

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

Dhrubo Alam¹, Md. Mazharul Hoque², Ananya Roy³

ABSTRACT: *Dhaka, the Capital of Bangladesh and one of the fastest growing megacities of the world, has been experiencing a rapid growth of privately owned motor vehicles (especially cars and motorcycles). The phenomenon is not unprecedented in developing cities (e.g. African and Southeast Asian cities). One of the main reasons behind this trend in Dhaka is the lack of effective public transport and almost non-existence of urban rail system. The present state of affairs results in serious congestion in almost whole traffic network of the city. This paper presents an overview of the historical evolution and the current situation of traffic using the available data from various sources (e.g. reports, researches, studies etc.) of about last 25 years and also tries to explain the impacts of some relevant policy decisions from the past and present perspectives. There is also a brief description of the traffic situation and transport network of recent past. It highlights the implications and striking features of the past studies, present scenario, recent developments, planning policies and programs. The goal was to comprehend the experience and lessons learned from the planning, and implementation of the past studies, projects and schemes in urban transport provision for efficient management of congestion, equitable accessibility and safety.*

Keywords: *Urban transport system, Metro-Dhaka, Motorization, Privately owned motor vehicle, Traffic management.*

1. INTRODUCTION

Dhaka, the capital of Bangladesh, is the eight largest city of the world, in terms of population [1]. It has been well known for being over-populated,

¹ Technical Consultant, Dhaka Transport Coordination uthority, Nagar Bhaban, Dhaka. Email: dhrubo101@yahoo.com

² Professor & Dean, Faculty of Science and Engineering, UITS.

* Corresponding author: Email: dirarc@gmail.com

³ PhD researcher, Department of Built Environment, Tokyo Institute of Technology, Tokyo, Japan, Email: roy.a.aa@m.titech.ac.jp

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

traffic congested and polluted (emission). With a current population of 17 million, Dhaka (location 23.42N and 90.22E) has been growing at an astonishing level since the independence in 1971. Its metropolitan area is home to almost 15 million people in an area of 1,528 km² (about 17 million in the Greater Dhaka). About 45,000 people per square kilometer lives in the core area, which makes it also one of the most densely populated cities in the world [2].

It is one of the seven cities which experienced urban population growth higher than 2.4% in between 1975-2005 [3]. The megacity's population is expected to rise to 20 million people by 2020 [2]. Many of the inhabitants of Dhaka are poor, per capita income averages around US\$ 900 per year, and around 30% of the population lives below the poverty line, with very poor access to transport services. This paper tries to provide a brief overview of the historical evolution of Dhaka's transport system and present situation. It also extensively covers the recent growth of motorization especially the number of motorcycles and deplorable condition of the public transport system mainly the bus industry.

2. HISTORICAL EVOLUTION OF THE TRANSPORTATION SYSTEM IN DHAKA

As per available data, Dhaka was fairly under motorized in the 70's and 80's. From Table 1, it can be seen that, around 60% of all the traffic are rickshaws. Actually, rickshaws have dominated the transport scene in the city from their introduction in the late 30's and early 40's (only 37 rickshaws in 1941 and 181 rickshaws in 1947 [4]. Shankland Cox Partnership et al.[5] included only public transport and para-transits in their study, but it also shows prevalence of rickshaws (almost 85%). In 1981 there were 26,925 registered rickshaws in the city. The actual total is said to be about 50,000~80,000 or 52~58% of total vehicles [5, 6]. But in 1998, the number of registered rickshaws grew to 112,572 [4]. The unofficial number hovers between 250,000 to 500,000 at present. Bangladesh Road Transport Authority (BRTA) does not record the number of rickshaws, but even without that data, it can be observed that the number of motorized vehicles increased significantly. Almost 80% of motorized traffic are now is either car or motorbike.

Table 1: Modal split (in percentage) of vehicular traffic volume in Dhaka city.

