



Original scientific paper

# Socio-Economic Impact of the Mass Rapid Transit (MRT) System in Dhaka: A Case Study of Mirpur Stations

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## ABSTRACT



*Mass Rapid Transport (MRT) has become pivotal in sustainable urban transportation, especially in densely populated cities like Dhaka, the capital of Bangladesh. Dhaka is implementing its first MRT system, which includes 17 stations, with three located in Mirpur. Mirpur, a significant area due to its diverse economic activity and population, is an important case study for understanding the effects of the MRT system. The study area spans 58.66 square kilometers and has a population of 632,664, representing a zone with unplanned mixed uses and a spontaneously developed favorable job-housing ratio conducive to transit-oriented development (TOD). Challenges such as last-mile connectivity and capacity limitations could impede the MRT's socio-economic potential. Moreover, the current land use and urban planning framework are not adequately prepared to support future TOD. This research highlights the necessity of proactive legislative changes and infrastructural improvements to optimize the success of Mirpur's MRT stations. Despite being in service for only a year and facing a lack of real-life data, this study focuses on Mirpur MRT stations to explore the socio-economic impacts of MRT systems, aiming to enhance knowledge in urban transportation and development.*

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### Highlights:

- MRT-6 aims to introduce a new mass transport mobility option as part of the future TOD policy.
- Examination of the MRT-6 route and station surroundings to assess socioeconomic impact.
- Implementation of MRT-6 has been ongoing for one year, with limited practical data available for conclusive study.
- Continued Research on MRT station success is necessary.
- Proactive Legislative Changes and infrastructural enhancements are crucial, as highlighted by this research.

### Contribution to the field statement:

This study advances the field of urban transportation by evaluating the socio-economic impacts of the MRT-6 system in Dhaka. It fills a critical gap in understanding MRT's effects on unplanned urban areas, proposing legislative and infrastructural improvements for optimal transit-oriented development (TOD), thereby enhancing sustainable urban growth and policy formulation.

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## 1. Introduction

### 1.1 Background and Context

Dhaka, the capital of Bangladesh, is among the world's most populous and densely populated cities, with over 10.2 million residents (BBS, 2022). The city has experienced rapid urbanization in recent years, marked by a population growth rate of 3.26% (WPR, 2024). Additionally, Dhaka attracts 3-4 million migrants annually from different parts of the country due to better job opportunities and higher wages (Karim, 2015). In 2018, Dhaka was ranked ninth in urban agglomeration among the top 67 cities globally, and it is projected to rank fourth by 2030 (The Economist Intelligence Unit, 2018). In a global urban risk assessment, Dhaka ranked second in four categories: Critical Infrastructure, Environment, Socio-Institutional, and Economic (TBS, 2023). The city's rapid urbanization has resulted in numerous challenges, including a lack of affordable housing, urban poverty, inadequate healthcare, limited empowerment of women, poor public transportation, illiteracy, slums, institutional corruption, social inequities, and insufficient green spaces (Barai, 2020). These issues are further compounded by severe traffic congestion due to a transportation system heavily reliant on road-based vehicles such as cars, buses, mini-buses, auto-rickshaws, cycle-rickshaws, and human haulers, all contributing to increased safety concerns and traffic accidents (Raj & Naem, 2022). Traffic congestion significantly impacts environmental pollution, particularly air quality, due to emissions of carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>) from congested traffic (Arefin, Mallik, & Islam, 2017). The economic loss associated with traffic congestion for a commuter is estimated at \$4 per day (Haider & Papri, 2021). Implementing a Transit-Oriented Development (TOD) strategy is essential for achieving sustainable urban development and meeting the Sustainable Development Goals (SDGs) by 2030 (Raj & Naem, 2022). The Strategic Transport Plan (STP) for Dhaka (2004-2024), developed by Louis Berger Inc. and BCL, introduced the concept of TOD by proposing an MRT system in Dhaka. The Japan International Cooperation Agency (JICA) conducted the Dhaka Urban Transportation Network Development Study (DHUTS) Phase 1 in collaboration with the Dhaka Transport Coordination Authority (DTCA), which emphasized an elevated metro rail system as a priority project to address the city's growing transportation challenges. The proposed MRT system is designed based on future urban socio-economic indicators rather than existing economic activity levels to address these issues (RAJUK, 2015). The Dhaka Structure Plan (2016-2035) recommended developing a mass transport system to ensure balanced urban development rather than focusing solely on traffic management within the existing urban areas.

A World Bank report proposed three elevated MRT and three Bus Rapid Transit (BRT) systems, with routes including MRT-1, 5, 6, and BRT-1, 2, 3 (DMTCL, 2020). MRT-6, which is partially operational, currently includes 16 stations on an elevated route connecting Uttara North and Motijheel. The MRT lines are expected to handle 10% of total traffic, with BRT-1 expected to be completed by 2035 (RAJUK, 2015).

### 1.2 Problem Statement

Dhaka, home to over 10.2 million people, faces enormous pressure on its infrastructure and public services due to rapid urban growth. The city is plagued by challenges such as housing shortages, increased poverty, inadequate healthcare, insufficient public transport, and severe traffic congestion. These problems are exacerbated by the reliance on diverse road transport modes and the lack of coordination among various transport agencies, leading to significant environmental pollution, economic losses, and social disruptions.

To address these challenges, government initiatives and research funded by the World Bank and JICA have emphasized the implementation of Transit-Oriented Development (TOD) through strategic transport plans. These plans include developing multiple MRT systems to alleviate transportation issues and promote sustainable urban growth. Despite the operationalization of MRT-6 for one year, existing studies and implementations have inadequately explored the socio-economic impacts of MRT-6 and the integration of station influence zones into surrounding urban plans. This creates an urgent



need for a comprehensive evaluation of the MRT-6 system to assess its impact on urban development and to develop effective strategies for TOD adoption.

### 1.3 Research Gap

- **Inadequate Consideration of Socio-Economic Factors:** Current studies on MRT systems primarily focus on trip characteristics based on future projections. There is a lack of comprehensive analysis that includes the socio-economic impacts of MRT stations and their influence zones, which is crucial for evaluating the MRT-6 system's impact on urban development.
- **Limited Focus on Land Use Planning:** While strategic plans propose developing transport routes to facilitate balanced urban growth, there is insufficient research on the redevelopment and densification of land uses around MRT stations. This gap restricts the potential of the MRT-6 system to promote TOD and sustainable urban expansion.
- **Scarcity of Empirical Studies on Environmental and Economic Impact:** Despite the pressing issues of traffic congestion and environmental pollution in Dhaka, there are few empirical studies that assess the effectiveness of the MRT-6 system in addressing these challenges. Comprehensive research is needed to evaluate the environmental benefits and economic savings associated with MRT-6 implementation.

This study aims to address these research gaps by thoroughly examining the MRT-6 system's impact on Dhaka's urban development. It uses three station areas as a pilot study to develop strategies for TOD adoption, contributing to the city's sustainable growth and long-term urban development goals.

### 1.4 Objectives of the research

Public transportation is a vital solution to traffic congestion and other urban transportation challenges. Advanced, reliable, and well-organized transit systems enhance mobility and ensure safe access to employment, community services, healthcare, education, and recreational activities. As an essential public good, public transportation must provide adequate mobility for all, including vulnerable groups such as the elderly, disabled, and economically disadvantaged, which is crucial in urban planning (Jaafar Sidek et al., 2020). Given Dhaka's continued growth, effective public transit is becoming increasingly important. The Government of Bangladesh (GOB) has made substantial investments to improve the Dhaka Metropolitan Area's (DMA) transportation system, including the construction of MRT-6, the country's first metro system, at a cost of \$2,910 million USD. The adoption of a TOD strategy is another critical policy measure that will enhance the success of this initiative. It is therefore essential to recognize the potential of the transit system and the TOD strategy to justify these substantial investments in public transportation.

The objectives of this research are:

- To identify the socio-economic factors and their impacts on the study area.
- To understand the need for proactive legislative changes and infrastructural improvements to maximize the success of the MRT stations in Mirpur.
- To evaluate the role of Transit-Oriented Development (TOD) in enhancing the effectiveness and sustainability of the MRT-6 system.

