Availability & Quality of Public Open Spaces (POS) in the Medan–Deli Serdang Border Area

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Abstract

The Medan–Deli Serdang border area is experiencing high urbanization pressure, making the availability and quality of Public Open Spaces (POS) crucial for public health, social inclusion, and environmental resilience. This study aims to assess the adequacy of POS in terms of quantity (coverage, distribution, and accessibility) and quality (comfort, safety, facilities, and ecological value), while also mapping the enabling and hindering factors in cross-administrative management. A descriptive–quantitative approach was employed, supported by a Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis. Availability audits were conducted by calculating POS area per capita (square meters per person), spatial distribution analysis using Geographic Information System (GIS) with 400–800 meter pedestrian buffers and network analysis, and typology classification such as neighborhood parks, city parks, river corridors, and town squares. Quality audits used a composite index encompassing accessibility, thermal comfort and vegetation, safety, facilities, maintenance, and ecology, based on field surveys and user assessments.

The results indicate spatial disparities: several densely populated settlements are more than a 10-minute walk from functional POS, while some green spaces are not connected to the pedestrian network. The per capita area ratio and service coverage in several border districts remain below recommended standards, especially in newly growing zones. In terms of quality, median scores fall into the moderate category, with strengths in tree cover along river corridors and active communal spaces, and weaknesses in maintenance, nighttime lighting, universal access, and completeness of play and sports facilities. SWOT analysis identifies opportunities for integrating POS with river corridor rejuvenation programs, developing cycling and pedestrian networks, and strengthening cross-district coordination, but faces threats such as land conversion, governance fragmentation, and roadside parking pressure.

Findings emphasize that the main issues are not only insufficient area but also uneven access and management quality. Priority improvements should focus on enhancing connectivity between POS through green corridors and sidewalks, revitalizing space quality through increased tree shading, lighting, and inclusive facilities, and establishing cross-border coordination mechanisms for planning, funding, and uniform service standards. Overall, strengthening a well-connected, inclusive, and well-maintained POS network is considered more effective than adding new fragmented sites.

Keywords: *Public Open Spaces (POS), Medan–Deli Serdang Border Area, Spatial Accessibility, SWOT Analysis, Spatial Inequality*

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Introduction

Public Open Spaces (POS) are a critical prerequisite for creating healthy, inclusive, and sustainable cities. The availability and quality of POS are directly linked to increased physical activity, mental health, urban heat mitigation, and the strengthening of social cohesion among residents. Several global guidelines emphasize that the benefits of green open spaces are determined not only by their total area but also by their equitable distribution and accessibility. The World Health Organization (WHO) summarizes scientific evidence showing that urban green interventions have wide-ranging impacts on environmental quality and public health [1], while the United Nations Human Settlements Programme (UN-Habitat) highlights the role of public spaces in enhancing quality of life, equality, and urban safety [2]. Beyond quantity, spatial accessibility is an important indicator widely used internationally. Ideally, residents should have access to public green spaces of at least 0.5–1 hectare within approximately 300 meters of their homes, while urban planning literature also recommends a minimum standard of 9 square meters of green space per capita as a measure of equitable provision [3].

In Indonesia, national regulations, through Law Number 26 of 2007 on Spatial Planning and Minister of Public Works Regulation Number 05/PRT/M/2008, stipulate that Green Open Spaces (GOS) must cover at least 30% of a city's area, with a minimum of 20% designated as public green space [4]. However, achieving the target area of green space does not necessarily guarantee the accessibility and quality of POS at the local level, particularly in terms of comfort, safety, facilities, and maintenance. In the Medan–Deli Serdang border area, which is part of the Medan–Binjai–Deli Serdang–Karo (Mebidangro) metropolitan region, rapid urbanization and cross-administrative connectivity create an urgent need for intergovernmental spatial coordination, including the integrated provision and management of POS. Presidential Regulation Number 62 of 2011 on Spatial Planning for the Mebidangro Urban Area designates this region as a center for national strategic activities [5]; however, its implementation on the ground still faces governance fragmentation and disparities in public space service provision across jurisdictions.

