JPSTD
Journal of Placemaking and Streetscape Design
JPSTD 2(2): 121-133
ISSN 3025-5449

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Policy optimization in providing green open spaces by urban government: A comparative study in streetscape design approaches

Herlina Merinda[1]*, Yekti Mei Mahanani[1]
[1] *School of Environmental Science, Universitas Indonesia, Central Jakarta City, 10430, Indonesia.*
*Correspondence: herlina.merinda@ui.ac.id

Received Date: December 12, 2024 Revised Date: January 29, 2025 Accepted Date: January 30, 2025

ABSTRACT

Background: Green Open Space (GOS) in urban areas is experiencing a significant decline in quality and quantity due to rapid population growth and urbanization. This growth drives land conversion for urban infrastructure, including buildings, trade, industry, and residential areas. In Indonesia, the provision of GOS is mandated by Law Number 11 of 2020, which stipulates that urban areas must allocate 30% of their land for GOS (20% public and 10% private). **Methods:** This study employs both qualitative and quantitative methods. The qualitative method explores geographic and societal conditions, as well as policies, success stories, and challenges in providing Green Open Space (GOS) in Jakarta, Surabaya, and Samarinda. This involves a literature review of statistical data, prior research, and policy documents, as well as secondary data to analyze GOS conditions and needs based on regulations. Challenges in fulfilling GOS are categorized into technical, policy, and political aspects. The quantitative method uses the Analytic Hierarchy Process (AHP) to prioritize policies for achieving the 30% GOS target in the three cities. **Findings:** The study identified five key priorities for GOS policy implementation based on AHP calculations: Commitment of leaders and political actors, Stakeholder collaboration, Availability of green regulations, Community participation, and Private sector involvement. The research highlighted that cities with lower population densities, such as Samarinda, have a comparative advantage in achieving the 30% GOS target compared to denser cities like Jakarta and Surabaya. Furthermore, the study emphasized the role of heterogeneous community characteristics in shaping the effectiveness of GOS policies. Achieving sustainable urban development requires a strong commitment from policymakers and local communities. **Novelty/Originality of This Article**: This research provides a novel perspective on GOS policy optimization by integrating AHP analysis with urban land-use strategies. This research highlights the importance of contextual factors, such as population density and community heterogeneity, in successfully implementing GOS policies.

KEYWORDS: AHP; government policy; green open space.

1. Introduction

Urbanization has put pressure on the urban environment. Population growth and its activities change the biophysics of urban ecosystems which include loss of vegetation, construction of buildings, roads, industry, water channels, fences and other infrastructure, changes in land cover which all absorb water with impermeable surfaces, the area of open space continues to decrease, aquatic habitats, such as lakes and rivers, are damaged, as well as the emergence of waste and pollution (Parris, 2016). Meanwhile, secondary biophysical processes cause several ecological changes in the environment, including habitat loss,

Cite This Article:
Merinda, H. & Mahanani, Y. M. (2025). Policy optimation in providing green open spaces by urban government. *Journal of Placemaking and Streetscape Design*, 2(2), 121-133. https://doi.org/10.61511/jpstd.v2i2.2025.1486

habitat fragmentation, climate change, changes in the water cycle, increased noise and air, water and soil pollution (Parris, 2016).

The world development path that accelerates global environmental change is cities, which are characterized by changes in land cover and use which have an impact on increasing land surface temperatures in cities (Li et al., 2021). Cities face the danger of flooding due to loss of vegetation and changes in land cover that previously could absorb water into areas of impermeable pavement. Apart from that, cities have problems related to air pollution originating from vehicle emissions and factory smoke. This pollution mainly contains CO, CO_2, SO_2, PM10, and PM 2.5. CO_2 is the main component of Green House Gases (GHG). High levels of CO_2 in the air are caused by several things, including vehicle emissions and factory exhaust fumes, previously studies states that the effect of high CO_2 levels on health is that it can cause respiratory acidosis, namely blood acid levels increasing excessively due to the accumulation of carbon dioxide in the blood, causing the body to lack O_2 (Safitri, 2022). According to Faradilla et al. (2016) the impact of high CO_2 concentrations on the environment is that it can increase the earth's temperature and cause a greenhouse effect (Safitri, 2022). Increasing concentrations of greenhouse gases in the atmosphere can increase air temperature, causing the earth to heat up. The greenhouse gas effect is generally caused by high concentrations of CO_2 in the atmosphere (Safitri, 2022). Plants absorb CO_2 in the air and use it for photosynthesis. The result of photosynthesis is O_2 which is very useful for humans and animals to breathe. This is where Green Open Space plays a role in absorbing CO_2 in the air, and reducing the environmental burden caused by greenhouse gas emissions (Lagioia et al., 2023).

Green Open Space is able to provide ecosystem services that can keep the ecosystem in balance (Hernandez et al., 2023). As stated by Groot (2012) in the book Ecology of urban environment, ecosystem services are the benefits felt by humans from ecosystem functions, including plants, food from animals, wood, plant fiber, clean air, clean water and a more comfortable atmosphere (Parris, 2016). On the other hand, humans need a suitable habitat to live, they need clean water and fresh air to stay healthy and active. The increase in population in big cities is directly related to the increasing need for space for activities. Economic, social and relationship changes that occur between regions or cities are the causes of city development. Safe, durable and sustainable city development is very dependent on the space needs and comfort of residents which can be improved through the provision of green open space. Green open space is an elongated area/lane and/or clustered, whose use is more open, where plants grow, both naturally grown and deliberately planted (BPK RI, 2007; Wahyudi, 2014).

