



AIR POLLUTION IN DHAKA CITY AND THE POLICY RESPONSES: A REVIEW

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Abstract: Dhaka is one of the crowded cities on earth. It has a population of about 10 million. City roads are chocked with manual rickshaw, rickshaw vans, three wheeler auto-rickshaw (two stroke engine), buses, trucks, cars, microbus, minibus and even push carts. The only oil refinery at Chittagong still produces leaded gasoline and high sulphur diesel. With the advent civilization and all around mechanization, scientific development has however turned around as a boomerang, as developments in agriculture, industrial and transportation arenas have been perturbed the natural balance and disarrayed the composition of air in the global scale.

Key words: SPM, SO₂, NO₂, Policy, air pollution, Bangladesh

Introduction

We know that air is life-sustaining resource of nature. Fresh air is one of the most valuable gifts of nature without which humankind will not survive on earth. But air pollution is really a problem. Air pollution today is virtually slow-poisoning humankind all over the world, specially in the urban centers. In Dhaka city, the capital of Bangladesh, the number of patients suffering form respiratory diseases continues to rise unabately. Smoke and dust are ubiquitous throughout the Dhaka Metropolitan Area (DMA). Dhaka has a total estimated population of more than ten million, which is an unbearable burden for the city's limited facilities and the population is expected to swell to 16 million by the year 2015, making Dhaka the seventh most populous city in the world (Azad *et al.*, 1998). In our country the number of motor vehicles per 1000 people rose from 1.4 in 1982 to 2.28 in 1991, and 2.72 in 1995 (Anon, 1995). Emissions from all types of motor vehicles like cars, buses, trucks, jeeps, mini-buses, two-stroke engine powered vehicles and motorcycle have been polluting seriously Dhaka city's air. Nearly, one third of these motor vehicles are operated by diesel, which contribute a greater portion of urban suspended particulate matter (SPM), sulphur oxides (SO_x), and nitrogen oxides (NO_x). Sometimes private cars are energized using a proportion of 3.2% petrol (regular gasoline) and octane (extra leaded) (Karim, 1999). In Bangladesh, pollution severity occur due to the high content of lead in gasoline because the country's only refinery is not able to produce lead-free fuel, large number of high polluting vehicles, impure fuel, inefficient landuse and overall poor traffic management (Karim *et al.*, 1997). Two-stroke engines emit greater proportion of black smoke. In Dhaka, two-stroke vehicles in the total vehicle population rose form 2.2% in 1982-1983, 18% in 1990-1991 and as high as 23% in 1996-1997 (Karim *et al.*, 1997).

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Global experience says that, the people of this earth had the first experience of large-scale air pollution after the Industrial Revolution. But until 20th century the air pollution draw great social attention (Rahman *et al.*, 1992). The most cases of 20th century air pollution were due to smog. Again, recent experience shows that in many industrial countries, nitras oxide (N₂O) and related compounds are more serious pollutants of air because it has decreased by the development of petroleum desulphurisation technology. Beside this, a large amount of fossil fuel has caused global air pollution and a new type of air pollution called acid rain which is created by carbon dioxide (Rahman *et al.*, 1993). In the context of Bangladesh, we know that, the industrial base is not well developed in Bangladesh. Its industries are seen in urban areas, particularly in Dhaka, the metropolitan city of Bangladesh. Other industrial cities of Bangladesh are as Chittagong, Khulna and other divisional towns. In 1970's there were small number of vehicles in the urban areas of this country and at that time environmental problem was not as serious as now. However, the situation was changed with urbanization and increasing number of vehicles in urban areas. Emission of black smoke from these vehicles, industrial boilers, brick burning etc. changed the air quality of the urban areas. The situation of air pollution in the cities became serious in the early 90's and in the last couple of years it became acute and grave actually (Rahman *et al.*, 1992).

