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Integrating Metro Stations with the Adjacent Urban Fabric Using TOD Principles: A Case of Agargaon Metro Station, Dhaka

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ABSTRACT

Transit-Oriented Development (TOD) principles offer a promising framework for integrating metro stations with their surrounding urban fabric, promoting sustainable urbanization and efficient transportation systems. Dhaka, one of the fastest-growing cities globally, faces significant challenges in traffic congestion, air pollution, and urban sprawl. Introducing metro systems offers a promising solution to alleviate these issues and enhance urban mobility. This study presents a case study of Agargaon Metro Station in Dhaka City, examining its integration with the adjacent urban fabric using TOD principles. Through a combination of field observations, spatial analysis, and stakeholder interviews, the study evaluates the current state of Agargaon Metro Station. On-site assessments examined the station's physical infrastructure, accessibility, and connectivity with nearby areas, while Geographic Information Systems (GIS) analyzed spatial data, including land use patterns and transportation networks. Semi-structured interviews with urban planners, government officials, and community members provided insights into the challenges and opportunities for implementing TOD at Agargaon. The findings reveal that the station is underutilized as a TOD hub, with inadequate pedestrian infrastructure and mixed-use developments, leading to poor connectivity and accessibility. The study highlights the necessity of improved land use planning, policy support, and community engagement to enhance the station's role in fostering TOD. These recommendations, if implemented, could alleviate traffic congestion, improve air quality, and create more livable urban spaces, thereby enhancing Dhaka's overall quality of life. Additionally, the research contributes to the social and economic dimensions of urbanization by offering a framework that can be adapted to similar metro stations in Dhaka and other rapidly urbanizing cities.

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Highlights:

- Agargaon Metro Station is a key part of Dhaka's MRT system, addressing traffic congestion and urban mobility.
- The study applies TOD principles like density, mixed land use, and walkability to better integrate the station with its fragmented surroundings.
- Recommendations include improving pedestrian pathways, public spaces, and mixed-use zoning within a 1 km radius, and enhancing coordination with other public transport modes.
- The findings propose design guidelines to improve the urban environment using TOD principles.

Contribution to the field statement:

This study contributes significantly to the field of urban design by offering an evaluative framework for assessing the compliance of station areas with TOD principles. By providing a structured approach, helps stakeholders understand the essential components of TOD and guides them in making decision making process. Continued research is essential to address the identified limitations and explore additional aspects of TOD design and implementation. This work advances the understanding of how TOD principles can address the socio-economic challenges posed by unplanned urbanization, with broader applications for enhancing public transit infrastructure in developing cities.

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1. Introduction

The urban form of Dhaka has created significant challenges for city planners and designers, primarily attributable to the fragmented land utilization and inadequate amalgamation of transportation amenities, services, and infrastructure. The urban area is distinguished by a notable dependence on individual modes of transportation and insufficient provision of public transit, leading to significant traffic congestion. In 2024, the city's population exceeded 21 million, with an estimated influx of 1,000 new people daily. The transportation infrastructure has faced challenges to keep pace, leading to significant traffic congestion, with average travel speeds in central areas dropping to less than 7 km/h during peak hours. Non-motorized and informal transport modes, such as rickshaws and CNG-run auto-rickshaws, account for over 75% of daily travel, while only 6% use formal public transport systems. In response to these issues, the Government of Bangladesh has initiated the construction of a metro rail system to improve urban mobility and reduce reliance on private vehicles. The Dhaka Metro is intended to provide a reliable, efficient, and environmentally friendly alternative to the congested road network. Nevertheless, the effectiveness of metro systems relies not alone on their technological proficiency, but also on their integration with the surrounding urban environment. Upon its implementation, it is anticipated that the project will effectively decrease the number of privately owned vehicles on the roads of Dhaka. Further, the implementation of Dhaka Metro is anticipated to be supplemented by other transportation modes such as Feeder buses, Intermediate Public Transport (CNG, Rickshaws), etc. This will establish the foundation of the multimodal urban public transport system of Dhaka. Given the present pace of development, Dhaka and its surrounding areas will likely need to strategize transit-oriented developments (TODs) to enhance the quality of life in its urban localities. Despite the development of the Dhaka Metro, there is a lack of research on integrating metro stations with the existing urban fabric, particularly through Transit-Oriented Development (TOD) principles. An increasing number of cities have adopted transit-oriented development (TOD) as a strategy to enhance the urban structure of cities. TOD, or Transit-Oriented Development, has been utilized as a comprehensive approach to combine land-use and transportation systems, improve dense urban structures, and encourage the use of public transit by minimizing reliance on private automobiles (Calthorpe, 1993). This study addresses the gap in understanding how TOD can be applied to Dhaka's unique urban challenges and socio-economic conditions.

Transit-Oriented Development model is a comprehensive approach that combines land-use and transport systems to create sustainable and pedestrian-friendly neighborhoods. These will result in a convenient, safe, and enjoyable space for people to move around. The area's diverse functions provide public open space, high-density housing, offices, and commercial centers, resulting in shorter and more rapid trips. By reducing auto-oriented activities, TOD integrates locals, especially those with restricted access to private vehicles because of their financial situation, their age, or the age of children or the elderly nevertheless have access to many facilities and may meet their needs, and provide access to many facilities. The execution of the Dhaka metro system, comprising numerous stations situated along primary routes, presents a prospect to implement a comprehensive approach that advocates for the revitalization of the city's main transit areas.

Thus, this paper aims to incorporate the Dhaka Metro into the city's urban fabric while adhering to the principles of transit-oriented development. This entails evaluating several facets of station area design to enhance the comfort and convenience of users. The inclusion of station amenities, such as physical infrastructure including parking areas, transfer areas, pedestrian networks, cycling facilities, feeder shelters, taxi stands, etc., is essential for enabling smooth transfers within a multimodal transit system. The study used qualitative as well as quantitative approaches. The methods employed in this study encompass a comprehensive theoretical evaluation of several topics, on-site observation, and the collection of data from pertinent authorities. The literature review focuses on the concept and principles of transit-oriented development. Additionally, a comprehensive inventory of the station area is conducted to evaluate the current situation. In addition, the analytical and applied study involves the use of site observation and analysis, as well as the collection of images and field notes. An analysis is conducted on several design factors to enhance the premises of the station area. This

research analyses to identify effective practices and provides recommendations to enhance the performance of the current system. The research suggests a method for enhancing the urban environment of the area under investigation by implementing a series of design guidelines and principles based on Transit-Oriented Development (TOD).

