

A SUSTAINABLE URBAN TRANSPORT INITIATIVE IN DHAKA: INTRODUCING BUS RAPID TRANSIT SYSTEM

Ishtiaque Ahmed²⁷, Noor -E -Alam²⁸ and Faizuna Warda²⁹

ABSTRACT

Rapid urbanization in Bangladesh has far outstripped the capacity of the urban transport infrastructure, leading to low level of efficiency and overall quality of the transport system. The transport condition of Dhaka city is characterized by chronic traffic congestion, lack of comfort, safety, and poor air quality. Due to increasing pressure on low capacity conventional public transport, it has become necessary to seek for a more efficient means of moving passengers, reduce travel time as well as lower air-pollution from motor vehicles. Greater Dhaka Sustainable Urban Transport Project (BRT Gazipur-Airport) is the first initiative by the Government to introduce rapid road based mass transport system in Dhaka. The Bus Rapid Transit System (BRT system) will present sustainable public transport system by replacing existing fuel-inefficient fleet with larger capacity modern BRT buses and improving average vehicular travel speed in the corridor. BRT system will address several Sustainable Development Goals (SDG), i.e. Goal 11 by improved urban public transport and reduce air pollution, Goal 13 by mitigating impacts of climate change in Dhaka and Goal 3 by improving road safety.

Keywords: Public transport, Bus Rapid Transit (BRT), Sustainable Development Goal (SDG)

INTRODUCTION

Dhaka, one of the most densely populated cities in the world, has a population of almost 17 million, which is expected to rise to 35 million by 2035 (World Bank). The city currently suffers from various impacts caused by lack of affordable, inclusive, efficient and safe transport mode for mobilization of its people. Insufficient malfunctioning old small buses and some informal paratransit against the demand of such an enormous population causes several externalities; congestion, accidents, air pollution, and climate change. Due to increasing pressure on public transport, it has become necessary to opt for a more efficient means of transport mode for moving passengers. In this regard, to ease the congestion and provide a safe, affordable, comfortable, and environmentally friendly solution, Bus Rapid Transit (BRT) has been introduced to Dhaka.

Greater Dhaka Sustainable Urban Transport Project (BRT Gazipur-Airport) is the first initiative by the Government of Bangladesh to introduce Country's first road based mass transport system along Gazipur-Joydevpur-Airport road and named as "Dhaka BRT". This technical paper focuses on how Dhaka BRT, through its operation, will contribute towards making Dhaka a liveable and safe city and showed how Dhaka BRT will assist in achieving some Sustainable Development Goals (SDG) goals.

²⁷ Economic Affairs Officer, Transport Infrastructure Section, Transport Division, United Nations ESCAP, Bangkok, Thailand, ahmed200@un.org

²⁸ Executive Engineer, Roads and Highways Department, House no 180, Road 5, Block D, Bosundhara R/A, Dhaka, Bangladesh. jewel_rhd2009@yahoo.com, Fax. 8807911029

²⁹ Sub divisional Engineer, Roads and Highways Department, Bangladesh

Figure 1. Existing Traffic Condition

MAJOR COMPONENTS OF DHAKA BRT

To ensure a sustainable future and in line with the Strategic Transport Plan, STP (2016-2035) for Dhaka (figure 2), Dhaka BRT aims to provide efficient, sustainable, environmental friendly, affordable and safe urban mass transport system along one of the busiest corridors of Dhaka city. This corridor is the main get-way to Dhaka from the northern districts of Bangladesh. Proposed BRT corridor passes through many industries, universities, public and private offices including the Bangladesh Rice Research Institution, engage a large number of people and economic activity. Medium and small buses are the main mode of travel for the commuters along this corridor. Some paratransit's (auto rickshaw, human-powered rickshaw, CNG etc.) are also used for some short trips.

