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Status of Particulate Matter and Its Impact on Roadside Population of Dhaka City, Bangladesh: A Review Study

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Abstract- Dhaka City, the capital of Bangladesh, has been affected by severe air pollution where particulate matter is being identified as the main pollutant of concern. This paper investigates the level of particulate matter and to determine adverse impact of this on health of roadside population of Dhaka city. It is a desk research which has involved the collection of previous research reports, newspapers and journal content and also collection and synthesis of existing project reports regarding to air pollution of Bangladesh. According to Department of Environment, Bangladesh since 2002-07, the maximum concentration of PM_{2.5} and PM₁₀ of Dhaka city was 405 µg/m³ and 543 µg/m³ respectively. The city's average particulate matter levels are about 2 times higher than the Bangladeshi standard of 200 µg/m³ in residential areas and are more than 10 times higher than the WHO guidelines of 120 µg/m³ (24 hours) in commercial areas. These increasing concentrations of particulate matter in the air of Dhaka city have an undesirable effect on the health of the mass population around the city. It is found that 98.83% roadside populations are affected by particulate matter concentration. It revealed that the identified diseases among roadside populations are asthma, allergy, coughing, breathing difficulties, headache and itching. Among these the incidences of eye problem is major which is 52.05%. The percentages of other recognized health problems like cough, breathing difficulties and allergy are 40.94%, 23.39%, and 18.71% respectively. It is also found that 3,580 premature deaths, 10 million restricted activity days, and 87 million respiratory system days annually could be avoided if the particulate matter concentration could be reduced to the level of Bangladesh air quality standard.

INTRODUCTION

Dhaka, the capital of Bangladesh, is facing serious air pollution, earning her the dubious distinction of being one of the most polluted cities on earth. The main thing of air pollution in this city is particulate matter. The concentration of particulate matter (PM) is higher than the Bangladeshi ambient air quality standard and even higher than the WHO guidelines. Now the health hazards due to air pollution is very much severe and burden to public health in Dhaka city. Particulate matter effects upon health is severe as it responsible for the diseases like asthma, bronchitis, emphysema, lung problem even cancer. The effects of particulate matter on health occur at levels of exposure currently being experienced by urban people and mostly exposed in roadside population of Dhaka city.

OBJECTIVES

Dhaka City has been affected by severe air pollution where particulate matter is being identified as the main pollutant of concern. This paper investigates the level of particulate matter and to determine adverse impact of this on health of roadside population of Dhaka city.

METHODOLOGY

It is a desk research which has involved the collection of previous research reports, newspapers and journal contents and also collection, collation and synthesis of existing project reports of governmental and nongovernmental organizations interventions relating to air pollution in Dhaka city, Bangladesh.

DHAKA CITY REGARDING TO AIR POLLUTION

Dhaka is a megacity and one of the major cities of South Asia. The population of the Dhaka Metropolitan area is presently estimated to be 15 million and the population of expanded Dhaka conurbation is expected to reach 36 million by 2024, making it the largest city in Bangladesh. It is one of the most densely populated cities in the world and forms the world's 9th largest agglomeration. Due to the huge volume of population, population demands and transport is one of the major sectors in Dhaka city. [1] For this reasons, air pollution has become one of the serious environmental concerns in Dhaka city, especially in view of the adverse health effects that have been associated with ambient fine particles.

The rates of increase in pollutant concentrations in the cities of developing countries are higher than those of developed countries. Up to 10% of respiratory infections and disease in Bangladesh may be attributable to urban air pollution. While the problem is most severe in Dhaka, both because the air quality is poor and large number of people are exposed. The air pollution is also becoming a growing concern in other major cities of Bangladesh. Like other developing Southeast Asian countries, emissions from various kinds of diesel vehicle and badly maintained automobiles contribute most to air pollution problems. [2]

SOURCES OF AIR POLLUTION IN DHAKA

The main source of air pollution in the cities of developing countries like Bangladesh is vehicles. Others sources are manufacturing industry, construction sector, domestic activity, and natural sources. Interestingly, Dhaka seems to enjoy two distinct advantages in terms of air pollution. First, its vehicular traffic has rickshaw, which is totally pollution free, as the most important element of public transport. Admittedly, at the same time, it is supposedly the main culprit in terms of traffic jam, which in turn causes increased air pollution. Second, natural gas is used, in most cases, as fuel for domestic as well as commercial cooking. Among the remaining sources, vehicular pollution seems to have drawn maximum attention. Most of the vehicles in Dhaka City, due to old age and ill maintenance, belch smoke and discharge large amount of pollutant in the atmosphere.

