ROAD TRANSPORT SCENARIO IN DHAKA CITY AND AIR POLLUTION ASPECTS – A COMPARATIVE ANALYSIS

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Abstract

This study is particularly focused on the current statistical scenario of road transport vehicles in the Greater Dhaka city area and its consequential impact on the city environment – especially on the air quality level. Dhaka, a city with 400 years of traditions and culture, is recently undergoing worse situations with its overcrowded population. Undoubtedly, the road transport sector is serving as the main backbone to the city commuters. With the overwhelming increase in population day by day, the city is experiencing with numerous transport options as some transport planning initiatives are to proceed in a few years. Although it has been revealed that air pollution level at traffic congestions has noticeably improved due to large scale introduction of CNG vehicles in Dhaka city, the overall air quality level of the city is deteriorating as more and more vehicles are adding to the current status without replacing the old and worn-out ones. Different studies show that transportation in Dhaka city is exposed as the leading contributor to the high concentration of Suspended Particulate Matters (SPM) and Lead (Pb) along with emissions of other Green House Gases (CHGs) such as Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (NO_X) etc. In addition, some recommendations for controlling the air pollution in Dhaka city are also incorporated in the paper.

Keywords: Road transport, Air quality, CNG vehicles, Greenhouse gas

1. Introduction

Air pollution due to road transport vehicles can be treated as one of the major critical concerns to the city commuters with its high concentration above the normal ambient level. Carbon monoxide (CO), Sulfur dioxide (SO_2), Nitrogen oxides (NO_X), Ozone (O_3), Hydrocarbons (HC) and Suspended Particulate Matter (SPM) are considered as the most significant pollutants. Lead (Pb) as another critical pollutant was added to this list in the late 1970s by the Environmental Protection Agency (EPA) of USA[1]. In 1987, PM_{10} (Particulate matter with an aerodynamic diameter of less than or equal to 10 microns) was also added to the list.

Drowsiness, eye irritation, cough, asthma, throat irritation, nose blockage, persistent, respiratory infections, bronchial infections, colds and headaches are observed as some of the common syndromes among the city people in recent times. Lead (Pb) affects the central nervous system, causing renal damage and hypertension. CO in air reduces the ability to carry oxygen and aggravates heart disorders.

Dhaka, the capital of Bangladesh accounts for nearly 40 percent of total urban population. With a population of over 14 million and with the rapid urbanization rate, Dhaka bears the distinction of being the fastest growing cities in the world. And if this trend continues, by the year 2025 Dhaka will be home to more than 20 million populations being larger than Shanghai, Beijing or Mexico City as some predictions exhibit (Shafi, 2010).

In serving that large number of rapidly growing population, road transport sector is playing the pivotal role with no other options as most of the rivers and their tributaries around the city are filled in due to escalating growth of real estate developers and other tertiary forms of entrepreneurs. While even a few decades ago, water transport was defined as the safest and cost effective mode of transport for Dhaka city and its vicinities. As a fact with an increasing number of vehicles adding to the existing infrastructure (about 2000 km) day by day, the situation is getting truly unmanageable generating overwhelming difficulties to the city commuters.

Air pollution in Dhaka city is testimonied to be serious and damaging to public health. In the winter of 1996-97, the lead (Pb) concentration in the atmosphere of Dhaka city was reported higher than any other place of the world[2]. Concern over air pollution rate of Dhaka city eventually led to the promulgation of National Ambient Air Quality Standards (NAAQS) in Bangladesh in 1997.

2. Literature Review

A remarkable number of studies were previously executed on Dhaka city's growing number of private vehicles and resulting air pollution. Jaigirdar (1998) conducted a study on assessing the ambient air quality of Dhaka city investigating the impact of improved bus service in reducing environmental pollution.

N. Ahmed and A. Begum (2010) performed a study on air pollution aspects of Dhaka city exemplifying both indoor and outdoor air pollution scenario. A. Begum (2010) accomplished another work on the impact of auto-exhaust on air quality in Dhaka city that identified traffic congestion and fuel quality as significant contributors in deteriorating the air quality.

W. Uddin and M. Hasan (2002) carried out a study on the concentration of particulate matters in air around Dhaka city. Faiz, Weaver & Walsh (2002) conducted a study on air pollution from motor vehicles suggesting standards and technologies for controlling pollutions.

M. Karim (2009) accomplished a work on traffic pollution in Bangladesh and metropolitan Dhaka investigating the current emission statistics.

