Sustainability Strategy for Urban Development Through the Optimization of Green Open Spaces and Spatial Interaction Patterns in the Urban Activity System

M. Almuttaqin
e-mail: taqin.arch04@gmail.com
Abdi Sugiarto
e-mail: abdisugiarto@dosen.pancabudi.ac.id

Universitas Pembangunan Panca Budi, Indonesia

ABSTRACT
Sustainable urban development requires optimal planning and management of Green Open Spaces (GOS) to deliver ecological, social, and economic benefits to the community. This study aims to analyze strategies for optimizing GOS to support sustainable urban development in Binjai City using a qualitative approach and SWOT analysis method. Primary data were collected through field observations, in-depth interviews, and focus group discussions (FGDs) with relevant stakeholders. The findings reveal that the availability of GOS in Binjai City is unevenly distributed, with concentrations in certain sub-districts. The quality and maintenance of GOS face challenges due to budget limitations and low community participation in management efforts. Community interaction with GOS primarily revolves around sports and recreational activities, yet remains limited to areas with adequate facilities. While GOS management policies are in place, their implementation is hindered by weak supervision and financial constraints. Based on the SWOT analysis, proposed strategies include improving accessibility and equitable distribution of GOS, increasing maintenance budgets, strengthening regulations, and enhancing community and private sector engagement in GOS management. These strategies are expected to enable GOS in Binjai City to contribute more significantly to a greener, healthier, and more sustainable urban activity system.

Keywords: *Green Open Space, Sustainable Development, SWOT Analysis*

Introduction

Sustainable urban development has become a major challenge in many cities across Indonesia, including Binjai City. Rapid urbanization and population growth have placed significant pressure on the environment, particularly in terms of the provision of Green Open Spaces (GOS). GOS play a crucial role in maintaining the urban ecological balance, mitigating the effects of global warming, and improving the quality of life for residents (Sugiarto et al., 2023). However, in recent years, the availability and optimization of GOS in many cities have declined due to development pressures that prioritize economic interests over environmental considerations (Yusuf, 2023).

This phenomenon is also evident in Binjai City, where the expansion of residential and commercial areas has reduced the proportion of ideal GOS. Previous studies indicate that limited GOS can lead to decreased air quality, increased urban temperatures, and reduced groundwater absorption capacity, which may result in flooding in certain areas (Novianti, 2023). In addition, social interaction among residents in public spaces has also become more limited due to the lack of accessible green areas (Mahipal, 2024).

At the national level, studies have shown that effective GOS management contributes to environmental quality and social well-being. For instance, research in Serang City highlights the importance of GOS management that integrates not only ecological but also social and economic aspects to enhance the city's capacity to accommodate population growth (Nuraini, 2021; Nuraini et al., 2023); Yusuf, 2023. Similarly, in Gowa Regency, research has demonstrated that local government participation in GOS management can create a healthier and more comfortable environment for residents (Amin, 2022).

International studies also affirm that effective GOS management improves the spatial interaction systems within cities (Meka Hasianta & Sugiarto, 2024; Purba et al., 2024). A study in Bogor found that increased GOS availability supports the emergence of healthier and more productive community activity patterns (Mahipal, 2024). In Pontianak City, another study revealed that imbalanced GOS allocation leads to unequal access among communities, necessitating more effective optimization strategies to support sustainable urban development (Novianti, 2023).

Although GOS is still available in several areas of Binjai City, its use has not been fully optimized and faces various planning and management challenges. Therefore, an in-depth study is needed to examine strategies for optimizing GOS and the patterns of spatial interaction among residents within the urban activity system, to support sustainable urban development.

Literature Review

A. Sustainable Urban Development

Sustainable urban development is an approach that integrates economic, social, and environmental aspects into the planning and management of cities. Its aim is to create a balance between economic growth, social welfare, and environmental conservation in order to meet the needs of the present generation without compromising the ability of future generations to meet their own needs (Aini et al., 2023; Linda et al., 2024). This concept emphasizes the importance of resource efficiency, emission reduction, quality of life improvement, and community participation in decision-making processes.