These objectives aim to provide insights into the sustainable development and efficient functioning of the MRT-6 system, ensuring it meets the diverse needs of Dhaka's growing population while promoting strategic urban planning through TOD.

## 2. Research Methodology

### 2.1 Study Design

This research employed a mixed-method approach to examine the impact of TOD and the development of MRT station surroundings. The study utilized both quantitative and qualitative techniques along with primary data collection. Preliminary data were collected through random online and physical

surveys. The stations were physically observed to understand existing infrastructure and social, economic, and development activities. This mixed-method approach provides a comprehensive view of the benefits of the TOD- system in the Mirpur area, capturing socio-economic variations. After the data collection process, the data were processed to classify accordingly. Data processing involves converting data from one format to another. In contrast, data analysis consisted of examining, categorizing, tabulating, or otherwise recombining the evidence to address the initial propositions of the study. Data based on area observation were graphically presented with GIS maps, tables, and graphs to depict the comprehensive socio-economic impact of land use in the study area.

### 2.2 Participants

The study focused on three MRT stations in the Mirpur area. 208 Participants' data were collected using protocols from Google Forms and questionnaire surveys. The Google form was circulated among social media groups of young and aged people, students, and professionals. Physical questionnaire surveys were conducted near concerned station areas. The participants included diverse individuals engaged in various social, economic, and development activities around the MRT stations. This selection aimed to capture the socio-economic variation of MRT-6 users.

Conceptual Research Methodology Framework

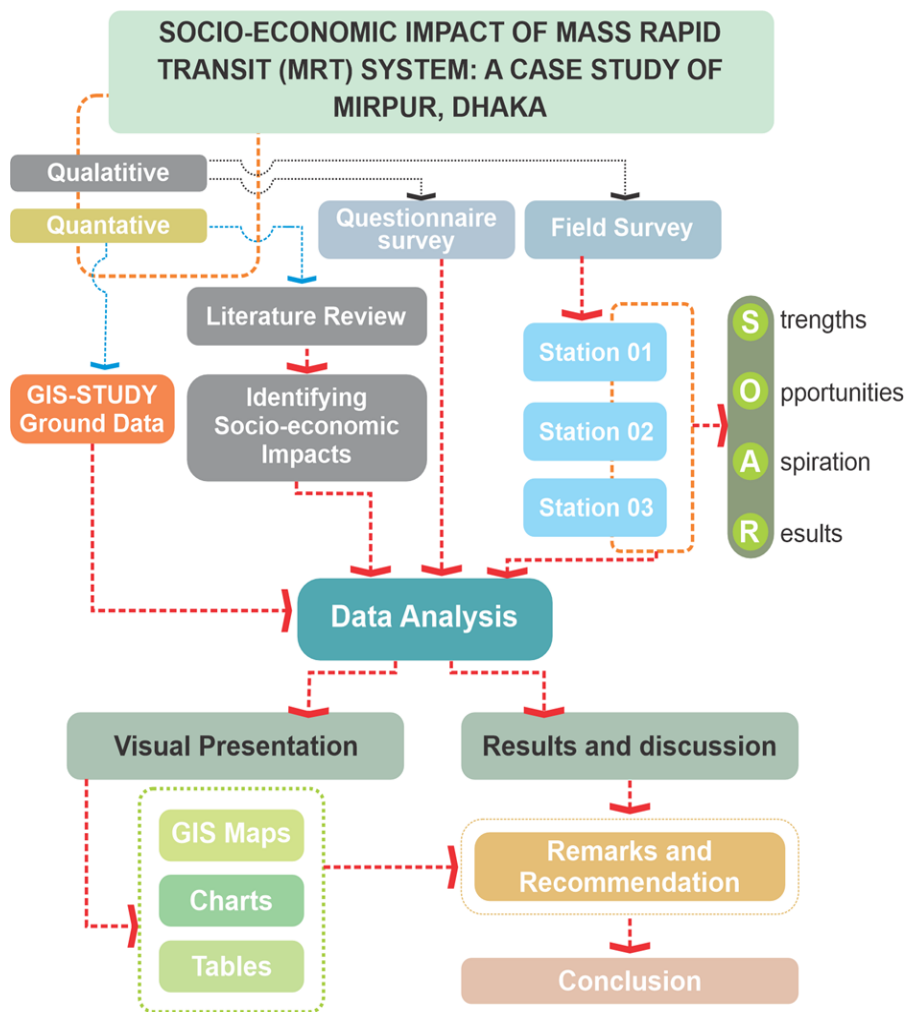


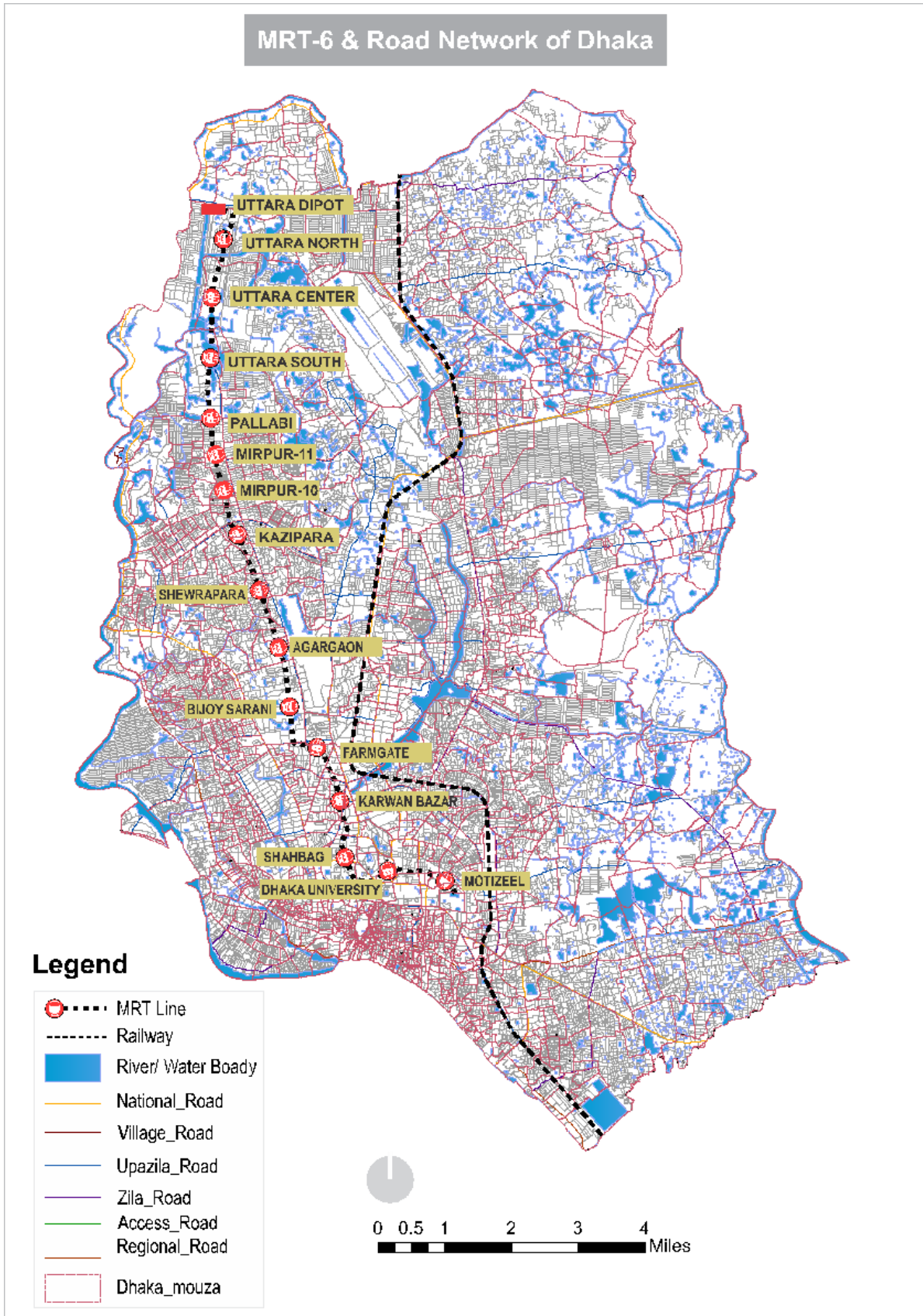
Figure 1. Conceptual Frame work of Research Methodology.