2. Literature Review

2.1 Concept of Transit-Oriented Development

Transit-oriented development (TOD) has become a prominent focus in urban planning and urban mobility research since the mid-1990s (Al-malki et al., 2022; Ibraeva et al., 2020). Several studies have investigated the relationship between the physical infrastructure and the various means of mobility that were prevalent in the early 20th century, before the widespread ownership of cars (Knowles, 2006). A crucial aspect of urban planning is comprehending the relationship between the built environment and urban mobility and the ability to plan for it.

Calthorpe (1993), argues that the American dream of suburban living with its emphasis on single-family homes, private cars, and low-density development is unsustainable and detrimental to the environment and social fabric of communities. He proposes an alternative vision of urban development that is centered on transit-oriented development (TOD) and compact, walkable mixed-use communities. His ideas have been very influential in shaping urban planning and design in the United States and beyond. He is considered one of the pioneers of new urbanism a movement that promotes walkable mixed-use neighborhoods with a focus on community and sustainability. He further argued that TOD can catalyze new investment in urban areas. Also mentioned, “TOD can generate new development by attracting investment to areas previously overlooked by developers because of their lack of access to transportation or other amenities.”

TOD is a Land-use strategy that emphasizes accessibility improvement by encouraging the development of compact, high-density, and mixed-use nearby transit stations. However, the majority of abstract conceptions contain many shared TOD components like mixed design, height, pedestrian access, and good mobility (Belzer & Autler, 2002; National Academies of Sciences, 2004). “Transit-Oriented Development in the United States: Experience, Challenges, and Prospects” Cervero & Kockelman (1997), do not propose a single theory of Transit-oriented development. Rather they provide a comprehensive analysis of the United States, drawing on a range of theoretical perspectives. They evaluate the history of TOD, tracing its roots to the early streetcar suburbs of the late 19th century and early 20th century. They discuss TOD's benefits, including reducing automobile dependency, increased mobility, and improved access to jobs and services. They also analyze the challenges of implementing TOD, such as financing, land use regulations, and community resistance. Arrington & Cervero (2008), define TODs as areas that have excellent pedestrian access and are planned to be compact, incorporating a mix of commercial and residential land uses. Similarly, TOD is a development pattern that revolves around transit hubs and promotes a combination of different types of land use in a well-connected and secure urban setting. Hence, the term TOD typically suggests that a specific location is easily accessible by foot and effectively connected to its environment. The area should accommodate numerous commercial establishments and provide a range of housing choices and job prospects.

TOD has been touted as a way to address a variety of issues related to transportation, urban sprawl, and sustainability. Some proponents argue that TOD can help reduce greenhouse gas emissions by reducing the need for car travel, while others believe that it can help revitalize urban areas by attracting new development and investments. Despite the potential benefits of TOD, it is important to note that it is not a one-size-fits-all solution. Different communities have different transportation needs and the success of TOD depends on a variety of factors, including the availability and quality of public transportation, the local land use context, and the preferences and behavior of residents. Nevertheless, TOD is an important theory in the field of transportation and development and it's likely to continue to be an important topic of research and discussion in the coming years.

2.2 Influence of TOD

The TOD idea has had a significant influence on the literature related to transportation and urban development. Peter Calthorpe, the prominent figure in the New Urbanism movement, provides a brief overview of a Transit-Oriented Development (TOD) as a diverse community situated within a 2000 feet (or 10-minute) radius of both a core commercial center and a transit station. TOD integrates many elements such as shops, housing, workplaces, public spaces, and green spaces, to create a pedestrian-friendly setting. This design facilitates the use of public transit, walking, cycling, or driving for both employers and residents (Furlan et al., 2021). The half-mile measure, which is about 800 meters, aligns with the Livable Neighborhoods Community Design Code of the Western Australian Planning Commission (WAPC) has also been widely utilized in other research studies (Dittmar & Ohland, 2003; Reid Ewing, 1999). The reason for using an 800m walkable catchment radius is because distances above 800m are considered "formal destinations" where individuals are more inclined to use transportation other than walking. Calthorpe differentiates between a "TOD district" (situated near local bus routes that connect to railway lines) and an "urban TOD" (situated right next to a railway line). Originally, several forms of Transit-Oriented Development (TOD) were primarily designed to urbanize suburban areas. Figure 1 illustrates that Calthorpe envisioned urban TODs to prioritize job hubs rather than housing- areas (Carlton, 2009).

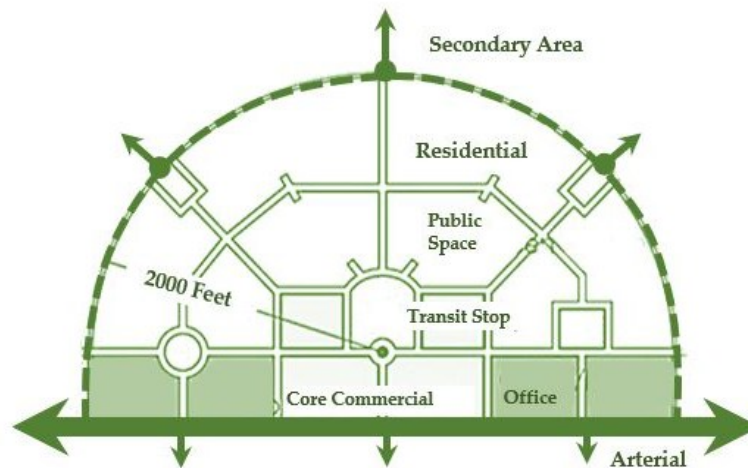


Figure 1. Concept of transit-oriented development (TOD) (Calthorpe, 1993).

TOD advocates for the development of urban areas that incorporate a variety of land uses, such as housing, recreation, commerce, and employment. This development is planned with a focus on pedestrians, ensuring that the scale of the area is suitable for walking while also accommodating cars. A compact city plan can provide proximity to transit terminals. This facilitates commuters to reach their desired locations more conveniently, hence fostering increased usage of public transportation by improving accessibility. TOD refers to the revitalization of an existing neighborhood or the creation of new structures that are designed to promote the use of sustainable and convenient modes of transportation, such as walking, cycling, and public transit (Lamour et al., 2019; Marthya et al., 2021). Figure 2 depicts a notion of a compact node for TOD (Transit-Oriented Development).

