nor et al., 2021) the impact of changes in the structure of Green Open Space influenced by urban expansion, population density, and management policies on change shows that Green Open Space in Jakarta, Metro Manila, and Kuala Lumpur reduced by more than 30% in the last 25 years due to the expansion of urban development. Jakarta and Metro Manila experienced more significant fragmentation than Kuala Lumpur, with

Green Open Space becoming less connected and more patchy. Policy factors and population density play an important role in this change. This study underscores the importance of sustainable planning and policy oversight to prevent ecological degradation and maintain quality of life in rapidly developing urban areas.

According to the Regulation of the Minister of Agrarian Affairs and Spatial Planning of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space, by 2030 the DKI Jakarta government seeks to pay attention not only to Green Open Space but also Blue Open Space which includes elements such as rivers, swamps, water sources, reservoirs, ponds, and lakes. These Blue Open Spaces are defined as open areas that consist mainly of water bodies and remain within the Green Open Space category, which support landscape settings both in terms of social and ecological aspects. This approach is in accordance with the calculation scheme of the Indonesian Blue-Green Index (IHBI) which serves as an indicator to assess Green Open Space in an integrated manner (Aristyowati et al., 2024). This is in accordance with the target of the Indonesian government to reduce greenhouse gas emissions, because Green Open Space utilized for tree planting can help absorb greenhouse gases as one of the actions to mitigate climate change on earth (Heriyanto et al., 2023). According to (Sari, 2021) in (Ufaira et al., 2023) vegetation also provides shade in the area under the trees, thus protecting people physically from the heat and making it comfortable to move in the shade. Green Open Space plays an important role in realizing a sustainable city because it functions as a carbon sink, maintains biodiversity, a place for aquifers, and helps in controlling air pollution (Indira et al, 2021). Green Open Space is provided for the public good that can support community social interaction, recreation, and connection with nature (Sutapa et al., 2023).

Public Green Open Space with good landscape quality has an important role in urban areas but can also be a challenge amid potential changes in the urban landscape, climate, socio-economic conditions, human activities, and political relations (Sutapa et al., 2023). According to (Wai et al., 2018 in Sarofah et al, 2023), Green open space is part of the management and utilization of space supported by its management. Green open space also plays a role in preventing pollution and environmental damage. Based on the law, the target of green open space is 30% of the total area, and to achieve this target requires good cooperation from various parties, not only the government, but also other stakeholders, namely: ecological function, green open spaces serve several purposes, including improving water quality, reducing flood risk, and playing a role in microclimate regulation. Social and cultural functions, reen open spaces create opportunities for social interaction. In addition, communities can utilize green spaces for recreation and as landmarks. Green open spaces also have architectural/aesthetic value that can provide comfort, such as parks and green corridors. Economic function, green open spaces can attract more people and visitors to a location. In addition, green open spaces can be used to manage green city tourism facilities, potentially boosting the local economy. The presence of green open spaces leads to the conclusion that these spaces can provide comfort, freshness, and beauty to the environment, thus making it clean and healthy for city residents. Green open spaces can also produce various types of wood, flowers, leaves and fruits.

The need for green open space in DKI Jakarta can be calculated based on area (30% according to Law No. 26/2007) or population, with the area approach being more appropriate given the complexity of the city. The fulfillment of green open space faces technical challenges, such as land conversion, economics related to land acquisition costs, and lack of regulation and political support. To achieve the 30% green space target, the main solutions are collaboration between stakeholders, increased community participation, and strengthened regulations. All of these require comprehensive planning and political commitment for policies to be effective and sustainable (Prakoso et al, 2019).

