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Air Pollution in the Capital City of Bangladesh: Its Causes and Impacts on Human Health

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ABSTRACT: Air is one of the precious natural resources that are essential for animal including the human being. It is also the most important gift of nature without which human cannot survive. Pollution in the urban areas like Cairo, Delhi, Mexico and Dhaka far surpasses the acceptable limits set by the World Health Organization (WHO). Urban air pollution in the South Asian region is approximated to cause more than 300,000 deaths and billions of cases of respiratory disease per year. In Bangladesh, about 200000 people die each year due to the air pollution as the WHO estimates in 2018. The air in Dhaka City, the capital of Bangladesh, has become worsen to a level that the city has been identified as one of the most polluted cities in the world. Taking the problem with utmost importance into consideration as it is related with the public health, air pollution is being treated as one of the priority issues. The level of pollution at roadside environment is deeply connected with the density of motor vehicles plying on the roads. This situation is expected to worsen further in the upcoming days due to the increasing number of motor vehicles resulted from rapid economic growth and industrialization. This paper aims to provide the present statues of the air pollution in Dhaka city and some specific recommendations for making the city as a better living place through reducing its air pollution.

Keywords: Air pollutants, Air quality, Bangladesh government, Dhaka city, Traffic volume.

INTRODUCTION

Man is responsible, in many ways, for the present statues of the environment disasters that are on the rise all over the world. It is common scenario and true feature that air pollution is one of the most concerning and alarming issues in the present world among the variety of the manmade disasters. Generally, Air Pollution can be described as a condition of the atmosphere where different elements are present at coagulations that are high enough than the normal ambient concentrations producing an effect measurable on humans, animals, vegetation or materials (Alam, 1999). Here the term ‘substances' refers to any chemical compound or elements which are natural or manmade and which may be airborne. Basically, theses chemical compound or elements are nothing but exist as solid particles, liquid drops or gases. There may any substances in the atmosphere whether they are harmful or benevolent (Khaliquzzaman et al., 2007). However, the term ‘measurable effect’ logically does not focus on those substances which cause unwanted effects. It is of no doubt that air is becoming more worsened day by day, and both human activities and natural phenomena are responsible for it. In Bangladesh, vehicular and industrial emissions are two great sources of air contamination (Salam et al., 2008). Particularly, the cities are subject to much air pollution as those have more vehicles plying on the road and industries

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than the rural areas. In the current years, air pollution has been given the best priority among environmental issues not only in Asian countries but also in the other countries of the world (Carslaw & Ropkins, 2012). In many parts of the world, exposure to air pollution, at present, has become the prime threat to human health. In particular, in cities urban population has been victimized of respiratory and other air borne diseases due to the emission issues that have increased the death rate significantly (WHO, 2018). Dhaka is the capital of Bangladesh and Dhaka is also the center point of most of the commercial activity, is facing this problem acutely (Begum and Hope, 2018). Being center of the country, it has a vast number of industries in and around the city i.e. ready-made garment (RMG) manufacturing industries, different types of mills, industries, factories along with chemicals industries, brick fields and so on (Mahmud, 2011). Moreover, the city is having too much population causing it polluted on a regular basis which is a matter of great concern. The increasing numbers of motor vehicles, industrial development on a random basis and continuous housing have made ambient atmospheric conditions deteriorated.