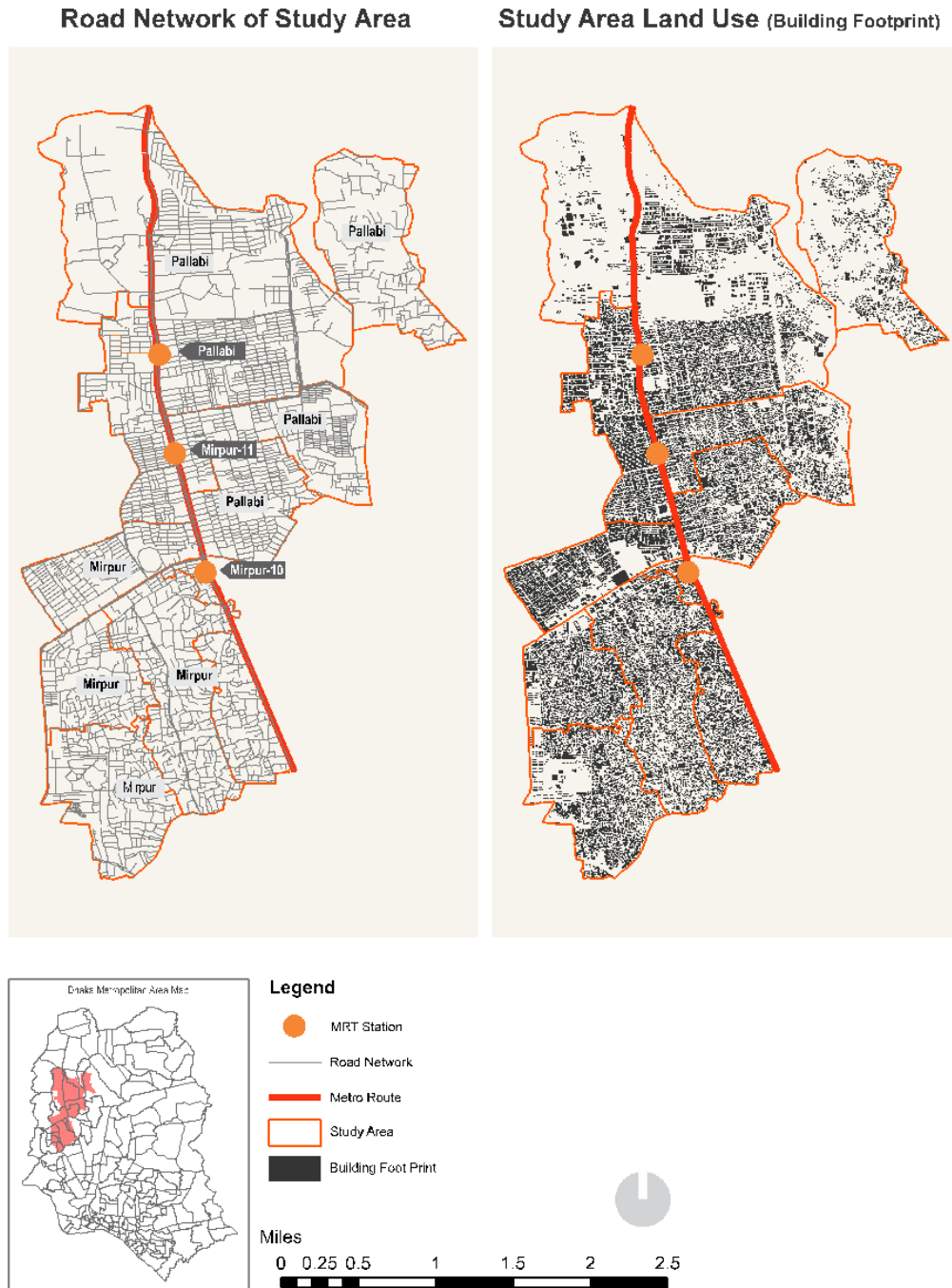
### 3. The study area

Mirpur is one of Dhaka's 21 administrative divisions. Most households living there are middle-class and impoverished; the residential and hygienic conditions are standard for any densely populated urban region. There are multiple wards (small areas under local government) on the site; partially included are Wards 11, 12, 13, 7, and 14. This area was developed to house primarily Muslim rehabilitated populations under the 1959 master plan. However, this master plan was rendered outdated during the colonial era, and Mirpur began to set a new pattern of urbanization, reinventing the scope of mixed-use development. Together with residential structures, there are several business and industrial communities (Afrin, Zerin, Sharmin, Kazi, & Morshed, 2012). A significant portion of homes are semi-pucca. There are rainfall runoff systems and markings on every pucca road. However, most internal roadways lack designated walking areas. Among the three MRT stations, Mirpur 11 and Mirpur 10 are more densely populated than Pallabi, and Mirpur 10 station is the busiest. Mirpur 10 has the intersection of four streets connecting other parts of Mirpur. Pallabi MRT station started operation on January 25, 2023. Mirpur 11 MRT station started operation on March 15, 2023, and Mirpur 10 MRT station became operational on March 1, 2023.

Nevertheless, most interior roads lack designated walkways; they are narrow, with occasionally damaged sections and illegal encroachments of roadside shops, thus hindering the metro station's walking connectivity with neighbours. Every Mirpur ward has several urban amenities, including colleges, schools, hospitals, speciality hospitals, markets, stadiums in the vicinity, open glossary markets, street markets, parks, workplaces, businesses, and unofficial economic activity areas (hawkers). The garment industry dominates the area's economy, and numerous unofficial businesses may be seen on the sides of the roads (Sharmeen & Houston, 2019).



**Figure 2.** Road Network system of Dhaka City and Super imposed MRT-6 route (grade separated-elevated route, adopted from OS map).



**Figure 3.** Study area road network and land use- showing the MRT-6 three Stations of Mirpur. (developed from OS map and field study).

#### 4. Theoretical background

##### 4.1 Transit-oriented development

Three decades ago, Petter Calthorpe and Peter Calthorpe introduced the concept of "Transit-Oriented Developments" (TOD) in the book "The New American Metropolis, Ecology, Community, and New American Dream." In this work, the authors emphasized the significance of smart density, walkability, public space, place-making, human-scale design, and mixed-use development, aiming to elucidate the crucial elements for creating sustainable and affordable communities with an enhanced quality of life (Jamme, Rodriguez, Bahl, & Banerjee, 2019). Aligned with the ideas of Calthorpe and other proponents of New Urbanism, they envisioned economically viable and environmentally responsible communities, contending that the integration of rail transit could play a central role in realizing such a

transformative urban lifestyle (P. Calthorpe, 1993).

TOD has recently gained increased attention for promoting smart urban growth (Renne, Voorhees, Bloustein, & Jenks, 2005). In many developing countries, the reliance on road-based public transportation systems persists because of the initial high costs and dependence on external donors for investment. The urban mobility landscape in these growing cities needs to be improved by inadequately designed urban networks (Chatman, 2013) and a decline in the quality of public transport services (Pojani & Stead, 2017). Research suggests that, in the long run, TOD can emerge as a successful development strategy for developing countries, potentially offering even more significant benefits than in more affluent nations (R. B. Cervero, 2013). However, TOD requires a well-designed transport network integrated with considerations such as land use diversity, density, affordability, and accessibility to residence and job opportunities.

The primary goal of TOD is to generate revenues where benefits will exceed costs on both local and regional scales (Singh, Zuidgeest, Flacke, & van Maarseveen, 2012). The economic vitality and long-term development of communities depend heavily on the effectiveness of transit networks in rural, urban, and suburban districts. Transit systems ought to serve everyone's needs and aid in commuting to work, school, the doctor, and visiting friends and family. These two domains come together in transit-oriented development (TOD), which results in substantial change. A dense, walker-friendly, mixed-use area near a transit hub draws people and enhances thriving, connected community partnerships that support the construction of affordable and low-cost housing close to transit can be fostered with the aid of public transportation. When implemented effectively, TOD creates more egalitarian communities. According to Stan Wall, Managing Partner for HRA Advisors, Washington D.C., TOD helps to develop a sense of place, a sense of ownership, and a secured future, acknowledging and realizing who are the real beneficiary of a transit investment or a TOD investment. (FTA, 2024).