In the management of green open space, various important factors must be considered to ensure its function is optimized. Physical factors are one of the most fundamental, including the shape of green open space which can be elongated, circular, or rectangular, which must be adjusted to environmental conditions and community needs. In addition, social factors also play an important role, considering that green open spaces become a

place for social interaction and recreation for residents. From an economic perspective, green open spaces also have commercial value as a source of valuable goods, such as timber or other natural products. Cultural factors also need to be considered, especially in maintaining local heritage and urban identity. On the other hand, people's right to an attractive, livable, comfortable and sustainable environment must be upheld through policies that support green space management. This includes efforts to maintain environmental sustainability while meeting the needs of a growing population. Collaboration between the government, the community, and the private sector is necessary for effective green open space management. (Sarofah et al, 2023). Adding public spaces and organizing the layout properly when designing green spaces above underground buildings is considered very important because it can reduce negative impacts on the environment, provide benefits to nature, and can become a sustainable developing city that is comfortable for its citizens to live in (Indira et al, 2021).

DKI Jakarta is considered to have failed in incorporating urban heat and thermal justice issues into the urban policy agenda, especially regarding the uneven distribution of Green Open Space as an important solution to reduce heat in metropolitan areas. Chronic heat issues are ignored, and the implementation of green open space policies does not use a thermal justice perspective. It is important to encourage the strategic merging of urban heat issues with recognized environmental problems, as well as the formation of alliances with representatives of vulnerable communities (Ufaira et al., 2023). The implementation of Green Open Space utilization may fail due to several factors, such as policies or technical rules from the government that have not been implemented, facilities visitor comfort is not maximized, and the proportion of Green Open Space area to the total population has not been met (Sihombing et al, 2022).

2. Methods

The literature review method and data collected in this paper are secondary data derived from several reviews from government agencies, both from the central government and from the local government, namely the DKI Jakarta Provincial government, related to regulations and policies used in the aspect of Green Open Space as well as the physical and non-physical conditions of Green Open Space areas in the DKI Jakarta area. Analysis using Geographic Information System (GIS) method is used in this paper. The GIS method can enable a more accurate mapping of Green Open Space against the distribution data in the area and can also identify areas that need Green Open Space improvement or development. With GIS analysis, spatial data can be analyzed in detail, providing a more in-depth picture of the potential and challenges in green open space management, so that it can be used as a basis for more informed decision-making in sustainable urban planning.

Data on the availability of Green Open Space in the DKI Jakarta area has decreased by 14.2% over a 21-year period, with the following details green open space reduced from 21,638.25 ha (33.70%) in 2000 to 15,067.71 ha (23.47%) in 2010, and 12,522.6 ha (19.50%) in 2020 (Nurfadhil & Zain., 2024). In 2024, based on data obtained from the website jakartasatu.jakarta.go.id which can be seen in Figure 1, the total area of Green Open Space in Jakarta decreased again to 3,362.82 ha (5.23%). In accordance with the applicable legislation, it is stipulated that the minimum amount of Green Open Space in an area is 30% of the total area, while the data shows that the DKI Jakarta area only has 5.23% Green Open Space in 2024. The following data is one of the backgrounds for the need to analyze the availability of Green Open Space in Jakarta, which continues to decrease in area from year to year. Based on the Green Open Space area data obtained from the website which can be seen in Figure 1, East Jakarta has the largest Green Open Space area compared to other cities in DKI Jakarta Province at 26.08%. In West Jakarta, the most determining factor in modeling potential Green Open Space based on needs is the risk of flooding (Aryaguna et al., 2014).