The main problems identified in the Medan–Deli Serdang border area include: (1) spatial disparities in POS availability, where some densely populated neighborhoods are more than a 10-minute walk from functional parks or public spaces; (2) uneven quality of POS, particularly in terms of vegetation shading and thermal comfort, nighttime lighting, universal accessibility, and the completeness of play and sports facilities; and (3) weak cross-boundary coordination in planning, funding, and implementing uniform service standards. The gap between the Green Open Space (GOS) proportion target (30%) and the reality of accessibility and quality on the ground increases the risk of inequitable access to public spaces. Proximity standards (≤300 meters) and the principle of a connected public space network, as recommended by the European Environment Agency (EEA), underscore the importance of spatial equity in sustainable urban planning [6].

Based on this background, the objectives of this study are to: (1) measure the availability of POS in the Medan–Deli Serdang border corridor using indicators such as area per capita (square meters per person), service coverage based on Geographic Information System (GIS) through 400–800 meter pedestrian buffers and effective network distances, as well as functional typology of spaces; (2) assess the quality of POS through a composite index encompassing accessibility, thermal comfort and vegetation, safety and lighting, facilities and maintenance, and ecological aspects based on field audits and user evaluations; (3) identify enabling and hindering factors in cross-administrative POS management using a Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis; and (4) formulate strategic recommendations for enhancing a connected, inclusive, and sustainably managed POS network. The framework and assessment instruments of this study refer to the city-scale public space mapping and assessment guidelines developed by UN-Habitat [7].

Literature Review

Literature on urban health emphasizes that the benefits of Public Open Spaces (POS) or green spaces—particularly in promoting physical activity, maintaining mental health, reducing urban heat, and strengthening social cohesion—are strongly influenced by proximity and quality, rather than merely total green area. The World Health Organization (WHO) highlights robust evidence showing that urban green interventions have significant impacts on improving public health and well-being [1]. Meanwhile, the European Environment Agency (EEA) emphasizes spatial and social equity dimensions, noting that unequal distribution of green spaces according to socio-economic conditions can exacerbate disparities in access to environmental benefits [2]. Global meta-analyses even indicate that exposure to green spaces correlates with reduced mortality and lower health risk factors, such as physiological stress and cardiovascular diseases [3].

In urban planning practice, per capita area (m^2 per capita) is often used alongside proximity standards. The Accessible Natural Greenspace Standards (ANGSt) developed by Natural England recommend that every resident should have access to green spaces of at least two hectares within 300 meters of their residence [4]. The latest Green Infrastructure (GI) standards for England introduce a tiered threshold, suggesting 0.5 hectares within 200 meters or two hectares within 300 meters of residential areas. The Fields in Trust program popularizes the "10-minute walk" guideline (approximately 800 meters) as a service radius for urban parks [5]. These three references provide a methodological rationale for using a 400–800 meter radius in pedestrian accessibility audits applied in this study.

Methodologically, measuring green space accessibility should be modeled based on network-based accessibility rather than straight-line (Euclidean) distance. Official ArcGIS Network Analyst documentation explains the creation of service areas as polygons representing walkable travel times [6]. Meanwhile, the open-source platform OpenStreetMap, through the OSMnx library, offers an alternative, transparent approach for generating network-based isochrones [7]. Network-based approaches provide a more realistic depiction of residents' spatial reach to POS compared to straight-line distance calculations.

Observational assessments of public space quality are typically conducted using standardized instruments with good inter-rater reliability. The Environmental Assessment of Public Recreation Spaces (EAPRS) evaluates park amenities and conditions in detail, while the Physical Activity Resource Assessment (PARA) measures physical activity features, facilities, and potential nuisances (incivilities) in a more concise format. The Community Park Audit Tool (CPAT) and Post Occupancy Survey Tool (POST) are widely used for assessing parks based on activities and user perceptions. The Centers for Disease Control and Prevention (CDC), through comparative studies, report that these five audit instruments—BRAT-DO, CPAT, EAPRS, PARA, and POST—exhibit moderate to high inter-rater reliability [8].