TOD is an urban planning strategy that integrates transport transit and land use seamlessly. This approach, widely advocated, revolves around creating a built environment with relatively high density and a mix of urban functions around transit stations (P. Calthorpe, 1993; Duany & Elizabeth, 1994). TOD is a planning tool that harmonizes land use and transit systems, fostering vibrant, sustainable, pedestrian-friendly city areas with high-density and diverse land use activities.

In the United States, metropolitan areas grapple with dispersed growth patterns or sprawl development, and TOD has been embraced to address the associated environmental and social impacts (Porter, 1997). Research highlights the significant effect of TOD in reducing private automobiles, increasing transit ridership, and fostering a stronger sense of community in neighborhoods (Cervero, 1996; Newman & Kenworthy, 1999).

In the context of European cities, where the use of automobiles is relatively low, and there is a more extended history of integrating transit and land use, TOD is employed to encourage urban renewal in city centers (e.g., the ABC location policy in the Netherlands) as well ascended to facilitate the reconfiguration of the cities' outskirts (Bertolini & Spit, 2005).

In the context of Asia, Japan has been at the forefront, experimenting with policies that, to a significant extent, serve as early models for the Transit-Oriented Development (TOD) concept (Delpirou, Doulet, & Delaunay, 2016). In Asian cities, TOD is overlaid on an existing culture of transport-land use integrated planning (Delpirou, Doulet, & Delaunay, 2016). This achievement intensifies urban development and relocates metropolitan functions, primarily addressing traffic problems.

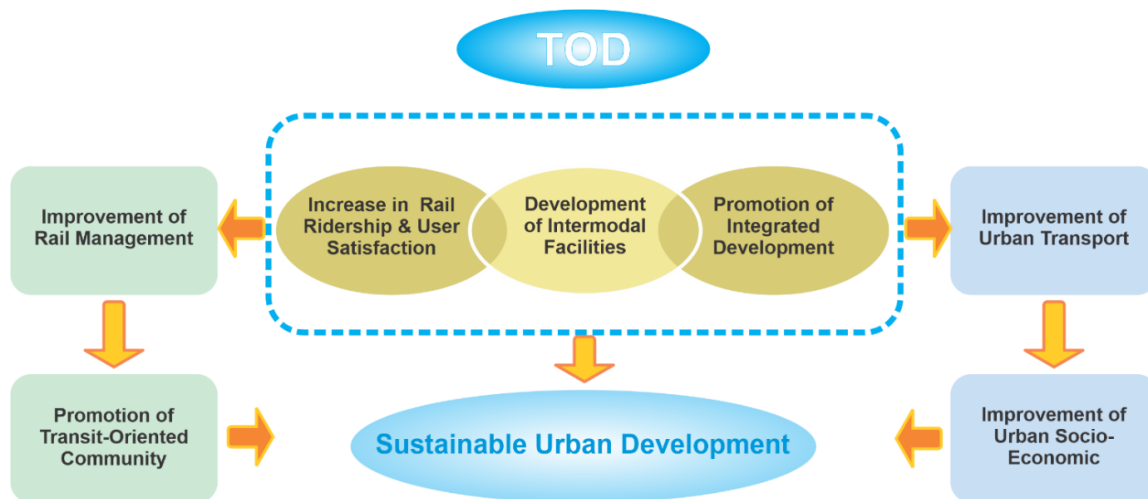


Figure 4. Conceptual TOD diagram-Dhaka (JICA, 2018).

Figure 4 summarizes the TOD operating process. The diagram illustrates the various conditions for a successful TOD are strongly interdependent. Maximizing the short- and long-term benefits of MRT demands the simultaneous achievement of the three goals: sustainable urban development, efficient urban transportation, and equitable socio-economic development (JICA, 2018).

#### 4.1 Mass rapid transit

Mass rapid transit refers to the public transportation services that combine individual trips into common trunk links or a significant amount of collectivization. It includes those modes that rely on a particular fixed track or an exclusive road track that may be used by many users separately. Bus lanes and other types of bus priority in mixed traffic are generally segregated or mostly separated busways (Ahmad & Hasan, 2019). As a component of the entire system, the kind and importance of secondary access and egress points to the trunk facility are considered. In developing cities, the primary need for mass transit is to transfer many people quickly. This requires cheap transportation costs (therefore low fares) and quickness in operation in the absence of significant subsidies. Because safeguarding its impacts depends on speed, this assessment will refer to mass rapid transit (MRT).

#### 4.2 Types of public transit

There are four general types of public transit. For this study, these are defined as follows:

**4.1.1 Busways:** are at-grade unless otherwise indicated, with horizontal protection from other traffic and frequent priority over other traffic at signalized crossings.

**4.1.2 Light Rail Transit (LRT):** refers to at-grade railing with comparable horizontal protection unless otherwise indicated. Generally, LRT contains one or two functional compartments. Light rail lies between the Train and tram. Light rail travels longer distances than trams but takes more travel time than trains and stops at more stands. Light rail is more suitable for regional routes than long distances (General Affairs, 2024).

**4.1.3 Metros:** are entirely segregated and typically located underground or elevated. Rapid service delivery depends on segregation, and carrying a considerable mass ridership is made possible by technology.

**4.1.4 Suburban Rail:** These services are fully segregated by controlled level crossings and are often at grade within a more extensive rail network (Majid & Singh, 2018).

#### 4.2 Need for mass rapid transit in Dhaka

Dhaka is a lively city; the increasing population, expanding urban area, enhancing economic activities, and promoting motorization have made life more prosperous. However, this attractive urbanization introduces many challenges, such as chronic traffic congestion, air and noise pollution, longer

commuting time, and scarcity of affordable housing, which will accelerate unless adequate urban strategies and effective frameworks exist.

According to RSTP, it was declared that MRT 1, 5, and 6 will affect both transportation and land use planning, and it is essential to integrate urban planning with transportation. In other words, the urban railway can suppress urban sprawl in Dhaka, promote appropriate development initiatives along the metropolitan railway, and establish an urban structure for TOD (Kumar Roy & Labony, 2019). In addition, urban railway users can avoid heavy traffic congestion with improved accessibility to the central areas of Dhaka. Moreover, it will bring environmental sustainability by alleviating air pollution and promoting economic growth through increased opportunities.

Numerous amenities on the MRT improve accessibility, safety, and comfort. The universal design includes features that increase accessibility for all users, such as elevators, escalators, and warning tile blocks. Automatic gates and platform screen doors (PSDs) will guarantee further security and comfort. According to the projection of Dhaka Structure Plan 2016-35, traffic volume will reach 60 million passenger trips. The limited road space and high traffic flow indicate the need for a long-term solution that can be achieved through the mass transit system. The government must develop MRT and BRT systems to manage increased traffic volume in the upcoming years (RAJUK, 2015).

**Table 1:** Modal share with consideration to MRT (in thousands).

Item		Car	Bus	Rickshaw	Others	Rail & Water	Walk	MRT	Total
No MRT	2013	2016	10708	12724	38	66	5803		31355
	2015	2518	12894	13145	49	87	6184		34877
	2025	5520	20739	15338	94	164	7784		49639
	2035	9737	24782	16360	120	203	8572		59774
With MRT services	2013	2016	10708	12724	38	66	5803		31355
	2015	2518	12894	13145	49	87	6184		34877
	2025	5054	19387	14549	90	159	7665	2735	49639
	2035	8772	21745	14698	113	195	8356	5895	59774

In Table 1, mass transit systems are built to efficiently transport vast numbers of people, which is crucial during peak travel times. Currently, Dhaka's public transportation system relies solely on low-capacity, road-based transit. This will change with the introduction of an MRT system structured according to the hierarchy of public transportation systems. To address future transportation demand, the Mass Rapid Transit (MRT) and Bus Rapid Transit (BRT) Systems should be implemented. Priority is given to public transportation systems with higher capacity (RAJUK, 2015).