Type of Vehicle	Ahmed (1980)[7]	Shankland Cox Partnership et al (1981)[5]	BRTA (2003)[8]	BRTA (2012) [8]
Cars	19	N/A	39.66	35.81
Buses	2	1	3.32	2.76

Trucks	1	N/A	6.71	5.85
Auto-rickshaws	7	13.1	3.52	2.86
Motorcycles	6	N/A	39.34	42.53
Rickshaws	59	84.2	N/A	N/A
Bicycles	4	N/A	N/A	N/A
Taxi	-	-	3.09	1.84
Others	2	1.7	4.35	8.35
Total	100	100	100	100

Other than rickshaws, walking was also a dominant mode back in the 80's and 90's (Table 2). But as a result of rapid motorization and urbanization, sub-urban development and urban sprawl, over population etc., walking has become almost impossible in many areas of the city. Furthermore, there is lack of pedestrian facilities. Only 388 kilometers of paved footpath and 53 over pass and 3 under pass are in the Dhaka City Corporation (DCC) area [9]. Unfortunately, even these limited available facilities can not used properly for the causes of ill maintenance and management. It can be concluded that, people are being bound to use rickshaws more (around 20% increase in trip share) as their walking options are getting limited day by day.

Table 2: Modal share (trips) in metro Dhaka [10].

Mode	Percentage of Share				
	DITS (1994)	DUTP (1997)	JBIC Study (1999)	STP(2005) [11]	JICA Study (2009)
Walk	60.1	62.82	62.05	14.0	19.09
Rickshaw	20.1	20.04	13.28	34.0	38.19
Bus	12.8*	10.42*	10.22	44.0*	29.83
Auto-rickshaw			5.83		5.73
Passenger Car	7.0**	6.72**	3.97	8.0**	4.30
Others			4.65		2.86
Total	100	100	100	100	100

* Transit, ** Motorized (Non Transit)

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

3. BRIEF OVERVIEW OF PRESENT TRANSPORT SCENARIO

Dhaka suffers from critical and deteriorated traffic congestion, despite low level of motorization, largely due to the absolute lack of roads, deficient road network configuration and inefficient traffic management [12]. Existing public transport system, bus transit operations in particular is characterized as far short of the desirable mobility needs of the people in terms of reliability, comfort speed and safety. In Dhaka, buses are generally considered unreliable and time consuming to reach the destination [13].

Public transport system in Dhaka city consists of conventional bus services (buses and minibuses) and para-transits (e.g. rickshaws, auto-rickshaws, taxis, battery bikes etc.). The modal share is known to be by rickshaw (13.3%), bus (10.3%), auto-rickshaw (5.8%), car (4%) and walking, which is the predominant mode with a share of 62 % of total trips [10]. Lack of effective public transport system and preference of door to door service influence the augmentation of private cars and other modal shifting. Though railway was very popular and still is a relatively safer and cheaper transport system in the context of Bangladesh, absence of proper initiatives and investment in the urban corridor, it could not play the expected role in Dhaka's public transport system. Moreover, rail tracks runs through the Central Business Districts (CBD) and congested areas of the city with lots of level crossing which results in enormous congestion.

Dhaka is surrounded by four rivers, namely Buriganga, Turag, Balu and the Sitalakhaya. As a city, it started to develop from the northern bank of the Buriganga from the place known as Sadarghat (a river port) since the ancient times. Though it is surrounded by four rivers which could have provided an inbuilt facility for operation of circular waterways, due to financial constraints and lack of appropriate planning for inter-connectivity amongst other modes, it is not effective. The only international airport (Shahjalal International Airport) is located in the northern part of the city. But there is effectively no integration among the airport and the public transport system, railway stations and waterway terminal (which is situated at the southern part).

A. Road Inventory

In an ideal city, 25% of the surface area should be used for constructing roads and lanes, but Dhaka has only 8% (DCC, 2002). Moreover, like most of the developing cities, Dhaka's road network hierarchy is poorly defined, with very limited number of arterial and main roads [14]. The

road inventory of Dhaka, affirmed by different organizations and areas are provided below:

Table 3: Road network within Dhaka Metropolitan Development Plan (DMDP) area (Bhuiyan, 2007)[15].