Air is one of the natural resources that are essential for animal including the human being. It is quite impossible to survive for the human being without air, the nature's most precious gift (Dasgupta et al., 2006). So, the pollution of air can interfere human activities, and it is only in recent times that mankind has realized to what extent this interference is sustainable (Chafe et al. 2014). Md Shahab Uddin, the Environment, Forests and Climate Change Minister of Bangladesh said on 25 November 2019 to the journalists that Dhaka city has the most polluted air in the world because the level of air pollution has been increasing here day by day. Taking the problem with utmost importance into consideration as it is related with the public health, air pollution is being treated as one of the priority issues. Contamination in the urban areas like the New Delhi of India, Linfen of China, Faisalabad of Pakistan and Dhaka far surpasses the acceptable limits set by the WHO. A study related to the Epidemiological show that air pollution is totally liable for the tens of thousands of extra death as well as the billions of dollars of loss of productivity each year in the developing countries like Bangladesh. (Faiz et al., 1996). In 2018, the WHO estimates that about 200000 people die in Bangladesh per year due to the polluted air. As per the Medical report, in Bangladesh perspective, four of the top 10 death-causing diseases are directly related with air pollution i.e. stroke (5%); lung cancers (13%); chronic obstructive pulmonary disease (7%); chemic heart disease (6%), and the lower respiratory tract infections (7%). Besides, different types of air pollutants effect on human health in different ways like: (i) Carbon di-oxide plays an important role regarding the planetary temperature structure as it is the major absorber of infrared radiation (Rana et al., 2016); (ii) The high concentration of Carbon monoxide in blood makes it difficult for our hearts to pump blood through the blood vessel that takes blood away from the heart to all parts of our body (Azkar et al., 2012); (iii) Hydrocarbons causes convulsion of our Central nervous system (Dey et al., 2005); (iv) Lead is liable for the kidney damages and irreversible brain of us and it is more dangerous for the young children; (v) Sulfur dioxide has a sharp odor in nature (Gonzalez et al. 2013). SO2 also affects in the functions of our lungs along with its respiratory system (Li et al. 2015). Moreover, it also causes cough, aggravation of asthma and mucus secretion (Padula et al. 2013); (vi) The excess O_3 in the air is responsible for the chronic, asthma, premature birth and for the lung malfunctioning (Zaidi et al., 2011). O_3 also effects on our cardiac development (Kannan et al. 2007); (vii) Nitrogen Oxide causes eye irritation, headaches, and

breathing problems, chronically reduces the functions of our lungs and corroded our teeth (Nishimura et. al. 2013). Besides, NOx can effect human being indirectly by damaging the ecosystems they rely on land and in water-harming the plants and animals (Mccreanor et. al. 2007). An estimated 70,000 deaths occur from exposure to NO2 whereas in Bangladesh it is estimated that 3000 premature deaths occur per year from exposure to PM and NOx (Faruque, 2017). As per the study conducted in Dhaka that 10 µg/m3 (each) increase in NOx corresponded to an adjusted OR of 1.25 (95% CI 1.16 to 1.36) for diagnosed asthma in six to thirteen years old Dhaka babies (Mathiros et al., 2018). Considering the above-mentioned factors, the author hypothesized that Dhaka city has very high air pollution level and the result of this study will assist decision-maker in formulating national policies to combat air pollution. Therefore, the aim of this study was to determine the level of air pollution in Dhaka city and to suggest few specific recommendations for making the Dhaka city as a better living place through reducing its air pollution.

MATERIALS AND METHODS

During the study, both primary and secondary data have been used. All the relevant data and information of the existing paper were collected and used from primary and secondary sources. The information from different books, journals, booklets, proceeding, newsletters, souvenir, and consultancy report that are available in the libraries of Daffodil International University, Bangladesh were compiled chronologically to complete it successfully. Maximum necessary supports were taken from internet searching. The study presents a synopsis of several monitoring and surveys conducted by the author; on ambient concentrations of lead, black smoke, *nitrogen oxides, (*NOx), Ozone (O3) particular matters, Carbon monoxide (CO) and Sulfur dioxide ($SO_{2)}$. The selected data (collected from the selected stations between 2018 and 2018) reveals that the ambient air of the capital city of Bangladesh (Dhaka) is polluted more than fifty five percent of the year. The Air Quality Index observed in different locations of the Dhaka city shows that the roadside environment of 70% areas is severely polluted while that of 30% is heavily polluted as per the WHO's standards. The level of pollution at roadside environment is deeply connected with the density of different types of motor vehicles moving on the roads regularly. This situation is expected to worsen further in the upcoming days due to the increasing number of motor vehicles resulted from rapid economic growth and industrialization. This existing study provides some considerable recommendations in order to reduce the air pollution in the capital city of Bangladesh, which is known as the Dhaka city.

RESULTS AND DISCUSSIONS

The industrial emissions and the vehicular are the two main great sources of air pollution in Dhaka city. The industrial emission sources like thousands of ready-made garment factories (RMG), chemical industries, brick kilns, different pharmaceutical industries etc. produce not only enormous amount of smokes but also dust, different types of gases, fumes etc. which are mainly responsible for air pollution. Moreover, the tanneries at Hazaribag in Dhaka city emit Ammonia (NH3), Chlorine (Cl), Hydrogen sulfide (H_2S) and some other chemicals which are the most poisonous and are the causes of public complaints and this may be important cause of headache of the people and their other health related problems. The number of vehicles is also increasing day by day in the capital city of Bangladesh as the population is increasing here and the unabated urbanization is going on here also and all of these lead to a rise in air pollution (Begum et al. 2011). The baby-taxies, tempos, mini-trucks, motorcycles and other vehicles where