**5. Socio-economic impact of mass rapid transit**

Developed countries like the United States, Canada, Germany, and France obtained rapid mass transit to achieve environmental goals and flourish in the economic sector (Walmsley, Perrett, & Laboratory, 1992). To make cities congestion-free, faster, and more reliable for the public necessitates effective transportation planning. The general purpose is to decrease the dependency on motorized vehicles. Conversely, developing countries implement costly TOD projects to control growing transportation needs, which may not reduce traffic congestion (Alam, 2010). TOD-based transport solutions enhance the overall quality of urban life, and both businesses and employees are attracted to the region, supporting additional growth and development in developing countries. Thus, agglomeration benefits are typically capitalized into land values and rents at locations where access to public transportation services is concentrated (Weisbrod & Reno, 2009).

With a lot of benefits from TOD, Banister and Thurstan Goodwin argue that TOD's impact can be measured on the economy at three distinct levels (Banister & Thurstain-Goodwin, 2011).

- Output and productivity changes;

- At the meso level, the impact related to agglomerative economics and labour market
- At the micro-level, the effect is determined by land and property market effects.

(Banister & Thurstain-Goodwin, 2011).

### **5.1 Identified socio-economic impacts of mass rapid transport:**

This research identified and concentrated on the social and economic impacts of mass rapid transit, and based on these three MRT stations, the surroundings are surveyed accordingly.

#### **5.1.1 SOCIAL IMPACTS**

##### **5.1.1.1 Accessibility and Mobility**

Accessibility means the description of the proximity to the desired destinations and the facilitation offered by the transport system, including public transport and preferably non-motorized transport to reach them. Mobility is the ability to travel to the desired destination and the necessary movement. Application of the TOD concept is expected to increase accessibility and mobility while reducing congestion and environmental pollution, ensuring the efficient use of energy in the transportation sector (Kristianto, Ismiyati, & Setiadji, 2020). Thus, as a mass public transport mode, MRT influences accessibility and provides mobility to an area. This study shows that 41% of participants feel that the MRT –system will reduce their time on the road and ease accessibility.

##### **5.1.1.2 Availability and Affordability**

Availability and Affordability refer to transport facilities such as buses or rail-based systems that enable basic mobility activities. The affordability ensures that the fare cost shall not exceed a certain percentage of household income. Measuring the Affordability of individual or household transport systems is essential to formulating any strategic transport policy, and it assists in formulating comfortable commuting strategies for low-income and mobility-constrained people (UN.ESCAP, 2018). The study shows that 33% of people agree that the system is affordable, and 36% somehow agree with the benefit; thus, a significant percentage realize that MRT-6 will be the most convenient mode of transport.

##### **5.1.1.3 Quality and Reliability**

Reliability and quality are paramount considerations for daily commuters. A dependable public transport service strictly adheres to schedules, ensuring vehicles run punctually while providing accurate information on routes, fare structures, and transport mode frequencies. Conversely, quality is assured by delivering comfort and cleanliness, maintaining courteous behaviour among service operators, and prioritizing safety.

##### **5.1.1.4 Safety and Security**

The safety of passengers is one of the most essential aspects of a successful transport mode, which refers to the prevention and protection from the exposed dangers to passengers in transport. The way to the station and waiting shall also be safe for all passengers. Commuters shall not experience theft, harassment, or harmful comments that provoke uneasiness or demotivate passengers from travelling with public transport.

##### **5.1.1.5 Health**

Health is another critical aspect, including passengers and other road users or persons living alongside the tracks or streets. Health should be protected from being jeopardized. The appropriate authorities must control air pollution, dust, noise, etc. Information about the lines, fares, routes, conditions for children, elderly, disabled, timetables, and transport system owners must be easily accessible in the language passengers speak. The station area must be adequately marked with eligible signage indicating the location of the information and eventual operational changes.

##### **5.1.1.6 Public Involvement**

The public, including passengers, shall have adequate authority to influence the planning policies and operation of public transport. Public transport authorities shall provide an exact place for messages or proper contact channels. Personnel attending to the answer and working with public relations are required.

### **5.1.1.7 Time-Saving**

Metro is a crucial component of TOD-supported public transit systems, where travel times are expected to be short and efficient. Time should be saved by using the service, not vice versa. Public transport should serve where people need to go and be economically significant for the passengers (Zamparini & Reggiani, 2007).

### **5.1.1.8 Economic benefit**

The use of efficient Metro Rail as public transport, income earning, or other can be reached by increasing access to different forms of resources.

### **5.1.1.9 Economic Impact**

Travel and vehicle ownership savings are realized by public transportation users and those opting out of personal cars. This leads to shifts in consumer spending. Concurrently, drivers of automobiles experience reduced traffic congestion, translating into direct travel cost savings for households and businesses. Additional benefits include lowered business operating costs tied to worker wages and increased reliability due to diminished traffic. Furthermore, expanded access to a broader pool of skilled workers, facilitated by fewer traffic jams and extended transit service areas, enhances business productivity. The indirect effects of business expansion on suppliers and worker wages further fuel regional business growth. The cumulative impact of cost reductions and improved productivity may influence a country's international competitiveness. (Weisbrod & Reno, 2009).

### **5.1.1.10 Job Housing Ratio**

Depending on how evenly the distribution of jobs and housing is distributed among the residents, there is a notable variation in the average commute distance and duration. The average commuter in Dhaka's housing-rich areas takes 8.17 minutes (2.92 km) longer than the employment-rich regions. Communities that are balanced economically and environmentally would be created by housing options within an affordable commute of their place of employment. To ensure a suitable balance between housing and jobs, cities must continue to grow and residents' travel habits within them (Rahman & Ashik, 2020).

## **6. Results and discussion**

### **6.1 Study area analysis (Field observation)**

The Mirpur area is predominantly residential in Dhaka. Roadside mixed-use developments are visible. Once there, many small garment industries flourished in this area because of the supply of cheap labour from nearby neighbourhoods. However, the scenario has changed in the last decade. The job scope of garment industries is replaced with small furniture manufacturing workshops, vehicle repair workshops, small manufacturing industries, and retail shops. Most of the streets at Mirpur and the adjacent area are comprehensive, and alternative connectivity has been created with well-bitumen-carpeted road networks. In addition, a linked flyover and a new MRT system are developed to ensure ease of traffic and speedy connectivity. However, Mirpur's significant challenges are the lack of a well-designed footpath network, the illegal encroachment of Hawkers, and road-adjacent economic activities.



**Figure 5:** Study Area Images- a. Mirpur 10 MRT station, Busy street with public transport; b. People are queuing for the ticket. c. People boarding on the Train; d. Mirpur 11- MRT station. e. Packed Train on peak hour; f. Pallabi MRT Station.

## 7. Data analysis from field survey

### 7.1 Determining job-housing ratio

The concept of Job-household balance is derived from initiatives of the self-contained community by Howard, Purdom, and Munford (Giuliano, 1991). Giuliano defines Job-housing balance as "the distribution of employment relative to the distribution of Workers in a given geographic area."

Job-housing balance can reduce travel demand and increase the quality of the place, which is visible through the adoption of cities' development and transport authorities in developed countries (Wu, Zhang, & Yang, 2015). Job housing balance is one of the preconditions for the effective implementation of the TOD policy (Rahman & Ashik, 2020).

**Table 2:** Recommended Jobs-housing balance ratios.

Study	Measurement	Recommended Ratio
(R. Cervero, 1989)	Jobs to household ratio Ceiling ratio	Ceiling ratio 1.5 (multiple workers) at a city level
(Frank & Pivo, 1994)	Jobs to household ratio	0.8:1–1.2:1 for census tracts
(Peng, 1997)	Jobs to household ratio	1.2:1–2.8:1 for TAZs covered by a 5-mile radius of a central TAZ
(Armstrong & Sears, 2001)	Jobs to household ratio	1:1–1:1.29 Commute shed within 14 miles radius of job centers
(Cervero R. , Jobs housing balance as public policy, 1991)	Jobs to housing unit ratio	1.4:1–1.6 for Medium-sized community

The job-housing balance has been calculated as a ratio of the number of jobs and households in this study area. The equation to calculate the ratio:  $JHR = J_i/H_i$

Where  $J_i$  = number of jobs (employed population) of neighbourhood  $i$

$H_i$  = number of Households in the neighbourhood

**Table 3:** Job-Housing Calculation Chart (Relevant et al., (BBS et al., 2011).

Job-housing calculation chart									
Thana	The base year is 2013			Present 2022			Projected 2030		
	Household	TPE	Job-Housing	Household	TPE	Job-Housing	Household	TPE	Job-Housing
Mirpur	117450	116700	0.99	152253.5 7	146254. 98	0.96	191760.0 4	178754. 58	0.93
Pallabi	143332	151381	1.06	185805.1 0	189719. 16	1.02	234017.4 6	231877. 01	0.99

The table shows household data, total employed population (TPE), and job-housing ratios for the Mirpur and Pollabi area for three years: the base year 2013, the current year 2022, and the estimated for 2030. These data indicate that the number of employed people and households in Mirpur and Pollabi has grown. Still, the job-housing ratio has shrunk, meaning that the number of jobs in Mirpur has not kept up with the growth in employed people and households, which could result in problems like increased unemployment or people having to commute to other places for work.