Once Dhaka, the capital of Bangladesh, was surrounded by rivers and canals on one side and green paddy field on the other. Innumerable trees all over all places were seen. But now, the situation has changed the environmental sustainability. In Dhaka city it is seen that, emissions from almost all types of automobiles like car, jeep, truck, bus minibus, microbus, two-stroke engine driven vehicles and motor cycles have been polluting city's air seriously. Beside this, railway engines, industrial plants, aircraft, power plants, brick fields, open burning incineration, dust particles and solid waste disposal sites are also contributing to the air pollution. Road diggings, construction and other developmental activities create dust pollution which contributes to the air pollution of Dhaka city. Actually the principal air pollutants from gasoline-powered internal combustion engines are carbon monoxide, nitrogen oxides, hydrocarbons, sulphur dioxide, particulates of lead compound and unburnt carbon particles. It should also be noted here that, actually emissions from diesel engines are odor, smoke, unburnt carbon, carbon monoxide, nitrogen oxides and sulphur dioxide.

The prime objectives were- (i) to examine the pattern of present air pollution in Dhaka city; (ii) to know about the main sources of air pollution in Dhaka city and the density of dangerous particles that are present in Dhaka city's air; (iii) to examine the worst affected areas of Dhaka city by air pollution; (iv) to evaluate the nature of slow poisoning polluted air of the study area ; (v) to find out the major effects of air pollution on human body, other animal and also on other species ; and (vi) to evaluate the environmental policy taken by the Government of Bangladesh (GoB) is appropriate to control air pollution problem or not.

Materials and Methods

The research work is based on secondary source. The researcher has been tendency to present a precise result. Generally in social research, data are collected from two types of sources, primary and secondary. Scientific validity, measurability and precision were considered critically for the present research work. Many sources such as materials, journals, books, articles many recent documents are used to present a reliable result. The policy of the Government of Bangladesh (GoB) on environmental issue is presented in short so that the present condition of air pollution and the position of government on this dangerous issue in Dhaka city can be presented simultaneously.

Results

Mass Killer in the Dhaka Metropolitan City Air

Vehicles are the main source of air pollution in Dhaka city. Vehicle related air pollution is growing at an alarming rate. Actually two categories of vehicles make significant contributions to overall particulate emissions, these are two-stroke engine, three wheelers and heavy-duty diesel vehicles. Vehicle ownership is growing rapidly in Dhaka city and so it is very urgent to initiate pollution control activities. The inhabitants of Dhaka, a large number of pedestrians, drivers, passengers, traffic police, street vendors, and other groups suffer form various types of health damage because of exposure to emissions from a large number and variety of motorized vehicles in the city. These vehicles are responsible for 25% of the particulate matter and about

60% of the toxic and smog forming hydrocarbons contributed by all motor vehicles. It is estimated that a baby taxi causes 30 times more air pollution than a normal car (Rahman *et al.*, 1992).

Table 1. Atmospheric composition of Dhaka City.

Gases	Proportion
Nitrogen	78.08%
Oxygen	20.94%
Argon	0.93%
Carbon dioxide	0.033%
Neon	0.18ppm
Helium	5 ppm
Methane	2ppm

Source: Shah *et al.* (1997).

Table 2. Major air pollutants in city area.

Components of air pollution	Major air pollutants
Gaseous substances	Gases, Vapors SO _x , NO _x , CO, ozone, NH ₃
Particulate Matter	Dust, fly ash, shoot, smoke, droplets, mist, fog, fumes, aerosol.

Source: Shah *et al.* (1997).

In a meeting in 1998, Dr. Khalequzzaman of Bangladesh Atomic Energy Commission reported that the air in the Tejgaon area of Dhaka contained 64-143 µg of sulphur dioxide per cubic meter of air. He also mentioned in his report that the composition of nitrogen dioxides in the air of Farmgate area of Dhaka was 25-32µg m⁻³ of air. A World Bank consultant in Dhaka, Environmentalist J. Core, in the same meeting reported that the concentration of suspended particulate materials in the air of Dhaka was found to be 665 – 2456 µg m⁻³ which is alarmingly higher than the recommended standard level of 220 g m⁻³ of air (Brandon, 1997). It should also be noted here that lead is also a heavy metal and is toxic and effects mammalian brains. The World Health Organization (WHO) report 2001 says that the lead concentration found in the blood of children in Dhaka city. This high level of lead concentration in blood is correlated with in the air.

In the context of urban environment of Bangladesh vehicles are regarded as the major culprits of air pollution. Vehicles that are available in Dhaka city are not as large number as it is in the other mega cities in the world, but the actual matter that, the mechanically defective vehicles cause serious air pollution. Again, sulphur and lead content of different types of fuels available not only in Dhaka city but also in all over Bangladesh are as follow:

Table 3. Sulphur content of different fuels available in Bangladesh.