the two-stroke engines are used, those types of vehicles are the prime source of air pollution in Dhaka city which are recently observed by the scientific research conducted by the specialists of the Department of Environment (DoE), Bangladesh along with other relevant organizations in Bangladesh. Currently, more than 500000 motor vehicles are plying in Dhaka City alone, including about 65,000 baby-taxies (Franchini, 2019). In addition, the number of trucks and mini-buses that are overloaded, poorly maintained and very old which are playing on the Dhaka city streets are also responsible to emit gases and smokes. Indeed, more than 80 % of vehicles playing on the street of capital Dhaka city on a daily basis are defective and these types of vehicles are emitting black smoke far beyond the limits. Vehicles use Petrol and Diesel as fuel and these fuels also emit black smoke which contains unburned fine carbon particles. In particular, the quality standards of air vary from one place to another place due its geographical location. Areas having more industrial and commercial institutions are more contaminated than the residential areas. Mohammadpur, Farmgate, Manik Mia Avenue, Tejgaon, Mohakhali, Gabtoli, Mirpur, Bonosree etc. areas are the worst affected areas in Dhaka city. Generally, 400 micrograms/cubic meter is the allowable limit for the concentration of suspended particulars in air. But the concentration of suspended particulars goes up to 3,000 micrograms/cubic meter (at the Farmgate area of the Dhaka city) as per the study conducted in 2019. The above mentioned study found that the presence of the SO_2 in the air at Farmgate area of Dhaka city are more than three times than the usual permissible limit. The presence of one hundred micrograms SO_2 in the air is the maximum permissible limit for per cubic meter. However, the presence of 385 micrograms Sulphur-dioxide was found the in the air of Farmagte area. Correspondingly, in the Tejgaon Industrial area the similar picture of the air pollution was also noticed where the maximum concentration of suspended particles was 1,849 micrograms/cubic meter (in January of 2018) though the permissible limit was 500 micrograms/cubic meter. Generally from the month of December to the month of March, these four months are considered as the dry month in Bangladesh and during this period the capital city Dhaka becomes the highest concentration of air pollution.

In March 2018 the average emission of air pollutants at Bangladesh Agricultural Research Council, Farmgate, Sangsad Bhaban and Darussalam Road, Mirpur are presented in association with Standard Air Quality in Bangladesh.

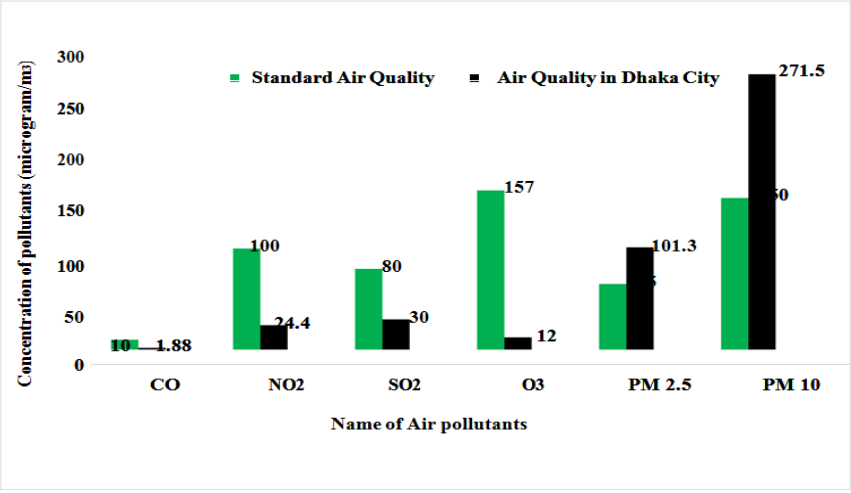

Fig. 1. Average ambient air pollutants of 3 locations in March 2018

Currently Dhaka city is the most polluted city in the world as per the report (on 25 February, 2019), released by Switzerland-based IQ Air and the seventh most populated city in the world. More than two crores people are living here and the number of population is increasing randomly as people are coming here from different parts of Bangladesh for their jobs and works (Sing et al., 2007). Due the population the city is bearing, this overpopulated city has been declared as the most polluted urban city worldwide, and its traffic volume is the largest relative to the other cities of Bangladesh. The Fig. 2 shows how the number of vehicles is increasing in Dhaka City each year. The non-motorized vehicles in particular in road intersections, are significantly responsible for the severe congestion and thus enhance emission problems. Of total trips, the ratio of Non-motorized transport (NMT) is 80% while that of motorized transport (MT) stands for only 5.9%.