Urban Green Open Space (GOS) provides environmental services, ecology, social facilities and psychological benefits for society and enriches human life with meaning and emotion (Miller, 1998, 2012). The relationship between urban open space and environmental, economic and social aspects is to improve the quality of urban life so that it can achieve sustainable urban development (Chiesura, 2004). Urban green open space can reduce noise levels, lower surface temperatures through CO2 absorption, reduce pollutants, improve the physical and psychological well-being of city residents (Haq, 2011; Rushayati et al, 2016). According to Shirvani (1985) states that the function of green open space is as shade, temperature control, dirty air filter, flood control, wind and animal sanctuary, children's recreation and play area, as well as a performance/city identity venue. According to Simond (1984), the green open space function is divided into two parts, namely: (1) Non-creative function, namely the function for the health and beauty of the city's physical environment, as a buffer between different land uses, conservation and economic value. (2) The recreational function is to maintain the harmony of physical growth and development of the human spirit, both as a group and as individuals. Based on the ATR/BPN Ministerial Regulation, the definition of green open space is an area that extends/lanes and/or is clustered where its use is more open, where plants grow, both naturally and artificially, taking into account aspects of water catchment function, ecological, socio-cultural, economic, and aesthetics (Alberti & Marzluff, 2004). The ecological function of green open space is to regulate the microclimate, act as shade, produce oxygen, act as part of the city's

lungs, absorb rainwater, provide habitat for plants and animals, absorb air, water and soil pollution, reduce noise and act as a wind barrier (Ernawati, 2015).

Jakarta is the largest city in Indonesia. Jakarta Indonesian capital city which is not only as the center of governance activity but also as the economic center in Indonesia. The large number of job opportunities and business opportunities are magnets that attract people to urbanize to Jakarta. This makes Jakarta become the most populous city in Indonesia. Jakarta's density reaches 16,084 people/km^2. Jakarta borders the sea on the north side, so apart from efforts to increase GOS in land areas, it can also use the coast as a GOS area. Jakarta is a benchmark in every activity and we can also use it as a benchmark in fulfilling GOS. Meanwhile, Surabaya is the capital of East Java Province. Surabaya is the second largest city in Indonesia. As a trade and industrial center, Surabaya is also a magnet that attracts people to urbanize. Surabaya is the most populous city in East Java. Just like Jakarta, Surabaya also borders the sea on the north and east. In the 1990s, Surabaya was known as a hot city. However, from 2010 to 2020, Surabaya became a green city, with many parks, trees island in the midlle or street corner. Surabaya was known for its corridors of beautiful Tabebuya flowers which became a photo spot destination for newcomers. Surabaya has a success story in providing GOS which used as a reference in providing GOS for other cities. Jakarta and Surabaya are on the island of Java. To complete this comparative study, 1 city located outside Java is needed. Samarinda was chosen as a city outside Java for comparison. Samarinda is the capital of East Kalimantan, which is a province located in the center of Indonesia. Samarinda faces environmental pressures originating from human activities in the form of ex-mining land left open. This open land often results in casualties, even though this land has the potential to be reclaimed and used for GOS. Just like Jakarta and Surabaya, Samarinda also has the potential to develop GOS on the area by the water. If Jakarta and Surabaya have coastlines, Samarinda has the potential to develop GOS on the Mahakam riverbanks and its tributaries. Comparison between big cities in Indonesia can be seen in Table 1.

Table 1. Comparison between big cities in Indonesia

City	Regional Regulations Concerning Spatial Planning	High Population Density	Metropolis	Lower Plain Region	Has A Big River
Jakarta	√	√	√	√	√
Bandung	√	√	√	-	√
Padang	√	-	√	√	-
Medan	√	√	√	-	√
Surabaya	√	√	√	√	√
Samarinda	√	√	√	√	√
Pontianak	√	√	-	√	√
Makassar	√	√	√	√	-

Green open space plays an important role in urban ecosystems. However, its existence is very limited due to massive land use as a result of human activities. The city government has difficulty meeting the minimum area mandated by law. This research will study Green Open Space compliance policies of big cities in Indonesia, their successes and the obstacles they face. Three big cities in Indonesia were chosen for comparison, namely Jakarta, Surabaya and Samarinda. These three cities have similarities as shown at Table 1. Then, by using the Analytic Hierarchy Process (AHP), the main policies in providing Green Open Space by the city government will be optimized. Due to limited budget and resources that urban governance has, it is important to determine priority policies to meet GOS needs. Hopefully this research could provide best practices that can use in formulating policies to accelerate the provision of urban Green Open Space.

2. Methods

This research uses two methods, i.e qualitative and quantitative methods. The qualitative method aims to study the geographic and society condition, also the policies implemented in three cities in providing GOS, success stories and challenges faced. This method was carried out through a literature study of statistics bureau data, previous research and policy documents related to the development of green open space in the three major cities determined, namely the cities of Jakarta, Surabaya and Samarinda. Apart from that, secondary data was also collected for analysis of GOS conditions and GOS needs based on applicable regulations. In this research, problems in fulfilling green open space are also presented which are analyzed from a literature review into two aspects, namely technical aspects, policy and political aspects.

The quantitative method in this research uses AHP to analyze priority policy to meet the 30% green open space requirement in three large cities in Indonesia. The AHP method is designed to solve complex problems with various criteria (Saaty, 2008). The aim of using the AHP method is to formulate a policy concept for fulfilling green open space which can be taken into consideration in achieving the percentage of green open space in 3 big cities. The advantage of AHP is that it has a hierarchical structure as a consequence of the selected criteria down to the most detailed sub-criteria. The first step in the AHP procedure is to make pairwise comparisons between each criterion with the following preference scale and can be seen in Table 2.