Previously Greater Dhaka Metropolitan Area Integrated Transport Study (1996) showed some important statistics on this issue illustrating baseline vehicles emission inventory in Dhaka city.

Another statistics on vehicle population, utilization and fuel economy in Dhaka was demonstrated in the working paper of Dhaka Urban Transport Project (DUTP, 1996).

D. Bongardt, F. Rudolph & W. Sterk (2009) worked on transport options in developing countries and climate policy suggesting the Copenhagen Agreement and beyond.

Clean air is judged to be a basic requirement of human health and well-being. In this regard, World Health Organization (WHO) published the updated worldwide air quality guidelines[3]. Table 1 below shows the acceptable limit for four common air pollutants:

Table 1: Allowed concentration level set by WHO

Type of Pollutant		Acceptable limit ($\mu g/m^3$)
Particulate Matter	$PM_{2.5}$	10 (annual mean) 25 (24-hour mean)
	PM_{10}	20 (annual mean) 50 (24-hour mean)
Ozone (O_3)		100 (8-hour mean)
Nitrogen dioxide (NO_2)		40 (annual mean) 200 (1-hour mean)
Sulfur dioxide (SO_2)		20 (24-hour mean) 500 (10-minute mean)

Source: WHO Air quality guidelines, 2005.

Previously an ambient AQ standard for Bangladesh was introduced in the Environment Conservation Rules (ECR) of 1997. Later on the World Bank funded Air Quality Management (AQM) project replaced that 1997 standard by a new set in July 2005. Table 2 below represents the updated ambient air quality standards comparing with WHO guideline values and US EPA standards:

Table 2: Updated (2005) ambient AQ standards

Pollutant	Mean period	Bangladesh[a] standard ($\mu g/m^3$)	WHO[b] guideline value ($\mu g/m^3$)	US EPA[d] standard ($\mu g/m^3$)
CO	8-hour	10,000 (9 ppm)	10,000[c]	10,000
	1-hour	40,000 (35 ppm)	30,000[c]	40,000
Pb	annual	0.5	0.5	-
NO_x	annual	100 (0.053 ppm)	-	-
TSP	8-hour	200	-	-
PM_{10}	annual	50	20	revoked
	24-hour	150	50	150
$PM_{2.5}$	annual	15	10	15
	24-hour	65	25	35
O_3	1-hour	235 (0.12 ppm)	-	235
	8-hour	157 (0.08 ppm)	100	157
SO_2	annual	80 (0.03 ppm)	-	78
	24-hour	365 (0.14 ppm)	20	365

Source: [a]S.R.O. No: 220-Law 2005; [b]WHO, 2005; [c]WHO, 2000 and [d]US EPA, 2006.

The new standards for PM (PM_{10}, $PM_{2.5}$), NO_2, SO_2, CO, and ozone (O_3) remained the same as set by the ambient AQ standards of US EPA and the standard for Lead (Pb) was equivalent to the guideline value set by WHO. Bangladesh has become the only country in South Asia who set $PM_{2.5}$ in its National Ambient Air Quality Standards[4].

3. Methodology

The entire study is carried out based on data collected from secondary sources i.e. research reports previously accomplished by individual researchers and various concerned local as well as international institutions/authorities. And the analysis and forecasted figures based on most recent statistics are presented afterward.

4. Data Analysis and Results

Table 3 below represents the number of vehicles added to the existing limited infrastructure on the roads of Dhaka city in recent years.

Table 3: Statistics of registered vehicles

Type of Vehicles	Up to 2003	2004	2005	2006	2007	2008	2009	2010	Grand Total
Private car	87866	4734	5633	7403	10244	13749	17654	19557	166840
Jeep/ Microbus	32391	2114	3303	4548	4372	5077	6803	6687	65295
Taxi	9369	523	514	266	0	0	10	0	10682
Bus	2614	779	728	949	1082	1144	914	1101	9311
Minibus	7460	368	118	75	77	107	112	142	8459
Truck	20342	1437	1104	1480	830	1642	3180	4543	34558
Auto-rickshaw/ tempo	10687	2344	139	230	121	155	1144	1362	16182
Motor cycle	119299	7872	12879	16284	17303	23713	22093	30264	249707
Others	13187	1300	2361	2728	2913	2550	4868	12225	42132
Total	303215	21471	26779	33963	36942	48137	56778	75881	603166

Source: BRTA, 2010.