Motor Gasoline- Premium	Max. 0.1 mass%
Motor Gasoline- Regular	Max. 0.1 mass%
High speed Diesel (HSD)	Max. 0.1 mass%
Low Sulphur (HSD)	Max. 0.5 mass%
Light Diesel oil	Max. 1.8 mass%
High Sulphur Furnace oil	Max. 3.5 mass%
Kerosene	Max. 1.0 mass%

Source: Faiz *et al.* (2004).

Table 4. Lead content (as pb) in motor gasoline available in Bangladesh.

Motor Gasoline- Premium	Max. 0.84 µg l ⁻¹
Motor Gasoline- Regular	Max. 0.5 µg l ⁻¹

Source: Faiz *et al.* (2004).

Air pollution in tanneries, textile and dyeing, pulp and paper, cement factory, metal industries, fertilizers etc, also create various environmental problems in Dhaka, Gaseous emissions affect the health of workers from the printing and dyeing operators of textile industries. The emission of foul odor from putrefying raw hides and solid wastes in tannery area also create serious environmental problem. The dangerous emissions from pulp mills such as sulphur dioxide, total reduced sulphur compounds and particulate matter, hydrogen sulphide and methyl causes air pollution. Many metal industries in the city generate acid mists, particulates and solvent fumes, which create serious air pollution. Again severe air pollution may occur from ammonia leakage during the nitrogen fertilizers production.

Effects of Air Pollution in Dhaka City

However, air pollution mainly affects the respiratory tract and creates headache, irritation, fatigue, asthma, high blood pressure, heart disease and even cancer. The children mental faculties of Dhaka city will be impaired by lead pollution and it may affect the central nervous system. It should be mentioned here that excessive lead of the blood of the children of the city could damage their brain and kidneys.

Air pollution causes cardio-vascular illness and higher rates of sickness, especially bronchitis and other chronic obstructive pulmonary diseases, as well as respiratory tract infections. Air pollution is not only harmful for human being it damages to crops and ecosystems, degraded visibility, soiling of buildings and damage to water quality through deposition of lead and other particles. When ecosystem is affected in such

way, it creates a great effect on people's livelihood as well as health. Again the lead level of the urban children of this country was 5.8 to 21.6 $\mu\text{g dl}^{-1}$ and the lead level of slum children of the urban areas ranged from 9.6 to 38.9 $\mu\text{g dl}^{-1}$, three times more than acceptable level (Azad *et al.*, 1998) and probably Dhaka is at the worst position where children are badly affected by air pollution. Professor Abul Hussan of the George Mason University, Virginia, USA, detected 200 organic compounds and identified 35 of them by observing four air samples collected from the Shewrapara area of the city (Faiz *et al.*, 1990). Actually is the first advanced analysis of air quality in Bangladesh. The air samples were analyzed and the tests showed that exhausts of auto-rickshaws contain VOCs (Volatile organic compounds), the amount of which is four to seven times (or more) beyond the allowable limit.

Slow Poisoning of Dhaka City Dwellers

According to the Bangladesh Atomic Energy Commission (BAEC) 50 tones of lead are emitted into the air of Dhaka city annually and this emission reaches its highest level during dry season, from November to January. Scientific studies earlier reports shows that the density of lead in Dhaka city's air reaches 463 nanograms per cubic metre in the dry season which is the highest in the world lead concentration on the polluted air of Mexico city is 383 nanograms and in Mumbai of India is 360 ng m^{-3} (Karim *et al.*, 1997). Another survey shows that the amount of lead in the blood of Dhaka city dwellers is higher (as high as 120 ppm) than the tolerable limit of eight parts per million (ppm) (Shah *et al.*, 1997).

It is estimated that the exposure of the public to air pollution in Dhaka city cause 15,000 premature deaths and several million cases of sickness every year (Faiz *et al.*, 2004). The residents of Dhaka are particularly vulnerable to air pollution. They are being slow poisoned by air pollution. However, the residents of Dhaka are not aware of this slow-poisoning by lead particles dispersed in petrol which is used as fuel. At the time of burning, this fuel releases invisible lead particles into the air. A recent report reveals that the air pollution reduces an estimated growth of as low as 200 to as high as 800 million US dollars per year (Faiz *et al.*, 2004).