Table 2. Example of preference comparison scale

Scale	Degree of Preference Scale
1	Equally important
3	A little more important
5	More important
7	Very important
9	Absolutely very important

In this study, we use policy as criteria. After studying the policies implemented in three big cities, we selected 5 (five) main policies to compare with each other using this AHP method. The second step is to normalize the matrix by adding the numbers in each column. Each entry in a column is then divided by the number of columns to produce a normalized score. The third step is consistency analysis to ensure genuine preference consistency. The next step is to use the same pairwise comparisons to determine the appropriate weight for each criterion. The purpose of this is to ensure that the original preference rankings are consistent. With AHP we can measure the ratio level consistently. If the consistent ratio is very large (>0.10) then it is not consistent enough and a repeat comparison is recommended. Hierarchy of goal and criteria for AHP can be seen in Fig. 1.

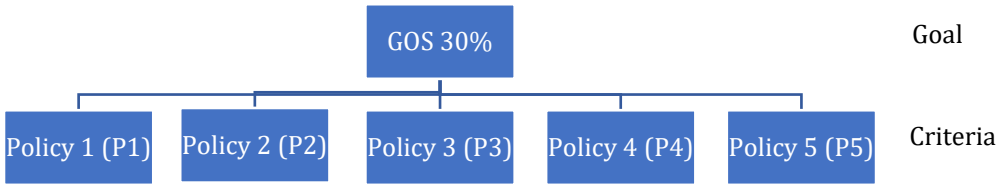

Fig. 1. Hierarchy of goal and criteria for AHP

3. Results and Discussion

Research was focussed on three big cities in Indonesia with similar condition, i.e Jakarta, Surabaya and Samarinda. Jakarta is the country's capital which is located astronomically at 6°12' South Latitude and 106°48' East Longitude. Jakarta borders Depok

City to the South, West Java Province to the East, Banten Province to the West and the Java Sea to the North. The city of Jakarta is a lowland with an average height of +7 meters above sea level. The city of Jakarta is a city with a relatively large number of reservoirs/situations and 17 rivers pass through it. Jakarta has a land area of 661.23 km2 and 6,977.5 km^2 of land area, consisting of 1 district, 5 municipalities, 44 sub-districts and 267 village-districts (BPS, 2022a). The population of DKI Jakarta in 2022 based on the results of the 2020-2023 Interim population projection (Mid year/June) is 10,679,951 people with an annual population growth rate of 0.66 percent. The population density of DKI Jakarta in 2022 is 16,084 people per 1 km2. The city of Central Jakarta has the highest population density in DKI Jakarta Province, namely 20,618 people/km^2. Based on the results of the August 2022 National Labor Force Survey, the number of residents aged 15 years and over working in DKI Jakarta was recorded at 4,875,102 people. The largest number of working residents is in the city of East Jakarta, reaching 1,271,123 people. The unemployment rate in DKI Jakarta in 2022 is 7.18 percent while the labor force participation rate is 63.08 percent (BPS, 2022a).

The Gross Regional Domestic Product of the City of Jakarta reached 3,186.47 trillion rupiah. The largest contributor to GRDP comes from 3 main sectors, namely Wholesale and Retail Trade; Car and Motorcycle Repair (17.44%), Manufacturing Industry (12.29%) and construction (11.04%) The economic growth rate was 5.25% while the GRDP per capita at current prices was around 298,630 thousand rupiah (BPS, 2022a). The Original Regional Income of the City of Jakarta in 2022 will be IDR 77,989.080 billion rupiah, this amount has increased from 2021 of 507.87 billion. Meanwhile, in 2020 DKI Jakarta's PAD was 43,327.14 billion rupiah with a balance fund of 17,855.18 billion rupiah (BPS, 2022a). DKI Jakarta Governor Regulation No. 31 of 2022 (BPK RI, 2022) concerning detailed spatial planning plans for the DKI Jakarta Provincial planning area which divides zones based on the Spatial Pattern Plan, namely protected zones and cultivation zones. Green Open Space is included in the protected zone which has an area of 4797.51 ha or around 7.25%. The GOS zone has 8 sub-zones, namely jungle sub-zone, city park sub-zone, sub-district park sub-zone, viilage-district park sub-zone, RW park sub-zone, RT sub-zone, cemetery sub-zone and sub-zone Green Line. However, according to data from www.jakartasatu.jakarta.go.id, DKI Jakarta Province has an area of Green Open Space (GOS) of 33.35 km^2 or around 5.18% of the total area of DKI Jakarta (Prakoso & Herdiansyah, 2019). This achievement is still far from the target mandated by Law Number 26 of 2007 concerning Spatial Planning where the minimum public open space area is 20%. The map of Jakarta city can be seen in Fig. 2.

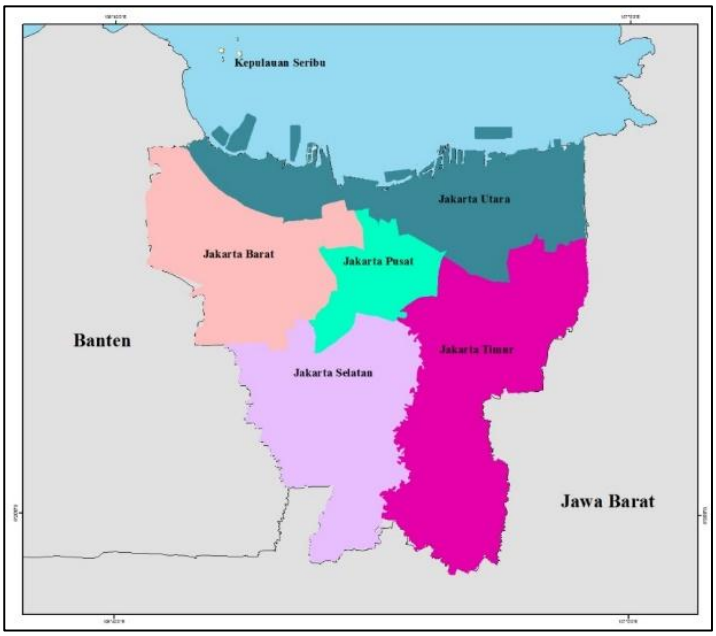

Fig. 2. Jakarta City
(BPS, 2022a)