Fig. 1. Green open space area in DKI Jakarta province in 2024

One of the areas in Central Jakarta, which can be seen in Figure 2, shows that most of the area in the area has been used for buildings and road functions, which has led to a reduction in Green Open Space in the Province. DKI Jakarta. This condition exacerbates the imbalance between physical development and the ecological needs of the city. Land cover dominated by buildings and road infrastructure reduces opportunities to provide Green Open Space that can support environmental balance, such as rainwater absorption, heat reduction, and air quality improvement. In addition, population growth and the need for urban land narrow the space for green space development. This poses a major challenge in achieving the minimum target of 30% green space as mandated by the law, which requires wiser spatial planning and a joint commitment from the government and the community to maintain and improve the quality of the urban environment.
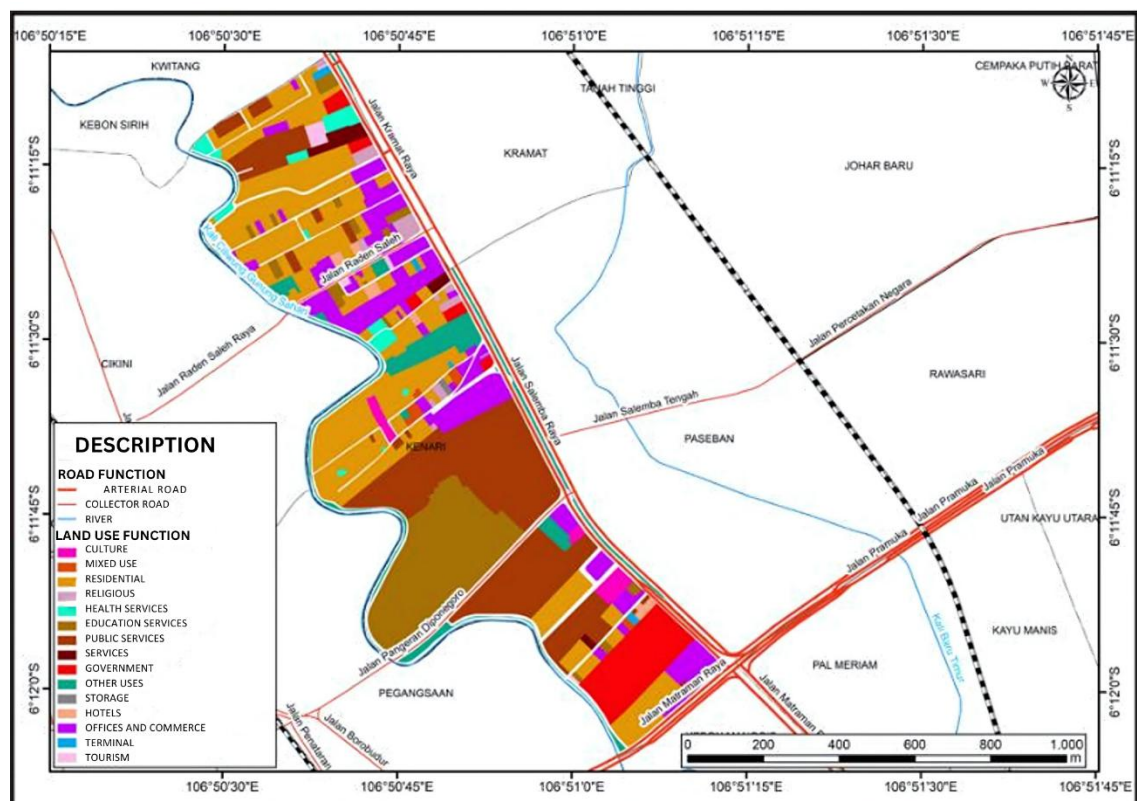

Fig. 2. Example of central Jakarta Area

In the Green Open Space area in South Jakarta City is Tebet Eco Park. Based on research that has been conducted (Yulita Suryantari et al., 2022), the park has an attraction for

residents to visit and can be a place to relax, this is very good because in addition to being an area to maintain biodiversity, it can also have a good impact on the health of its citizens because it can improve the air quality index. According to the website https://aqicn.org, the Air Quality Index (AQI) is a measurement index that indicates the air quality in an area, specifically how free the air in the area is from pollution. There are six groups of AQI levels, namely Good (AQI 0- 50), Moderate (AQI 51-100), Unhealthy for sensitive groups (AQI 101-150), Unhealthy (AQI 151-200), Very Unhealthy (AQI 201-300), Hazardous (AQI above 300). AQI helps people understand the health risks that may arise from poor air quality. Based on data from the website https://iqair.com accessed on October 18, 2024, Jakarta ranks 9th in the world with an AQI value of 149 which means unhealthy for sensitive groups. This can prove that air quality management in DKI Jakarta Province has not been managed properly, one of which is due to the lack of green open space area in the DKI Jakarta area which does not match the minimum amount required by law.