B. Green Open Space (GOS)

Green Open Space (GOS) refers to areas or corridors within urban environments that are predominantly covered by vegetation, whether naturally occurring or deliberately planted. These spaces serve as the "lungs" of the city, functioning as water absorption areas as well as recreational and social interaction zones for the community. According to Law No. 26 of 2007 on Spatial Planning, urban areas are required to allocate a minimum of 30% of their total land area for GOS, comprising 20% public and 10% private spaces. GOS performs multiple roles, including ecological, aesthetic, socio-cultural, and economic functions. Ecologically, GOS improves air quality, reduces ambient temperatures, and provides habitats for flora and fauna. Aesthetically, it enhances the urban landscape and offers visual comfort (Nasution Hasyim & Sugiarto, 2024; Nuraini, 2017, 2019). From a socio-cultural perspective, GOS provides venues for public interaction and community activities and supports cultural and educational events. Economically, it can increase surrounding property values and contribute to the growth of the tourism sector.

The optimization of GOS within the context of sustainable urban development involves efforts to improve both the quality and quantity of GOS so that it can fulfill its intended functions effectively. This process requires proper planning, efficient management, and active participation from the public and various stakeholders. Strategies for GOS optimization may include expanding the area of green spaces, improving accessibility and user comfort, and integrating GOS with other urban elements such as transportation networks and residential areas. A study conducted in Sidoarjo District highlighted that the effectiveness of GOS optimization strategies depends on the specific characteristics of the green spaces, the needs of the community, and the various factors influencing their utilization.

C. Spatial Interaction within the Urban Activity System

Spatial interaction refers to the condition of mutual influence and interdependence between two or more areas, manifested in the movement of people, goods, information, or energy. In urban contexts, spatial interaction encompasses relationships among various urban components such as business centers, residential areas, public facilities, and GOS. These interactions shape community activity patterns and influence the social, economic, and environmental dynamics of cities.

D. Urban Structure Theories

To understand spatial interaction patterns in cities, several urban structure theories have been proposed, including:

a. Concentric Zone Theory (Ernest W. Burgess): Cities grow outward from the center in concentric rings, each with a distinct function.
b. Sector Theory (Homer Hoyt): Cities develop in sectors radiating out from the central business district, typically along transportation corridors or geographical features.
c. Multiple Nuclei Theory (Harris and Ullman): Cities consist of multiple centers of activity (nuclei), each serving specific functions such as business, industry, or commerce.

Understanding these theories is essential for analyzing how GOS can be integrated into the urban structure and how spatial interaction patterns are influenced by the distribution and accessibility of GOS.

E. The Relationship between GOS and Spatial Interaction in Sustainable Development

GOS plays a key role in shaping spatial interaction patterns in cities. Strategically located and easily accessible GOS can promote social, recreational, and cultural activities, thus enhancing residents' quality of life. Furthermore, GOS functions as a connecting element between various urban components, such as residential areas, business centers, and public amenities, thereby supporting mobility and interaction among citizens.

In the context of sustainable development, integrating GOS into urban planning can help mitigate the negative impacts of urbanization, including air pollution, flooding, and environmental degradation. It also contributes to the creation of more inclusive, safe, resilient, and sustainable cities.

By understanding these concepts, this study aims to analyze how GOS optimization and spatial interaction patterns can be applied to support sustainable urban development in Binjai City.

Methodology

Research Approach and Type

This study employs a qualitative approach using the SWOT analysis method to explore strategies for optimizing Green Open Space (GOS) in support of sustainable urban development in Binjai City. A qualitative approach is selected because the research focuses on gaining in-depth understanding of the existing conditions of GOS, spatial interaction patterns within the community, and the factors influencing the management and utilization of GOS in the urban activity system.

SWOT analysis is applied to identify the strengths and weaknesses of GOS in Binjai City, as well as the opportunities and threats that may affect its optimization within the context of sustainable development. This approach allows the researcher to formulate appropriate strategies based on an analysis of internal and external conditions.