Surabaya is a city located in the northeastern part of Java Island. The city of Surabaya is geographically located at coordinates 07° 9' to 07° 21' South Latitude and 112° 36' to 112° 54' East Longitude. Surabaya borders the Madura Strait to the north and east, borders Sidoarjo Regency to the south and borders Gresik Regency to the west. The Surabaya region is lowland with a height of 3 to 6 m above sea level, except in the south which has a height of 25 to 50 m above sea level. The city of Surabaya has a total area of 326.81 km2 consisting of 31 sub-districts and 154 sub-districts (BPS. 2022b). The population in the city of Surabaya in 2022 will reach 2.88 million people with a population density of 8,633 people/km2. The most populous sub-district is Simokerto (33,186 people/km^2), and the lowest density is Benowo District (2,886 people/km^2) (BPS. 2022b).

The Gross Regional Domestic Product of the City of Surabaya reached 655,616.2 billion rupiah. The largest contributor to GRDP comes from the wholesale and retail trade sector, car and motorbike repairs (28.16%), processing industry (19.22%), and provision of accommodation and food and drink (15.60%). (Surabaya in Numbers 2023) Surabaya City's Original Regional Income in 2021 is IDR 4,727,280,630,- and a balancing fund of IDR 2,154,338,429,- Plus other legitimate income so that the total income of the City of Surabaya in 2021 is IDR 8326,878,046,- (BPS, 2022b). The city of Surabaya succeeded in increasing the green open space area from 20.21% in 2010 to 26% in 2017 (Ulfa et al., 2024). Via the surabaya.go.id page, in 2022 the percentage of public green open space will reach 22% or reach 7,358.87 hectares. This area consists of green open space for parks and green belts covering an area of 1,672.75 hectares, green open space for a forest park covering an area of 66.03 hectares, green open space for a protected area covering an area of 4,570.33 hectares, green open space for public and residential social facilities covering an area of 205.50 hectares, green open space for a lake /reservoir/boezem covering an area of 198.23 hectares, green open space for fields and stadiums covering an area of 361.08 hectares, and green open space for cemeteries covering an area of 284.95 hectares. This achievement exceeds the target mandated by Law Number 26 of 2007 concerning Spatial Planning, which states that the minimum public open space area is 20% (BPS, 2022c). The City of Surabaya is committed to continuing to increase the area of Green Open Space (Budiman et al., 2014). This is stated in all planning documents, such as RPJPD, RPJMD and planning documents at the regional apparatus level. Not only does it increase the area, the Surabaya City Government is also revitalizing city parks so public are interesting to visit (BPK RI, 2021). Apart from that, the city government is also developing city parks on land that has not yet been developed, as well as adding a long green belt area (Ulfa et al., 2024).

Adding green open space in big cities is difficult due to limited land. However, the city government has succeeded in pursuing this through land acquisition, changing the function of gas station land, utilizing former Village Treasury Land and utilizing land used for Final Disposal Sites (Ulfa et al., 2024). In its implementation, this increase in green open space area in Surabaya can be achieved because the factors: (1) Collaboration and cooperation of various stakeholders in adding green open space. These stakeholders consist of government, private sector and society (Prihandono, 2010). The government here is a regional apparatus with various different tasks and functions which then work together to achieve the increase in green open space (Ulfa et al., 2024). (2) The mayor's facilitative leadership is carried out in terms of supervision and checking from planning to development. The mayor uses a strategy that attracts land owners who are generally residents of illegal settlements, namely by providing facilities in the form of flats, street vendor centers (pusat UMKM) and more decent jobs (Ulfa et al., 2024). (3) Returning land functions and replanting mangroves on the East Coast of Surabaya (Pamurbaya). This area was previously converted into a residential area very close to the beach. In an effort to fulfill the green open space, the city government demolished the settlement and designated it as a conservation area and replanted mangroves. The determination of this conservation area is contained in the Surabaya City Regional Spatial Plan/*Rencana Tata Ruang Wilayah* (RTRW) Number 3 of 2007. In this provision, it is stipulated that permitted waterfront buildings must not be less than 1000 meters from the coastline. In 2015 there was a drastic

increase of open green space area, namely an additional 2,514.29 Ha Green Open Space from mangroves (Andriani, 2023).

The city of Samarinda is located at 117o03'00" to 117o18'14" East Longitude and 00o19'02" to 00o42'34" South Latitude. Samarinda is a city crossed by the equator. Samarinda City to the north, east, south and west borders Kutai Kartanegara Regency, in other words, Samarinda is surrounded by Kutai Kartanegara Regency. The city of Samarinda has an area of 718 km2 which is divided into 10 sub-districts and 59 village-districts (BPS, 2022c). The population of Samarinda City in 2022 reach 834,824 people with a population density of 1,153 people/km2. The highest population density is in Samarinda Ulu District with a density of 5,869 people/km2 and the lowest is in Palaran District at 286 people/km2 (BPS, 2022c).