The continuous air quality monitoring station was firstly set-up in 2018 by the Department of Environment at the premises of the Parliament Buildings, the most important public institution in the country which is located in the center of the city, in an attempt to monitor air quality and control air pollution in Dhaka city. And it was observed that the level of concentration in the air is high between the months of October to April and the PM was found as PM_{10} and $PM_{2.5}$.

Photo: Daily traffic jam in Dhaka City

Map of the Dhaka City (The area of Dhaka is 1,353 km^2, of which Dhaka City Corporation occupies 276 km^2. The city is situated between 23° 42' and 23° 54' north latitude and 90° 20' and 90° 28' east longitude). Source: Armin Eva (2018).

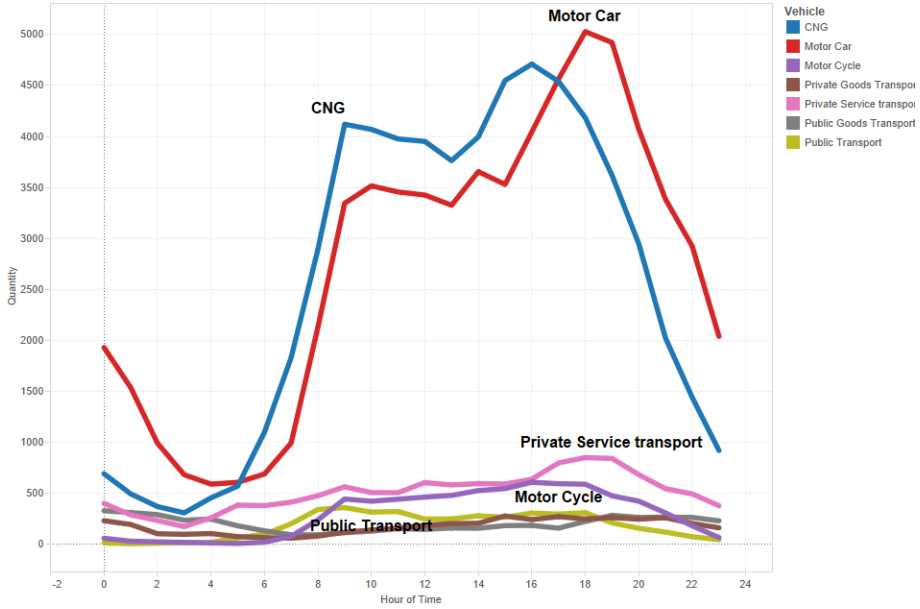

Fig. 2. How the number of vehicles is increasing in Dhaka City each year

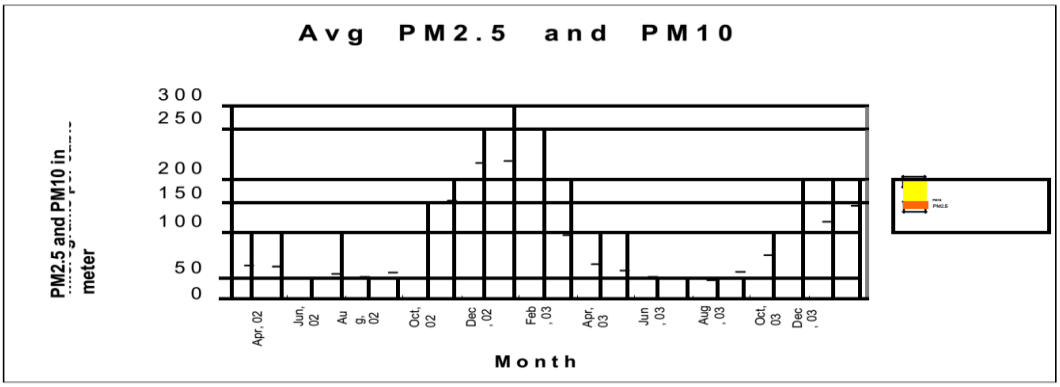

Fig. 3. Monthly 24hr Average of PM concentration CAMS, Sangsad Bhaban

Over the period ‘between’ November 2019 to January 2020, the author found the presence of the Pb in the air of capital Dhaka city in a level which was 14.6 µg/m3, though the maximum allowable limit for Pb in air, as per the WHO guideline (1 year average), is 0.51 µg/m3. According to an article published in the Dhaka Tribune on January 30, 2020, air is graded as "hazardous" in nature. The article states the Dhaka city has earned the top position among the cities with worst air in the Air Quality Index. United News of Bangladesh in another report terms the city to be ‘dangerous’ with an AQI score of 408’. Around 301 and 500, an AQI level includes emergency health alarms and is much more likely to affect the community as a whole.