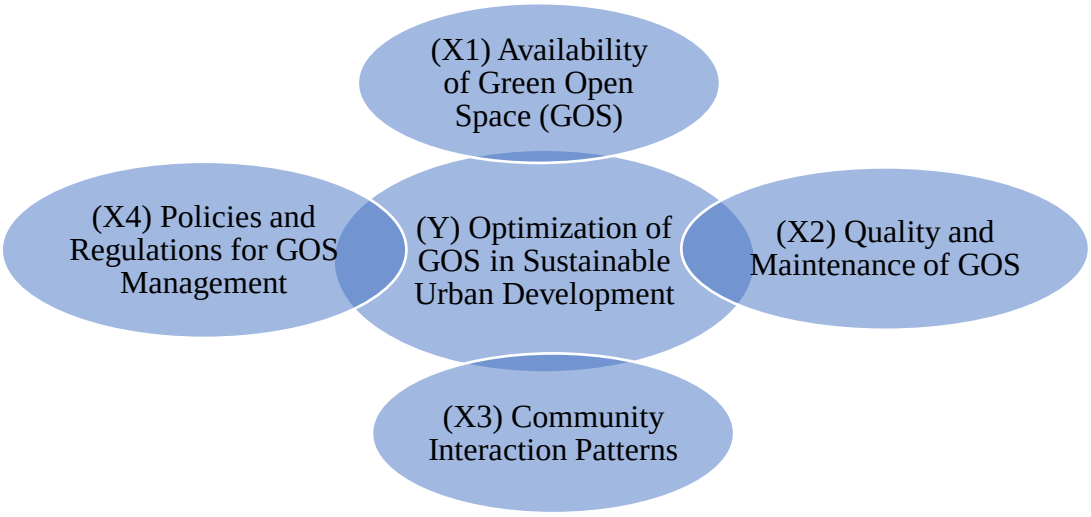

Figure 1. Conceptual Framework of the Study
Source: Author's Analysis, 2025

This framework illustrates that sustainable urban development is significantly influenced by the availability, quality, community interaction patterns, and policy

management of GOS. Therefore, SWOT analysis will be employed to formulate appropriate strategies to optimize the use of GOS.

Results & Discussion

A. Availability of Green Open Space (X1)

a. Area and Distribution of GOS
Based on field observations and data obtained from the Binjai City Environmental Agency, the total area of Green Open Space (GOS) in the city amounts to 520 hectares, consisting of both public and private GOS. The distribution is uneven, with the largest concentrations located in Binjai Utara and Binjai Selatan sub-districts, while other sub-districts have limited GOS coverage.

b. Accessibility of GOS
Observation results indicate that GOS accessibility varies. Some urban parks are well-accessible, equipped with supporting infrastructure such as pedestrian paths and parking areas. However, some GOS locations are difficult to reach due to inadequate infrastructure.

c. Land Utilization of GOS
Interviews with local residents reveal that some GOS areas are utilized for sports, recreation, and community events. Nevertheless, there are also GOS plots that are underutilized and appear neglected.

B. Quality and Maintenance of GOS (X2)

a. Vegetation and Environmental Condition
Interviews with local residents reveal that some GOS areas are utilized for sports, recreation, and community events. Nevertheless, there are also GOS plots that are underutilized and appear neglected.

b. Supporting Infrastructure
Amenities such as park benches, lighting, and children's play areas are available in some GOS locations but are not evenly distributed. Some facilities are also damaged and in need of repair.

c. Maintenance Efforts
Interviews with GOS management personnel indicate that regular maintenance is conducted, but efforts are constrained by limited budget and human resources. Community participation in maintenance remains minimal.

C. Community Interaction Patterns with GOS (X3)

a. Frequency and Types of Activities
Focus group discussions (FGDs) with community representatives show that GOS is used for various activities such as morning exercise, family picnics, and community events. However, usage frequency declines during the rainy season and when GOS conditions are poorly maintained.

b. Persepsi Community Perceptions of GOS
Interviews with residents reveal that most respondents consider GOS important for quality of life, although they feel that the available facilities are inadequate. Some residents are also unaware of the ecological benefits of GOS.

c. Participation in Management
Community participation in GOS management remains low. While there are some community-led initiatives to keep GOS clean, these efforts are not yet well-coordinated with local government authorities.

D. Policies and Regulations on GOS Management (X4)

a. Local Government Policies
Policy document analysis indicates that Binjai City's government has regulations concerning GOS management, but their implementation has not been optimal. Some policies have not been adequately socialized to the public.

b. Implementation and Oversight
Interviews with relevant officials suggest that oversight of GOS utilization remains weak. There have been instances of land-use conversion from GOS to commercial areas without clear authorization.

c. Budgetary Support
Information from the Environmental Agency states that the budget for GOS management is limited, which affects the quality of maintenance and the development of supporting facilities.

