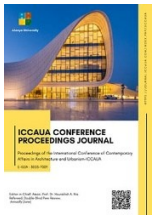

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Integrating Green Spaces with Mass Transit: A Comparative Analysis of Bangkok, Singapore, and Kuala Lumpur for Sustainable Urban Development

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A b s t r a c t

As Southeast Asia faces rapid urbanization, cities struggle to balance infrastructure development, environmental sustainability, and green space access. Bangkok faces poorly planned urban expansion, leading to limited green spaces and a disconnected public transportation system. This study examines the relationship between green spaces and mass transit in Bangkok, compared with Singapore and Kuala Lumpur. Analysing the 400-meter catchment around transit stations, the research explores green space distribution and road network connectivity through spatial analysis and space syntax methods. It evaluates how these cities integrate green spaces with transit systems and whether adopting a Transit-Oriented Compact Green City (TOCGC) model could improve Bangkok's connectivity. The findings highlight that green space accessibility is more important than size, with land subdivision and road networks influencing this relationship. The study proposes strategies for improving green space access and public transport integration, contributing to sustainable urban planning in line with UN SDGs 3 and 11.

K e y w o r d s : Green Space; Transit; GIS; Space Syntax; Southeast Asian Cities.

1. Introduction

1.1 Topic Background

Urbanization is one of the most significant global trends, with over 56% of the world's population currently residing in urban areas, and this is expected to rise to 68% by 2050 (United Nations, 2018). Rapid urban growth often brings a range of challenges, particularly in infrastructure development, environmental sustainability, and access to green spaces (Amen 2021; Amen and Kuzovic 2018b; Aziz Amen 2022; Al-Dujaili, and Amen 2018). As cities expand, the integration of transit systems with green spaces is often neglected, resulting in increased congestion, environmental degradation, and a reduced quality of life for urban residents (UN-Habitat, 2020). This issue is particularly pronounced in Southeast Asia, where cities are undergoing rapid urbanization, and the demand for efficient transportation and environmental sustainability is escalating.

One major challenge in Southeast Asia's urban centers is the decline in the quantity and accessibility of green spaces. As urbanization accelerates, land use increasingly shifts towards dense residential and commercial developments, leading to the loss of natural spaces. According to the World Health Organization (WHO), cities should aim to provide at least nine square meters of green space per capita, yet many cities in the region struggle to meet this standard (WHO, 2020). This highlights a significant gap between the need for green spaces and their provision in rapidly urbanizing regions like Southeast Asia. The lack of sufficient green space not only contributes to environmental degradation but also poses health risks to urban populations, including reduced air quality, higher temperatures, and limited opportunities for physical activity.

One potential solution to this challenge is the integration of public green spaces following Transit-Oriented Development (TOD) and compact city urban development approaches. TOD emphasizes the development of high-density, mixed-use neighborhoods around transit hubs, which reduces dependence on private vehicles, promotes walkability, and enhances overall urban sustainability (Institute for Transportation and Development Policy, 2019). Several Southeast Asian cities, such as Singapore, have successfully implemented TOD strategies, integrating green spaces within Transit-Oriented Developments to create vibrant, pedestrian-friendly environments (Encity, n.d.). Likewise, compact city approaches focus on concentrating development along transportation corridors, which helps

minimize urban sprawl and promotes environmental sustainability (United Nations, 2024). However, in cities like Jakarta and Bangkok, where urban sprawl continues to be a significant issue, integrating transit systems with green spaces remains a challenge. Poorly planned urban development often results in fragmented green spaces and disconnected transit networks, undermining both transportation efficiency and environmental sustainability.

The relationship between transit systems and green spaces is crucial for creating livable and sustainable cities. Effective integration of these elements is necessary not only to improve mobility and reduce the urban heat island effect but also to enhance the health and well-being of residents. Research shows that green spaces near transit hubs can significantly improve air quality, reduce stress, and promote physical activity (Vichiensan et al., 2024). However, when these green spaces are not easily accessible from residential areas (where people live) or transit systems (where people move), their potential benefits are greatly diminished. Therefore, fostering a better relationship between transit networks and green spaces is essential for enhancing urban livability, particularly in cities like Bangkok, where public transport systems and green areas are often fragmented and poorly connected. By adopting models from cities like Singapore and Kuala Lumpur, it may be possible to create more integrated urban environments that prioritize both sustainability and quality of life.

1.2 Research Gap

Despite much research on urban planning/design and green spaces, most of the research focuses on the catchment of green spaces or the accessibility of green spaces from the surrounding road networks. Moreover, urban planning concepts such as 15-minute cities may not be suitable for Bangkok, and public green spaces are often overlooked in typical TOD developments in Bangkok. Thus, a new concept of green relationship with mass transit nodes, in the form of a Transit-Oriented Compact Green City or TOCGC is explored for the context of Bangkok with dense urban fabric and superblocks. This research will explore this new concept of Transit-Oriented Compact Green Cities by analyzing catchment areas and accessibility, focusing on the relationship between transit systems, green spaces, and surrounding road networks. It will compare three cities, addressing the gap in existing research on integrating transit and green space accessibility.