Samarinda City's Gross Regional Domestic Product reached 83,335.59 billion rupiah. The largest contributor to GRDP comes from 3 main sectors, namely construction (20.51%); wholesale and retail trade sector, car and motorbike repair (16.07%); and the mining and quarrying sector (15.66%) (Samarinda in Figures 2023). Samarinda City's Original Regional Income in 2021 is IDR 594,620,186 932.71 and a balancing fund of IDR 1,324,423,498,281,- Plus other legitimate income so that the total income of the City of Samarinda in 2021 is IDR 1,919,138,232,711.71 (BPS, 2022c). In Regional Regulation concerning RTRW for the City of Samarinda for 2014-2034, locations have been allocated for the public GOS for the City of Samarinda, where the area reaches 16,460.33 hectares or 22.93%.

The public green open space in Samarinda City that is still implemented is 4,308 Ha or only 7%. This value is still far below the mandate of the Spatial Planning Law. (Santoso et al, 2022) The obstacle faced in providing Green Open Space in Samarinda City is the limited land owned by the city government. The available land is already owned by the private sector and community. therefore negotiations and land acquisition by goverment are needed. However, the government also has a limited budget for land acquisition. Budget limitations and a lack of human resources for managing public Green Open Spaces, both in terms of quality and quantity, are another challenges in providing and maintaining GOS (Novianty et al., 2012). The people of Samarinda City are also known as people who grow and live at riverbank. Especially along the Mahakam river which divides Samarinda City is filled with dense settlements. Likewise, the borders of reservoirs and lakes are used as dense residential areas. Actually, the riverbank, the borders of reservoirs and lakes has great potential to be developed into Green Open Space.

The potential for providing Green Open Space can be carried out in collaboration with mining owners to reclaim mines that are no longer in use. Mining is the dominant private sector in Samarinda. They used to leave no longer use mining without any efforts to reclaim it. firm government policy is needed to regulate this matter, so that unused mining land can be converted into GOS. Samarinda City Government has programs for providing GOS to fullfill 30% minimal area, i.e: GOS and Recreational Parks Development Program; Subdistrict 1 Playground; proposing mining pits as public green open spaces; ordered sub-district to comply 20% GOS on its area; and converting the Mahakam and Karang Mumus Riverbank into GOS (Santoso, 2022).

3.1 Comparison GOS in Jakarta, Surabaya, and Samarinda

Based on data of GOS in three big cities, the relationship between green open space and population of Jakarta, Surabaya and Samarinda in 2022 can be shown in Table 3. From a comparison of the 3 cities, it can be seen that Jakarta is the most densely populated city with the highest income. Followed by Surabaya and then Samarinda. From Table 3 it is known that Surabaya is better in terms of providing green open space. Where Surabaya currently provides GOS 73.59 km^2 or 22% of its area. When compared with the population, Surabaya managed to provide 39.14 m^2/person. Meanwhile, Jakarta provides GOS covering an area of 33.35 km^2 or around 7.25% of the total area. When compared with the population, Jakarta provides GOS of 3.12 m^2/person. This value worth to be appreciated considering that the population of Jakarta is far above Surabaya, almost 4 times larger. Even compared to

Samarinda, Jakarta's population is almost 13 times larger. Meanwhile, Samarinda currently provides GOS covering an area of 43.08 km^2 or around 7% of the total area. When compared with the population, Samarinda has provided GOS of 5.2 m^2/person. Anguluri & Narayanan (2017), stated that WHO standard for GOS area is 9.5 m^2/person When comparing with the WHO standard, then of the three cities, only Surabaya meets the standard. Relationship between green open space and population of three cities in 2022 can be seen in Table 3.

Table 3. Relationship between green open space and population of three cities in 2022

No	Study Area	City Population in 2022 (Person)	Area of GOS in 2022 (km^2)	Density of GOS Based on Population (m^2/person)
1	Jakarta	10,679,951	33.35	3.12
2	Surabaya	2,880,000	73.59	39.14
3	Samarinda	834,824	43.08	5.2

Based on Table 4, the Jakarta government has the most homework. From the 198.39 km2 of GOS that must be provided, the government has only been able to provide 33.35 GOS, so an additional 165.02 km2 of GOS is needed. Next, Samarinda had homework to add 50.80 GOS, because of the 215.4 GOS that had to be provided, only 43.08 were actual GOS areas. Meanwhile, Surabaya has the least homework, because of the 98,043 km2 of GOS that must be provided, Surabaya has provided actual GOS of 73.59 km2. The city of Surabaya has the highest success in implementing 30% green open space requirements with the smallest area compared to Jakarta and Samarinda. This achievement because the Surabaya City Government succeeded in returning social facilities and public facilities which were previously managed by the private sector or to be handed over to the City Government. Likewise, empty land that is not maintained or does not have ownership status is arranged and used by the Surabaya Government as a park. This method allows the city of Surabaya to meet its green open space targets in a relatively short period of time. The need for green open space in three cities using the applicable regulatory approach can be seen in Table 4.

Table 4. Green open space needs based on area

Study Area	Area (km2)	Area GOS Requirement 30% (km^2)	Actual GOS Area (km^2)	Difference in GOS Requirement (km^2)
Jakarta	661.23	198.39	33.35	165.02
Surabaya	326.81	98.043	73.59	24.45
Samarinda	718	215.4	43.08	50.80

3.2 Analytical hierarchy process (AHP)

Based on the literature study, the key policies for successfully providing Green Open Space (GOS) in the three major cities are identified as follows: stakeholder collaboration, private sector involvement, commitment of leaders and political actors, availability of green regulations, and community participation. These five policies are analyzed using the Analytic Hierarchy Process (AHP), where each policy element is compared pairwise using a comparison scale as shown in Table 2. The Total Priority Value (TPV) is then calculated, expressed as a percentage, and compared to determine the priority policy. The AHP calculation results are detailed in Table 5.