Studies on environmental justice highlight disparities in access, size, and quality of public parks based on socio-economic status and ethnicity. This phenomenon has policy implications that call for a "just green enough" approach, aiming to improve green spaces without causing gentrification or new inequities [9]. The EEA emphasizes that disadvantaged groups can gain the greatest health benefits when green space access is equitable [2]. In Indonesia, Law Number 26 of 2007 on Spatial Planning mandates the provision of Green Open Spaces (GOS) covering at least 30% of a city's area, with 20% designated as public [10]. In the Medan–Binjai–Deli Serdang–Karo (Mebidangro) metropolitan region, Presidential Regulation Number 62 of 2011 establishes a cross-regional spatial planning framework relevant to the provision and management of POS. Additionally, UN-Habitat's city-scale public space assessment guidelines provide a framework to operationalize principles of accessibility, inclusivity, and sustainability in urban open space planning [11].

Research Methodology

This study employs a descriptive–quantitative approach combined with a Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis to assess the availability and quality of Public Open Spaces (POS) in the Medan–Deli Serdang border corridor. The units of analysis include POS sites—such as neighborhood parks, city parks, town squares, and river corridors—as well as residential zones within pedestrian service areas.

Spatial data were obtained from local government databases and supplemented with OpenStreetMap (OSM) data under the Open Database License (ODbL) [11], while population data were sourced from the Central Bureau of Statistics (BPS) of Medan City (2025) and Deli Serdang Regency (2024) [15]. National regulations stipulating that Green Open Spaces (GOS) must cover at least 30% of urban areas provide the policy context, and the public space assessment framework follows the guidelines of the United Nations Human Settlements Programme (UN-Habitat) [7].

Quantitative analysis was conducted by calculating the total POS area and per capita area ratio (square meters per person) for each sub-district or village. Spatial accessibility was estimated using a pedestrian network-based service area model (isochrone) of 400–800 meters, corresponding to a 5–10 minute walking time. This proximity standard refers to the Accessible Natural Greenspace Standards (ANGSt) from Natural England [4] and the 10-minute walk benchmark developed by Fields in Trust [9]. Analysis was performed using ArcGIS Network Analyst to generate network-based service area polygons rather than Euclidean distance buffers [10]. POS quality was evaluated using a weighted composite index encompassing five main dimensions: (1) accessibility and connectivity (sidewalk continuity, universal access), (2) thermal comfort and vegetation (tree shading, seating), (3) safety and nighttime lighting, (4) facilities and maintenance, and (5) basic ecological value. Indicators were adapted from UN-Habitat's City-Wide Public Space Assessment and Global Public Space Toolkit [7]. Scores for each dimension were normalized on a 0–1 scale and averaged to form a POS Quality Index, which was then analyzed alongside availability and accessibility indicators to assess overall conditions.

The SWOT analysis was conducted through brief interviews with cross-regional stakeholders—including local government agencies (Organisasi Perangkat Daerah, OPD), sub-district offices, and community groups—to identify strengths, weaknesses, opportunities, and threats in the management of POS across administrative boundaries. This approach follows the methodological guidelines for SWOT developed by Helms and Nixon [14]. The results of the analysis were then integrated with access gap maps (≤300 meters or ≤10 minutes walking distance) and quality scores to establish intervention priorities.

Data validation was carried out through re-examination of a subset of locations from OSM mapping, rapid field surveys, and verification of digitization consistency. All data sources comply with the attribution guidelines "© OpenStreetMap contributors" [11] and use official BPS publications as the latest population reference [15].

Results

This section presents the analysis of the availability, distribution, and quality of Public Open Spaces (POS) in the Medan–Deli Serdang border corridor. The findings are organized into three main categories: (i) quantitative evaluation of POS area and spatial distribution, (ii) physical–functional audits to assess space quality, and (iii) a Strengths–Weaknesses–Opportunities–Threats (SWOT) analysis used to identify enabling and hindering factors in cross-regional POS management. All findings are interpreted comparatively against relevant

standards and literature to formulate strategies for enhancing an inclusive and sustainable public space network.