3. Results and Discussion

DKI Jakarta Province as shown in Figure 3, is divided into 6 regions namely North Jakarta, West Jakarta, Central Jakarta, South Jakarta, East Jakarta, and Thousand Islands. This map shows the distribution of land without specific information on the proportion of green open space. Based on data obtained from BPS in 2024, DKI Jakarta's Green Open Space is only 5.28% of the total area. Furthermore, analysis using ArcGIS software in Figure 4 provides a more detailed picture of the distribution of Green Open Space in various areas in Jakarta. The analysis shows that most of the Green Open Space areas are concentrated in certain areas, while densely populated areas such as Central Jakarta and West Jakarta experience a lack of Green Open Space. Based on these results, there is an imbalance in the distribution of Green Open Space that has the potential to affect the quality of the environment in urban areas.
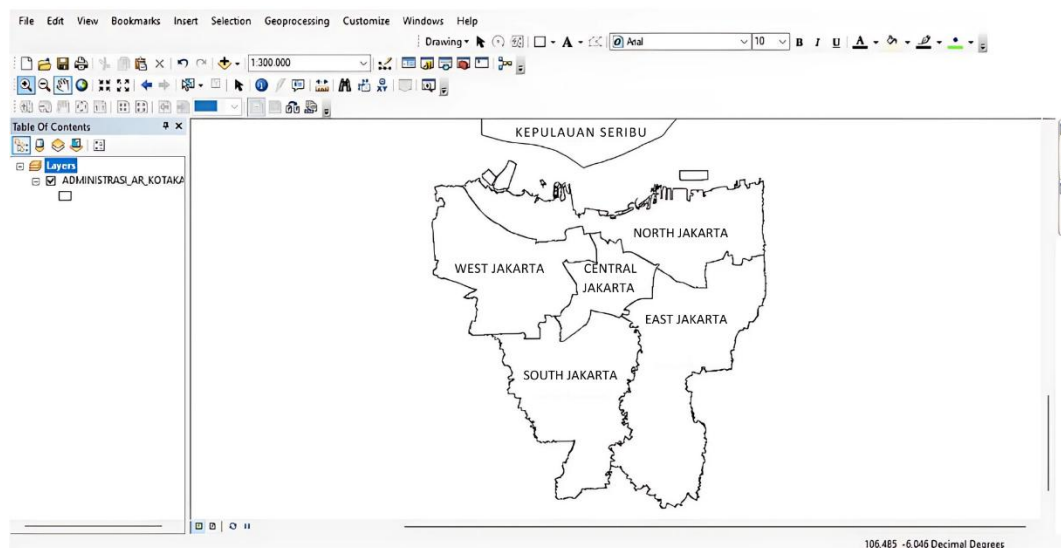