1.3 Research Question &Research Objectives

Research questions:

1. What is the relationship between green spaces and transit nodes in Bangkok, and how does it compare with Singapore and Kuala Lumpur?
2. How can Bangkok implement walkable compact districts to enhance connectivity between green spaces and transit nodes?

This research aims to understand the relationship between urban green spaces and transit to enhance the connectivity of green spaces to transit stations in Bangkok, to improve green space per capita, and contribute to sustainable urban development.

Research Objectives:

1. To conduct a green catchment analysis to understand the relationship between green spaces and transit nodes along transit networks in Bangkok, Singapore, and Kuala Lumpur.
2. To analyze the walkability of transit-oriented / adjacent neighborhoods in Bangkok and visualize the connectivity between green spaces and transit stations, drawing comparisons between Singapore and Kuala Lumpur.

1.4 Significance & Structure of the Paper

This research underscores that the distribution of green spaces is more important than their size. In dense urban contexts like Bangkok, smaller but well-placed green areas near transit stations can provide greater benefits than large, isolated parks. Prioritizing location and accessibility ensures that more people can interact with green spaces as part of their daily routines, supporting health, comfort, and urban sustainability.

The study also highlights the importance of connectivity between green spaces, transit nodes, and road networks. Cities with well-connected street grids, like Singapore, offer more equitable access to public amenities. In contrast, Bangkok's fragmented street and road networks limit walkability and reduces the effectiveness of green and transit infrastructure. Improving connections is essential to creating inclusive, people-centered urban environments.

Finally, the research shifts the perspective of green spaces from being just destinations to becoming part of the urban journey. By embedding greenery within walkable paths and transit corridors, cities can enhance everyday experiences and promote sustainable mobility. The proposed Transit-Oriented Compact Green City (TOCGC) model offers a framework to improve Bangkok's urban form, aligning with UN SDGs 3 and 11 by supporting healthier, more resilient, and livable cities.

This paper is organized into five parts. The following section will explore the literature review, research gap, and conceptual frameworks. The third section presents the spatial analysis methodology, presented in two forms of mapping: GIS analysis and Space syntax analysis, which will be applied to three cities in the Southeast Asian region – Bangkok, Singapore, and Kuala Lumpur. The fourth and fifth sections will cover the research findings discussion, and, conclusions, elaborating the main contributions of this paper.

2. Literature Review

2.1 Rapid Urbanization

As the world is rapidly urbanizing, currently 56.2 percent of the world's population is living in cities, with the United Nations predicting that the urban population will continue growing and increase to 68 percent in 2050.

Urbanization has many benefits, such as productivity and efficiency, economies of scale and network effect, and opportunities that urban areas can offer. However, rapid and unplanned urbanization can bring risks such as poor infrastructure, health issues, climate-related challenges, environmental degradation, and social instability, especially in developing countries (Zurich, 2023).

Unplanned and rapid urbanization has a substantial impact on infrastructural development and environmental sustainability. According to UN-Habitat in the latest *World Cities Report*, we have witnessed, on average, a green space loss in urban areas from 19.5 percent to 13.9 percent globally in the past 30 years, from 1990 – 2020. The decline of green space shares in urban areas has health and social impacts on urban dwellers. This decline in green space is due to urban expansion and/or poor planning, however, some cities have managed to increase the share of green space through policies and good planning (UN-Habitat, 2024). With environmental degradation and climate change affecting urban residents, well-managed urban planning is required to tackle these problems, and some of the most popular urban development strategies are Transit-Oriented Development (TOD) and 15-minute compact cities, which promote more walkable neighborhoods connected to public transportation and green spaces, providing positive outcomes for public health, well-being, and building climate resilience (United Nations, 2024).
Southeast Asia is one of the regions facing rapid urbanization, with 47 percent of the population living in cities with high urbanization rates ranging from 20 percent in Cambodia to 53 percent in Indonesia and 100 percent in Singapore (ASEAN, 2022). Due to urbanization in Southeast Asian countries, they face unique environmental and climate-related challenges, as well as a mismatch between economic growth and investment in infrastructure and environmental management. Rising socioeconomic status led to an increase in private automobile ownership and motorcycle sales, causing ever-degrading air quality, as seen in January 2025 when Bangkok, Ho Chi Minh, and Phnom Penh were ranked in the top five most polluted cities due to crop-related burning, industrial pollution, and heavy traffic (Reuters, 2025). In addition, the region is highly vulnerable to the impacts of climate change and natural hazards, notably heatwaves, heavy rain, and floods (Dahiya, 2014).