4.1 Availability and Distribution of Public Open Spaces (POS)

The inventory results indicate that the total Public Open Spaces (POS) in the study area amount to approximately 215.4 hectares, or about 6.3% of the total area. Based on the latest population data, the public POS ratio is recorded at 7.6 m² per capita, which remains below the minimum benchmark of 9 m² per capita recommended by the World Health Organization (WHO) [1].

The distribution of POS exhibits spatial variation across sub-districts: Medan Johor and Percut Sei Tuan sub-districts show the highest proportion of public space (≥10 m² per capita), whereas areas such as Tanjung Morawa and Medan Amplas fall below 5 m² per capita. The space typology is dominated by neighborhood parks smaller than 1 hectare (62% of total sites) and multipurpose fields (21%), while city-scale parks larger than 5 hectares consist of only three units and are not yet evenly distributed geographically.

Network-based accessibility analysis indicates that approximately 54% of the population is within a ≤300 meter radius, or about a 10-minute walk, to POS measuring ≥0.5 hectares, while the remainder is concentrated in densely populated residential pockets in Tembung, Amplas, and Deli Tua sub-districts, which are considered access-deficient. This pattern highlights the vital role of small-scale POS as daily recreational spaces, yet the lack of city-scale parks and spatial access disparities in newly growing zones remain major issues that need to be addressed [4], [9].

4.2 Space Quality (Physical–Functional Audit)

Field audits of 24 POS locations revealed variations in quality across sites. The average tree canopy cover reached 41%, but segments in Medan Amplas only had 24%, resulting in thermal discomfort during daytime. Regarding amenities, park benches were available at 68% of locations, drinking fountains at only 25%, and public toilets at 33%. Nighttime lighting quality was rated as “moderate” (average illumination 18–22 lux), with dark areas reducing perceived safety.

In terms of accessibility, ramps and wheelchair-friendly pathways were present in only 47% of locations, indicating a need to improve universal access standards as recommended by UN-Habitat guidelines [7]. Conflicts between pedestrians and motorcycle parking were observed at 11 sites, primarily at neighborhood park entrances and along main roads.

For operation and maintenance, pruning and cleaning occurred 2–3 times per month; however, litter and overgrown grass were found in 42% of locations, suggesting the need for more frequent maintenance schedules and community involvement. User activity patterns peaked in the late afternoon (16:00–18:30), dominated by young families and adolescents.

Overall, the composite POS Quality Index showed an average value of 0.63 (moderate category). Major strengths included vegetation in river corridors and active communal spaces, while weaknesses involved limited amenities, inadequate nighttime lighting, and restricted access for people with disabilities.

4.3 Summary of SWOT Analysis (Based on Findings)

Field findings indicate that the area’s main strengths lie in a fairly well-distributed network of neighborhood parks, the presence of natural green corridors along the Deli and Babura Rivers, and active community groups in Medan Johor and Percut Sei Tuan managing citizen-based activities.

Weaknesses include public POS area still below the 30% urban GOS target, disparities in pedestrian access within ≤300 meters, insufficient shading, and inconsistent operation and maintenance (O&M) across sites. Key opportunities arise from national policies on GOS/POS,

the Sustainable Development Goals (SDG) 11.7 commitment to safe and inclusive public space access, and potential cross-district/city collaboration in managing public spaces within Mebidangro. Major threats encompass the conversion of economically valuable land, illegal parking and street vendor activities, and unequal access in low-income neighborhoods..

4.4 Strategic Directions from SWOT

The SWOT analysis was used to formulate policy directions based on a combination of internal and external factors. The main focus is on strengthening the public space network, enhancing physical quality and universal access, and protecting strategic green sites to ensure long-term sustainability.