The length of the Dhaka BRT corridor (BRT line 3, north Part) is 20.5 kilometres with 4.5 kilometres of elevated BRT at the narrowest section of the corridor. At the elevated section, there will be space both for BRT bus and mixed traffic. The project cost is USD 255 million, financed jointly by the Government of Bangladesh, Asian Development Bank (ADB), France Development Agency (AFD) and Global Environmental Facility (GEF). The BRT corridor will have one BRT lane in each direction between Hazrat Shajajal International Airport to Gazipur. Based on available land, the BRT corridor is divided into 4(four) sections. From Uttara to Housebuilding (Type 1), Housebuilding to Cheragali (Type 2), Charagali to Joydebpur Chowrasta (type 3) and Joydebpur Chowrasta to Gazipur (type 4).

All sections have the following components:

- BRT lane (lane width 3.5m, at stations 3.0m)
- Mixed traffic lane (lane width 3.5m, at stations 3.0m)
- Non-motorized traffic (NMT) lane (2.5 – 4.5 m)
- Footpath (1.5-3.0m)

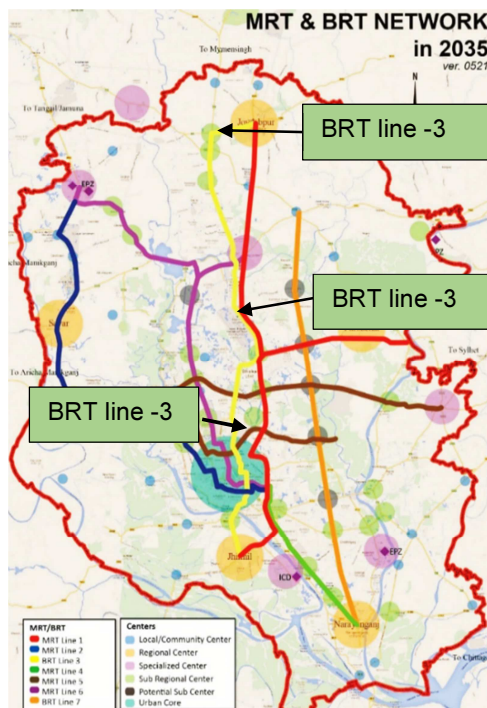


Figure 2. STP (2016-2035) for Dhaka

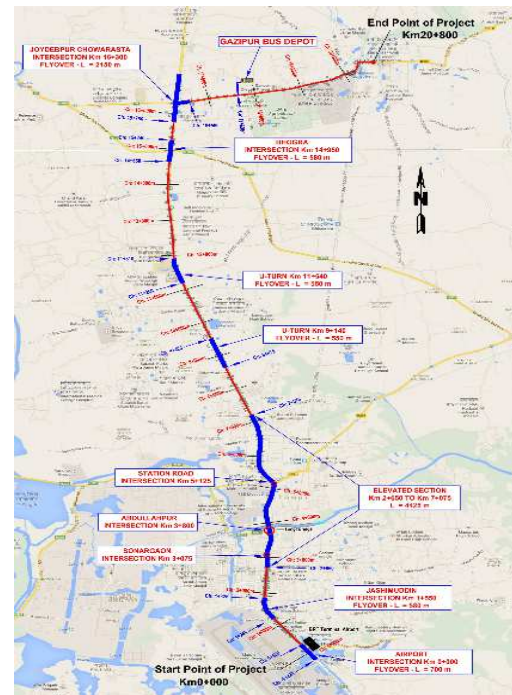
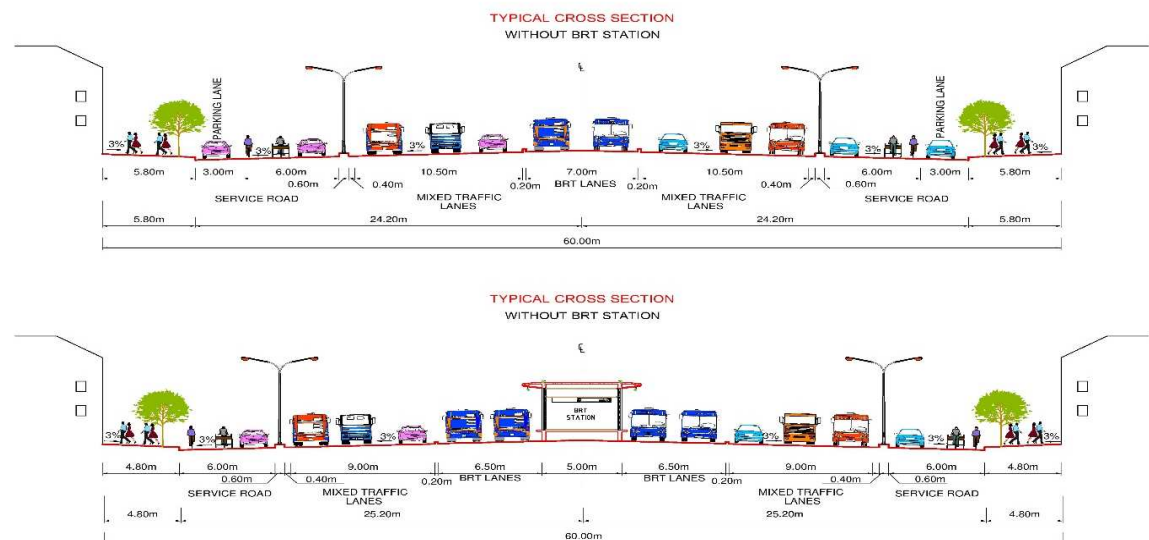