The above statistics shows only the registered vehicles as per the estimation by Bangladesh Road Transport Authority (BRTA). Besides these a considerable number of vehicles are left unregistered due to low enforcement of registration regulations. Based on a study, varied by type only about 25-50% of the actual number of vehicle is registered (Intercontinental Consultants and Technocrats Pvt. [ICTP] 2001).

From 2003 to 2010 almost all type of vehicles increased by near about 20 percent than the previous year's figure except the metered taxi and minibus. A steady growth is apparent in case of private car and motor cycle during the year 2004 to year 2010. At the end of 2010, the number of motor cycle reached more than double comparing with 2003's figure; private car increased by 90 percent than the gross number in 2003.

Despite not having such a large vehicle fleet on the roads high traffic volumes, congestion and poor vehicle maintenance resulted in the transport sector act as major contributors to air pollution. Inefficient land use and overall poor traffic management further adds to the problem. Motor vehicles are often observed as old, overloaded and poorly maintained. Old trucks and dilapidated minibuses are often traced on the city streets. Fig.1 below visualizes the growth of all type of vehicles at the end of year 2010 comparing with the base year 2003.

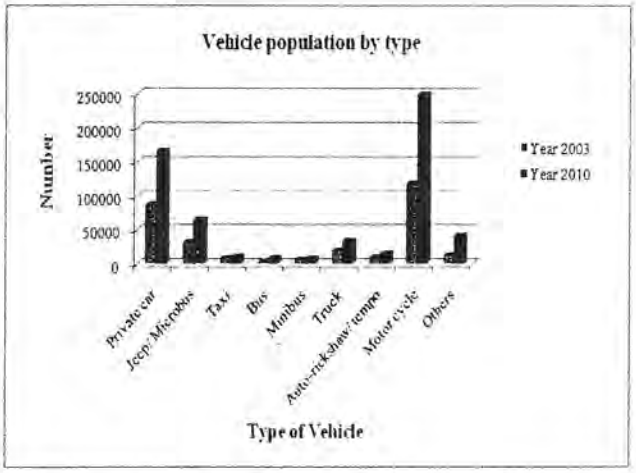


Fig. 1: Vehicle pop^n comparison (2003 vs 2010)

From the above figure it is evident that within a short time almost doulbled vehicles entered on the same roads with valid permission of the vehicle registration autority (i.e. BRTA) leaving the city's infrastructure in a truly unmanageable situation.

Fig. 2 below depicts the occupied percentage contribution of all type of vehicles among which motor cycle (41%) alone ensured the fastest ever growth followed by private car (28%); which are considered as most significant contributors in deteriorating the air quality level along with truck and minibus (grossly 7%). In broad sense, more than 75 percent of city's vehicles are directly contributing to air pollution as these vehicles are normally operated by diesel or gasoline.

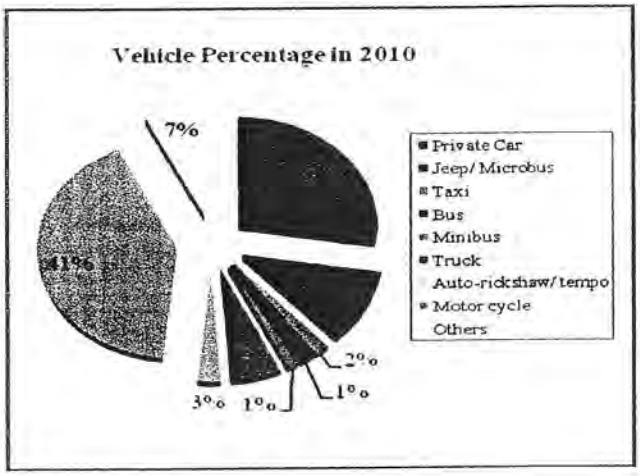


Fig 2: Vehicle percentage in Year 2010

Based on Table 3, if the same growth rate continues by the end of year 2015 the total number of vehicles will reach at more than 850,000. With this same trend alone in year 2015, newly registered number of motor cycle and private car will be near about 52,000 and 34,000 respectively which are the most dominant air pollutant sources (Fig. 3).