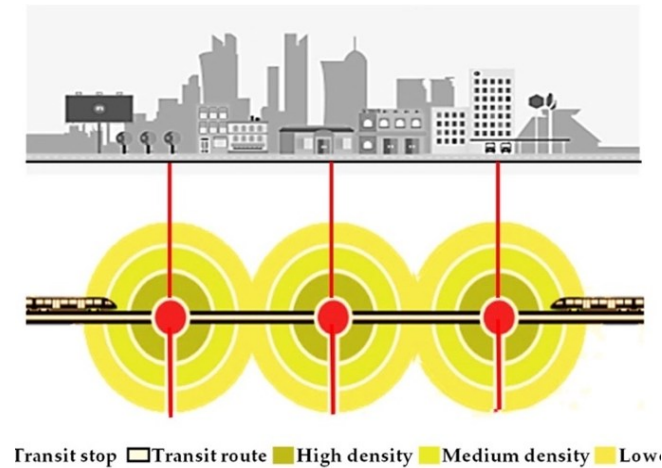


Figure 2. TOD nodes are interconnected with a public transit system (Nafi et al., 2021).

According to the US state of Florida, TODs are considered as specific places that include a combination of several types of land use, are compact, have a moderate to high population density, are connected to other land uses, are favorable to pedestrians and cyclists and are intended to support frequent transportation services that operate either independently or together (Pal, 2018). Many definitions agree that a well-executed Transit-Oriented Development (TOD) improves the transportation system of a specific area and boosts economic opportunities for its customers. These advantages arise from a variety of causes, namely the creation of mixed-use facilities that are conveniently located in a small area. These facilities cater to the demands of users and allow for beneficial and active activities throughout the day and night (Alwehab et al., 2016).

TOD rules must encompass both transportation and development, as well as urban form. The objective is to establish a condensed, top-notch, diverse development that is conducive to walking and incorporates effective public transportation alternatives. Introducing a novel kind of development into a thriving urban area with a high density of existing construction and a well-established transit system is a complex task. However, in the case of a large city, it might be advantageous to create transit systems before or concurrently with the establishment of the urban infrastructure, as this can have positive implications for future growth plans. Refer to Figure 3 (Loo et al., 2010) for further details.

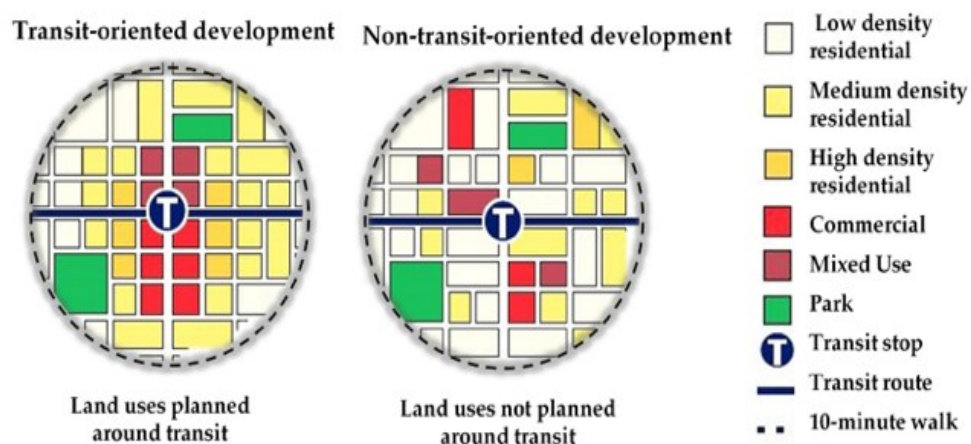


Figure 3. The ideal design of cities.

Transit-oriented development is characterized as a concentrated combination of pedestrian-friendly, moderately compact construction centered around transit stations. Its purpose is to promote the usage of public transportation, improve the quality of walking and cycling, and provide alternatives to private automobile usage. An ideal neighborhood should have bicycle and pedestrian networks within

a radius of approximately 400 m, along with tram and/or bus stations located at the periphery. Tram, metro, and/or bus stops should be situated at the outer edges of neighborhoods with a radius of approximately 800 m to facilitate simple access (Ann et al., 2019).

TOD is a planning approach that emphasizes compact, mixed-use development close to transit nodes to encourage walking, cycling, and the use of public transportation. Key principles of TOD include density, diversity, and design. Density refers to the concentration of development around transit stations, encouraging higher land use intensity and reducing the need for car travel. Diversity is the integration of various land uses, including residential, commercial, and recreational, within a short walking distance of transit stations, thereby fostering livable, vibrant communities. The primary objective of design principles is to establish pedestrian-friendly environments that are equipped with amenities that facilitate social interaction and active transportation, as well as well-connected streets and public spaces.

2.3 Integration of Metro Stations with the Urban Fabric considering TOD concept

Integration of transit-oriented design (TOD) and pedestrian-oriented design can create a convenient, safe, and suitable walkable environment in the station area (Wey & Chiu, 2013). Shorter and faster trips result from the combination of different roles and activities. These land uses include public open spaces, medium-to-high-density regions of population, offices, retail stores, services, and commercial hubs (Wey, 2015). The integration of metro stations with the urban fabric, particularly with a focus on Transit-Oriented Development (TOD), is crucial for creating sustainable, accessible, and vibrant cities. Different literature discussed how such integration can be achieved. Some are discussed below:

- a) **Mixed-Use Development:** Encourage the development of mixed-use buildings around metro stations. This includes a combination of residential, commercial, and retail spaces. Mixed-use development optimizes land use and fosters a vibrant urban setting where individuals may reside, work, and engage in recreational activities close to the station.
- b) **Pedestrian Connectivity:** Design pedestrian-friendly pathways and plazas to connect metro stations with surrounding neighborhoods seamlessly. Safe and attractive walkways enhance accessibility and encourage walking as a mode of transportation, reducing reliance on cars.
- c) **Transit Plaza Design:** Create well-designed transit plazas around metro stations as focal points for community gatherings and activities. These plazas can serve as vibrant public spaces with seating, greenery, public art, and amenities such as bike-sharing stations and outdoor cafes.
- d) **Bicycle Infrastructure:** Implement bicycle lanes, racks, and storage facilities near metro stations to promote cycling as a sustainable mode of transport. Integrating bike-sharing systems with metro stations encourages multi-modal commuting and provides convenient first and last-mile connectivity.
- e) **Affordable Housing:** Ensure the availability of affordable housing options near metro stations to accommodate a diverse range of residents. TOD should prioritize inclusivity and prevent displacement of existing communities by offering a mix of housing types and income levels.
- f) **Transit-Oriented Zoning:** Establish zoning regulations that support TOD principles, such as higher density near metro stations and reduced parking requirements. TOD zoning encourages compact, walkable development patterns that minimize sprawl and maximize transit accessibility.
- g) **Public Spaces and Green Infrastructure:** Integrate parks, plazas, and green spaces into the design of metro station areas to improve the quality of life for both residents and visitors. Green infrastructure offers recreational opportunities, enhances air quality, and reduces the urban heat island effect.
- h) **Transit-Oriented Design Guidelines:** Develop design guidelines that promote transit-oriented principles and ensure compatibility with the surrounding urban fabric. These guidelines should address building setbacks, façade articulation, street-level activation, and other factors that contribute to a cohesive and pedestrian-friendly environment.