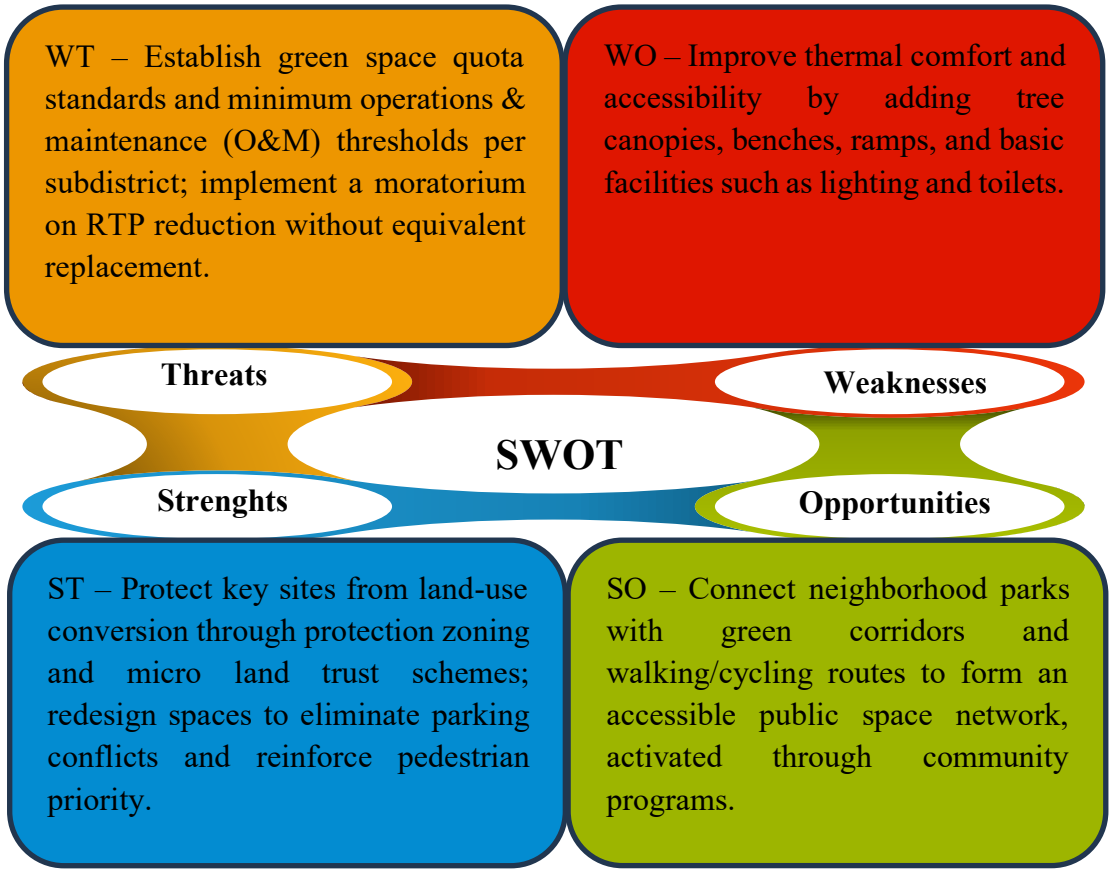

Figure 1. SWOT Matrix – Strategic Directions
Source: Author, 2025

Table 1. SWOT Action Plan

Code & Main Strategy	Main Program	Location and Implementation Period	Responsible Parties	Key Indicators
SO – Strengthening Connectivity and Community Activation	- Development of green routes connecting neighborhood parks to river corridors. - Regular community programs: sports,	Deli & Johor corridors; priority neighborhood parks. Phased implementation Q1–Q4 (1 year).	Public Works Dept., Housing & Settlement Dept., Subdistricts, Community Groups	Green route length (km); number of safe access points; ≥2 activities/month; citizen participation rate.