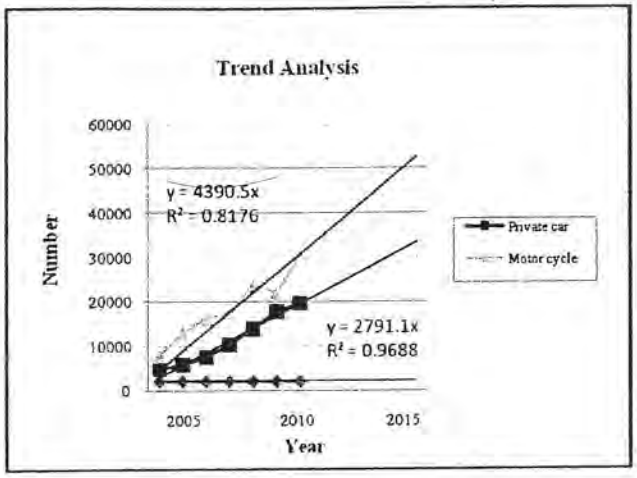
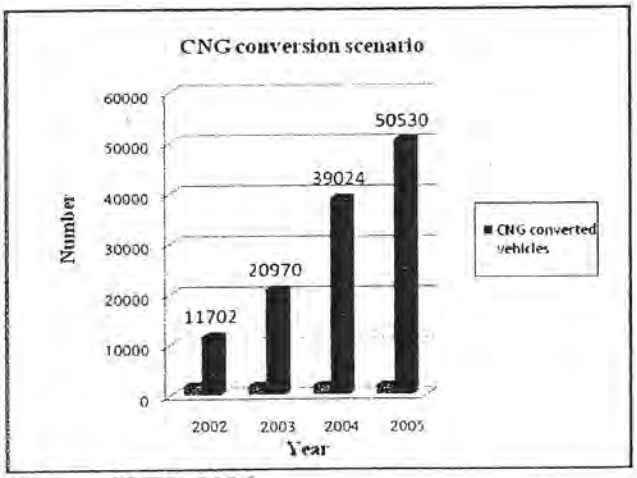


Fig. 3: Forecasted vehicles (2 types) by 2015

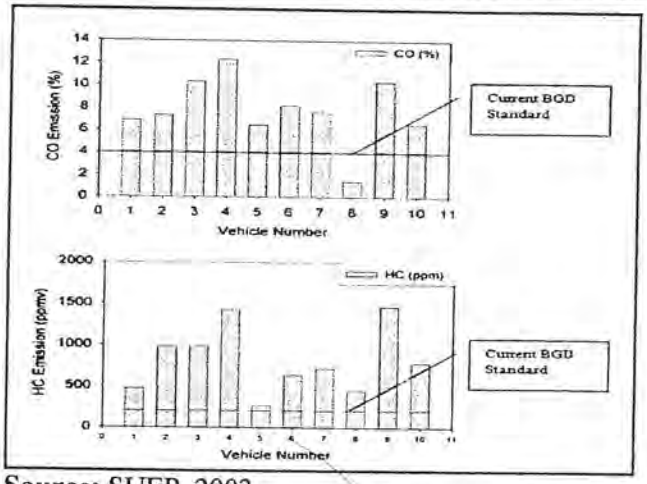
In this context, Govt. has promoted and given CNG (Compressed Natural Gas) conversion license for setting-up new industries in private sector whch was earlier started in 1983 under a World Bank pilot project. Thereafter currently 87 number of componies are converting diesel or gasoline operated vehicles into CNG[5]. The scenario of CNG coversion till year 2005 is illustrated below (Fig. 4).



Source: SUEP, 2006.

Fig. 4: Number of CNG converted vehicles

Having the same conversion rates by the end of year 2015, only about 180,000 vehicles (one-fifth of the total projected vehicles) would be operated using CNG. However, earlier a pilot survey was conducted by Society for Urban Environmental Protection (SUEP), Dhaka in 2003 to examine the emission level of CO and HC from 10 CNG converted vehicles.



Source: SUEP, 2003.

Fig. 5: CO and HC emission from CNG vehicles

The result (Fig. 5) showed that the observed emissions contained 7-12 percent of CO against tolerable level of 4 percent, as well as 450-1472 ppm of HC against approved level of 180 ppm. Lack of proper conversion skills of the workers and poor maintenance were identified as the prime reasons behind such poor performance. In addition, periodical maintenance of each vehicle is also lacking.