- i) **Community Engagement:** Involve local communities, stakeholders, and transit users in the planning and design process of metro station integration. Community input ensures that TOD projects reflect the needs and aspirations of residents and fosters a sense of ownership and pride in the development.

TOD around existing transit stations is complicated because it implies certain types of development in qualitatively different forms of structure it replaces (Rayle, 2015). Nevertheless, additional research has also regarded the Ds model as a more precise method for determining the potential performance of Transit-Oriented Development (TOD) in station areas. Destination, density, diversity, distance, design, and demand management are all factors this model considers (Dittmar & Ohland, 2003). After analyzing the literature and the preceding discussion, Table 01 has highlighted key indicators essential for evaluating station areas. These components are crucial for attaining the study's goals and assessing a possible Transit-Oriented Development (TOD) station.

The density context in Table 1 is represented by the population surrounding the station area and the total number of passengers at each operational station. Additionally, the contexts provide a comprehensive overview of various land use patterns, such as the number of businesses and employment within the catchment area of transportation stations. The design contexts delineate the attributes related to accessing transport services at the station. These encompass the station's connectivity with other transportation modalities, essential amenities, safety, and pedestrian accessibility in the streetscape.

By implementing these strategies, cities can effectively integrate metro stations with the urban fabric and realize the full potential of Transit-Oriented Development as a catalyst for sustainable and inclusive growth.

Table 1: TOD Indicators to integrate station area with the urban fabric.

Indicators	Employment influences on station area assessment	Related context
Population density	Number of the population within a catchment area	Density
Total ridership	Number of commuters for each active station	Density
Employment around transit	Number of jobs within a catchment area	Diversity of land use
Commerce around transit	Number of businesses in a catchment area	Diversity of land use
Walkability	Availability of walkable foot-paths around the station area	Design
Distance to transit station	distance between an origin to the station	Design
Built environment design	Quality of street crossing improved for pedestrian accessibility to station, including ped-shed, lighting around the station area	Design
Station accessibility	Basic amenities, commuter safety at the transit station	Design
Station Capacity	Accessibility of the station for intermodal connections	Design
Parking lots	Availability of car parking in the area of a transit station	Design

2.4 Study area: Metro line 6 and Agargaon Station

The Dhaka Metro Rail is a high-level mass rapid transit (MRT) system that is part of the 20-year Strategic Transport Plan (STP) established by the Dhaka Transport Coordination Authority (DTCA), a governmental organization. Line 6 (Figure 4) comprises a total of 16 elevated stations, with each station being 180 meters in length. Additionally, the line spans a distance of 20.1 kilometers and is powered by electricity, utilizing light rail tracks. The entirety of Line 6, except for the depot, is constructed at an elevated level over existing highways, namely above the medians, to facilitate the smooth flow of traffic beneath it. The stations are likewise built at a raised height. Therefore, it serves the purpose of designating regions for investment and coordinating policies to facilitate compact growth. The Agargaon station on MRT line 6 has been selected as an empirical case for this study. It is already constructed and mostly exhibits administrative and mixed-use features, as seen in Figure 5. The TOD precinct has been selected based on a radius of 800 meters, which aligns with the theoretical definition of TOD as a 10-minute walking distance according to Calthorpe (Calthorpe, 1993).

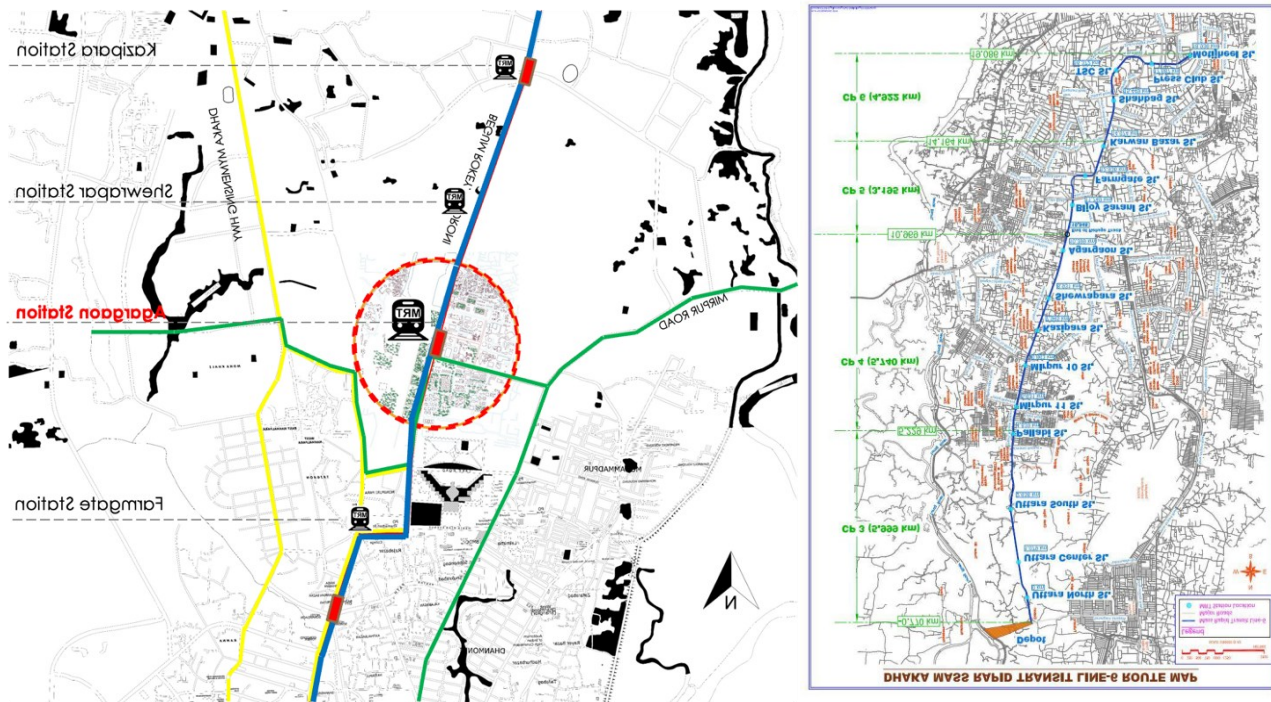


Figure 4. Line 6 and location of Agargaon Metro Station.



Figure 5. Image of its surrounding area.