Type of Road	Length (km)	Percentage (%)
Primary*	200	6.7
Secondary	110	3.7
Feeder	152	5.21
Other Narrow Roads	2,540	84.6
Total	3,002	100

* Primary road is defined as road having bus bay, footpath etc. Source: Dhaka Transport Coordination Authority (DTCA).

From Table 3 it can be observed that only 10.4% roads are satisfactory for bus operation. Even by considering connector roads are suitable for bus flow, there is around 30% road available for bus services, which is only about 400 km (see Table 4). Moreover, this road space is also shared by NMTs and as a result for absence of any bus priority measures, buses often come second when they compete for road space with other modes.

Table 4: Road network within Dhaka City Corporation (DCC) area (Bhuiyan, 2007) [14].

Type of Road	Definition	Length (km)	Percentage (%)
Primary	Minimum of 31m wide, 6 lanes of 3.25m, footpath and median	68.45	5.29
Secondary	Minimum of 25.50m wide, 4 lanes of 25m, 2 NMV lanes of 2m wide, footpath and median	108.20	8.37
Connector	Minimum of 22 m wide, 2 lanes of 3.25m each, 2 NMV lanes of 2m each, footpath and median	221.35	17.12
Local	Minimum of 8.75 m wide, two lanes of 1.36m and footpath (1.5m each way)	573.75	44.37

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

Narrow	Minimum of 4.5 m wide with two lanes of 1.36m	321.27	24.85
Total		1,293.02	100

Source: RMMS Component, Dhaka Urban Transport Project (DUTP)

B. Modal Share

The prevailing situation is even worse when taken into account the fact that, this inadequate road space is shared by both motorized and non-motorized traffic (heterogeneous traffic mix) and vehicles with varying characteristics (e.g. three-wheelers, human haulers, pickups, rickshaw-vans etc.). Some striking features found from the survey conducted for ‘Clean Air and Sustainable Environment’ project can be acknowledged as [16]:

- Buses comprise 9.7% of the vehicle mix that combines all vehicles and pedestrians;
- Rickshaws and vans comprise 28.4% of all vehicles;
- Auto-rickshaws (with 36.8%) and Cars/Light Vehicles (with 43%) comprise a substantial proportion of all motorized vehicles (2-stroke three wheelers);
- Whereas buses comprise a small proportion (9.7%) of the mix, bus passengers account for 77% of all people.

Table 5: Modal share of trips with respect to income groups [10].

Income Group	Proportion of Income Groups (%)	Modal Share			
		Walk	Rickshaw	Transit	Motorized (non-transit)
Low (<12,500)	48	73	38	41	14
Medium (12,500-55,000)	49	26	59	56	66
High (>55,000)	3	1	3	3	20
Total	100	100	100	100	100

The Table 5 shows modal distribution (in terms of trips) by income groups. From the table, it is clear that the low income group is responsible for the lion's share of trips on foot (73%) while most of the rickshaw trips are made by the middle income group (59%) [10]. These two income groups are also main users of available transit services in Dhaka, which is a very promising sign. The significance of walk, rickshaw and transit trips is obvious as they cater for 97% of the city dwellers. Unsurprisingly, very few of the lower income people (e.g. day laborers, garments workers etc.) can afford the fares on buses even though they are quite low and most of their trips are short. Thus, they are forced to travel on foot, which is reflected in the provided table, suffering lower levels of mobility and accessibility.

4. RAPID INCREASE OF PRIVATELY OWNED MOTOR VEHICLES

A. Vehicular Growth

The rapid urbanization process, income growth, inferior transportation facilities and policies, heterogeneous traffic with over concentration of non-motorized vehicles, absence of a decent public transport system and inefficient traffic management practices have created a situation where cars and motorcycles are becoming increasingly necessity for the middle class, to get around in the metropolitan Dhaka [13]. As a result, further congesting the roads and worsening the air pollution, noise, and safety problems. The number of registered motorized vehicle stands at 1,255,402 in April, 2018 increasing from 303,215 in 2003 (a fourfold increase in 15 years). More than 36% of all registered vehicles are in Dhaka (total 3,419,884 in Bangladesh) [8], [17].