Suppose there is a decline in the employment-to-housing ratio despite an increase in the number of families and employed people. In that case, it might cause problems such as more unemployment rates and more commuting. The Mass Rapid Transit (MRT) system may provide a workable option by providing mass people in and out of the area for various purposes.

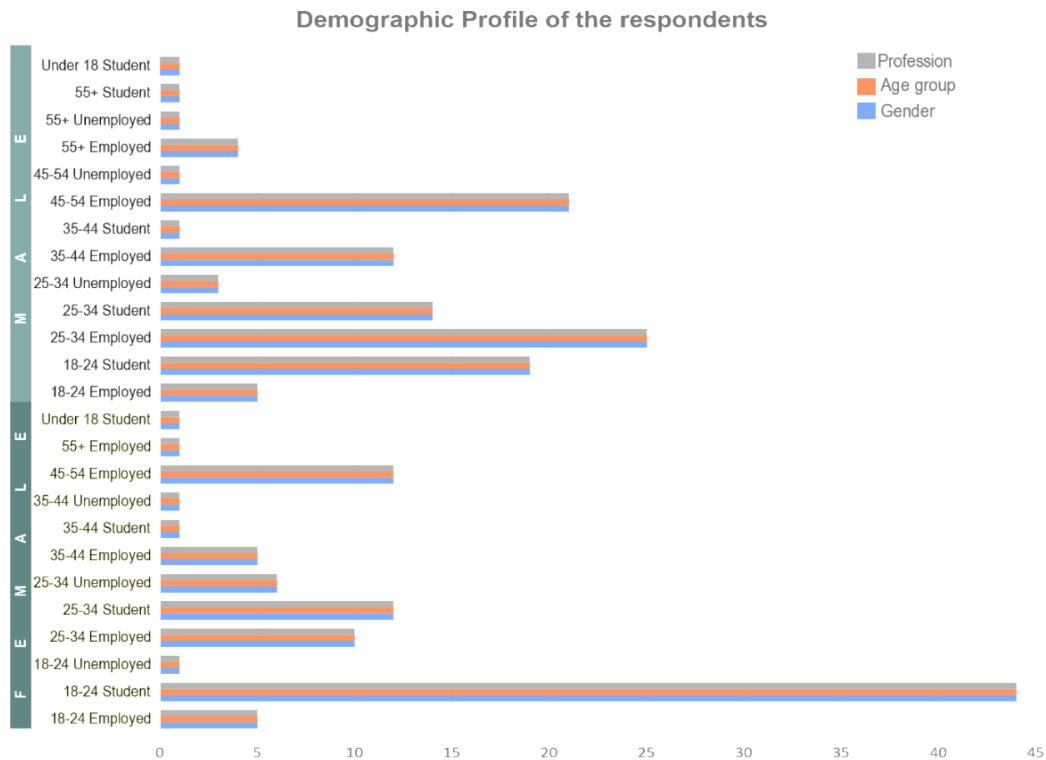
### 8. Field survey – SOAR analysis

**Table 4:** SOAR analysis of MRT stations.

MRT-ST	Strengths	Opportunities	Aspirations	Results
PALLABI	<ul style="list-style-type: none"> <li>▪ Good Location</li> <li>▪ Moderate Traffic</li> <li>▪ Street Side Economic Activities</li> <li>▪ Residential</li> </ul>	<ul style="list-style-type: none"> <li>Good Land Mark</li> <li>Scope of Commercial Development</li> <li>Good quality road</li> <li>New MRT Station</li> </ul>	<ul style="list-style-type: none"> <li>MRT station</li> <li>Scope to increase Economic activities</li> <li>Increased accessibility</li> </ul>	<ul style="list-style-type: none"> <li>▪ MRT will generate traffic and, thus, the scope of economic activity</li> <li>▪ Retail shops</li> <li>▪ New Urban Spaces-Theater</li> <li>▪ Rise in property price</li> </ul>
MIRPUR-11	<ul style="list-style-type: none"> <li>▪ Good Neighborhood</li> <li>▪ Vibrant Surroundings</li> <li>▪ Good Road Network</li> <li>▪ Street Side Mixed Use Development</li> </ul>	<ul style="list-style-type: none"> <li>Good Land Mark</li> <li>Road Side Commercial activities</li> <li>Less Traffic Congestion</li> <li>New MRT Station</li> </ul>	<ul style="list-style-type: none"> <li>MRT station</li> <li>Scope to increase Economic activities</li> <li>Increased accessibility</li> </ul>	<ul style="list-style-type: none"> <li>▪ MRT will generate traffic and, thus, the scope of economic activity</li> <li>▪ Retail shops</li> <li>▪ New Academic Facilities</li> <li>▪ Business offices</li> <li>▪ Low traffic on the road</li> <li>▪ Rise in Property price</li> </ul>
MIRPUR-10	<ul style="list-style-type: none"> <li>▪ Good Neighborhood</li> <li>▪ Road Transport Junction</li> <li>▪ Good Road Network</li> <li>▪ Heavy Economic Activities</li> <li>▪ Street Side Mixed-Use Development</li> </ul>	<ul style="list-style-type: none"> <li>Good Land Mark</li> <li>Road Side Commercial activities</li> <li>Less Traffic Congestion</li> <li>New MRT Station</li> </ul>	<ul style="list-style-type: none"> <li>MRT station</li> <li>Scope to increase Economic activities</li> <li>Increased accessibility</li> </ul>	<ul style="list-style-type: none"> <li>▪ Might experience huge traffic</li> <li>▪ Excessive economic activity</li> <li>▪ Street Vendor</li> <li>▪ Unsafe Padeterian movement</li> </ul>

A questionnaire survey was conducted to understand the impact of metro service on the Mirpur area. Total number of respondents was 208, The demographic profile of the respondents is given below: Among the total respondents, 51.4% were male, 48.1% were female, and the rest did not prefer to answer. A large number of female respondents are between 18 and 24 and are students by profession. On the contrary, most male respondents were employed and aged between 25 and 44. A minimal number of respondents were under 18. And no respondents were over the age of 55. (Figure 6 is the reference Chart).

According to the survey, most people choose buses and rickshaws for frequent travel. Besides, automobiles and CNG are popular travel modes in Mirpur. A small number of people use motorbikes and cycles. Motorbike-ride sharing is also widespread among people. People are spending more money while travelling by bus and rickshaw. From the graph, MRT is still the least popular travel mode in the area. (Figure 6 is the reference Chart).



**Figure 6.** Demographic Profile of the Responded.

The study draws attention to the wide range of housing options and demographics of those residing close to the metro station. By comprehending the housing patterns of inhabitants and tackling related issues, it is possible to enhance the station's accessibility and promote a livelier and more involved community. Figure 6: The chart indicates that a noticeable number of people live in rented houses that are very far (relative to the MRT influence zone) from the metro station in the Mirpur area. In the long run, eventually, while the benefit of MRT will be exposed to the neighbour, a significant number of households may shift to near the MRT station for their accessibility, convenience, and comfort.

Survey data shows another important scenario: around 40.4% of the respondents live very far from the station influence area, and 37.5% live far from the station area. This means they are not actively participating in local community initiatives facilitated by metro stations. However, if these people start using metro services, traffic around the station area will increase and positively impact local businesses, thus contributing to the local economy.