E. SWOT Analysis

Based on the findings presented above, a SWOT analysis was conducted to identify internal and external factors influencing the optimization of Green Open Space (GOS) in Binjai City.

1. Internal Factors

a. **Strengths:**
1). Several GOS areas are well-equipped and well-maintained.
2). A portion of the community is aware of the importance of GOS.

b. **Weaknesses:**
1). Uneven distribution of GOS across districts.
2). Inconsistent quality of GOS maintenance.
3). Low community participation in GOS management.

2. Eksternal Facyors

a. **Opportunities:**
1). Potential collaboration with community groups and the private sector for GOS development.
2). Support from national policies aimed at increasing urban GOS coverage.

b. **Threats:**
1). Pressure to convert GOS land into commercial use.
2). Limited government budget for GOS maintenance.

F. SWOT Matrix

The following matrix outlines the strategies derived from the combination of internal and external factors:

Table 1. SWOT Matrix of the Study

Internal Factors	**External Factors**
Strengths (S):	Opportunities (O):
- Some GOS areas are well-equipped and well-maintained.	- Potential collaboration with community and private sector.
- Public awareness of GOS importance.	- National policy support for GOS development.
Weaknesses (W): Threats (T):	**Weaknesses (W): Threats (T):**
- Uneven distribution of GOS	- Pressure for land conversion to commercial use.
- Inconsistent maintenance quality.	- Limited government maintenance budget.
- Low community participation.	

Source: Author's Research Findings, 2025

Discussion

The research findings reveal that the total area of Green Open Space (GOS) in Binjai City amounts to 520 hectares, with uneven distribution. The sub-districts of Binjai Utara and Binjai Selatan have the largest GOS areas compared to other sub-districts. These findings are consistent with research by Sugiyanto and Sitohang (2017) in Ayodia Park, South Jakarta, which found that unequal GOS distribution affects accessibility and utilization by the public. Similarly, Najikh (2017) in Sidoarjo District also identified uneven distribution as a source of imbalance in public space utilization. Research in Jambangan District, Surabaya, likewise found that suboptimal GOS distribution impacts urban environmental quality. In contrast, a study in Bekasi Regency showed that although GOS distribution had not reached the ideal proportion, optimization efforts through partnerships with private entities successfully increased GOS availability. Additionally, research in Pangkajene City demonstrated that, with proper planning, GOS distribution can be optimized even with limited land area.

The varying accessibility of GOS in Binjai City is influenced by infrastructure conditions and geographic location. Research in Ayodia Park showed that good accessibility increases visitation frequency. Similarly, a study in Sidoarjo emphasized that accessibility is crucial in GOS planning to ensure equitable reach across all social groups. However, research in Bandung found that even with adequate accessibility, public participation in GOS utilization remained low due to limited awareness and lack of community-engaging programs. Research in Palembang also highlighted challenges in providing accessibility for people with disabilities, indicating a need for more inclusive GOS design.

GOS utilization in Binjai City varies, with some areas underutilized. Research in Ayodia Park revealed that a lack of supporting facilities and activity programs hampers optimal use. In Sidoarjo, the importance of public participation in planning and managing GOS was underscored as a way to enhance usage. Contrarily, in Bekasi Regency, partnerships between government and private sectors helped improve utilization through user-centered facilities. Pangkajene's case further emphasized that participatory approaches can enhance GOS use even under limited resources.

Regarding vegetation and environmental conditions, some GOS areas in Binjai City were found to have poorly maintained vegetation. The Ayodia Park study similarly reported that inadequate maintenance lowers environmental quality. Research in Sidoarjo emphasized the necessity of regular upkeep to sustain ecological and aesthetic functions. However, in Bogor, active community involvement was shown to improve GOS quality despite budget constraints. Palembang's findings further added that inclusive design enhances environmental quality and user inclusiveness. The lack of supporting infrastructure in some areas of Binjai's GOS aligns with the Ayodia case, where poor facilities discouraged public visits.