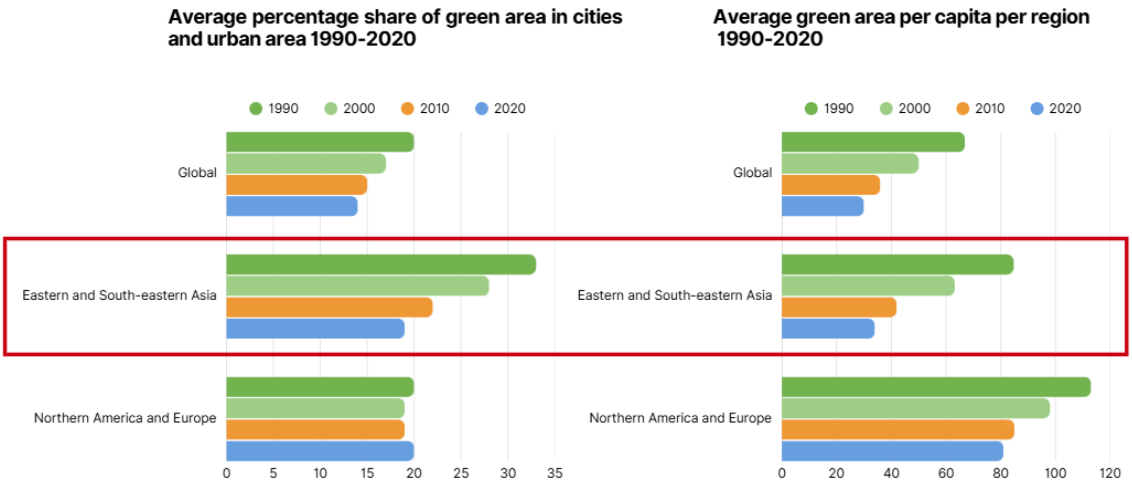


Figure 1. Declining urban share of green space and green space per capita over 30 years (1990-2020) information from UN-Habitat, 2024.

2.2 Transit & Green Spaces in Southeast Asia

This research will focus on urban areas of Southeast Asian countries, including Thailand, Malaysia, and Singapore, which are three countries that have direct land connections but have very different backgrounds.
In Thailand's bustling capital, Bangkok, the city faces multiple issues, including its urban transportation system and green space scarcity. Typically, urban expansion within the city is unplanned, and this has caused a loss of urban green space as well as inefficient public transport systems, which cannot handle the increasing population (Lertudompruksa et al, 2024). Bangkok has 1.47m² of green space per capita, significantly below the World Health Organization's (WHO) international standard which recommended a minimum of nine square meters per capita (Kraitong, 2023). These challenges lead to accessibility issues between the city's green spaces and transit nodes as well as urban heat islands (Vichiensan et al.; Thongnoi, 2024). Furthermore, Bangkok's urban fabric and development are substantially built-up (atlas of urban expansion, 2024), making it difficult and expensive to develop further, especially government developments that could provide more public green spaces.
Singapore, on the other hand, has a successful urban development model with strong policy and well-managed urban planning following their first concept plan since independence in 1971. This allows Singapore, one of the top cities in the Green City Index, to have a good relationship between people and urban green spaces, whilst being able to develop new urban centers along high-capacity public transportation routes following a Transit-Oriented Development concept (Encity, n.d.), making them ranked fourth in the best public transport in the world (Urban Mobility Readiness Index, 2022). Singapore is an extreme case when compared with Bangkok, in terms of historical context, as Singapore has been more recently developed. However, Singapore provides a useful case study of well-

managed planning in urban design, as Singapore and Bangkok are comparable in terms of size and urban expansion both horizontally and vertically.
While Singapore is an extreme case, Kuala Lumpur may be a more suitable case to compare with Bangkok, as Kuala Lumpur and Bangkok are more comparable to each other because both cities have shared challenges like rapid growth, urban sprawl, and fragmented development. They are both in larger, more diverse countries with different economic sectors, and their urban planning reflects their rapid urbanization and evolving infrastructure. Singapore, on the other hand, is a more controlled and planned environment with a smaller, more efficient land use model that makes its development path significantly different from the urban dynamics in Kuala Lumpur and Bangkok.