To make the public anticipation about the air pollution problems clear, some calculations have been carried out as per the collected data as well as the projected air quality standards, to provide some AQI numbers. On the basis of Air Quality Rating, the index is measured for every single pollutant. For a number of pollutants, AQI is obtained from the geometric mean of the Air Quality Ratings. The findings are abridged in Table 1. It has been found in the observation that the roadside environment of 70% areas, if we take the WHO’s standards into consideration, is severely contaminated

while that of 30% is heavily contaminated. Even, if we take the standards set by the Government of Bangladesh into consideration, severe contamination is found in all areas. As per the guidelines of WHO, Mohakhali, Jatrabari and Panthopath are the most polluted areas where the AQI is above 200. The AQI is above 100 even at roads besides residential areas like Dhanmondi and Jigatola.

With the increasing mass industrialization, urbanization, and infrastructure construction, air is becoming more polluted day by day. In dry season, air pollution reaches its peak (Kan & Chen, 2004). The vehicle emissions, the industrial emissions and the waste burning are the most responsible for the air pollution among the various causes of air pollution. Particulate matters PM10 refers to those substances which are of 10 micrometer (in size) and these are considered as the rigorous health exposures (Flossmann et. al. 2018). Brick kilns, cement, steel and ceramic factories are the sources from where PM10 is emitted. Per year, among the sources, a cement factory emits most contributing 130 tones PM10 while a brick kiln adds 83 tons (Biswas, 2020). Along with this, a steel re-rolling mill and a ceramic factory also contribute 17 tons and 20 tons of PM10 per year. As per the report of the State of Global Air 2019, approximately 72% of domestic households use solid fuel that also leads to the air pollution. A survey was carried out at several places including those of busy roads of Dhaka city where the department took 8 hours measurements. The survey results show SMP concentrations of 660-2450ug/m3 at the area of Farmgate of Dhaka city though the minimum SMP concentrations, as fixed for the Standard for Commercial Area, is 400 ug/m3. During the dry season (from the month of December to the month of March), the SMP trends are most elevated because of increment in dust and the open burning.

Table 1. Air quality levels in the roads of Dhaka City

Standard	Category of Air Quality	Range of the Estimated Value of AQI	Average AQI for the Category	Number of Locations in Category
AQI calculated on the basis of Bangladesh Standard	Severely Polluted	209-454	318	49 (100%)
	Severely Polluted	131-215	167	34 (70%)
AQI calculated on the basis of WHO Standard	Heavily Polluted	102-124	114	14 (30%)
	Polluted	99	-	1

Table 2. Bangladesh AQI values and observable health implication

Air quality index (AQI) Range	Category	Health Implications
0-50	Good	This level will not impact patients suffering from diseases.
51-100	Moderate	This level has partly impact on patients regarding the chronic exposure.
101-150	Caution	This level has harmful impacts on patients and members of sensitive groups (specially on children and old age people).
151-200	Unhealthy	This level harmful impacts on patients and members of sensitive groups (children, aged or weak people).
201-300	Very Unhealthy	This level has very serious impact on patients and members of sensitive groups in case of acute exposure.
301-500	Extremely Unhealthy	This level has very strong serious impacts on patients, members of sensitive groups and mass people.

Table-2 represents the quality or category range of air which is good healthy or unhealthy. Here Green color = the air quality is good and it is good for human health; Light yellow color = Moderate for health; Yellow = Caution sign; Orange color=spells out the air is unhealthy; Red and Violet= Sign of very unhealthy and extremely unhealthy category of air.

It is true that pollutants are everywhere of the present world and that is why currently air pollution is a burning issue for all (Lawrence & Lelieveld, 2010). In 1996 to 1997 the air pollution of the Capital City (Dhaka) of Bangladesh became the severest when lead in the air was reported higher than in the atmosphere of any other place of the world. In 21st century Dhaka City also kept its trend of air pollution where presence of particulate matter (PM10) was one of the most destructive levels.