Figure 3. Dhaka BRT Corridor

Due to this road widening, the dedicated BRT Bus lanes will not obstruct other traffic on this corridor. All access roads along BRT corridor will be upgraded to ease the accessibility to the BRT stations.

Figure 4. Typical Cross Section of BRT lane (Type 1)



BRT Stations, Terminals and Depot

Dhaka BRT will have 25 stations along the corridor including Airport and Gazipur Terminal. The average distance between stations is 750 meters. Passengers will have access to the stations through Foot-Over-Bridges (FOB) with easy accessibility for all passengers with the provision of automated escalators and lift especially for the female, physically challenged and elderly passengers.

Station height will be same as the bus floor, that is 900 mm, to reduce boarding and alighting time of passengers and increase convenience, comfort, and safety.

All station will be equipped with e-ticketing system for the absolute convenience of the passengers. Passengers will have to make a prior purchase at the ticket counters to board the buses. Stations will be equipped with high-security systems by CCTV, information screens, and voice information systems. Entrance and exit to all Stations will be controlled with electronic gates. There will be adequate queuing space to wait for the buses and some seating arrangement for special need passengers. At the terminals, separate spaces for parking and drop-off points for cars, auto-rickshaws, and rickshaws will be developed. A depot for 100 articulated BRT buses will be located at Gazipur. The bus depot will be equipped with parking and maintenance facilities for the buses and provision for refuelling and restrooms for drivers. Detail feasibility study in processes for Transit Oriented Development (TOD) which will create a new opportunity for residential and commercial development around major BRT stations.

BRT terminals will act as the integration point with other modes. There will be a multimodal hub near airport BRT terminal where interchange facilities will be established among Rail, BRT, MRT, Air and intercity bus passengers. BRT buses will extend its service to link with MRT depot as Uttara.

Figure 5. Proposed Multimodal Hub at Airport



BRT Coach and Fuel

Articulated buses of approximately 18 metres in length, with right-hand drive and doors on the right side, were selected for operation of the BRT Line 3 corridor. Buses with emission standard of at least EURO III are selected. Bus capacity will be 140-160 passenger including seating and standing. Hi-capacity buses will include special seats for women, elderly and handicapped people. LED panels will announce the approaching next stations, time and the weather outside. On board systems will be installed for possible communication between the bus and the control centre, where vehicle position will be monitored using GPS. Low sulphur diesel and Compressed Natural gas (CNG) will be used as fuel of BRT buses. In future Hybrid and Electric bus will be introduced.

BRT Operation

A platoon of 3 articulated buses will run with a headway of 2 minutes (peak hour) and 5 minutes (off-peak hour) from 7 am to 11 pm. While open to the passengers, the system will carry approximately 250,000 passengers each day and has been designed to carry a maximum of 400,000 passengers per day. The government established a 100 Per cent government own company named "Dhaka Bus Rapid Transit company limited (Dhaka BRT)" to operate and maintain the BRT system. There will be regular BRT service (all stops) and express BRT service (limited stops). For express

services, there will be provision for bypass lanes at stations. Dhaka BRT will engage BRT bus operator from the existing bus operator initially through a negotiated contract, so that existing operator will get adequate compensation through a fleet scraping program and can continue their business as BRT bus operator.