2.3 Bangkok Green Space Problems

Research from the visual Thai PBS on green space in Bangkok mentions that the WHO international standard is 9.0m² per capita, whereas Bangkok only has 6.9m² per capita from the government report, however, we looking into public green spaces that are accessible, so this comes down to only 0.92m² per capita (2019). This can be compared with the research by Kraitong in 2023 which highlights an improvement in green space per capita, rising from 0.92m² to 1.62 m². However, despite this progress, the figure remains significantly below the World Health Organization's recommended standard. Furthermore, the suggestions for Bangkok to meet the WHO Standard of 9m² per capita will require the transformation of all of the spaces under the highways and all the remaining open spaces left in Bangkok into green spaces (The visual Thai PBS, 2024). Moreover, research from JLL looked into the catchment area of Bangkok's public green spaces, and they mentioned that Bangkok has sizable parks, Nevertheless, the problem is the distribution and proximity of their catchment and coverage within the city (Kraitiong, 2023).

Transportation Issues in Bangkok

Bangkok's urban planning has been heavily car-centric, with a lack of integrated public transportation infrastructure, contributing to severe traffic congestion. The city's rapid and unplanned expansion has led to a reliance on private vehicles, which has worsened congestion on already crowded roads. Car ownership has surged due to rising incomes, further exacerbating the situation. According to the Nation, the number of registered vehicles in Bangkok is over 10 million (Nation Thailand, 2022), pushing the city into a vicious cycle of traffic jams and air pollution.
Public transportation options like the MRT and BTS have seen growth, with approximately 700,000 daily riders for the BTS and 300,000 for the MRT (Bangkok Post, 2024), but these numbers are still insufficient given the city's population of over 10 million. Despite improvements, these transit systems are often disconnected, covering only limited areas of the city. Additionally, the lack of incentives for public transit, such as high fares, limited coverage, and poor integration with other forms of transportation, discourages wider use, leaving many residents dependent on cars or motorcycles.
Public transportation remains underutilized in part because it fails to meet the convenience and accessibility needs of many Bangkok residents. The absence of a fully integrated system that connects various transit modes, including MRT/BTS, bus, ferry, and others, along with limited development around mass transit stations, has led to minimal incentives for people to switch from private vehicles to public transport.
Typical of Bangkok's urban planning is the occurrence of megablocks which are large blocks, or tracts of land with little pedestrian or vehicular porosity, without access to major roads which mean that Bangkok residents opt to use motorized transport to get around, even for short distances which causes more problems of traffic congestion and air pollution (Marks, 2019).

2.4 Green space accessibility

Alamri's research about Green Space Mapping based in Riyadh, Saudi Arabia, used a method of spatial analysis mapping of the catchment area of green spaces such as public parks in Saudi Arabia and rating their accessibility by district (Alamri, 2024).From Long et al., research on the analysis of 'Urban Park Accessibility Based on Space Syntax: Take the Urban Area of Changsha City as an Example' used space syntax (Depthmapx Program) parameters such as choice, connectivity and road at both global and local scales to explore the accessibility of urban parks with a matrix (Long et al., 2023). This research shows the accessibility of green spaces by analyzing road networks to help determine the hierarchy of road networks and their connection to green spaces.

Urban Development Strategies

To tackle car-centricity, the concept of the Compact 15-minute city, such as 15-minute Paris, is an urban planning strategy that puts all daily necessities within a 15-minute distance by foot and/or bike to create more human-centric and sustainable neighborhoods (Award & Moreno 2021). However, this concept may not match with the Southeast Asian context due to the excessively hot and humid weather. One can ask, does Bangkok suit 15-minute city principles?

Another urban planning strategy is Transit Oriented Development (TOD), and according to ITDP (Institute of Transportation and Development Policy), TOD is designed to make connections between people, activities, buildings, and public spaces to help reduce motorized transport and promote citizen-centric environments. By implementing TOD, cities can create inclusive access for all, and it is the most efficient and healthy combination of affordable mobility modes and as such, TOD is a necessary foundation to help the growth of the city in the long term (ITDP, 2019). However, a critical gap in the secondary road network in Bangkok creates a bottleneck for local traffic and becomes a barrier for the development of effective, accessible services such as feeder bus, which leads

to more motorized transport such as motorcycle taxis, also Bangkok has a difference approach to transportation development with the concentration of condominium developments along transit corridors.
(ASEAN SUSTAINABLE URBANISATION REPORT, 2022)
From the urban planning/design strategies discussed, this research sought to combine both these approaches to make a planning strategy that is more suitable and feasible for the urban context of Bangkok by putting the mass transit node at the centre of a compact neighbourhood or district, as opposed to the residence, so having all daily necessities within 400 meter (5-minute) walking distance from a train station or transit hub, as we can see from the diagram in figure 2. This we can call a Transit-Oriented Compact Green City, or TOCGC.

Figure 2. Diagram comparing traditional 15-minute city (Left) adapted from Parisen common and proposed TOCGC urban planning strategy suiting Bangkok context (images by author, 2024) (Right).