Table 5. Comparison matrix using AHP calculation

Policy	P1	P2	P3	P4	P5	TPV	Percentage
P1	1	5	1/5	1/7	5	11.34	25.53
P2	1/3	1	1/7	1/5	1/3	2.01	4.52
P3	7	5	1	3	1	17.00	38.26
P4	1/5	3	1/5	1	5	9.40	21.16
P5	1/3	3	1/7	1/5	1	4.68	10.53
Total						44.43	100.00

From the AHP calculations shown in Table 5, policy in column is then compared with the policy in row. when policy compared with itself, then the score will be 1. Example, P1 compared with P1 the score is 1, P2 compared with P2 the score is 1, P3 compared with P3 the score is 1 etc. When P1 (stakeholder collaboration) compared with P2 (private sector involment), it comes out that stakeholder collaboration is more important than private sector involment, That's why the score at row 1 column 2 is 5. When we compare P1 (stakeholder collaboration) with P3 (Commitment of Leaders and Political Actors), it comes out that Commitment of Leaders and Political Actors is more important than stakeholder collaboration. That's why the score at row 1 column 3 is 1/5. Then we proceed the calculation until row 5 column 5. After the matrix is completed. We calculate the total number and percentage for each row to find the TPV (Total Priority Value) for each policy. The largest TPV is the most priority policy. From the calculation, we find that P3 has the highest TPV compared to the four other policies. The TPV of P3 (Commitment of Leaders and Political Actors) reached 38.26%. Next is P1 (Stakeholder collaboration), where the TPV value reached 25.53%, while P4 (Availability of green regulations) is in third place with a TPV value reaching 21.16%. P5 (Community participation) is in fourth position with a value of 10.53%. and the last position is P2 (Private sector involvement) with a TPV of 4.52%.

Based on the TPV value, GOS providing policy priorities can be arranged as follows: commitment of leaders and political actors; stakeholder collaboration; availability of green regulations; community participation; and private sector involvement. This order can be used as a reference for urban governments that have limited budgets and resources in proposing strategies, programs and development activities in fulfilling GOS. Urban governance should implement first order from this priority policies, before implement the next one. Of course implement this all five policies are the best, But if the government has limitation, following this order would be helpful.

These five policies can be described as follows. First, the commitment of leaders and political actors plays a crucial role in mobilizing resources for the provision of Green Open Space (GOS). Strong and facilitative leadership can inspire subordinates and society, encouraging stakeholder collaboration, private sector involvement, and voluntary community participation in greening the city. Additionally, support from political actors, such as the DPRD, can facilitate the formulation of green regulations. Second, stakeholder collaboration is essential to address budget limitations in providing GOS. Through collaborative efforts, different stakeholders can contribute according to their respective duties and functions, allowing the development of green spaces in a more efficient and sustainable manner. Third, the availability of green regulations provides clear guidelines on permissible and non-permissible actions. These regulations serve as a benchmark for all parties and ensure compliance with sustainable city development goals. When well-defined green regulations are in place, the fulfillment of GOS becomes more achievable. Fourth, community participation is a key factor in urban development, as government resources alone are insufficient to tackle all urban challenges. Given their dual role as both the object and subject of development, the community can be actively engaged in creating a comfortable and livable city by contributing to urban greening efforts. Even in areas where large spaces are unavailable, small-scale solutions such as roof gardens or vertical gardens can be implemented to enhance greenery. Lastly, private sector involvement is critical, as businesses and industries play a significant role in land conversion. While they utilize land for various purposes such as construction, trade, and residential development, they also tend to comply with regulations, particularly when incentives and penalties are in place. Moreover, private entities often allocate budgets for Corporate Social Responsibility (CSR) initiatives, which can be leveraged to support GOS development. Establishing clear policies on private sector contributions to urban green spaces would further enhance their participation in sustainable city planning.

Many companies also has concern in sustainability, especially company that has go public. It is because apart from preserving the environment, they also need to develop a good image in the shareholders and society perception. If CSR is well managed, given space and directed, CSR will be a strength in providing green open space. It should be mananged

so there's no overlap or untouched areas. Here, the government should to make program proposals that can be offered to the private sector. Furthermore, providing rewards in the form of tax reductions to companies that hand over responsibility for public facilities to the government. It is hoped that this will encourage companies to immediately organize and carry out their obligations to hand over public land to increase the area of green open space.

3.3 Best practice for increasing open green space area

Based on the comparison of the three big cities and the AHP calculation, a concept for fulfilling green open space can be formulated. First, leaders and political actors must have a sustainable development vision, from mayors to department heads and political representatives, ensuring their commitment to achieving GOS targets. Second, stakeholder collaboration is crucial, requiring joint planning, clear task distribution, and shared budgeting among stakeholders. Third, the availability of green regulations is essential, including incorporating GOS into urban design and strategic plans like RPJPD, RPJMD, and strategic targets, supported by a roadmap for uninterrupted green space and policies for ecosystem restoration. Fourth, community participation should be encouraged through programs like tree planting campaigns, green and clean neighborhood initiatives, and citizen-led tree planting movements. Lastly, private sector involvement can be enhanced by maximizing CSR programs and introducing incentives and disincentives to support GOS development. This comprehensive approach ensures a sustainable and collaborative effort toward fulfilling GOS.