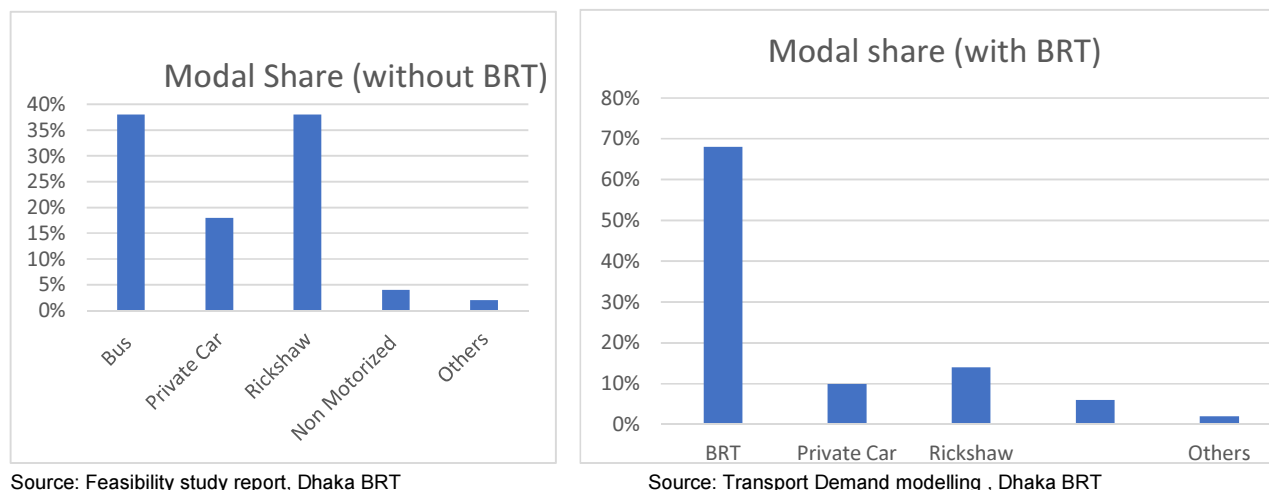
SUSTAINABLE DEVELOPMENT GOALS AND DHAKA BRT

The Sustainable Development Goals (SDGs) also known as transforming our world: the 2030 Agenda for Sustainable Development was adopted at the UN Sustainable Development Summit 2015 in New York, USA. It is a set of 17 "Global Goals" with 169 targets. It has been prepared in essence of the achieving the follow-up goals of Millennium Development Goals (MDG). SDGs related to Dhaka BRT that this paper intends to address are Goal 11, 13 and 3. Target 11.2 of Goal 11 focuses on providing access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. Target 11.6 of Goal 11 aims to reduce the adverse per capita environmental impact of cities, including by paying by 2030. Target 13.3 of Goal 13 emphasis on mitigation measures of climate change. Target 3.6 Goal 3 targeted to halve the number of global deaths by 2020.

Sustainable and Inclusive Public Transport with Dhaka BRT

Bus Rapid Transit (BRT) has been adopted as an initiative towards improvement on regular bus services through a combination of features like the construction of a comprehensive corridor that includes exclusive BRT lanes, mixed traffic lanes, non-motorized traffic lanes. High-capacity buses will replace defective and polluting buses with adequate safety measures.

Figure 6. Change in modal share along the BRT Corridor



Elevated BRT sections will enhance the overall capacity of the corridor and improve traffic flow. BRT Bus with an average speed of 25Km/h, journey time from Gazipur to Airport will be 45 minutes while currently it takes 2.5 -3 hours. Primary Business Model indicates that Dhaka BRT will be profitable with current fare structure due to higher ridership (max. 400,000 passengers per day). Thus, the city dwellers will have better options with safer, comfortable journey with affordable cost.