The alarming trend which can be spotted from the Figure 1 is that, while the percentage of buses and minibuses remain almost same in this period, private vehicles, particularly, number of cars and motorcycles almost tripled. Public transport such as buses and minibuses has grown at a very insignificant rate even though the demand for public transport services is increasing. Motorcycles and cars constitute around 54% and 26% of total motorized vehicles respectively.

B. Resulting Negative Impacts from Two-wheelers

The role of motorized two-wheelers (motorcycles and scooters) cannot be ignored in the context of developing world, as it can be said that they serve as an individual motorized mobility equalizer. The inclusion of two-wheelers changes the perception of the motorization phenomenon. There are many cases in which the consideration of two-wheeled motor vehicles in cities in "two-wheeler regions" brings their motorization levels up to the same level as cities of much higher incomes.

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

Along with many benefits, like proving a cheap way of providing increased mobility and accessibility, they also come with harmful consequences. The foremost is that they have serious negative environmental implications. Considering Carbon monoxide (CO) emission by each transportation mode for the year 1996, it was estimated that auto-rickshaws and cars are the major contributors (35%), followed by Motorcycles (24%). It has also been noted that auto-rickshaw is the major contributor of Hydrocarbon (HC) emission (56%), followed again by motorcycle (26%) [18]. It should be noted that after banning of the petrol-run auto-rickshaws and introduction of auto-rickshaws run by Compressed Natural Gas (CNG); motorcycles may have become the most polluting transportation mode in terms of CO and HC pollution.

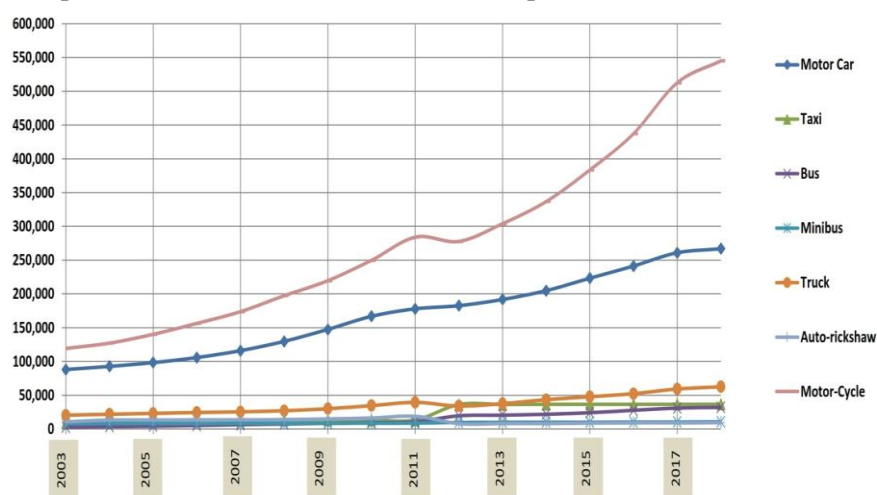


Figure 1: Motorized vehicle growing trend in Dhaka (from 2003 to April 2018); Source: BRTA Registration.

Not only do motorcycles tend to have higher local pollutant emission rates than other motorized modes, they also tend to be extremely dangerous. The latter challenge (safety) has no obvious technological solution. Users have a penchant for taking advantage of the vehicles' narrow profile to dart in and out of traffic, which disturbs and in extreme cases, poses as a serious risk to) pedestrians, cyclists, auto drivers, bus service, and law enforcement. If the right of way is divided between cars and bicycles, motorized two-wheelers prove disruptive because they don't fit either facility. Kabir and Mahmud showed the red light infraction phenomena of the motorbikes in four important, busy and congested intersections of Dhaka in the morning peak. Around ~10-15% of them violates the signal

[19]. This percentage decreases when the roads are congested, because of their speed reduction resulting in less maneuverability.

5. PRESENT SITUATION OF PUBLIC TRANSPORT

Dhaka is one of the very few megacities without a properly managed public transit system. Mainly buses and minibuses are considered as public transports. Obviously they cannot fulfil their demand, so there various motorized paratransit systems are also prevalent (e.g. auto-rickshaws, tempos, minivans etc.). In this paper we only consider buses and minibuses as mainstream public transport of city and their present condition is described in the following sections.