4. Conclusions

Providing Green Open Space can be done by optimizing space utilization policies in each city government. The area-wide approach is the best approach to use in achieving 30% green open space fulfillment. The selection of three large cities in Indonesia, namely Jakarta, Surabaya and Samarinda, was based on considerations of similar geographical locations, and as provincial capitals. Fulfilling green open space in big cities has various problems, including economic problems, technical problems and policy problems. Currently, both at the national and city levels, there are regulations regarding the fulfillment of green open space, but these regulations are still unable to spur city governments to achieve the targets that have been set.

From the AHP calculations, Green Open Space providing policy can be arranged based on priorities, namely: commitment of leaders and political actors; stakeholder collaboration; availability of green regulations; community participation; and private sector involvement. This order can be used as a reference for urban governments that have limited budgets and resources in proposing strategies, programs and development activities in fulfilling GOS. This takes into account the environmental, social and economic aspects of society. The city of Samarinda with a low population density will find it easier to achieve the 30% target, compared to Surabaya and Jakarta with a higher density level. Heterogeneous community factors also influence the implementation of policies to achieve green open space needs. Efforts to realize 30% green open space require commitment from the community and the commitment of policy makers. These two factors are the basic capital in fulfilling open space efficiently so that sustainable urban development can be achieved.

Acknowledgement

The authors would like to express our sincere gratitude to the editorial team and reviewers for their invaluable contributions in evaluating and reviewing this scientific article. Their insightful comments, constructive feedback, and meticulous assessment have significantly enhanced the quality and rigor of this work.

Author Contribution
Conceptualization, H.M. and Y.M.M.; Methodology, Y.M.; Software, H.M. and Y.M.M.; Validation, H.M. and Y.M.M.; Formal Analysis, H.M. and Y.M.M.; Visualization, H.M. and Y.M.M.

Funding
This research did not receive funding from anywhere.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The authors declare no conflict of interest.

References
Alberti, M., & Marzluff, J. M. (2004). Ecological resilience in urban ecosystems: Linking urban patterns to human and ecological functions. *Urban Ecosystems, 7*(3), 241–265. https://doi.org/10.1023/B:UECO.0000044038.90173.c6

Andriani, S. Waryono T., dan Thayib, M. H (2014). Identifikasi kawasan pejuang pemenuhan target ruang terbuka hijau 30% di DKI Jakarta. *Bumi Lestari, 14*(2). https://ojs.unud.ac.id/index.php/blje/article/view/18386/11908

Anguluri, R., & Narayanan, P. (2017). Role of green space in urban planning: Outlook towards smart cities. *Urban Forestry & Urban Greening*, 25, 58–65. https://doi.org/10.1016/j.ufug.2017.04.007

BPK RI. (2007). *Republic of Indonesia Law Number 26 of 2007.* https://peraturan.bpk.go.id/details/39908/uu-no-26-tahun-2007

BPK RI. (2021). *Rencana Pembangunan Jangka Menengah Daerah (RPJMD) Kota Surabaya Tahun 2021-2026.* https://peraturan.bpk.go.id/Details/193589/perda-kota-surabaya-no-4-tahun-2021

BPK RI. (2022). *Peraturan Menteri Agraria dan Tata Ruang/Kepala Badan Pertanahan Nasional Republik Indonesia Nomor 14 Tahun 2022 tentang Penyediaan dan Pemanfaatan Ruang Terbuka Hijau*. https://peraturan.bpk.go.id/Details/255207/permen-agrariakepala-bpn-no-14-tahun-2022

BPK RI. (2022). *Regulation of the Governor of DKI Jakarta Province Number 31 of 2022 concerning the detailed spatial planning (RDTR) or zoning of Jakarta 2022.*

https://peraturan.bpk.go.id/Home/Details/228166/pergub-prov-dki-jakarta-no-31-tahun-2022

BPS. (2022a). *Jakarta dalam Angka*. BPS Provinsi DKI Jakarta. https://jakarta.bps.go.id/id/publication/2022/02/25/5979600247867d861a1f334c/provinsi-dki-jakarta-dalam-angka-2022.html

BPS. (2022b). *Samarinda dalam Angka.* BPS Kota Samarinda. https://samarindakota.bps.go.id/id/publication/2022/02/25/9bccd10b81b1be9b0637bf8e/kota-samarinda-dalam-angka-2022.html

BPS. (2022c). *Surabaya dalam Angka.* BPS Kota Surabaya. https://surabayakota.bps.go.id/id/publication/2022/02/25/e65b36a5a3abccf19e24dd79/kota-surabaya-dalam-angka-2022.html

Budiman, A., Sulistyantara, B., & Zain, A. F. (2014). Deteksi perubahan ruang terbuka hijau pada 5 kota besar di Pulau Jawa (Studi kasus: DKI Jakarta, Kota Bandung, Kota Semarang, Kota Jogjakarta, dan Kota Surabaya). *Jurnal Lanskap Indonesia*, *6*(1), 7-15. https://doi.org/10.29244/JLI.2014.6.1.7-15

Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and urban planning,* 68(1), 129-138. https://doi.org/10.1016/j.landurbplan.2003.08.003

Ernawati, R. (2015). Optimalisasi fungsi ekologis ruang terbuka hijau publik di Kota Surabaya. *EMARA Indonesian Journal of Architecture*, *1*(2), 60-68. https://doi.org/10.29080/emara.v1i2.8

Faradilla, R. F., Lee, G., Rawal, A., Hutomo, T., Stenzel, M. H., & Arcot, J. (2016). Nanocellulose characteristics from the inner and outer layer of banana pseudo-stem prepared by TEMPO-mediated oxidation. *Cellulose*, *23*, 3023-3037. https://doi.org/10.1007/s10570-016-1025-8

Groot, J. (2012). *State-of-health estimation of li-ion batteries: Cycle life test methods*. Chalmers Tekniska Hogskola (Sweden).