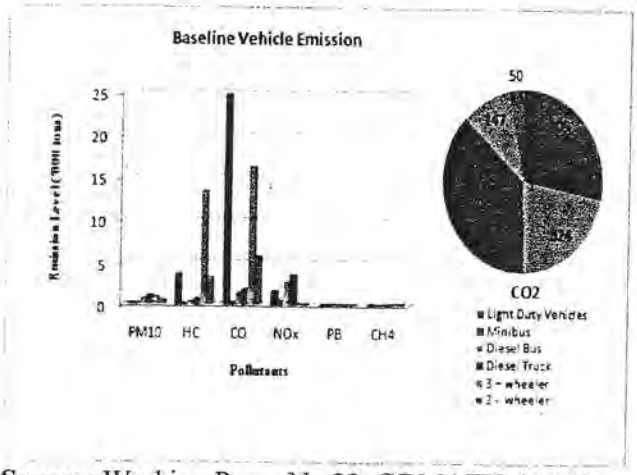
Initially vehicle population, annual utilization and fuel economy are another important criteria to judge the overall emission level a city clutches. Table 4 below represents a typical scenarion on the roads of dhaka city in terms of those factors:

Table 4: Veh pop^n, annual utilization and fuel economy in Dhaka

Type of Vehicle	Vehicle Pop^n	Annual Utilization (Km/Yr)	Fuel Economy (Km/l)
Car & Taxi	42,000	19,200	8.0
Jeep & Microbus	12,000	19,200	8.0
Disel Bus	4,000	57,600	4.8
Disel Truck	5,000	64,000	2.4
3-Wheeler	14,500	38,400	2.4
2-Wheeler	73,500	10,000	35.0

Source: DUTP, 1996.

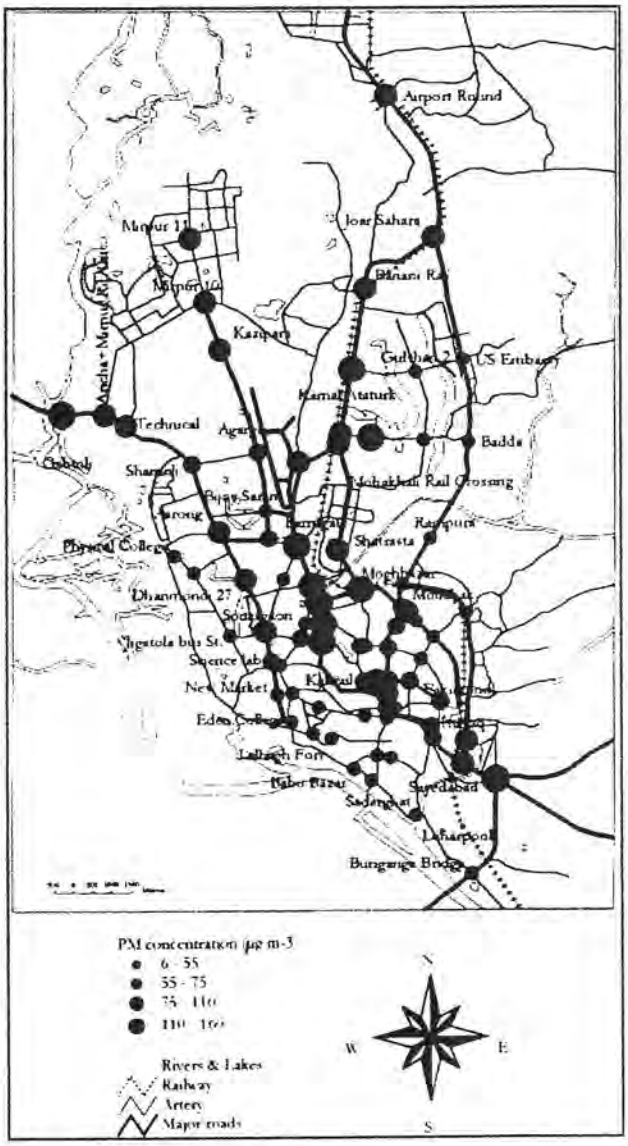
Almost all type of vehicles significantly produce various concerned air pollutants. In 1995, Bangladesh emitted 20 millions of tons CO (International Energy Agency, 1995). Initial estimates show that motor vehicles annually emit 3,700 tons of particulate matters (PM_{10}), 8,550 tons of nitrogen oxides, 50,700 tons of carbon dioxide, etc. CO_2 and CO recorded as much higher than other pollutants in terms of 1000 tons units (Fig. 6).