2.5 TOD vs TAD

According to a study by the Office of Transportation and Traffic Policy and Planning (OTP), in a Thailand Executive summary report, they distinguish between TOD (Transit-Oriented Development) and TAD (Transit-Adjacent development). Here, the main point is that TOD consists of four main components, which are Densify, Linkage, Amenities, and Non-Motorized Transit, whereas TAD can only be achieved with one part, which is Densify (OTP, 2021). Reflecting on Bangkok, it appears the city is currently developing according to the concept of TAD development, which often begins to densify and develop after transit stations are completed, leading to a disconnection between the transit system and its surrounding area. This undermines the core goals of TOD, such as promoting non-motorized transport, creating linkages, and providing amenities.

2.6 Research Framework

The concept of this research links green spaces and urban planning strategies such as TOD and compact cities, focusing on mass transit nodes. Along with rapid urbanization, Bangkok urban areas are mostly built up, and the need to address poor urban planning with low green space per capita becomes ever more important. Hence the Concept of TOCGC (Transit-Oriented Compact Green Cities), which combines TOD, Green Space, and Compact cities, will be explored to tackle the said problems in Bangkok.

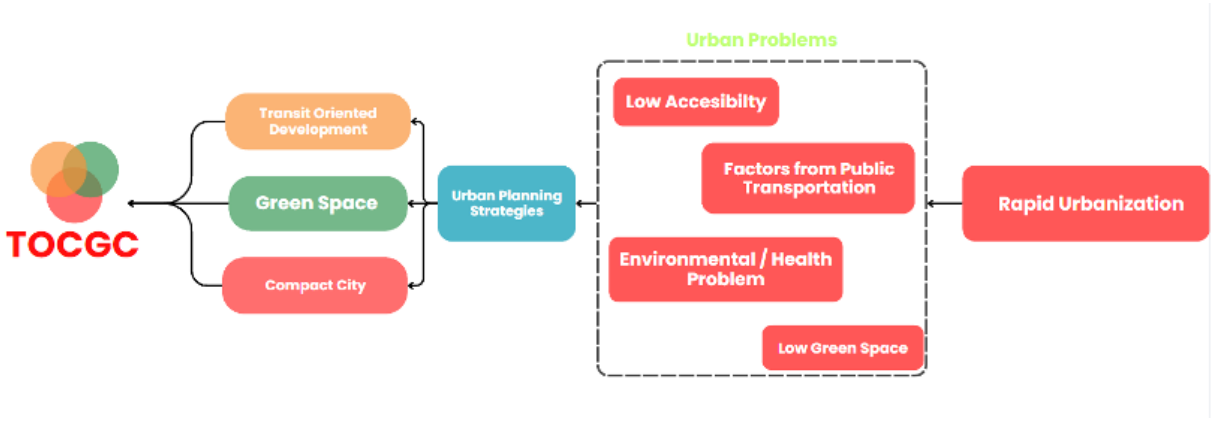
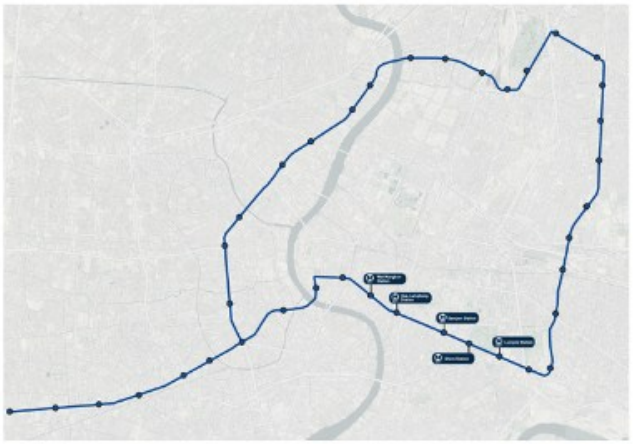


Figure 3. Diagram of Research Framework.