Worst Affected Areas of Dhaka City

The worst affected area in Dhaka city include Fram Gate, Manik Mian Avenue, Mohakhali, Agaragaon, Hatkhola, Tejgaon Industrial area, Motijheel, lalmatia and of course the inter-district bus terminals (Shah *et al.*, 1997). Surveys conducted between December 1996 and June 1997, showed that the concentration of suspended particles at Fram Gate goes up to as high as 2465 ng m^{-3} where the allowable limit is only 400 $\mu\text{g m}^{-3}$. Sulphur dioxide and nitrous oxide concentration was below the permissible limit of 100 ng m^{-3} (Rahman *et al.*, 1992).

On the other side, the maximum concentration of suspended particles in the Tejgaon industrial area was 630 μg where the allowable limit is 500 $\mu\text{g m}^{-3}$. Again, the sulphur dioxide present in the Tejgaon's air is higher than allowable limit of 120 $\mu\text{g m}^{-3}$. According to the surveys conducted by the Department of Environment (DOE), the concentration of pollutants in the air of Dhaka city was the maximum during the dry months.

Table 5. Analysis of ambient air sample of Dhaka city for the month of June 2005 at Farm gate, Dhaka.

Location	Date	Ambient air pollutant concentration ($\mu\text{g m}^{-3}$)		
		SEM	NO _x	SO ₂
Fram Gate, near police box	02.06.05	2367.34	38.00	119.79
Fram Gate, near police box	03.06.05	2371.59	44.00	116.35
Fram Gate, near police box	06.06.05	2256.42	47.00	104.27
Fram Gate, near police box	07.06.05	2285.93	51.00	97.96
Fram Gate, near police box	08.06.05	2317.14	57.00	123.48
Fram Gate, near police box	09.06.05	335.68	67.48	136.54
Fram Gate, near police box	10.06.05	2465.25	79.00	136.54
Standard Value for Commercial and Mixed Area		400	100	100

Source: Department of Environment, 2005

Policy Responses to Air Pollution in Bangladesh

To prevent and mitigate environmental problem every country needs a practical and dynamic set of rules and regulations. As monitoring of air is taking place recently, environmental laws have actually been in affected in our country from a long time (Azad *et al.*, 1998). These environmental laws existing in Bangladesh may be categorized as follows into three groups-(i) protection of environmental health; (ii) control of environmental pollution; and (iii) conservation of natural and cultural resources (Table 6).

Actually, Bangladesh is committed to implement the international legal instrument through national programs and policies, as a signatory to Agenda 21. The Environmental policy of 1992 was an important development in this regard. Again, the Environmental Conservation Rules 1997 was approved by Bangladesh National Assembly to restrict and mitigate ever-growing environmental problems in the country. Therefore, the Bangladesh National Environmental Policy 1992, Environmental Conservation Act 1995, and the Environmental Conservation Rules (ECR) 1997, now contain relevant policies, such as authority to inspect and regulate facilities, collect samples, impose civil penalties, adopt rules and implement environmental clearance (Azad *et al.*, 1998). Under the Rules of 1997, the following standards have been set-(i) ambient Air Quality Standards ; (ii) vehicular Exhaust Emission Standards ; (iii) river transport (Mechanized) Emission Standards ; and (iv) standards for Gaseous Emission for industries or Projects.

Table 6. Policy responses to air pollution through acts, rules, and laws in Bangladesh.

Act / Rule / Law	Control / Prevention Response
The Brick Burning (Control) Act, 1989 (Act no. 8 of 1989)	1. Control of brick burning. 2. Required a license from the appropriate authority.
The Brick Burning (Control) Amendment Act, 1992	3. Restricts brick burning with fuel wood.
Bangladesh Environmental Conservation Act, 1995 (ECA, 1995)	1. Declaration of ecologically critical areas. 2. Regulation with respect to vehicles emitting smoke harmful for the environment. 3. Environmental clearance 4. Regulations of the industries and other development activities-discharge permit. 5. Promulgation of standards for quality of air, water, noise and soils for different areas and for different purposes. 6. Promulgation of acceptable limits for discharging and emitting waste.
D. Environmental Conservation Rules, 1997 (ECR, 1997)	1. The National Environmental Quality standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc. 2. Requirement for the procedures to obtain environmental clearance. 3. Requirement for IEE/EIA according to categories of industrial and other development inventories.
E. Environmental Court Law, 2000	1. Government has given highest priority to environmental pollution and passed 'Environmental Court Act 2000' for completing environment related legal proceedings effectively.