This investigation explores respondents' differing perspectives about how the new MRT system might affect housing, the economy, and transportation systems. A survey on 208 people within at least a mile radius of the study area of concerned MRT stations would directly impact was used to gather data.

In the pie chart-1, 39% of the respondents believe introducing a new MRT system would effectively reduce traffic congestion in the Mirpur region. However, 41% of respondents were unsure about the impact. Only 5% of respondents strongly agreed about the ability of MRT to decrease traffic problems. The rest expressed doubts about the positive effects of traffic congestion. The field observation also verifies the respondent's notions regarding traffic management. However, it is understandable that the MRT service is in its infant stage. While all supporting services will be in place, traffic congestion should decrease and ease the traveller's waiting time on the street. The positive notion of the people is also expected to encourage them to use the MRT service at their convenience.

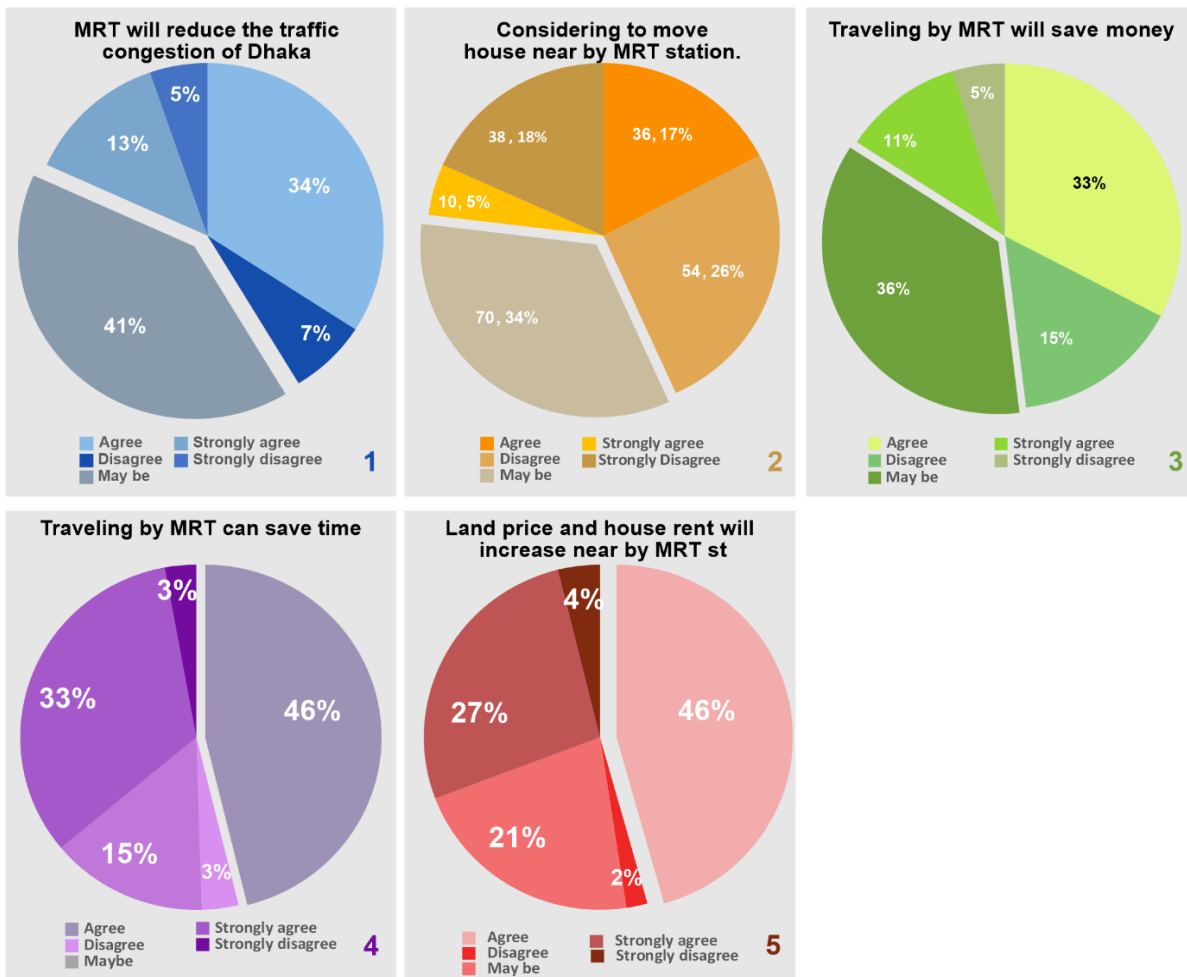


Figure 7. Pie Charts- showing survey data

The second pie chart assesses respondents' thoughts regarding possibly moving their home closer to an MRT station. A questionnaire Survey was used to collect data from 208 people who lived more than one mile away from the locations of the current MRT stations. Here, 34% of respondents are unsure about it. 44% disagreed, and the rest agreed to move near the MRT station.

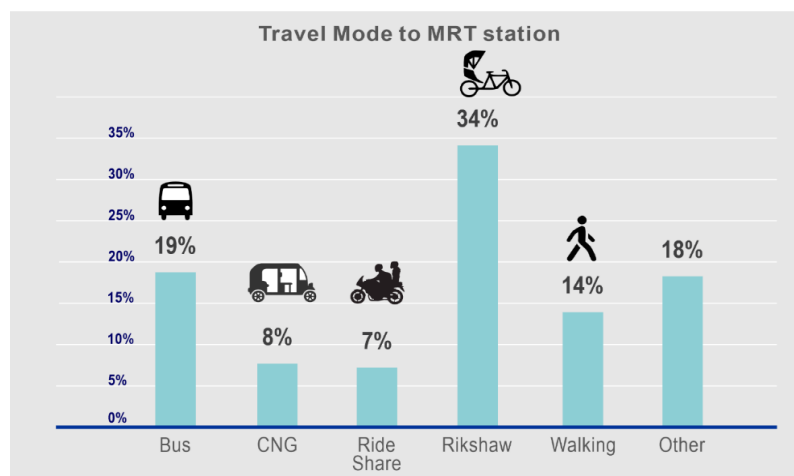
Regarding the possible cost-saving advantages of utilizing the MRT system for travel, respondents' opinions are split, as seen by the third analysis. While a significant portion, a total of 56%, acknowledge the possibility of reduced travel expenses. 20% of the responses are not in favor of acknowledging the cost-saving benefits of utilizing the MRT system for commuting. Disagreement might relate to the additional cost the traveler is spending to reach the MRT station. The rest are still confused about it.

This fourth chart assesses respondents' perceptions of the possible time-saving benefit of using an MRT system to commute. According to the analysis, respondents mostly agreed on the potential time-saving advantages of using the MRT system for transportation. The percentage is 79%. 15% of respondents are unsure, and only 6% disagree or strongly disagree that the MRT system will save them time during travel.

The Fifth graphic illustrates respondents' differing opinions about how a Mass Rapid Transit (MRT) system might affect the cost of real estate. Although a sizable fraction (73%) recognizes that there may be a price-hike in property values close to MRT stations, a sizable minority continue to express worries about the magnitude of the impact and economic uncertainty. Of those surveyed, 21% were unsure, and 6% disagreed or strongly disagreed that the MRT system would affect land and home values. Field observation shows that 10%-15% of real estate has increased since the work of the MRT system started.

The analysis aims to comprehend the most common ways people get to the MRT station. The data indicates that people use a variety of forms of transportation to get to the MRT station. It will be essential to comprehend demographic preferences and deal with related issues to improve accessibility and support environmentally friendly transportation options. Survey data from 208 respondents was analyzed and plotted 71% of respondents reached the station by rickshaw. 29 % of the respondents reported walking as their primary mode of getting to the MRT station. 39% of respondents utilize public buses. Around 16% of respondents are using ride-sharing to reach the station. 38% of respondents reported using other modes to reach the station. And 19% of respondents accounted for using CNG. So, we can address the parking challenges as many people use vehicles rather than walk to the MRT station.

In the Mirpur area, according to the respondents, people living very far and far from the metro station have a low crime rate, so much importance to living in their current location. So, there is a chance that by reducing the crime rate around the metro station, the area can create a sense of safety, which will bring more people to live and work around the station.