The quantities of different type of vehicles running on the capital are increasing day by day at an alarming rate. This is also consequences of the higher population. The total number of the year wise registration of motor vehicles in Dhaka city was 139675 before 1995. But in 2005, this quantity rises to 378577. There is a strong relationship with vehicles and Particulate matter health hazards. The higher vehicle amounts the higher Particulate matter health effects.[3]The annual growth of motorizes vehicles increased 10% per year up to 2003.[4]

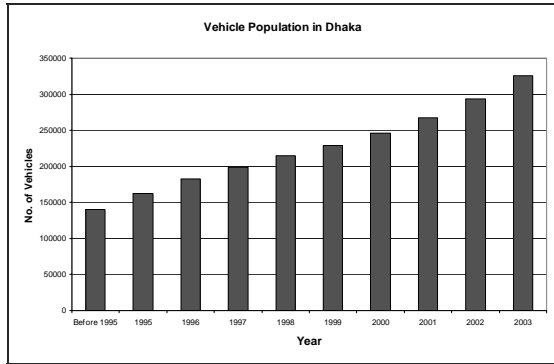


Figure 1: The growth of motorized vehicles during 1995-2003[4]

Up to 2003 in Dhaka city, the percentage of motor cycle was 19%, auto rickshaw 22%, truck 6%, Bus & minibus 4%, Texi 15%, jeep 5%, motor car 17% and others 10%.[4]

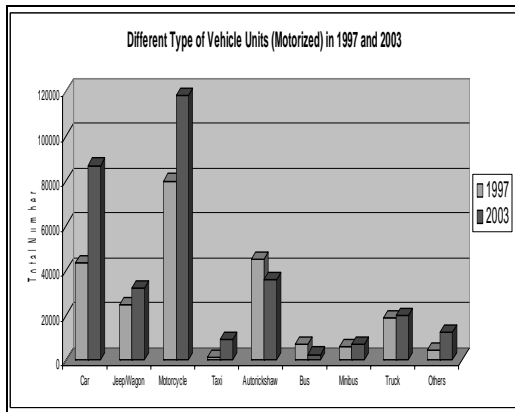


Figure 2: Number of Motorized Vehicles during 1997 and 2003[4]

It is observed from various data that two-stroke motorcycles account for 22% of the gross pollution in Dhaka and Two-stroke 3-wheelers account for 36% of the gross pollution in Dhaka, 35% of black smoke, and 47% of oil particulate. [4]

SYNTHESIZED RESULTS AND DISCUSSION

Status of Particulate Matter (PM) during 2002-2007

WHO's annual guideline values for PM_{2.5} and PM₁₀ is 10 and 20 µg/m³ respectively. According to Department of Environment, Bangladesh, Particulate matter concentrations never drop below 9 µg/m³ for PM_{2.5} and 18 µg/m³ for PM₁₀ since 2002-07. Moreover, the

concentrations have been risen up to 405 µg/m³ for PM_{2.5} and 526 µg/m³ for PM₁₀. [5]

Table 1: Particulate matter concentrations of Dhaka city during 2002-2007[5]

Pollutants	Annual mean (µg/m ³)	Maximum mean (µg/m ³)	Minimum mean (µg/m ³)
PM _{2.5}	71.86	405	9
PM ₁₀	125.13	543	18

The status of the air quality includes the comparison between the average concentrations of PM_{2.5} and PM₁₀ with WHO standards which shown that the level of PM_{2.5} much higher than the WHO standards.

It indicated that urban dwellers and especially roadside population are greatly vulnerable to this fine particle because PM_{2.5} is now generally accepted that the very small particles emitted by combustion and abrasion have a large effect on annual death rates. In a typical west European and North American population, a modest 10microgramme /m³ increase in the ambient annual average level of PM_{2.5} is associated with a 6% increase in death rate. Built up areas where solid domestic fuel combustion is common can easily raise PM_{2.5} levels by 20 microgrammes per cubic meter. [6]

Table 2: Comparison between Particulate matter concentration and WHO standards [6]

Pollutants	Concentration in Dhaka (µg/m ³)	WHO standard (µg/m ³)
PM ₁₀	71.86	50
PM _{2.5}	125.13	10

Trends of Particulate matter concentration in Dhaka city during 2002-2007[7]

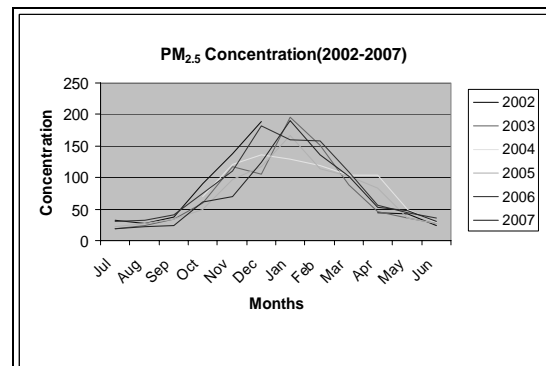


Figure 3: The Concentration of PM_{2.5} in Dhaka city during 2002-2007.[7]

In this figure it shown that the concentration is much higher in December- February which is dry season in Bangladesh.