Recently the ministry of Energy and Mineral Resources (MEMR) has taken important decisions in this connection are shown below.

1. The minimum standard for lubricating oil for two-stroke engine should be APOTC or JASOFB.
2. Marketing of straight mineral oil should stop immediately. If anyone sells straight mineral oil, he should be penalized. Bangladesh Petroleum Corporation (BPC) will circulate this information in the newspaper, and ensure implementation properly. A monitoring cell should be constituted by BPC.
3. BPC will mention the minimum standard of lubricating oil determined by the Government when signing agreements with private companies.
4. To protect the environment, appropriate regulations are to be enacted on disposal of used lubricants.
5. All blending plants (including private) should be of international standard, and must be upgraded with laboratory facilities.
6. Marketing of products in small packs is to be encouraged and a committee is to be constituted to determine the packing standard.
7. A well-equipped and effective laboratory is to be established for testing lubricants and fuel oils.

Discussion

From the results we may reach at a simple logic that, we can replace a baby taxi by 30 cars in Dhaka city, considering the condition of environmental point of view. Beside this vehicular emissions, there are a number of other factors that significantly contributing to the worsening the air quality all over the country, not only the air of Dhaka. The impact of the composition of air on mankind is limited to possible changes in the concentrations of the trace gases, like carbon dioxide (CO₂), sulphur dioxide (SO₂), total ozone (O₃), Methane (CH₄), nitrogen dioxide (NO₂) and liquid and solid aerosols (Rahman *et al.*, 1992).

At present, a developing country (like Bangladesh) can be characterized by a rapid increase of energy consumption accompanied by a rapid growth of population and economic activities. In this way, the increasing contribution of atmospheric loads of SO₂ and NO_x to global climate change is anticipated and it is

necessary to quantify these emissions in a hurried manner. In Dhaka city, the serious air pollution occurs because of high content of lead in gasoline, large number of high polluting vehicles, impure fuel, inefficient land use and overall traffic management. The major air pollutants of Dhaka city are particulate matter, leaded fuel, dust nitrogen oxides and sulphur dioxide.

The poor are mainly affected by air pollution. The poor are more exposed, because they work in the streets for long hours and at times live and die by the side of the road (Azad *et al.*, 1998). Because of their poor nutrition and general health, they have less resistance to disease. A day lost to ill health with little or no savings means a day without meeting basic needs, again contributing to a vicious circle of sickness. The air quality of Dhaka city is not normal anywhere. Air quality monitoring shows that the concentration of suspended particles in the ambient air of Dhaka city is many times higher than normal (Azad *et al.*, 1998). The air city dwellers breathe contains lead ten times more than the government standard.

There is no point in Dhaka city where the air quality is actually normal. However, comparatively higher air pollution occurs around the industrial areas, bus stations and some commercial areas of Dhaka city. No active controlling measures have been seen in the past to reduce such high amount of air pollution. However, none of the above-mentioned rules and ordinances addressed air pollution problem in Bangladesh. Although enacting laws to protect air pollution is the first and the easiest step, but it is far more difficult to take primitive stands when laws are not followed. It remains to be seen whether the air quality in Dhaka and all over Bangladesh will reap the benefits of having laws in place.

Conclusion

The ambient air quality in Dhaka is going down day by day. The increasing air pollution is impeding the development of the country. The conflict between the air pollution and the public health is good enough to give a serious thrust of resolving the problem. The plausible reasons of air pollution are mostly known and the major causal culprits of the pollution are identified. A set of feasible and cost effective technical measures is already available to combat the pollution and bring it down to a shape. Government should strengthen moves for pollution regulation enforcements. In addition, social awareness and the mass media campaign are required to be incorporated in this process. Development of new industries in the city should also be stopped. Beside these long-term projects, tree plantation program is to be strengthened in the city as immediate action.

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