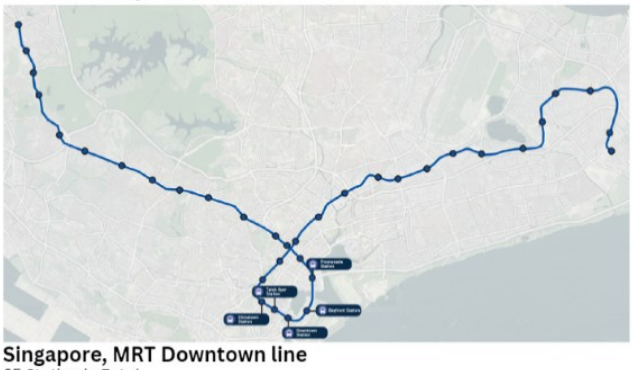
3. Materials and Methods

3.1 Methodology

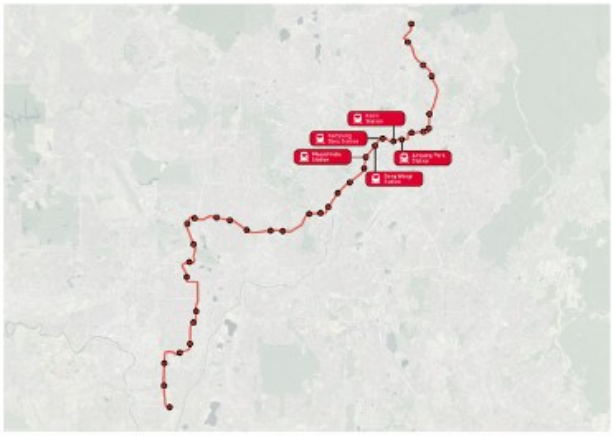
This research adopts a qualitative approach and will primarily compare three cities—Bangkok (MRT Blue Line), Singapore (Downtown Line), and Kuala Lumpur (Kelana Jaya Line) (Figure6). This research utilizes spatial analysis to examine the locations of green spaces, train stations, and road networks in the study area in each of these three cities.



Bangkok, MRT Blue Line
38 Station in Total



Singapore, MRT Downtown line
35 Station in Total



Kuala Lumpur, Kelena Jaya line
37 Station in Total

Figure 4. Study area Bangkok, Kuala Lumpur, and Singapore (images by author, 2024).

Two main methods will be employed: firstly, a catchment area analysis of 400m / 5-minute walking distance or Ped-Shed Distance (*Frequently asked questions | Ped Shed*. (n.d.). https://pedshed.net/?page_id=5
, which will be more suitable in the context of Southeast Asia cities will assess the density and percentage of green spaces around mass transit stations, focusing on their provision and accessibility. This will include mapping various types of urban green spaces near stations along mass transit lines in each case study city. This will help visualize how much green space is near each station and how accessible they are.

The second method involves Space Syntax analysis using the DepthmapX program, which will analyze the walkability and connectivity of green spaces, transit nodes, and road networks (Figure 7). This will employ a dual methodology of axial analysis and angular analysis. Axial analysis will focus on the hierarchy of road networks, focusing on their connectivity and accessibility, while angular analysis will focus on the angle of the road networks (Nes &Yamu, 2021). By integrating both methods, the research aims to assess the effectiveness of green space and road network planning in these cities and determine whether Bangkok would benefit from a Transit-Oriented Compact Green City (TOCGC) urban development approach.

3.2 Research Scope and Limitations

This research analyzes the relationship between public green spaces and mass transit nodes within the 400-meter catchment area around mass transit stations in Bangkok, Kuala Lumpur, and Singapore. The study examines only the main mass public transportation systems (MRT in Bangkok, Downtown Line in Singapore, and Kelana Jaya Line in Kuala Lumpur). It evaluates the connectivity and accessibility of green within these 400-meter zones of five stations of each city metro line. The research is limited to inner urban areas within the central business districts, excluding peripheral suburban or peri-urban areas. It does not account for other transit lines or modes of transport, such as buses, ferries, or taxis. Additionally, only the accessibility of green spaces within the immediate catchment zones is considered, excluding areas further from the transit nodes. Despite these limitations, the method explored can give useful insights about transit and green space relationships, and further areas can be mapped following the same or similar approach in future research.