It can be seen from the Table 6 that nearly 70% of the route length is within 11 to 30 km, which is about the extent, Dhaka city can be termed by length in north-south direction. It seems these routes crisscrossed the city and serving the users quite well. But in reality, there are unnecessary and unwanted overlapping of the routes, with sole intention of profit maximization and operational advantages, as observed from Table 7. Most of the bus companies in Dhaka are small to medium size (roughly 70% of them have 11 to 30 buses) (see Table 8). However, all buses of a company may not be owned by a single person, rather, generally, a good number of individuals own one or more buses, make a group, form and run a bus company. So, even these companies' buses ply on the roads like individually owned buses.

Table 6: Distribution of routes by length [14].

Route Length (km)	Number of Routes	Percentage (%)
<10	1	0.97
11-20	39	37.86
21-30	31	30.10
31-40	17	16.50
41-50	5	4.85
51-60	7	6.80
>71	3	2.91
Total	103	100.00

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

Table 7: Top ten locations of overlapping routes [14].

Location	Number of Routes overlapping	Number of Permits issued to pass through
Paltan	56	2,337
GPO	50	1,889
Motijheel	59	1,838
Shahbagh	48	2,203
Press Club	43	1,847
Gulistan	41	1,368
Airport	36	1,767
Jatrabari	35	1,703
Abdullahpur	34	1,551
Mohakhali	33	1,339

Table 8: Distribution of Bus Companies by Fleet Size [14].

Fleet Size	Number of Companies	Percentage (%)
1-10	2	2.67
11-20	21	28.00
21-30	31	41.33
31-50	14	18.67
51-70	4	5.33
71-99	1	1.33
100-150	1	1.33
>150	1	1.33
Total	75	100.00

There are 31,922 buses and 10,441 minibuses registered (as of April, 2018) which represent only about 5.7% (buses and minibuses combined) of total motorized traffic. Though the number of large buses and minibuses increased for last 5 years (hovering around 5-7% of total traffic), the share/ percentage of bus fleet (buses and minibuses combined) has been in fact declining slowly (see Figure 2), which proves the

increment in supply cannot cope up with the huge travel demand [17].

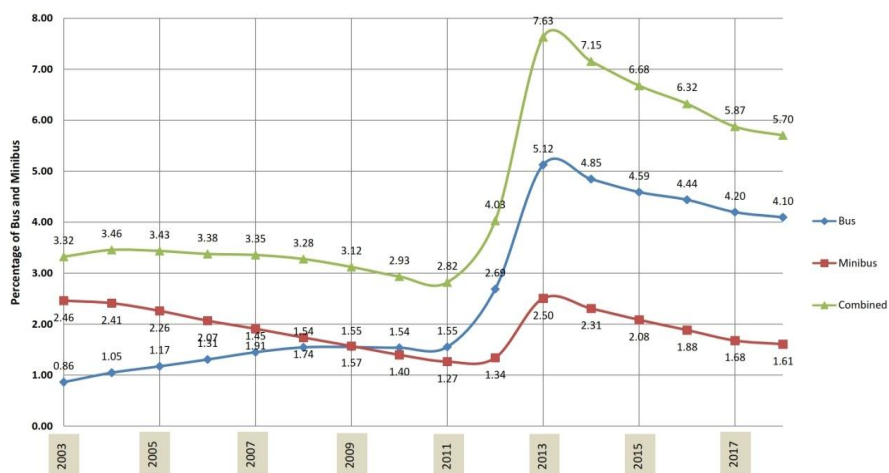


Figure 2: Growth of buses and minibuses in Dhaka; Source: BRTA Registration.