Source: Working Paper No.23, GDMAITS (1996)

Fig. 6: Baseline emission inventory in Dhaka

Undoubtedly air pollution in the city has taken an alarming turn, exposing serious health hazards for city dwellers. Things get worse especially during the dry season. The health related economic cost is approximately $360 per vehicle per year. Air pollution kills 15,000 Bangladeshis each year, according to a World Bank report released recently[6].



Source: Karim, 1998.

Fig. 7: PM concentration in the streets of Dhaka

Although it is claimed that the city's pollution level reduced by 25 percent after the withdrawal of 2-stroke vehicles in 2003, the annual mean concentration of particulate matters (PM) has risen significantly despite a massive drop in pollution levels in 2004. Recently the density of airborne particulate matter (PM) has reached 247 micrograms per cubic metre (mcm) which is nearly five times the acceptable level of 50 mcm set by NAAQS[7]. Table 5 below gives an obvious picture about the current statistics of Particulate Matters in the air of Dhaka city:

Table 5: PM_{10} and $PM_{2.5}$ concentration in Dhaka city (mcm)

Pollutant	Year 2003	Year 2004	Year 2008
PM_{10}	330	238	291
$PM_{2.5}$	266	147	191.83

Source: AQMP, 2008.

Based on the current progression by the year 2016, the annual mean concentration level of PM_{10} and $PM_{2.5}$ will be 350 mcm and 240 mcm respectively; correspondingly which will be almost 18 times and 24 times the acceptable level set by WHO (Table 1). The predicted PM concentration level is shown below based on the present trend (Fig. 8):

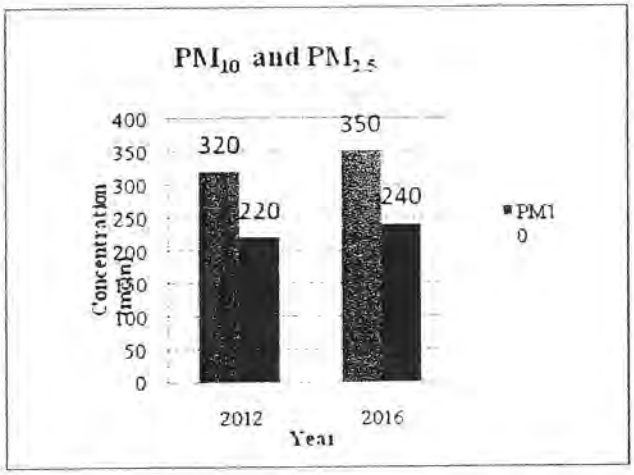


Fig. 8: Forecasted PM Concentration level

A large number of unfit, old and diesel-run vehicles continue to ply Dhaka's streets worsening the pollution levels. At least 25 percent of vehicles in Dhaka are over 20 years old. In addition, on an average each year nearly 80,000 more vehicles are adding to the current statistics and in the same infrastructure as well.

5. Conclusion

Commuting in Dhaka city is indisputably a public hassle having the ever-growing population and disordered traffic on the roads. Getting locked in jam-packed traffic for even hours is a usual experience. The resultant loss is definitely unattainable to measure in terms of money. Poor traffic management, congestion and delays, conflict of jurisdictions and lack of coordination among agencies, and fast growing air pollution dilemmas characterize the transport scenario in Dhaka. Several studies also affirm that vehicles are

believed to comprise the leading source of particulate emission in Dhaka since there are no such power stations, significant industrial sources of emissions, or deserts to cause dust pollution in the city.

6. Recommendations

On the basis of the above existing and projected figures, it is clearly observed that in a next couple of years the situation will appear likely more perilous due to irresistible growth of population and required number of vehicles. Therefore, some innovative and effective strategies have to be introduced. Old and worn-out vehicles have to be replaced to reduce vehicular emissions. Appropriate transportation planning is to be adopted to control the growth of private vehicles by introducing efficient mass transit options. Rickshaws have to be gradually phased out from the main roads since they slow down the traffic which eventually causes higher pollution. Steps should be taken to reduce traffic congestion as past studies show that congestion is one of the main reasons behind high level of pollutant concentration. Department of Environment (DoE) and BRTA should enforce their regulations strictly. Government should launch effective programs ensuring coordination among various concerned authorities like DESA, DWASA, DoE, and BRTA etc. In this regard, a Dhaka Pollution Control Authority should be established comprising of both local and international experts who would be authentic to monitor the situation on a regular basis and provide continual update in public. In addition, FM Radio, TV channels and print media can play a significant role in creating awareness among the public.

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