Dhaka Metro within the city's urban framework by upholding the principles of transit-oriented development. This effort involves the comprehensive exploration of diverse aspects of station area design, aimed at elevating user comfort and convenience. This integration required improvements of station amenities, incorporating tangible features like parking facilities, transfer modes, metro ridership data, pedestrian pathways, bicycle provisions, feeder shelters, and taxi stands, all vital for enabling smooth transitions within a multifaceted transportation network.

3. Materials and Methods

To accomplish the goals of this study, a mixed-method approach was employed, integrating both qualitative and quantitative methods. This comprehensive methodology was executed through the following key steps (Figure 6):

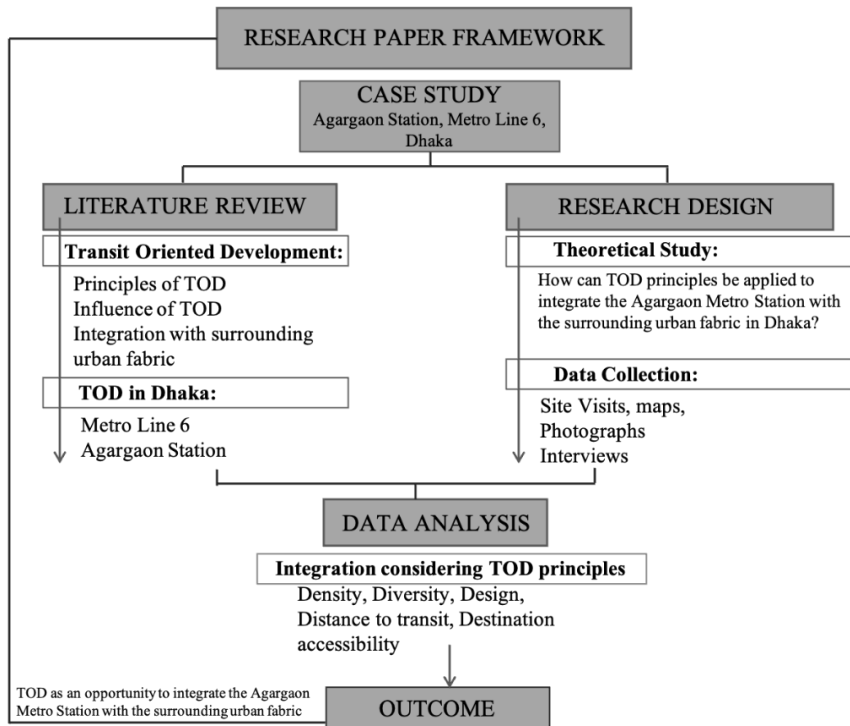


Figure 6. Research Methodology.

3.1 Literature Review

The literature review served as the foundational phase, encompassing an extensive array of sources related to Transit-Oriented Development (TOD) in both international and local contexts. This review included academic articles, policy documents, and case studies, focusing on the principles of TOD, its relationship with sustainability, and concepts of smart growth. The review aimed to identify critical elements for effective TOD implementation, such as pedestrian-friendly areas, public accessibility, mixed-use development, connectivity, walkability, and a comprehensive public transportation system. The findings from this literature review informed the theoretical framework and conceptual model used in the study, providing a basis for understanding how TOD principles could be applied to the specific context of Dhaka.

3.2 Data Collection

Data collection involved both qualitative and quantitative approaches, gathering a range of verbal and graphic information. This phase included:

3.2.1. Field Observations

Multiple site visits were conducted to the Agargaon Metro Station area to assess the current physical and social conditions. The selection criteria for these observations focused on key TOD factors such as pedestrian flow, infrastructure quality, land use diversity, and public space utilization. Observations were systematically recorded through detailed field notes and photographs, capturing the area's dynamics and identifying potential for TOD interventions.

3.2.2. Stakeholder Interviews

Key stakeholders were selected for interviews based on their relevance and expertise in urban planning, local governance, transportation, and community engagement. These interviews provided qualitative data on the perceptions, challenges, and opportunities related to the integration of the

metro system with the urban environment. The interviews were semi-structured, allowing for flexibility in exploring various aspects of TOD while ensuring coverage of essential topics.

3.2.3. Quantitative Data Collection

Quantitative data were gathered on demographic trends, land use patterns, transportation modes, and infrastructure features in the study area. This data provided a statistical basis for analyzing the current urban dynamics and assessing the potential impact of TOD.

3.3 Data Analysis

Data analysis involved a detailed examination of both qualitative and quantitative data. The qualitative data from field observations and interviews were analyzed using thematic analysis, identifying key themes and patterns related to TOD elements and urban integration challenges. This analysis helped in understanding stakeholder perspectives and the practical implications of TOD implementation.

Quantitative data were analyzed using statistical methods to identify trends and correlations between different urban factors, such as population density, land use diversity, and transportation accessibility. GIS (Geographic Information System) tools were also employed to visualize spatial relationships and highlight areas of potential improvement.

4. Findings

The results section of this study is split into three distinct parts. The first section provides a comprehensive examination of the study area, which is further classified as follows: (1) population density and ridership, (2) land use, (3) Road Network, (4) pedestrian accessibility, (5) Traffic movement, (6) Existing building condition, and (7) urban fabric. The subsequent section presents a detailed analysis of the valuable information obtained from the interviews conducted with experts. The third section comprises the recommendations and guidelines that primarily address the examination of mixed-use spaces, community and public spaces, public realms and pedestrian-oriented development, connectivity and walkability, and an integrated public transit system.

4.1 Site Analysis

This section provides a comprehensive overview of the study area considering the following factors: (1) population density and ridership, (2) land use, (3) Road Network, (4) pedestrian accessibility, (5) Traffic movement, (6) Existing building condition, and (7) urban fabric.

4.1.1. Population Density and Total Ridership

The Agargaon area falls within the administrative zones of Ward 27 and Ward 28 of Dhaka city. It is located in the Sher-E-Bangla Nagar Thana, which, as of the 2022 census, has a population of approximately 142,640, a total area of 4.911 square kilometers, and a population density of 29,046 persons per square kilometer. This station is targeted to serve several neighborhoods, including Ward 28 Agargaon Staff Quarter, West Agargaon, Kafrul, Taal Tola Staff Quarter, Shamoli Road No. 1, the Space Science Building, and the G Type area. The Ministry of Communication (MOC) authorized the Strategic Transport Plan (STP) developed by the Dhaka Transport Coordination Board (DTCB) in December 2006, which identified MRT Line 6 as a high-priority project in its Phase 1 Study. The proposed MRT Line 6 is expected to attract a substantial number of passengers due to the high demand for trips along this corridor, which surpasses that of other corridors both presently and in the future.