Fig. 3. Map of DKI Jakarta province personal

Figure 4 explains the Green Open Space Map in DKI Jakarta Province which includes park areas, lakes, and streams, each of which is very lacking when compared to the total area of DKI Jakarta Province. The existence of adequate Green Open Space is very important to create a healthy and comfortable urban environment. Green Open Space not only serves as a place for recreation, but also plays a role in microclimate regulation, flood risk mitigation, and increased biodiversity. Planting trees in green open spaces can help in carbon sequestration, reduce the effects of global warming, and create a cooler and more comfortable area for the community.
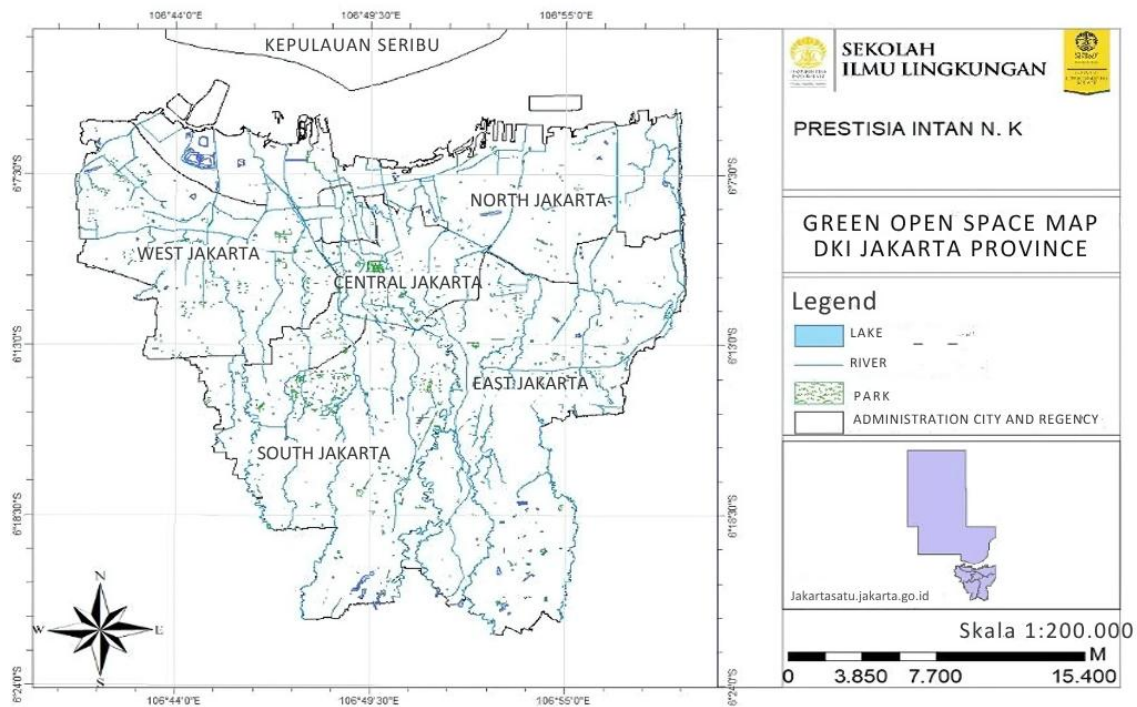
Fig. 4. Map of DKI Jakarta province personal

4. Conclusions

One of the significant impacts of the lack of Green Open Space is the decline in air quality in Jakarta. Based on Air Quality Index (AQI) data, Jakarta ranks 9th in the world with an AQI value indicating that the air quality in the region is unhealthy for sensitive groups. This suggests that air quality management has not been well managed, which can be addressed by increasing the amount of green open space. Green open space can function as a pollution sink, help in reducing greenhouse gas emissions, and improve people's quality of life. The availability of Green Open Space in Jakarta is still far from expectations and requires serious attention from all stakeholders.

Referring to the benefits obtained from the existence of Green Open Space which is one of the efforts to implement climate change mitigation, loss of biodiversity, and pollution that pollutes the environment. Success in increasing Green Open Space will depend on commitment and effective collaboration between the government, the community, and the private sector. By doing so, Jakarta can move towards a greener, more sustainable and livable city. This research is the first step to inspire the behavior and awareness of the public and encourage concrete actions to better manage Green Open Space in Jakarta from the government, community institutions, and the people who live in the city.

Author Contribution
The author was responsible for the conceptualization, data collection, analysis, and manuscript writing. All aspects of the research, including the formulation of research questions, literature review, and interpretation of findings, were conducted independently. The author also reviewed and approved the final version of the manuscript.

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