6. GOVERNMENT INITIATIVES

To improve the current situation and reorganize the existing traffic system methodically, the government prepared the Strategic Transport Plan (STP) for Dhaka which recommended a package of comprehensive programs for the development of transport infrastructure over 20 year period. This strategy includes various types of development agenda, such as three Bus Rapid Transit (BRT) routes, three Mass Rapid Transit (MRT) (Metrorail) routes, 50 highway projects etc. The implementation program has been divided into four periods of five years each; beginning in 2005 and ending in 2024. But, unfortunately, for the same reason most of the needs of the mass people are ignored: the lack of political and economic power, and thus the inability to influence politicians who shape government policies; the implementation of the components of STP to mitigate transport problems of theirs has not been put into action. Instead, ignoring the needs of non-motorized travelers, recent policies at all government levels have focused on trying to speed up travel for the motorized elite by constructing numerous grade-separated flyovers, overpasses and interchanges (e.g. Jatrabari-Gulistan flyover, Kuril interchange, Banani overpass etc.).

7. DISCUSSION

Economic development resulting in rapid motorization comes at a price of depleting the transportation equity of a city. For example, from an environmental and equity perspective, major concerns exist regarding the

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

rapid increase of motorized two-wheelers. Some have even characterized the motorcycle as likely the “most challenging” transport problem that Asia will face in the next decade [20]. The recent private motorization and current prevalence of NMTs is not a sustainable solution although they may help to increase mobility in short term. Already authorities tried to and have been successful in banning NMTs from some parts of the city. So, like other developing cities around the world, NMTs will be restricted in near future for Dhaka too.

The city is facing a fast transition from a compact walking and para-transit based city to a increasingly motorized one with motorcycles and private cars. This trend has been observed in other cities of the region. For example, the number of registered cars in Hanoi, Vietnam rose by 179 percent to 235,000 while the number of motorcycles rose by 85 percent to 4.0 million units between 2006 and 2011 [21]. According to Shimazaki and Rahman’s (1996) classification, Dhaka is still a ‘Cycle rickshaw dependent system’, which may make it the only megacity depending solely on non-motorized transport (NMT) [22]. If we observe the figure given by Barter (1999) for the evolution of cities in terms of transport system, we can conclude that Dhaka is on the way of becoming a motorcycle city from a walking or NMT city [23]. The reason behind this is sheer absence of public transit (namely bus) and high demand for mobility resulting from increase in income (because of a developing economy). Hence, for transportation equity and accessibility, not only public transit is necessary but also Mass Rapid Transit (MRT) (e.g. subway, BRT, LRT etc.) is required.

8. CONCLUDING REMARKS

This paper summarizes and briefly describes the evolution of the transportation system of modern Dhaka (post-independence, since 1971). The main objective of the paper was a brief exposition of the overview of the past studies, present scenario, recent developments and planning policies with succinct review. The goal was to comprehend the experience and lessons learnt from the planning, implementation and shortcomings of the past studies, projects and schemes in the delivery of accessible, safe and sustainable urban transport system. The succeeding scope of this research paper is to glean the essence from the comparative analysis of the motorization and commensurate measures of similar economies and cities in the efficient management of congestion around the region (e.g. Vietnam, Laos, Cambodia, Nepal etc.).

ACKNOWLEDGEMENTS

The authors would like to acknowledge the contribution from the suggestions and comments from the reviewers and the editors. The authors are also indebted to Dhaka Transport Coordination Authority (DTCA) for providing access to various information and reports.