From the Table-3, it is clear that in 2010 the concentration level of CO was within the limit of Bangladesh Standards by the Department of Environment (DoE) of the Government of Bangladesh (GoB). In case of SO2, the same result was observed. But the concentrations of NOx in the ambient air exceed the standard values set by the DoE, GoB. But, it may be mentioned here that the standard value of NOx set by the DoE was annual average and the results shown in Table 3, were 4 hours average. Particulate matter was also exceeded its standard level among all the 6 locations in Dhaka City at an alarming rate. Table -3 clearly spells out that the Mohakhali Location contained the highest concentration of PM10 as well as NOx comparing all the 6 locations. With the 5 years (2013-2017) monitoring of BARC farmgate location, it is observed that only NOX crossed its standard limit of National Ambient Air Quality Standard with alarming rate (Table-4).

This area is basically a traffic hotspot and thus the NOx concentration was higher than other monitoring stations. With the increase of vehicular fleet and other industrial activities, the NOx concentration was increased in the year of 2013-2015. Whereas in 2017 concentration of NOx decreased slightly but still it exceeded its NAAQS. In case of Particulate matter, only PM2.5 was showing the increasing trend from 2013-2017 year. Among all, it was reached its peak in the year of 2014.

All other pollutants were well below its standards values for Bangladesh (Table-4). By observing all pollutants level at BARC, Farmgate station except NO_x and $PM_{2.5}$ all ambient concentrations were in the satisfactory level. Therefore, it is expected that all the pollutants concentration would be low in future. However, due to heavy traffic, proper monitoring is to be needed systematically near those places for better judgment on the exposure levels of all pollutants levels in the city. Sangsad Bhaban (the Parliament of Bangladesh) is an urban/semi-residential area, it was observed that the temporal coverage of the air quality data on criteria pollutants was fairly good except $PM_{2.5}$ (Table-5)

Table 3. Ambient Air Quality of different location in Dhaka City in the year of 2010

Pollutants Conc\Location	Mohakhali	Farmgate	Mogbazar	Sonargaon	Science Lab	Bangladesh Standard value
CO(µg/m3) 8-hour average	2519	7730	5726	3435	5726	10000 (8-hour average)
PM10 (µg/m3) 24-hour average	547.66	289.92	383.53	161.93	167.64	150 (24-hour average)
NOx (µg/m3) 4-hour average	376	752	339	75	113	100 (Annual)
SO2 (µg/m3) 24- hour average	Trace	Trace	Trace	Trace	Trace	365 (24-hour average)

Table 4. Ambient Air pollutants at BARC, Farmgate (Dhaka)

Concentration of pollutants	2013	2014	2015	2017	NAAQS
PM10(µg/m3) 24-hour average	123	94.4	152	65.5	150
PM2.5(µg/m3) 24-hour average	65.7	130	78.3	77	65
SO2 24-hour(ppb)	7.74	6.44	6.63	16	140
NOx(ppb) 24-hour	104	153	143	80	53 (Annual)
CO (ppm) 8-hour average	1.11	1.90	2.75	1.8	9
O3(ppb) 8-hour average	15.9	6.97	6.67	6.6	80

NAAQS=National Air Quality Standard

Table 5. Ambient Air pollutants at Sangsad Bhaban, Dhaka

Concentration of pollutants	2013	2014	2015	2017	NAAQS
PM10(µg/m3) 24-hour average	148	139	131	65.4	150
PM2.5(µg/m3) 24-hour average	81.6	72.6	78	61.83	65
SO2 (ppb) 24-hour)	5.05	4.93	---	---	140
NOx(ppb) 8-hour average	33	33.5	32.7	---	53 (Annual)
CO(ppm) 8-hour average	1.06	1.15	0.67	1.55	9
O3(ppb) 8-hour average	4.61	2.54	0.84	---	80

NAAQS=National Air Quality Standard

Table 6. Comparison between National Air Quality Standard and Ambient Air pollutants at Darussalam, Mirpur-1 Dhaka

Concentration of pollutants	2013	2014	2015	2017	NAAQS
PM10(µg/m3) 24-hour average	156	160	162	160	150
PM2.5(µg/m3) 24-hour average	90.2	96.8	88.4	83.8	65
SO2 24-hour(ppb)	10.3	9.95	7.89	12.05	140
NOx(ppb) 24-hour	49.4	45.4	45.4	31.34	53 (Annual)
CO (ppm) 8-hour average	2.26	2.67	1.96	2.6	9
O3(ppb) 8-hour average	6.44	5.75	12	7.7	80