4. Results & Discussions

Bangkok, MRT Blue Line

Singapore, MRT Downtown line

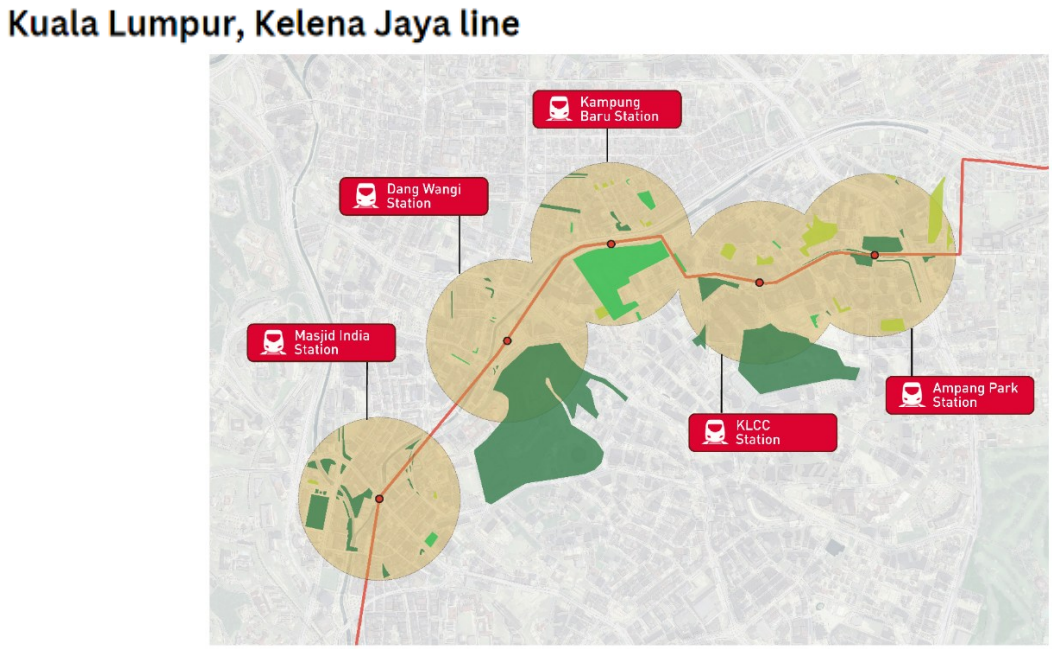


Figure 5. Visualization result of three cities: Bangkok, Singapore, and Kuala Lumpur, green & Transit analysis (image by author, 2024).

Figure 6. Visualization result of three cities: Bangkok, Singapore, and Kuala Lumpur, Space Syntax Analysis (image by author, 2024).

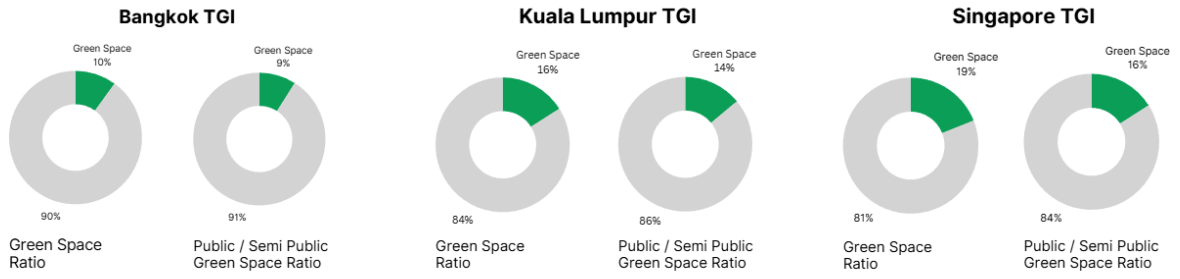


Figure 7. Pie chart of three cities: Bangkok, Singapore, and Kuala Lumpur TGI (Transit & Green Index) (image by author, 2024).

The spatial analysis (catchment and space syntax) conducted within the study areas of five stations in each of Singapore, Kuala Lumpur, and Bangkok reveals important differences in the availability and accessibility of public green spaces, including parks and median strips. While all three cities demonstrate broad coverage of public green space throughout their respective study areas, further examination shows marked contrasts in the accessibility and density of usable public parks.

In terms of overall coverage, all five stations studied in Singapore, Kuala Lumpur, and Bangkok exhibit good provision of green spaces, including median strips. However, when focusing specifically on public parks—spaces that are accessible and usable by the public for recreational and social activities—there is a notable difference. Singapore and Kuala Lumpur both offer a variety of high-quality, accessible public parks within their study areas, such as (name some of these parks) in Singapore and (park names) in Kuala Lumpur, ensuring that residents and visitors have ample opportunities to engage with green spaces. In contrast, Bangkok presents a more limited

offering. Of the five stations in the study, only three (Lumpini, Silom, and Wat Mangkon) have access to usable public parks. Two of these stations (Lumpini and Silom) share access to the same park (Lumpini Park), while the third station (name this station) is connected to a memorial park that lacks active recreational space, reducing its utility for everyday public use.

Further analysis of green space density reveals that Bangkok's study area has the lowest percentage of green space coverage (within proximity of the five case study stations), with only nine percent of the area designated as green space. In comparison, Kuala Lumpur has 14 percent and Singapore 17 percent. This lower density in Bangkok reflects a broader urban design challenge, where green space provision does not match the demand for accessible public parks, particularly in more peripheral areas of the city, reiterating that green space distribution matters more than their size.

In addition to spatial catchment analysis, the research also conducted a space syntax road network analysis to evaluate the connectivity and accessibility of the road network in these cities. The space syntax model uses color coding, where darker roads indicate higher connectivity and accessibility whereas lighter shades show more isolation and disconnection. This analysis highlights significant differences in the road networks of each city, which in turn affect public access to green spaces and other urban necessities.