REFERENCES

- [1] Begum D A, (2004) Air pollution: A Case Study of Dhaka City', presented at the conference 'BAQ-2004, Organized by Society of Indian Automobile Manufacturers, Agra, India.
- [2] ADB, (2011) Preparing the Greater Dhaka Sustainable Urban Transport Corridor Project, Consultant's Report.
- [3] United Nations, (2006) World Urbanization Prospects: The 2005 Revision, Working Paper No. ESA/P/WP/200, Department of Economic and Social Affairs, Population Division.
- [4] Banglapedia, (2015) Rickshaw', <http://en.banglapedia.org/index.php?title=Rickshaw>. Accessed on 27 October, 2015.
- [5] Shankland Cox Partnership, (1981) Dacca Metropolitan Area Integrated Urban Development Project, Government of Bangladesh/Asian Development Bank/United Nations Development Programme, Dhaka.
- [6] Ara H, (1983) Socio-Economic Correlates of Urban Travel Patterns: A Study in Dhaka City. MSc Thesis, Bangladesh University of Engineering and Technology (BUET), Dhaka.
- [7] Ahmed K A, (1980) Traffic Problems in Dhaka City', Local Government Institute, Dhaka.
- [8] Bangladesh Road Transport Authority, (2012), Number of Yearwise Registered Motor Vehicles in Dhaka, Available at: http://www.brta.gov.bd/images/files/motor_v_dhaka_05-08-12.pdf.
- [9] Dhaka City Corporation (DCC). 2002, Structure plan, master plan and detailed area plan for Dhaka city, Volume. 1, Dhaka, Bangladesh.
- [10] Dhaka Urban Transport Development Study (DHUTS), (2010) Final Report, prepared by Bangladesh University of Engineering and Technology (BUET) and Japan International Cooperation Agency (JICA) Study Team for 'Dhaka Transport Co-Ordination Authority' (DTCA), Ministry of Communications.

Historical Overview of the Transport System of Dhaka and the Rise of Privately Owned Motor Vehicles

- [11] Strategic Transport Plan (STP) for Dhaka, (2005) Final Report, prepared by Louis Berger Group, Inc. & Bangladesh Consultants Ltd (BCL) for Dhaka Transport Co-Ordination Authority (DTCA), Ministry of Communications.
- [12] Japan Bank for International Co-Operation (JBIC), (2000) Study of the Improvement of Transportation and Environment in Dhaka, Dhaka, Bangladesh.
- [13] Hoque M M, Barua S, Ahsan H M, Alam D, (2012) BRT in Metro Dhaka: Towards Achieving a Sustainable Urban Public Transport System, Proceedings of CODATU XV: The Role of Urban Mobility in (re)shaping Cities, Addis Ababa, Ethiopia.
- [14] Hossain M (2006), 'The Issues and Realities of BRT Planning Initiating in Developing Cities, Journal of Public Transportation, 2006, BRT Edition.
- [15] Bhuiyan A A, (2007) Study on Bus Operation in Dhaka City, Air Quality Management Project (AQMP), Final Report, Department of Environment (DoE), Ministry of Environment and Forest (MoEF).
- [16] Clean Air and Sustainable Environment (CASE) Preparation project, (2009) Final Report, 'Consultancy Services for Pilot Bus Priority Corridor Pre- Feasibility Study', prepared by 'DevConsultants Limited Bangladesh' (DevCon) for Department of Environment (DoE), Ministry of Environment and Forest (MoEF).
- [17] Bangladesh Road Transport Authority, (2018) Number of Yearwise Registered Motor Vehicles in Dhaka, Available at: <http://brta.gov.bd/site/page/4632772e-f586-46f5-a0ac-0fcbe2ba12ae/> ঢাকা-মেট্রোতে -মোটরযান-নিবন্ধনের-সংখ্যা.
- [18] Karim M M, (1999) Traffic Pollution Inventories and Modeling in Metropolitan Dhaka, Bangladesh, Transportation Research Part D 4, 291-312
- [19] Kabir M I, Mahmud S M N, (2013) A Comparative Study between Traffic Flow and Red Light Infraction by the Motorcyclists in Dhaka City, International Journal of Scientific & Engineering Research, Volume 4, Issue 10.

- [20] Gwilliam, K. 2003, 'Urban transport in developing countries', *Transport Reviews*, Vol. 23, No. 2, 197-216.
- [21] Bray D, Holyoak N, (2015), 'Motorcycles in Developing Asian Cities: A Case Study of Hanoi.', In 37th Australasian Transport Research Forum, unpublished conference paper.
- [22] Shimazaki T, Rahman M, (1996) Physical Characteristics of Paratransit in Developing Countries of Asia, *Journal of Advanced Transportation*, Volume. 30, Issue. 2.
- [23] Barter P A, (1999) An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia: The Challenge Of Rapid Motorisation in Dense Cities, PhD Thesis, Murdoch University, Perth, Western Australia.