Dhaka BRT will be accessible to all groups of the society. The level boarding, alighting, escalator, and elevator at stations will make easy access for women, elderly and disable people. Adequate lights at stations and on streets will be provided to ensure safety for women. Thus, the

Dhaka BRT will make a significant improvement in the public transportation system in Dhaka. After the opening of Ahmedabad BRT in India modal share to public transport (BRT) increase rapidly. According to a survey conducted by centre of excellence in urban transport of CEPT University, India in 2014 17.5 per cent of auto (shared) / 12 per cent of two wheelers / 6 per cent of walk / 5 per cent of cycle/ 2.5 per cent of car/ 5.5 per cent auto-rickshaw passenger shifted to BRT due to more comfort, affordable, safe and time saving mode. Dhaka BRT is excepting similar modal shift as well as shaping the transport culture in Dhaka thus addressing Goal 11.

Better Environment and Dhaka BRT

Bus rapid transit systems can have positive impacts on environment by reducing air pollution, smog and greenhouse gases that contribute to global warming. Reductions in vehicle emissions can be achieved by through Dhaka BRT in two ways:

Table 1. Ambient air quality test results for five locations along the project corridor

Parameter	Unit	Location			Bangladesh Standard
		Airport	Tongi Station Road	Joydebpur Chowrasta	
PM_{10}	$\mu g/m^3$	315.7	137.9	407.17	150 (24 hrs.)
$PM_{2.5}$	$\mu g/m^3$	94.3	79.2	82.4	65(24 hrs.)
SO_2	$\mu g/m^3$	106.53	50.44	28.38	365 (24 hrs.)
NO_x	$\mu g/m^3$	390.75	198.47	176.27	100 (Annual)
CO	mg/m^3	9.86	9.69	10.98	40 (1 hr.)

Source: Environmental baseline monitoring report 2017

Direct reduction of Air pollutants and GHG

- Dhaka BRT operation will reduce fuel consumption by replacing older transit buses (5- 10 years old and 30-40 passenger capacity) with modern articulated (140-160 passenger)
- Black carbon and other harmful pollutants will be reduced due to use of ultra-low sulphur diesel and CNG.
- Dust from the existing road will be reduced due to the better asphalt surface of the new roads.
- Dhaka BRT buses will run with an average speed of 25 km/hour due to the dedicated lane and uninterrupted flow at all intersection (flyovers will be built at all intersections). As a result, overall vehicle kilometres travelled (VKT) will be reduced thus reducing overall emission.

Indirect reduction of Air pollutants and GHG

- Due to better service, a significant number of passengers will shift from private vehicle to BRT buses. On a per-passenger kilometre basis, emissions from single-occupancy vehicles are on average four times higher than the per-passenger kilometre emissions of public transport; these figures are even higher during peak periods.
- Transit-oriented Development (TOD) along BRT corridor will make BRT corridor more compact nature thus reduce the number and length of daily trips.
- With improved walking and cycling facility, shorter motorized trips can be avoided.
- All BRT station will have solar Panel which will reduce the demand of electricity.

The impact of exposure to harmful air pollution is a function of both the concentration of the pollutant in the environment as well as the duration of the exposure. BRT systems can, therefore, help reduce personal exposure to air pollution of passengers who switch to BRT from other modes in two ways:

- Lowering the concentration of ambient air pollution citywide or inside the BRT vehicles;
- Reducing the amount of time BRT passengers are exposed to air pollution at stations or inside the bus by reducing travel times.

After 5 years of operation of Ahmedabad BRT, results showed that there is a reduction of 122-177 per cent of P.M 2.5 along BRT corridor (UNESCAP, 2014). As per Initial Environmental Examination (IEE) report of Dhaka BRT, toxic residues from vehicle emissions near the GDSUTP road should be less likely under the improved conditions when the BRT is implemented, and are unlikely to accumulate or create worse impacts than at present under local conditions. Therefore, the project is believed to be sustainable in terms of particulate emissions. As per Environmental Impact Assessment (EIA) report of the project, it is estimated that about 42 tons/day of GHG emission can be avoided due to this project. Thus, the new BRT system will assist in achieving Goal 11 and Goal 13 of the SDG.