NAAQS=National Air Quality Standard

In this location, PM2.5 did not exceed only the standard air quality level but also reached its pick level in the year of 2014. The concentration was 96.8 μg/m^3. The concentration of PM10 was also found above the National Air Quality Standard of Bangladesh. The amount of Particulate matter was increased significantly within 5 years a reflection of the growing challenge of pollution in Dhaka City. (Table-6). The other pollutants like Carbon monoxide, Ozone, sulfur dioxide, nitrogen oxide remain below standard level. However, during 2013-2015 the concentration level of SO2 was near to its standard value but it decreased slightly by the year of 2017. Therefore, proper inspection is mandatory to inhibit the increase of these pollutants in future.

Generally, by comparing Table-4, Table-5 and Table-6 it was observed that the temporal coverage of the air quality data on criteria pollutants is fairly good except few cases. With the assessment of the data among the three tables, it can be concluded that yearly average PM concentration levels in both fractions ($PM_{2.5}$ and PM_{10}) in all monitoring sites were high and usually exceeded the Bangladesh National Ambient Air Quality Standards (BNAAQS). The maximum value of the PM concentration levels reaches as high as 2/3fold compared to the 24 hours BNAAQS values (150 μg/m3 for PM10 and 65 μg/m3 for PM2.5). Thus, PM was recognized as the most important pollutant of concern for Bangladesh. In the table-3 same scenario was found about PM level in 2010 at Mohakhali, Farmgate, Mogbazar, Science lab as well as Sonargaon. Therefore, exposure of PM concentration is a burning issue for Dhaka City from 2010 to till now.

Table 7. Average concentration of $PM_{2.5}$ in three locations of Dhaka City (2013-2017)

Year	Darussalam Mirpur	Sangsad Bhaban Agargaon	BARC Farmgate
2013	90.2	81.6	85.7
2014	96.8	72.6	130
2015	88.4	78	78.3
2017	83.8	61.83	77

It is clear from the Table-6 that the ambient 24-hour average $PM_{2.5}$ of Darussalam, Mirpur from 2013 to 2017 was significantly higher than Sangsad Bhaban and BARC Farmgate area. Because of larger emission sources (higher motorization rate, larger population) are found here. On the other hand, a massive surge in the number of brick kilns situated near this area. About 60% of $PM_{2.5}$ comes from brick kilns in Dhaka City. It was also seen from literatures that the PM concentrations in winter to some extent influenced by the transboundary movement of air pollution. Therefore, emission of $PM_{2.5}$ from Brick kiln also pollutes the air of nearby locations like Gabtoli, Darussalam road and so on.

Table-7 spells out the ambient 24-hour average PM2.5 of Darussalam, Mirpur from 2013 to 2017 was significantly higher than Sangsad Bhaban and BARC Farmgate area. Because of larger emission sources (higher motorization rate, larger population) are found here.This is because of larger emission sources (higher motorization rate, larger population) are found here. On the other hand, a massive surge in the number of brick kilns situated near this area. It was also seen from literatures that the PM concentrations in winter to some extent influenced by transboundary movement of air pollution. Therefore, emission of PM10 from Brick kiln also pollutes the air of nearby locations like, Gabtoli, Darussalam road and so on. Heavy motor vehicles are also the effective cause for increasing level of PM10 in this location. During night time very high concentrations of the fine

particulate matters were observed in this location presumably due to the emissions from tracks and Lorries running only at night. These tracks and Lorries are not allowed during daytime in Dhaka city. However, the total average $PM_{2.5}$ mass concentration was about eight times higher than WHO and about 3.0 times higher than DoE, Bangladesh guideline values for 24-hours.

It is known to all that among the 17 Sustainable Developments Goals (SDGs), there are two specific goals related to the air and environment. These two SDGs are: SDG 3 and SDG 11 that must be addressed if we want to materialize the importance of the air control management because a clear reference has been made in the duo goals about the air pollution. This issue is not only mentioned the duo goals but it has multiple drivers and related sustainability impacts linking around 14 out of United Nations' 17 SDGs (Pawar et al., 2015). These goals, related objectives and indicators are linked with multiple drivers**,** while the best outcome regarding to ensure the clean air can be achieved via the integrated approach of air quality management. Otherwise, the dream behind the SDGs will remain quite meaningless and unfulfilled. The Bangladesh government along with the Dhaka City Corporations can consider the following recommendations to reduce the air pollution in Dhaka city.