Conclusion

Based on the research conducted, it can be concluded that the availability of Green Open Space (GOS) in Binjai City remains uneven, with the largest concentration located in Binjai Utara and Binjai Selatan sub-districts. Other sub-districts have limited green space, affecting accessibility and utilization. The quality and maintenance of GOS show significant variation, with some areas having well-maintained vegetation while others face maintenance challenges due to budget constraints and limited public participation. Supporting infrastructure remains inadequate in many locations, where amenities such as lighting, benches, and children's playgrounds are still lacking, limiting the optimal use of GOS.

Community interaction patterns with GOS in Binjai City show that most green spaces are used for sports, family recreation, and community events. However, usage frequency remains low in areas with limited accessibility and infrastructure. Public participation in GOS management is still minimal, as most residents consider maintenance to be the government's responsibility, with only a few actively involved in maintenance and improvement efforts. Although GOS-related policies and regulations exist, their implementation remains suboptimal due to weak oversight and insufficient budget allocation, and cases of unauthorized land conversion to commercial use still occur.

To address these issues, the Binjai City government should prioritize the equitable distribution of GOS by allocating more land for green spaces in under-served sub-districts and strengthening policies to protect GOS from land-use change. In terms of maintenance, budget increases and improved management systems are necessary to ensure the upkeep of vegetation and infrastructure. To enhance community involvement, environmental awareness campaigns and education programs should be actively promoted, alongside the formation of community-based GOS stewardship groups involving diverse stakeholders.

Optimization efforts should also focus on adding user-oriented supporting facilities, such as pedestrian paths, sports zones, and children's playgrounds, to boost GOS appeal and utilization. The government should reinforce monitoring mechanisms for GOS policies through stricter zoning regulations and transparent budgeting for development and maintenance. Collaborations with private sectors and local communities can serve as effective strategies for sustainable GOS management, such as adopting parks or joint facility management programs to ease the burden on public resources.

With these strategic steps, Green Open Spaces in Binjai City can be managed more effectively and sustainably, delivering greater environmental and social benefits while supporting greener, healthier, and more sustainable urban development in the future.

References

[1] Aini, C. N., Azizah, Q., & Muharrani, S. (2023). ARAHAN PELESTARIAN TATA RUANG PERMUKIMAN MASYARAKAT ETNIS MANDAILING DI SUMATERA UTARA. *NALARs*, *23*(1), 1. https://doi.org/10.24853/nalars.23.1.1-16

[2] Amin, B. (2022). Pengelolaan Ruang Terbuka Hijau oleh Dinas Lingkungan Hidup Kabupaten Gowa. Jurnal KIMAP, 5(4), 814-822.

[3] Angestiwi, T., & Wahyuniati, F. (2022). Analisis Kualitas Ruang Terbuka Hijau Taman Monumen Perjuangan Rakyat Jawa Barat. Jurnal Kajian Ruang, 2(2), 195-207.

[4] Fauzan, MC, & Sari, DR (2022). Analisis Kesenjangan Distribusi Ruang Terbuka Hijau Pelayanan Tingkat Kota dan Kecamatan dari Sisi Aksesibilitas dengan Metode Space Syntax (Studi Kasus: Kota Bandung). Reka Lingkungan, 186-200.

[5] Ghozali, A., & Edinita, DC (2021). Arahan Peningkatan Kualitas Ruang Terbuka Hijau Publik Berdasarkan Persepsi Masyarakat di Kecamatan Samarinda Seberang, Kota Samarinda. Jurnal Pembangunan Wilayah dan Kota, 17(4), 444-456.

[6] Girardet, H. (2021). Menciptakan Kota Berkelanjutan. Schumacher Briefings, Edisi ke-2.

[7] Linda, N., Andiyan, A., Nuraini, C., Milanie, F., & Novalinda, N. (2024). Characteristics and Gender Interaction Patterns of the Mandailing Natal Community in the Housing Area of Sorik Marapi Sub-District: A Case Study of Sibanggor Julu Village 186 JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH Characteristics and Gender Interaction Patterns of the Mandailing Natal Community in the Housing Area of Sorik Marapi Sub-District: A Case Study of Sibanggor Julu Village. *Article in Journal of International Crisis and Risk Communication Research*. https://www.researchgate.net/publication/386344996

[8] Mahipal, R. (2024). Upaya Meningkatkan Ruang Terbuka Hijau Pada Kawasan Bogor. Jurnal Internasional Ilmu Islam dan Sosial, 5(2), 1906-1912.