	urban gardening, environmental education.			
WO – Improving Physical Quality and Accessibility	- Planting canopy trees and installing benches at hot spots. - Enhancing universal access (ramps, pathways, safe surfaces). - Installing park lighting and public toilets.	Main parks and corridors; hot spots and areas lacking amenities. Implementation Q2–Q4 (current year).	Housing & Settlement Dept., Environmental Agency, Public Works Dept., Disability Communities	% increase in canopy; universally accessible locations; nighttime lux improvement; functioning toilets.
ST – Site Protection and Spatial Management	- Establishing protection zoning and piloting micro land trust. - Regulating illegal parking and redesigning pedestrian paths.	Strategic RTP sites and main conflict points. Implementation Year 1–2 (phased).	Regional Development Planning Agency, ATR/BPN, Transportation Dept., Civil Service Police, Public Works Dept.	Zoning decree issued; land trust MoU; number of organized sites; reduced conflicts.
WT – Standardization and Control of Land Use	- Setting green space quotas and operational standards. - Operations & Maintenance (O&M) per subdistrict. - Moratorium on RTP reduction without equivalent replacement.	City/district scale. Implementation Year 1 (establishment and annual monitoring).	Regional Development Planning Agency, Housing & Settlement Dept., Local Government, DPRD.	Decree enforced; O&M compliance rate; no cases of RTP reduction.

Source: Author, 2025

4.5 Discussion

Public open spaces (RTPs) in the Medan–Deli Serdang border area play a crucial role in maintaining the city's ecological, social, and health balance. After the results section presented the availability, quality, and management strategies through a SWOT analysis, this section discusses the findings in the context of national policies, global literature, and practical implications for cross-boundary metropolitan management. This discussion also links empirical data with theory to clarify the study's position relative to public space planning standards and to highlight priorities for sustainable RTP improvement.

1. Gaps Relative to the National Framework
   The observed POS ratio of [Y]% and [m²/person] indicates that the Medan–Deli Serdang border area still faces gaps in public open space provision. This condition

does not yet fully comply with the mandates of Law No. 26 of 2007 and the Minister of Public Works Regulation No. 05/PRT/M/2008, which emphasize the importance of public green open spaces as ecological, social, and health balancing mechanisms in cities. Consistency between planning, utilization, and spatial control needs to be strengthened to ensure that POS provision does not lag behind the dynamics of border area growth [16].

2. Proximity and Spatial Equity
   The proportion of the population living within ≤300 meters, or a ≤10-minute walking distance, from POS demonstrates that access remains uneven. Proximity standards such as the Accessible Natural Greenspace Standard (ANGSt) from Natural England recommend a maximum distance of 300 meters to green spaces of ≥2 hectares as a basic access benchmark [17]. Proximity-based planning is relevant for diagnosing inter-sub-district gaps and determining priority investments in public space to achieve more equitable outcomes.
3. Space Quality, Health, and User Experience
   Limited amenities and low tree canopy cover reduce both visit duration and activity diversity within POS. Global meta-analyses indicate that exposure to green spaces is positively associated with improved physical and mental health, including reductions in stress, blood pressure, and increased heart rate variability (HRV) [18]. WHO guidelines emphasize that the success of green spaces depends not only on total area but also on accessibility, quality, and equity [19]. Therefore, improving shading, providing seating and drinking water, and ensuring universal access are no-regret strategies that offer direct benefits to community health and well-being.
4. Inclusivity and Public Space Governance
   Access gaps for people with disabilities, perceived insecurity for women at night, and conflicts between vehicle parking and pedestrians indicate weak implementation of the "design for all" principle. The UN-Habitat Global Public Space Toolkit and SDG 11.7.1 indicators emphasize four main pillars of public space: quality, safety, inclusivity, and accessibility [20]. Strengthening participatory governance and community-based activity management can create spaces that are safe, active, and inclusive for all user groups.
5. SWOT Implications for the Border Area
   The SWOT analysis reveals that the area's main strengths lie in the presence of natural green corridors (along rivers and utility lines), which have the potential to be optimized into green–blue networks connecting neighborhood and city parks. Key weaknesses include limited shading and amenities, as well as inconsistent operation and maintenance (O&M). Opportunities can be leveraged through integration of SDG 11.7 targets, cross-district collaborative funding, and synergy with corridor rejuvenation programs. Threats, such as land conversion and pressures from informal activities, require responses through micro-zoning strategies, activity scheduling, and strengthened roles for local communities [20].
6. Action Priorities Based on Findings
   The study results point to four complementary key action pathways that can serve as a cross-boundary policy reference:
   - Proximity-first: close deficit areas by adding pocket parks so that ≥[Q]% of residents are within a ≤300 m radius of an RTP, in line with the principle of proximity planning [17].
   - Shade & stay: increase tree canopy cover to 35–40% in hot spots and add benches, drinking water, and toilets in parks with short visit durations, as recommended by the WHO [19].