- As winter is the dry season, the air of Dhaka city usually becomes severe polluted in December-March. Therefore, the air pollution varies from one season to another season. So, the air control strategy needs to be quite unique and it will not be like the other overall management policy of the government.
- For the developing strategy for air quality control, the priority pollutants need to be determined soon. Determining pollutants and health hazards resulting from poor air quality of a particular area or location can help form a solution to that area or location.
- Along with other pollutants in the air, the increasing level of dust pollutants has gradually becoming a serious health threat to the residents of Dhaka City which is a great concern now a day. For that reason, a cost-effective control system should be set-up immediately that include assimilating control measures in light of reducing the sources of dust and waste points. In order to meet the SDG objectives and indicators, other dominant source points like construction sites, brick fields, the total transportation system of Dhaka city etc. should be taken into consideration.
- In order to reduce the air pollution, the citizens of Dhaka city can play an important role individually or unitedly. They can play the vital roles regarding air pollution by less driving or driving wisely; avoiding unnecessary driving; using fuel-efficient vehicles; public transports, walking, cycling and so on.
- However, to ensure a better response in city air quality management, it is must to develop an integrated system. The three general classifications of prerequisites such as: i. economic sustainability, environmental and engineering must be meet by the air management system. Regarding the air quality management, Bangladesh government has some effective strategies and guidelines but there is no adequate monitoring and implementation programs. But these are very important not only to mitigate the air pollution but also to allow the owners of source's points for getting the information they need to monitor and improve and upgrade their system further.

- Generally, the decision makers of Bangladesh typically follow a traditional method to air control system. In the manufacturing fields, this system primarily lays a set of standards for polluters. This could be a positive achievement for just only industrial sector, but the government can extend the process towards punishing all kinds of polluters and provide economic stimuli to mitigate emissions.
- While a limited incentive system is currently in operation, it may be extended to involve numerous initiatives and activities such as tax incentives related to pollution, waste-treatment subsidies, waste disposal rebate schemes, etc.
- It is true that the air control management policy mostly depends on the regulatory authorities of Bangladesh working within the missions-visions and network of the SDGs, declared by the UN and we should promote a greater public involvement in the system.
- The Bangladesh government, different types of mass media along with environmental activists and organizations should encourage the mass people of Dhaka city along with the other people of the country to contribute something good from their positions to make the Dhaka city as the green city, as the living city as well as air-pollution free city. The proper direction, counselling and motivation from the government level and other concerned levels can motivated the people of Dhaka city to reduce less air pollution.
- Finally, Bangladesh government should identify the real causes of air pollution in Dhaka city as per the given directions of the Supreme Court of Bangladesh. On 27 November 2019, the High Court Bench of Bangladesh Supreme Court directed the authorities concerned to identify the causes of air pollution.

CONCLUSION

Air is one of the precious natural resources that are essential for animal including the human being and it is impossible for the human being to alive without air. It is known to all that fresh air is good for our digestive system; it helps improve blood pressure and heart rate; it makes us happier; fresh air strengthens our immune system; it cleans our lungs; it gives us more energy and a sharper mind. But the pollution of air can interfere human activities, and it is only in recent times that mankind has realized to what extent this interference is sustainable. All the air pollutants are health hazardous for instance, short-term exposure to SO_2 to human, causes aggravation of asthma and chronic bronchitis. Moreover, different types of air pollutants effect on human health in different ways. Those pollutants are also responsible for the lung infection, pulmonary infection and sometimes increase death rate. So, the air pollution in Dhaka city has become the most important issue in the present context. The present study reveals that 70 per cent of the city's roadsides are severely polluted. Consequently, its impacts on the health of the city dwellers are very alarming. The presence of PM, SO_2, Pb levels in the air of Bangladesh exceeds the acceptable limits set by WHO resulting pollution. The ambient level of NO_2 is, as defined by the air quality standard, regularly lower than the acceptable limit. Though the available time-series data are insignificant, accessible air quality indicators suggest that air of Dhaka city is getting worse day by day. Some positive measures, such as replacement of 2-stroke 3-wheelers with 3-wheelers and the introduction of unleaded gasoline, have improved air quality but are still insufficient to track and control motor

vehicles 'pollution, limited number of roads in comparison with growing traffic volumes, lack of traffic management, have enormously hampered air quality.

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CONFLICT OF INTERSET

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

LIFE SCIENCE REPORTING

No life science threat was practiced in this research.

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