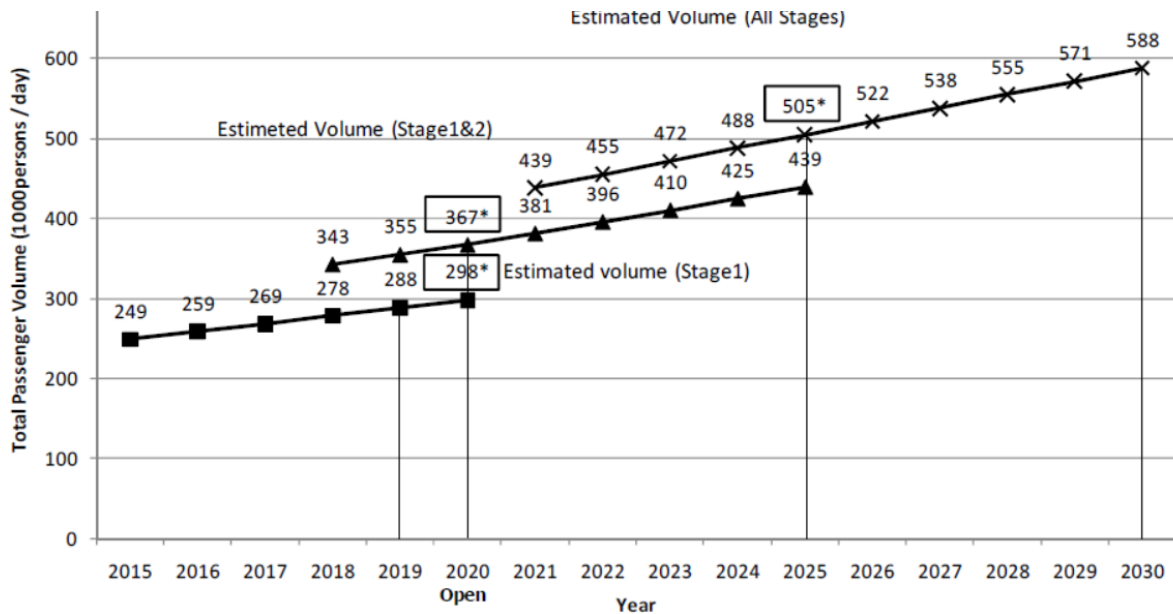


Figure 7. Population density and ridership.

The survey report published by the metro rail construction authority prior to the construction of the metro rail in 2014 presents the comparative findings of traffic count, as displayed in Table 2. This outcome is the mean synopsis of the traffic count conducted over a period of one week. The vehicle has been classified into two categories: Motorized Traffic (MT), which includes vehicles such as Jeeps, cars, motorcycles, auto-rickshaws, minibuses, buses, and trucks, and Non-Motorized Traffic (NMT), which includes vehicles like rickshaws and vans. The survey findings were multiplied by the Passenger Car Unit (PCU), and the gross total was represented by G. Total. Two methods have been used to conduct the traffic count at each point.

Table 2: Traffic Count at Various Points From Mirpur 12 to Agargaon Road

Traffic Count at Various Points From Mirpur 12 to Agargaon Road								
Location: Mirpur-12, Mirpur-10, Agargaon								
Survey Location	Direction	Total MT (PCU)		Total NMT (PCU)		G. Total (PCU)		Remarks
Mirpur10	Mirpur 10 To Agargaon	1653	742	970	242	2622	983	62.50% Less than before
	Agargaon to Mirpur 10	1497	710	992	289	2489	1000	59.82% Less than before
Agargaon	Agargaon To Farmgate	1765	1223	1037	876	2802	2099	25.10% Less than before
	Farmgate To Agargaon	1558.67	1102	850.5	700	2409	1802	25.20% Less than before

4.1.2. Land Use

The current land use of the site is predominantly characterized by a varied combination of development, encompassing residential structures, a hospital, commercial establishments, public institutions, and a recreational space. The commercial uses encompass shopping complexes and office space, whilst the residential uses comprise low-income housing and staff quarters. Public institutions include IDB Bhabhan, governmental offices, and several educational establishments. During the site visit and observation, it was observed that the Agargaon area lacks accessible green areas and public places, which hampers social inclusion and interaction. Furthermore, at present, outdoor areas that are intended to foster social engagement among persons have typically been disregarded. Figures 8 depict the notable characteristics of the study area.



Figure 8. Land use of the study area and accessible and non-accessible green areas.

4.1.3. Road Network

The road network surrounding the Agargaon MRT station area exhibits a mix and coexistence of the grid layout and spontaneous, organic development. The road network surrounding the new MRT station has a more natural and harmonious layout. Based on the physical assessment, the road design may be categorized as a

- Primary Arterial Road, namely the Agargaon Road, which serves as a connection for major offices and commercial buildings.
- Secondary roads refer to distributary roads that provide access to major roadways.
- Local road tertiary - Provides access to specific properties or structures.



Figure 9. The road network of the study area.

4.1.4. Pedestrian accessibility

The Agargaon station features extensive pedestrian pathways on either side of the station, which transition into comparatively narrower pathways on secondary roads. The station lacks dedicated bicycle stands and parking facilities, although it provides universal access to and from the station. Commuters predominantly rely on rickshaws, which do not have designated stands, resulting in traffic congestion on the feeder roads. Additionally, due to the proximity of the old airport site on the

opposite side of the station, commuters primarily utilize the pedestrian pathways on the IDB building side. Additionally, squatters and street sellers have encroached on the feeder pedestrian way, making it difficult for pedestrians to walk freely and safely.



Figure 10. Pedestrian frequency of surrounding roads.



Figure 11. Pedestrian accessibility of surrounding roads.

4.1.5. Traffic movement

Agargaon experiences moderate average daily traffic relative to the rest of the city. The commuter demographic is primarily composed of office employees, workers, and residents of staff quarters. Additionally, due to the area's designation as an institutional zone, individuals from various regions visit for a range of purposes, including academic, administrative, and professional engagements. Traffic congestion typically occurs between 9:00 and 11:00 am, coinciding with the arrival of commuters, primarily from the Mirpur area. This congestion is most pronounced at major nodes where bus stops and transit hubs are located. After 7:00 pm, traffic volumes decline significantly as office hours conclude and workers depart for their homes (Figure 12). This daily pattern underscores the critical influence of work schedules and institutional activities on traffic dynamics in Agargaon.