Urban Road Safety improvement and Dhaka BRT

There has been an alarming rise in the number of road accidents in Bangladesh over the past few years, especially on highways. The BRT route which is a part of the national highway N3 (Dhaka-Joydebpur-Mymensingh Road) has been well known for being a death trap recently, especially for pedestrians. In 2012 there were 19 major accidents and most casualties were with pedestrians (Accident research center, ARI 2013). Many Garment factories, universities, college, and schools which engages a large number of pedestrian movement (table 2) every day along BRT corridor. Especially during the opening and closing time, sudden pedestrian crossing causes accidents along this corridor. Therefore, to ensure adequate safety, Dhaka BRT aims to provide the following safety elements.

Modern Articulated Bus

It is revealed from field visit that old buses and inexperienced driver with higher speeds, invariably leads to increased incidents. The Operational Plan of Dhaka BRT suggests using 18.0m long High Platform vehicles with preferable 3 doors of 1.0-1.2m wide. The buses aim to carry large number of passengers, thus, reducing the number of vehicles on the road. Thus, an overall reduction in Vehicle Kilometer Travel (VKT) results in fewer drivers on the road and a safer transport environment for drivers, pedestrians, and cyclists.



Figure 7. Proposed BRT station and BRT Bus

Table 2. Pedestrian Volume at major Intersection along BRT corridor

Location	AM		PM	
	Volume Peak Period (3 hours)	Max Volume on Peak Period (15 minutes)	Volume Peak Period (3 hours)	Max Volume on Peak Period (15 minutes)
Joydebpur Chowrasta	68,170	2,040	60,337	1,190
Bhogra Intersection	32,623	2,165	32,312	1,187
House Building) Intersection	30,139	726	46,041	84
(Azampur) Intersection	45,193	1,560	48,700	1,643
Airport	28,413	677	38,269	1,086

Segregation of traffic

The implementation of a BRT system generally results in improved vehicle and pedestrian safety by reducing conflicts between the various modes. Dedicated bus lanes reduce interaction between buses and other vehicles, minimizing the risk for traffic crashes.



Figure 8. Current Unsafe Pedestrian crossing and Future Safe Pedestrian crossing

A closed system

Closed station design will improve safety by ensuring that access can only be made at designated points allowing pedestrian access to be better controlled. This is particularly relevant in Dhaka, where pedestrian behaviour and discipline is means that people cross outside of controlled or designated crossing areas.

Access to station

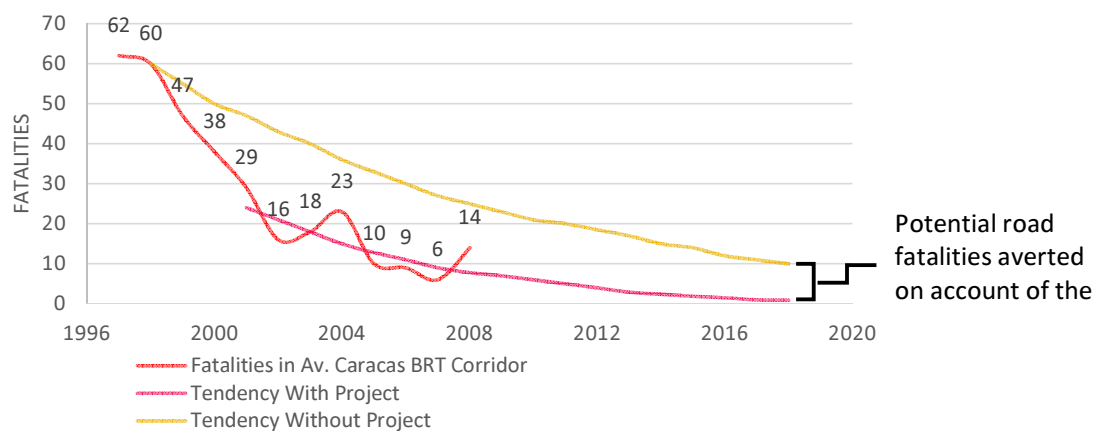
Passengers will be made to access the stations from footpaths on both sides of the road through Foot- Over-Bridges (FOB). This will integrate the BRT system, particularly at stations, with pedestrian and non-motorized vehicles in a safe and efficient manner, minimizing conflicts between fast-moving and slow vehicles and pedestrians by separating these movements while maximizing efficiency in how people transfer between modes and access the BRT system.