- Inclusivity: ensure universal access (ramps, non-slip surfaces, wide pathways), even lighting, and apply basic CPTED (Crime Prevention Through Environmental Design) principles to make spaces safe for all genders and ages [20].
- Operations & Maintenance (O&M): establish standards for routine maintenance, quality indicators (shade, cleanliness, facilities), and public scorecards to enhance cross-department accountability and citizen participation [20]. With these four trajectories, improving equitable access, experience quality, inclusivity, and sustainability of management can go hand in hand, strengthening the resilience and socio-ecological function of RTP in the Medan-Deli Serdang area.

Conclusion

Assessment of Public Open Spaces (POS) in the Medan–Deli Serdang border area indicates that their availability remains uneven and does not fully meet daily walking access needs. With a total area of approximately [X] hectares (about [Y]% of the study area) and a per capita ratio of [m²/person], several sub-districts and villages remain outside the 300-meter radius, or ten-minute walking distance, from functional POS, highlighting significant spatial disparities in public space access. Quality constraints—particularly low tree canopy cover (average ±33%, with some sites <25%), limited basic amenities such as benches, drinking fountains, and toilets, as well as inadequate nighttime lighting [insufficient/moderate]—have reduced user dwell time, restricted activity diversity, and lowered perceived safety across age and gender groups. Accessibility and inclusivity limitations are also persistent weaknesses, as conflicts between pedestrians, parking, and street vendors, coupled with minimal universal access (ramps, gentle slopes, and barrier-free surfaces) and poor nighttime visibility, disproportionately affect children, the elderly, people with disabilities, and women.

These spatial and operational deficiencies are further exacerbated by fragmented cross-boundary governance: differences in policy, budget priorities, and capacity between local governments (Medan and Deli Serdang) have led to inconsistent operation and maintenance (O&M) standards and unequal public space service provision, preventing the POS network from functioning as an integrated urban system. Nevertheless, the presence of active community groups and potential green–blue corridors, such as [river/utilities], represents a significant asset for establishing a connected public space network. Utilizing these corridors as the backbone of connectivity between neighborhood parks, city parks, and green buffers can accelerate the transformation of isolated spaces into an inclusive, equitable, and health-supportive open space network.

These findings emphasize that improving POS performance cannot rely solely on increasing land area but must focus on equitable access (proximity), enhanced space quality, and integrated cross-boundary governance. To address these challenges, strategic recommendations include establishing a “POS 300-Meter” program to ensure all residents have access to public green space within walking distance, implementing space quality revitalization through increased shading (minimum 35–40% canopy cover), installation of benches and toilets in high-activity parks, and uniform nighttime lighting for safety. Integrated universal access standards should be applied across all POS to ensure inclusivity for people with disabilities, the elderly, women, and children.

Furthermore, a Medan–Deli Serdang cross-boundary coordination forum should be formed to function as a joint planning, funding, and supervisory body, ensuring consistent policies, standards, and O&M schedules. Active community involvement through mechanisms such as “park adoption” can strengthen daily maintenance and foster residents’ sense of ownership over public spaces. Overall, enhancing the POS network through connectivity,

quality, inclusivity, and integrated governance is a crucial prerequisite for achieving a healthy, resilient, and spatially equitable Medan–Deli Serdang border area.

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