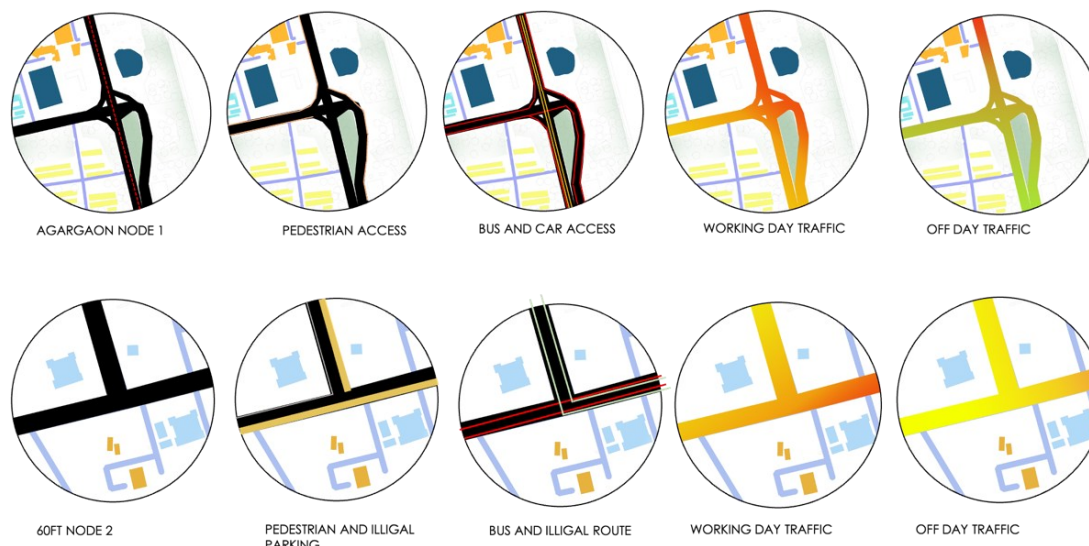


Figure 12. Traffic movement of different modes of surrounding roads of the station area.

4.1.6. Condition of Buildings in the Area

The Agargaon area, within an approximate 800-meter radius, presents a complex and evolving urban landscape characterized by a blend of modern and traditional structures. This region has undergone significant development, particularly in the last decade, transforming into a major administrative and healthcare hub in Dhaka.

Table 3: TOD Indicators to integrate station area with the urban fabric.

Institution	Building Condition
Administrative structure	The Administrative structure of Agargaon exemplifies substantial advancements in urban planning and development. National Board of Revenue (NBR) Headquarters - A modern 12-story building with automated building management systems and fire safety measures. Bangladesh Election Commission - Plays a crucial role in overseeing elections throughout the country. Bangladesh Public Service Commission - Responsible for recruiting civil servants. Bangladesh Bureau of Statistics (BBS) - The principal government agency for statistical data. Bangladesh Atomic Energy Commission - Focuses on research and development in nuclear science and technology. Bangladesh Institute of Governance and Management (BIGM) - Provides postgraduate education in governance and management, and Institute of Architects Bangladesh (IAB) - A professional organization for architects that also engages in educational and advocacy activities.
Healthcare Institutions	Agargaon is a critical healthcare hub in Dhaka, hosting key medical institutions such as the National Institute of Cardiovascular Diseases, the National Institute of Kidney Diseases & Urology, and Shaheed Suhrawardy Medical College and Hospital. These facilities not only provide essential healthcare services but also boost the local economy by attracting patients, healthcare professionals, and ancillary services. The concentration of these institutions underscores Agargaon's strategic importance in the national healthcare infrastructure.
Residential and Educational Facilities	The residential landscape in Agargaon includes a mix of older government staff quarters and newer apartment complexes. This area is also notable for its educational institutions, such as the Sher-e-Bangla Agricultural University and several secondary schools, which cater to the local and surrounding communities. The presence of these institutions not only serves the educational needs of the population but also contributes to the socioeconomic vibrancy of the area.
Mixed Use and recreational amenities	20-storey BCS Computer City which is a commercial hub mainly for electronics and computer-related products. BICC building- used for conferences, exhibitions and trade fairs. Other than that there are a park (Chandrima Uddyan), a children's amusement center (Shishu Mela), and two museums- the Liberation War Museum and the National Museum of Science and Technology. These mixed-use buildings and recreational facilities highlight Agargaon's strategic importance in Dhaka's urban landscape, providing a blend of residential, commercial, institutional, and recreational spaces that cater to a diverse population.

4.1.7. Urban Fabric: Solid and Void

Figure 13 illustrates the proportionate allocation of "solid" and "void" spaces within the study area, together with the existence of both grid and organic street patterns in the urban layout. However, that there are good proportion of open and green areas exists in the study area but most of them are restricted.



Figure 13. Built area and open area of the study area.

4.2 Stakeholder interviews

To gain a comprehensive understanding of the challenges and opportunities in this integration process, feedback was collected from various stakeholders, including Architects and urban planners, local government officials, community members, and transportation experts. The primary subjects of discussions revolved around Transit-Oriented Development (TOD) as a concept and integration of the Agargaon station area with the surrounding urban fabric. This summary encapsulates the key points raised by these stakeholders.

4.2.1. Urban Planners and Designers

Urban planners emphasized the importance of enhancing pedestrian and bicycle infrastructure around the station. They noted that currently, the station lacks sufficient sidewalks, pedestrian crossings, and dedicated cycling paths, making it difficult for users to access the station safely. They suggested implementing wider sidewalks, pedestrian bridges, and secure bike parking facilities to encourage non-motorized transport modes. Also highlighted the potential for mixed-use developments around the station.

4.2.2. Local Government Officials

Local government officials focused on the need for improved coordination between different agencies involved in urban development and transportation planning. They pointed out that fragmented planning efforts have led to a lack of cohesive strategies for integrating metro stations with existing urban areas. Officials stressed the importance of developing comprehensive land-use plans that align with the goals of Transit-Oriented Development (TOD). Additionally, they acknowledged the challenge of managing informal settlements and vendors around the station area. While these informal activities provide livelihoods for many residents, they often lead to congestion and hinder pedestrian movement. Officials suggested creating designated spaces for vendors and implementing regulations to manage informal activities effectively.

4.2.3. *Community Members*

Feedback from community members revealed concerns about accessibility and safety. Many residents noted that the current access points to the station are inconvenient and poorly maintained, particularly for the elderly and people with disabilities. Safety was another significant concern. Community members reported feeling unsafe due to inadequate lighting and a lack of security measures around the station, especially during early morning and late evening hours. They called for increased security personnel, better lighting, and CCTV surveillance to enhance safety and security.

4.2.4. *Transportation Experts*

Transportation experts emphasized the necessity of a multimodal transport network to complement the metro system. They recommended the development of feeder bus routes, shared transportation options (such as ride-sharing and auto-rickshaws), and well-designed drop-off/pick-up zones around the station. Experts also discussed the need for effective wayfinding and information systems to guide passengers smoothly between different modes of transport. They highlighted the potential for using digital technology, such as mobile apps and real-time information displays, to keep commuters informed about transit schedules and services.