**Figure 8.** Travel Mode to reach MRT station (in percentage)

## 9. Recommendation

Dhaka, the vibrant capital of Bangladesh, has consistently faced the challenges of crowded streets, air pollution, and lack of systematic urban development. Dhaka is considered one of the most challenging cities globally to traverse (Afrin, 2023). Addressing this issue, the introduction of MRT6 stands as a noteworthy advancement that holds the potential to reshape the city's transportation dynamics. However, including MRT-6 as a Transit-Oriented Development (TOD) component in the Dhaka Detailed Area Plan 2022-35 is a significant step in changing Dhaka's transport horizon. Relying solely on MRT-6 without advancing other TOD elements could lead to overly optimistic anticipation of its impact on Dhaka's traffic conditions and economic, social, and environmental spheres. Following are recommendations based on the survey data analysis and literature reviews.

### 9.1 Infrastructure Investment

'MRT construction is a large capital investment, which becomes a heavy burden to the railway operator in financing and repayment by fare-box revenue. Europe and the United States generally cover the whole construction cost with public funds, which is a better approach. This will support financially viable railway businesses. A project like MRT is expensive and might require a special budget allocation in the national fiscal budget' (JICA, 2010)

Most developing countries built such projects with the help of donor agencies like the World Bank, JICA, or donor countries. A stable supply of funds is required to construct the METRO line and develop surrounding road networks, footpaths, parking routes, infrastructure, and facilities to attract

economic development and create a scope of mixed-used development.

### **9.2 Integration with Current Transport Systems:**

A well-integrated transport system contributes to the attractiveness of public transport, thus reducing the number of automobiles on the street (Mrníková, Poliak, Šimurková, Hernandez, & Reuter, 2017). Establishing an excellent integrated street network with the MRT stations is essential. Safe and evenly levelled footpaths are a priority requirement to create walkable access to the MRT station. Surveys showed that the studied MRT stations lack connectivity through safe and quality footpaths and parking facilities. People use Buses, Rikshaws, or Ride share to reach the MRT station, causing additional travel costs. People may be encouraged to use MRT as their primary form of transportation by putting in place a single ticketing or transfer system.

### **9.3 Accessibility and Inclusivity:**

The mobility concept will undergo massive changes in the upcoming years based on how it will be articulated with the transport of people and goods, always considering universality and accessibility (Silva, Verde, Paiva, Barreto, & Pereira, 2023). Railways and stations should be designed to support the accessibility of elderly and physically challenged people. To meet the various demands of commuters, this should include tactile pathways, elevators, escalators, ramps, and priority sitting places. Appropriate visual and native language signs should be billed as required.

### **9.4 Environmental Sustainability:**

One of the anticipated benefits of MRT is that it will reduce dependency on automobiles. Every day, 532 new vehicles hit the Dhaka Metropolitan Area (Ullah, 2022). Eco-friendly technologies in MRT trains and infrastructure should be encouraged. The engineering design of MRT should incorporate energy-efficient technologies. The scope of the use of renewable energy should be there. The traffic volume and peak-hour integration must determine the frequency and the service. Initiatives must be taken to encourage people to switch from driving cars to using public transit to protect the environment. Educational TVC, social media, easy ticketing service, and promotional initiatives should be designed.

### **9.5 Safety Precautions:**

Stringent safety procedures and well-thought-out action plans must be developed to safeguard passenger security. Separate female-only compartments should be encouraged. CCTV monitoring must be permanently installed, and the system should be visible to travelers. In-compartment emergency communication and use-instructions should be established. All the instructions and information should be displayed in the native language.

### **9.6 Public Education Efforts:**

Start efforts to inform the public about the advantages of MRT systems, such as fewer traffic jams, lower pollution levels, and faster travel times. Programs for community participation and various media outlets could be used for this.

### **9.7 Regulatory Framework:**

Clear rules and policies addressing rates, timetables, and maintenance requirements should be established to maintain a sustainable MRT system and its seamless operation.

### **9.8 Urban Planning and Development:**

Introducing MRT is Dhaka's most crucial component of more significant TOD planning. Implementing TOD in urban designs has become a common challenge for developing countries. Three types of urban sprawl affect the growth throughout the cities of developing countries: the low-density sprawl of higher-income regions that become auto-dominant, low-income sprawl that isolates the poor from

economic, social, and cultural opportunities, and high- the density sprawl of superblock, towers (P. A. Calthorpe, 2022). As an alternative to these challenges, cities must create walkable and transit-oriented communities offering many automobile options. Sustainable TOD needs mixed-used neighborhoods that can create places for a broad range of economic activities, ages, and household types (P. A. Calthorpe, 2022). The MRT system should coordinate with the expanding urban planning and requires a logical route rationalization. Encourage transit-oriented development (TOD) around MRT stations by combining land-use planning and transit development. A comprehensive strategy would be needed to develop and implement new policies, including public involvement, government actions, and partnerships with diverse stakeholders. Ultimately, with careful and research-based approaches that are unbiased to political influences, the new MRT system of Dhaka would become more accessible, sustainable, and efficient.

## 10. Conclusion

This study presents a comprehensive evaluation of the socio-economic impacts associated with the implementation of the Mass Rapid Transit (MRT) system in Mirpur, Dhaka. The findings highlight several key areas where the MRT system contributes positively to urban development and community well-being, while also identifying critical challenges that must be addressed to maximize the system's potential.

Firstly, the MRT system in Mirpur has demonstrated significant improvements in accessibility and mobility, offering efficient and reliable transport options for a diverse population. This has led to reduced travel times and increased connectivity between residential areas and commercial hubs, fostering economic growth and development. The analysis shows that 41% of participants believe the MRT system will reduce their time on the road and enhance accessibility, aligning with the objectives of transit-oriented development (TOD) principles.

Moreover, the MRT system has had a notable impact on land values and economic activities surrounding the stations. Property prices in the vicinity of MRT stations have experienced an upward trend, with an observed increase of 10-15% since the commencement of the MRT project. This trend indicates the potential for TOD to stimulate urban renewal and densification, contributing to sustainable city expansion. The study also reveals several challenges that need to be addressed to ensure the MRT system's long-term success. The lack of well-designed pedestrian pathways and last-mile connectivity remains a significant barrier to maximizing the system's socio-economic benefits. Illegal encroachments and insufficient infrastructure further hinder the full realization of the MRT's potential.

Furthermore, the job-housing ratio analysis indicates a disparity between employment opportunities and housing availability in the Mirpur area, necessitating targeted interventions to balance this equation and reduce commuting pressures. This calls for strategic urban planning that integrates land use with transit development, promoting mixed-use neighbourhoods and facilitating economic activities around MRT stations. To enhance the MRT system's effectiveness and sustainability, several recommendations have been put forward. These include investing in infrastructure improvements, integrating current transport systems, enhancing accessibility for all commuters, and adopting eco-friendly technologies to promote environmental sustainability. Public education efforts and a robust regulatory framework are also essential to ensure the MRT system's successful operation and maintenance.

In conclusion, the implementation of the MRT system in Mirpur offers valuable insights into the transformative potential of mass transit in rapidly urbanizing areas. By addressing the identified challenges and leveraging the system's socio-economic benefits, stakeholders can contribute to Dhaka's sustainable urban growth and achieve long-term development goals. This research highlights the importance of strategic planning and collaboration among government agencies, urban planners, and the community to create a more prosperous and interconnected urban future for Dhaka.

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### Conflicts of Interest

The authors declare no conflicts of interest related to this research.

### Data availability statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

### Institutional Review Board Statement

Not applicable.

### CRedit author statement:

Conceptualization: Shahriar Iqbal Raj; Methodology: Shahriar Iqbal Raj, Dr. Inmaculada Mohino Sanz; Software: Shahriar Iqbal Raj, Farjana Khatun; Validation: Farjana Khatun; Formal Analysis: Shahriar Iqbal Raj; Investigation: Farjana Khatun; Resources: Shahriar Iqbal Raj; Data Curation: Shahriar Iqbal Raj, Farjana Khatun; Writing - Original Draft: Shahriar Iqbal Raj; Writing - Review & Editing: Shahriar Iqbal Raj, Farjana Khatun; Visualization: Shahriar Iqbal Raj. All authors have reviewed and approved the final version of the manuscript.

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