Haq, S. M. A. (2011). Urban green spaces and an integrative approach to sustainable environment. *Journal of environmental protection*, *2*(5), 601-608. http://dx.doi.org/10.4236/jep.2011.25069

Hernandez, Pallagst, & Wielgolaska (2023). Urban green spaces as a component of an ecosystem. *Sustainable Development and Envinmental Stewardship,* 165-198. https://doi.org/10.1007/978-3-031-28885-2_8

Kusumaningrum, R. (2006). Perancangan model pendukung keputusan untuk penentuan lokasi industri berdasarkan proses hierarki analitik. *Jurnal Matematika*, *9*(1), 139-143. http://eprints.undip.ac.id/2340/1/4_Retno.pdf

Lagioia, G., Spinelli, M. P., & Amicarelli, V. (2023). Blue and green hydrogen energy to meet European Union decarbonisation objectives. An overview of perspectives and the current state of affairs. *International Journal of Hydrogen Energy*, *48*(4), 1304-1322. https://doi.org/10.1016/j.ijhydene.2022.10.044

Li, X., Stringer, L. C., & Dallimer, M. (2021). The Spatial and Temporal Characteristics of Urban Heat Island Intensity: Implications for East Africa's Urban Development. *Climate*, *9*(4), 51. https://doi.org/10.3390/cli9040051

Miller, G.T., Spoolman, S.E. (2012). *Environmental Science Fifteenth Edition.* Cengage Learnong Boston.

Miller, R.W. (1988). *Urban forestry: Planning and managing urban green spaces.* Englewood Cliffs, N.J.

Novianty, R., Neolaka, A., & Rahmayanti, H. (2012). Evaluasi mengenai kuantitas dan kualitas ruang terbuka hijau di wilayah dki jakarta. *Menara: Jurnal Teknik Sipil*, *7*(1), 26-26. https://doi.org/10.21009/jmenara.v7i1.7950

Parris, K. M. (2016*). Ecology of urban environment*. John Wiley & Sons Ltd.

Prakoso, P., & Herdiansyah, H. (2019). Analisis implementasi 30% ruang terbuka hijau di DKI Jakarta. *Majalah Ilmiah Globe*, *21*(1), 17-26. http://dx.doi.org/10.24895/MIG.2019.21-1.869

Prihandono, A. (2010). Penyediaan ruang terbuka hijau (RTH) menurut UU No. 26/2007 tentang penataan ruang dan fenomena kebijakan penyediaan RTH di daerah. *Jurnal Permukiman*, *5*(1), 13–23. https://doi.org/10.31815/jp.2010.5.13-23

Rahmadi, M. H. (2017). Survey kenyamanan dan keamanan ruang terbuka hijau (RTH) publik di Kota Samarinda. *Jurnal Ilmu Administrasi: Media Pengembangan Ilmu Dan Praktek Administrasi*, *14*(1). https://doi.org/10.31113/jia.v14i1.11

Rushayati, S. B., Prasetyo, L. B., Puspaningsih, N., & Rachmawati, E. (2016). Adaptation strategy toward urban heat island at tropical urban area. *Procedia Environmental Sciences*, *33*, 221-229. https://doi.org/10.1016/j.proenv.2016.03.073

Saaty, T.L. (1980). *The analytical hierarchy process planning.* McGraw-Hill International Book Company.

Safitri, R., Marzuki, M., & Syafii, M. A. (2023, September). Effect of land cover change and deforestation around maninjau lake on rainfall and surface temperature. In *Journal of Physics: Conference Series* (Vol. 2582, No. 1, p. 012019). IOP Publishing. https://doi.org/10.1088/1742-6596/2582/1/012019

Santoso, E., Rahmadanita, A., & Ryandana, M. (2022). Ruang terbuka hijau di kota Samarinda: Pencapaian, permasalahan dan upayanya. *Jurnal Ilmu Pemerintahan Widya Praja*, *48*(1), 103-126. https://doi.org/10.33701/jipwp.v48i1.2828

Shirvani (1985). *The urban design.* Van Nostrand Reinhold Company.

Silas, J. (2014). *Ruang terbuka hijau Surabaya menuju metropolitan yang cerdas, manusiawi dan ekologis.* Badan Perencanaan Pembangunan Kota.

Simond (1985). *Landscape architecture building sites-planning.* McGraw-Hill.

Ulfa, M., Sulistiyono, N., Fadhilla, S., Tumangger, N., Gultom, A. N., & Saragih, R. H. (2024, May). The low diversity of vegetation seedling and sapling threatening the tree existence at the university green space of Universitas Sumatera Utara, Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1352, No. 1, p. 012055). IOP Publishing. https://doi.org/10.1088/1755-1315/1352/1/012055

Wahyudi, T. (2014). Tinjauan yuridis mengenai ruang terbuka hijau di Kota Samarinda berdasarkan undang-undang nomor 26 tahun 2007 tentang penataan ruang. *Journal of Law (Jurnal Ilmu Hukum)*, *3*(2), 69-88. http://ejurnal.untag-smd.ac.id/index.php/DD/article/view/824

Biographies of Authors

Herlina Merinda, School of Environmental Science, Universitas Indonesia, Central Jakarta City, 10430, Indonesia.

- Email: herlina.merinda@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Yekti Mei Mahanani, School of Environmental Science, Universitas Indonesia, Central Jakarta City, 10430, Indonesia.

- Email: yekti.mei@ui.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A