The stakeholder feedback underscores the multifaceted challenges and opportunities involved in integrating Agargaon Metro Station with its surrounding urban fabric. Key recommendations include improving pedestrian and cycling infrastructure, enhancing safety and accessibility, promoting mixed-use developments, managing informal activities, and ensuring effective coordination between planning agencies. Addressing these concerns and leveraging the opportunities identified by stakeholders can significantly enhance the usability and appeal of the metro system, fostering a more connected, accessible, and vibrant urban environment around the Agargaon Metro Station.

5. Discussion

Analyzing the mode of transport and its impact on the urban fabric near Agargaon Metro Station requires the following issues that must be addressed such as infrastructure, connectivity, pedestrian access, and land use. This analysis will provide insights into how the transportation system interacts with the surrounding urban environment and influences its development.

- a) Expand and improve footpaths: Work with the relevant authorities to expand and improve the footpaths underneath and around the stations. This could involve widening the existing footpaths or constructing new ones where necessary. The footpaths should be designed to accommodate the expected volume of pedestrians, ensuring safety and ease of movement.
- b) Reorganize rickshaw stands: Properly organize and designate rickshaw stands in a way that minimizes their impact on traffic flow. Ensure that the stands are located in areas that do not obstruct the movement of vehicles and pedestrians. Consider the number of rickshaws that can be accommodated at each stand to avoid overcrowding.
- c) Reorganize rickshaw stands: Properly organize and designate rickshaw stands in a way that minimizes their impact on traffic flow. Ensure that the stands are located in areas that do not obstruct the movement of vehicles and pedestrians. Consider the number of rickshaws that can be accommodated at each stand to avoid overcrowding.
- d) Integration with other modes: Enhance the connectivity between the metro station and other modes of transport, such as Bi-cycle, bus stops, and parking facilities. This will encourage commuters to use the metro as their primary mode of transport, reducing the reliance on rickshaws and private vehicles.
- e) Dedicated pick-up and drop-off zones: Designate specific pick-up and drop-off zones for rickshaws near the metro station. This will help streamline the flow of rickshaws and reduce congestion caused by random stopping and parking. These zones should be clearly marked and easily accessible for both rickshaw drivers and passengers. Additionally, consider implementing dedicated pedestrian-only zones around the stations to further enhance safety.
- f) Increased Economic Activity: Pedestrian-only zones have the potential to boost local businesses and economic activity. With more people walking in the area, there is a higher likelihood of

increased foot traffic and potential customers. This can lead to the revitalization of local businesses and the creation of new economic opportunities.

- g) **Implement traffic management measures:** Work with local authorities to implement traffic management measures around these stations. This could include traffic signals, pedestrian crossings, and speed reduction measures to improve safety for pedestrians.
- h) **Environmental Benefits:** By reducing vehicular traffic, pedestrian-only zones contribute to lower levels of air pollution and noise pollution. This helps improve the overall environmental quality of the area, making it more sustainable and enjoyable for everyone.
- i) **Improved Aesthetics:** Pedestrian-only zones often incorporate elements of urban design, landscaping, and public art, enhancing the visual appeal of the area. This creates a more attractive and inviting space for pedestrians, contributing to the overall beautification of the station's surroundings.
- j) **Involve community participation:** Engage with the local community and stakeholders to gather feedback and suggestions on improving the safety and functionality of the footpaths. This collaboration can help identify specific challenges and implement solutions that take into account the needs and concerns of commuters and city dwellers.
- k) **Raise awareness and educate:** Conduct awareness campaigns to educate both commuters and city dwellers about the importance of pedestrian safety and responsible behavior. Encourage pedestrians to use designated footpaths, follow traffic rules, and be aware of their surroundings to minimize the risk of accidents.

6. Conclusion

The successful integration of metro stations with the adjacent urban fabric using Transit-Oriented Development (TOD) principles is essential for promoting sustainable urban development and enhancing the quality of life in Dhaka City. Dhaka can foster lively and pedestrian-friendly communities by prioritizing density, diversity, and design around transit hubs, ensuring that citizens have easy access to convenient, affordable, and environmentally friendly transportation options. However, achieving this vision requires concerted efforts from government agencies, private developers, and local communities to overcome various challenges and seize opportunities for positive change.

The findings of this study confirm the feasibility of implementing TOD in both the inner areas and new parts of the city. The analysis revealed that macro-scale urban structure traits—such as density, mixed land use, and connectivity—align more closely with TOD requirements compared to micro-scale traits like streetscape characteristics. This underscores the importance of considering macro-scale features in promoting sustainable modes of transportation, particularly in addressing critical issues such as traffic congestion and inefficient transportation systems, which pose significant barriers to economic productivity and social interaction.

Furthermore, the promotion of mixed-use developments has the potential to invigorate local economies and cultivate vibrant communities, thereby enhancing residents' overall quality of life. The integration of various modes of transportation, coupled with the establishment of pedestrian-friendly infrastructure, aims to connect diverse communities and foster equitable access to resources and opportunities. To address the car-oriented design practices prevalent in Dhaka, the study suggests modifications to design regulations and procedures. City officials and practitioners should move beyond cosmetic design projects and focus on broader aspects of the built environment, including physical, social, aesthetic, and functional dimensions.

Moreover, this research emphasizes the importance of engaging stakeholders—including urban planners, government officials, and community members—to gather insights and encourage community participation in the planning process. This participatory approach empowers local communities, ensuring that their needs and aspirations are effectively incorporated into urban development initiatives. Highlighting the economic advantages associated with TOD—such as

increased property values, enhanced opportunities for local businesses, and improved environmental conditions—this study seeks to influence policy decisions that advocate for sustainable urban growth. Despite its contributions, the study has limitations in terms of generalizability due to the lack of detailed digital data. Future research could further explore microscale challenges in TOD walkability, examine the reflection of urban forms in different contexts, and compare selected stations with examples from both developing and developed nations. Incorporating graph theory, space syntax, social network indices, and behavioral research would provide insights into the relationship between physical characteristics and mobility patterns.

Overall, this study contributes significantly to the field of urban design by offering an evaluative framework for assessing the compliance of station areas with TOD principles. By providing a structured approach, it helps stakeholders understand the essential components of TOD and guides them in making informed decisions. Continued research is essential to address the identified limitations and explore additional aspects of TOD design and implementation. Ultimately, this work aims to support the development of a more sustainable, accessible, and livable urban environment in Dhaka and similar rapidly growing cities, thereby enhancing both the social and economic dimensions of contemporary urbanization.

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The author(s) declare(s) no conflicts of interest.

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The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

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