Construction of Elevated BRT

To ensure uninterrupted flow and restrict collisions 8.5 kilometre of elevated BRT will be provided at busy intersections and areas where the existing road is narrow, to segregate BRT buses and high-speed vehicles. This will also minimize the collision between the Non-motorized vehicle with others vehicles.

Overall, the condition of the road facilities will be enhanced and driving conditions should improve. Routine safety measures, signage, and road markings will assist to reduce driving risk further in accident-prone areas and provide enhancements to driving conditions on the BRT corridor. Thus it is projected that the target 3.6 of SDG on the proposed BRT corridor can be achieved easily. As this corridor is well known as pedestrian accident prone, it is expected that with the measures taken by Dhaka BRT project, there will be a decrease of 50 per cent of injuries of the pedestrian. Thus, the new BRT system will address the Target 3.6 of Goal 3 of the SDG. A direct evidence of improvement of road safety can be found from the case of TransMilenio BRT in Bogota, Colombia.

Figure 9. A high quality public system of TransMilenio in Bogota, Colombia improves safety



Source: Road Safety and Bus Rapid Transit-Workshop on Quantifying the Environmental, Social and Economic Benefits from Bus Rapid Transit Systems, EMBARQ India

Potential reasons behind expected success of Dhaka BRT

Despite many challenges to implementing BRT in an overcrowded city like Dhaka. It is expected that Dhaka BRT will be a successful mass-transit initiative. During Planning and design phase, several case studies were examined thoroughly both failure and success of BRTs worldwide. Two specific systems: Delhi and Bangkok BRT were studied due to their unsuccessful history. Complex operational plan (direct service), inadequate branding and marketing effort & introduced in a small corridor where the numbers of cars are very high, thus did not get much support of the daily commuters. Corridor selected for Bangkok BRT has very less demand and does not get political goodwill to push the project to success. Considering the failure of BRT systems discussed earlier, Dhaka BRT has the following potential reasons for being a successful BRT system.

- The first phase of Dhaka BRT is being implemented from Gazipur to Hazrat Shah Jalal International Airport, which is located on the outskirts of Dhaka demarcating the entrance of the city. The location of the corridor has high passenger demands.
- According to the Operational Plan, Dhaka BRT will provide Trunk and Feeder Services. An express service, running the entire length of the corridor will benefit the BRT operation, reducing the stops of some buses to a few strategic stations. Passing lanes in both directions and at all stations is recommended at all BRT stations.
- Communication with the stakeholders is an ongoing process for the system since its planning stage. Workshops have been organized to introduce the system and disseminate the information of potential problems during implementation. The system has also been introduced in the print and electronic media.

CONCLUSION

A BRT system is expected to improve quality of life in a city like Dhaka, by saving travel time, reduce air pollutant and greenhouse gas (GHG) emissions. BRT systems have gained worldwide popularity as an option for public transport system due to its capacity to deliver low cost, quickly-implemented, flexible and high-quality solutions to developing cities' transport needs. The introduction of the BRT and widening of the usable width of the existing corridor (Gazipur –airport) will improve traveling conditions along the BRT corridor. The proposed BRT system will help to achieve few Sustainable Development Goals for Bangladesh. Goal 11 (Target 11.2) will be achieved by providing a dedicated corridor containing BRT lanes, mixed traffic lanes, and non-motorized traffic lanes. The use of modern high capacity articulated buses will reduce the emission of GHG in the corridor, which will ensure the achievement of Goal 11 (Target 11.6) and Goal 13. Goal 3 (Target 3.6) will be achieved by introducing routine safety measures, signage, foot over bridge for pedestrian and road markings to reduce safety risk in accident-prone areas and provide enhancements to driving conditions near the BRT corridor. The implementation of the proposed improvements will bring a wide range of social, political and economic benefits including a forward-looking image of Dhaka city.

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