Bangkok's road network is characterized by a concentration of high-connectivity roads along the main arterial roads, which are connected to mass transit nodes. However, this structure creates a major challenge for accessibility—roads further from these main corridors (Soi / Side Road) tend to be poorly connected from dead-end roads and unconnected street, lack of grid layout, and urban block are not connected, which means that people living in peripheral areas or further from mass transit nodes face difficulties accessing essential services, including parks and green spaces. In particular, the lack of direct road connections to green spaces in these peripheral areas exacerbates the issue, limiting the public's ability to easily reach parks, especially if these parks are located farther from the mass transit network.

In contrast, Singapore's road network benefits from a grid-based system, which provides highly efficient and evenly distributed connectivity throughout the urban landscape. The grid system ensures that even areas further from the city center maintain strong connectivity, allowing residents to have convenient access to public parks, green spaces, and other necessities. The only areas with lower connectivity in Singapore tend to be private access roads, which do not hinder the public's overall accessibility to key urban amenities. Therefore, the grid layout in Singapore contributes to equitable access to both public services and recreational spaces, ensuring that no areas are disproportionately underserved.

Kuala Lumpur falls somewhere between the extremes of Bangkok and Singapore in terms of road network connectivity. While the city has a moderate level of accessibility, it lacks the robust grid network found in Singapore. Instead, Kuala Lumpur's Road network relies more heavily on arterial roads that provide connectivity to key urban areas. Moreover, the arterial roads also connect with collector roads, some of which form a grid network of collector roads. Although the road network is not as universally interconnected as in Singapore, it still supports reasonable access to both green spaces and essential services. Kuala Lumpur also benefits from a well-distributed network of parks and green spaces, which helps offset any gaps in the road network's coverage.

In summary, the comparison of road network accessibility and public green space provision in Bangkok, Kuala Lumpur, and Singapore highlights the following key differences:

Public Green Space Access (Green Catchment Analysis – Transit-Green Index):

- **Singapore** and **Kuala Lumpur** provide extensive access to well-developed public parks within the study areas.
- **Bangkok**, however, is more limited, with only three of the five stations having direct access to usable public parks. Additionally, the green space density in Bangkok is the lowest among the three cities, at just 9%, compared to 14% in Kuala Lumpur and 17% in Singapore.

Road Network Connectivity (Space Syntax Mapping):

- **Bangkok's** road network, while effective along major arterial routes, lacks connectivity in peripheral areas, making it harder for residents to access parks and other urban amenities located outside the main roads.
- **Singapore's** grid-based system provides high levels of connectivity throughout the city, ensuring equitable access to parks, green spaces, and daily necessities, even in more peripheral areas.
- **Kuala Lumpur's** road network is moderately connected, with strong accessibility along major roads, but without the full benefits of a grid system. Despite this, Kuala Lumpur's distribution of green spaces compensates for any connectivity limitations, offering residents reasonable access to parks.
-

5. Conclusions

In summary, this research mapped coverage, catchment, walkability, and accessibility between mass transit stations and adjacent urban green spaces within three cities in Southeast Asia to explore and compare their relationships. This research highlights significant differences in the integration of green spaces and mass transit in Bangkok, Singapore, and Kuala Lumpur.

While Singapore and Kuala Lumpur offer well-distributed, accessible public green spaces with robust road network connectivity, Bangkok faces challenges due to its unplanned urban expansion, limited green space density, as well as fragmented transportation infrastructure and urban layout. The findings reveal that Bangkok's green space accessibility is lower, with only a few transit stations providing direct access to usable parks. In contrast, Singapore's grid-based system and Kuala Lumpur's mixed system ensure better public access to parks and other urban amenities.

Although this study focuses on a single transit line, which may overlook areas where multiple lines intersect, in future research, the analysis, using the method introduced here of green catchment and space syntax, will shift to an area-based approach, accounting for all transit lines and green spaces within a broader area, including those beyond the 400-meter catchment radius of individual stations.

Nevertheless, this study suggests that adopting a Transit-Oriented Compact Green City (TOCGC) model; putting the mass transit node at the centre of a compact neighbourhood or district, and having all daily necessities including green space integrated in the public realm as a destination and part of the journey within 400 meter (5-minute) walking distance from a train station or transit hub, could improve Bangkok's green space accessibility and public transit integration, fostering a more sustainable and livable urban environment. By enhancing connectivity between green spaces and transit stations, Bangkok can better meet the needs of its growing population, reduce traffic congestion, as well as promote climate resilience and environmental sustainability, which can eventually help cities achieve UN Sustainable Development Goal 3; on good health and well-being and Goal 11; sustainable cities and communities. Furthermore, it is essential to recognize that the significance of research lies not only in the findings but also in how these findings influence our understanding of the relationship between distribution and size, as well as accessibility and destination. Green spaces should be viewed as integral components of our journeys, enhancing our experiences rather than merely serving as endpoints.

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Conflict of Interests

The Author(s) declare(s) that there is no conflict of interest.

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