[9] Meka Hasianta, A., & Sugiarto, A. (2024). *The Role of Transportation in the Development of Medan Urban Areas a Study of Infrastructure and Mobility Patterns*. *1 No 1*. http://creativecommons.org/licenses/by-sa/4.0/

[10] Najikh, A. (2017). Evaluasi Kualitas Ruang Terbuka Hijau di Kecamatan Sidoarjo. Jurnal Tata Kota dan Lingkungan, 6(1), 45-55.

[11] Nasution Hasyim, N., & Sugiarto, A. (2024). The Role Of The Binjai Tavip Market As A Distribution Center For Local Agricultural Products In Binjai, North Sumatra. *International Conference in Artificial Intelligence, Navigation, Engineering and Aviation Technology (ICANEAT)*, *1*, 576–580. http://creativecommons.org/licenses/by-sa/4.0/

[12] Novianti, R. (2023). Analisis Kebutuhan Ruang Terbuka Hijau Publik Berdasarkan Luas Wilayah Kota Pontianak. Jurnal Mahasiswa Teknik Sipil, 1(1), 1-10.

[13] Novianti, R., Rahmayanti, H., & Neolaka, A. (2012). Evaluasi Mengenai Kuantitas dan Kualitas Ruang Terbuka Hijau di Wilayah DKI Jakarta. Jurnal Menara Jurusan Teknik Sipil FT.UNJ, 7(1), 100-112.

[14] Nuraini, C. (2017). ROOM ARRANGEMENT CONCEPT: THE SACRED-PROFANE OF HEIRLOOM HOUSES IN HUTAGODANG VILLAGE, MANDAILING. *International Journal on Livable Space*, *2*(2), 109–118. https://doi.org/10.25105/livas.v2i2.4820
[15] Nuraini, C. (2019). Morphology of residential environment of Singengu village in Mandailing Julu, North Sumatra. *Journal of Regional and City Planning*, *30*(3), 241–260. https://doi.org/10.5614/jpwk.2019.30.3.5
[16] Nuraini, C. (2021). *KARAKTER LINGKUNGAN PERUMAHAN BERBASIS SPACE ATTACHMENT YANG ADAPTIF DAN RESPONSIF DI MANDAILING*. https://jurnal.umj.ac.id/index.php/nalars/article/view/8035/4962
[17] Nuraini, C., Alamsyah, B., Novalinda, Sagala, P., & Sugiarto, A. (2023). Planning With 'Three-World Structures': A Comparative Study of Settlements in Mountain Villages. *Journal of Regional and City Planning*, *34*(1), 55–82. https://doi.org/10.5614/jpwk.2023.34.1.4
[18] Purba, B. M., Sugiarto, A., Dian, R., & Kurniawan, H. (2024). KAJIAN PEMANFAATAN RUANG TERHADAP SISTEM TRANSPORTASI PADA KAWASAN PERKOTAAN BATANG KUIS. *Jurnal Darma Agung*, *32*(4), 188–199. https://doi.org/10.46930/ojsuda.v32i4.4621
[19] Sari, DR (2020). Analisis Kesenjangan Distribusi Ruang Terbuka Hijau Pelayanan Tingkat Kota dan Kecamatan dari Sisi Aksesibilitas dengan Metode Space Syntax (Studi Kasus: Kota Bandung). Reka Lingkungan , 186-199.
[20] Sugiarto, A., Manalu, S. P. R., & Pakpahan, E. (2023). Pengaruh Jumlah Kunjungan Wisatawan Dan Pajak Restoran Terhadap Pertumbuhan Ekonomi Kabupaten Tapanuli Utara Dengan PAD Sebagai Variabel Intervening. *Jesya*, *6*(1), 221–232. https://doi.org/10.36778/jesya.v6i1.903
[21] Sugiyanto, D., & Sitohang, S. (2017). Analisis Persebaran Ruang Terbuka Hijau di Jakarta Selatan. Jurnal Populis, 9(2), 55-65.
[22] Yusuf, M. (2023). Strategi Pengelolaan Ruang Terbuka Hijau di Kota Serang. Jurnal Kajian Pemerintahan Daerah , 5(1), 1-15.