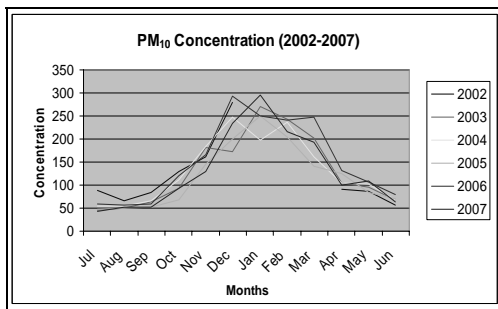


Figure 4: The Concentration of PM₁₀ in Dhaka city during 2002-2007[7]

This figure shown that the concentration is much higher in December- February which is dry season in Bangladesh too.

Health Impact of air pollution due to Particulate matter

High level of air pollution due to particulate matter causes serious damage to health is a well-known phenomenon. It is found that Ambient particulate matter (PM) with aerodynamic diameter <10 mm (PM₁₀) have both short-term and chronic adverse effects on health in both children and adults. Long term exposure to air pollution can lead to premature death by increasing the rate at which lung tissue ages, by contributing to chronic obstructive lung disease, and by exacerbating cardiovascular disease. Sudden rise of pollution level (acute exposure), on the other hand, can cause the people who have history of cardiopulmonary diseases or simply weak or susceptible to die prematurely. This is known as the short-term or acute effect.[8]

A high concentration of air pollutants such as black carbon in Dhaka City air has been reported. Vehicular emissions, as well as coal in the brick kilns around the city, are the main contributor to these emissions. The characterization of these fine particles is very important for the regulators, and researchers due to their potential impact on human health, their ability to travel thousands of kilometers across countries, and their influence on climate forcing and global warming.

A report by the World Bank indicates that concentration of suspended particulate matter (SPM) and airborne lead are higher than the Bangladeshi ambient air quality standard and even higher than the WHO guidelines. In particular, the city's average SPM levels are about two times higher than the Bangladeshi standard of 200µg/m in residential areas and are more than ten times higher than the WHO guidelines of 120µg/M3 (24 hours) in commercial areas (Brandon, 1997).

Another World Bank report estimated that Dhaka's motor vehicles emit more than 3,700 tons of particulate matter less than 10 microns in diameter (PM₁₀) per year. It is also found that 3,580 premature deaths, 10 million restricted activity days, and 87 million respiratory system days annually could be avoided if the particulate matter concentration could be reduced to the level of Bangladesh air quality standard.[9]

The association between particulate matter (PM) and health is generally regarded as causal, and a non-threshold linear relationship with, for example, mortality and hospital admission has been observed in several settings.

The ubiquitous PM air pollution is likely to have a large overall impact on human health, even if risks are relatively small. It has been estimated that concentrations beyond 30 µg/m³ are responsible for about 3,500 extra deaths per year.[10]

Impact on Road side population

According to above data, it can be easily found that Particulate matter concentration is very high in Dhaka city. These big amounts of inhabitants and road side population are exposed to higher concentration all time. So, they are facing various types of serious health problems. From various data, it found that, road side population are mostly affected by air pollution due to particulate matter and among those health problems, eye problem i.e. visibility is major. It also found that the percentage of receiving treatment is dangerously low. The case of diseases occurrence rate is higher in winter season which is December-February. 98.83% people of Dhaka city is affected by the mounting concentration of Particulate matter. Almost everybody stays on roads facing the Particulate matter concentration and got some health problems.[11]

Diseases identification

Particulate matter, one of the major components of air pollution, is increasing in air day by day. This excessive concentration of Particulate matter deserves greater importance as it carries worst effects on public health has always been disregarded. The monthly average concentration of PM_{2.5} and PM₁₀ of Dhaka city was 73.34µg/m³ and 132.11µg/m³ in last year respectively. The high rising concentration affects badly on health of roadside population responsible for causing the diseases like severe asthma, sudden cardiac failure, collapse respiratory tracts, continuous cold and fever, different eye diseases and so on. According to various research contents, it found that there are several diseases for which excessive Particulate matter concentration is certainly responsible. The identified diseases among roadside population are Asthma, Allergy, Coughing/cold, Breathing, Headache, Fever, Itching, and Eye Irritation. Almost 100% people of Dhaka city are continually exposed by Particulate matter and they got various problems every time running beside roads. 98.83% people reported about the dust as well as Particulate matter health problems. [11]

Diseases Occurrence Rate/ reported case

The rates of the major identified diseases are shown in Figure 5. This Figure carries mainly the identified diseases and its occurrence percentage on population. Eye problem i.e. irritation is the most recognized problems reported by roadside population in Dhaka city. About 52.06% people are affected by increasing Particulate matter concentration by losing their visibility power. The second abundant disease identified is cold/cough which occurrence rate is 40.94%. As consequences, fever and runny nose have been also found.[12]The percentage of breathing problem is not so less about 23.39%. This problem is getting higher for finer particles like PM_{2.5} than the coarse as PM₁₀.

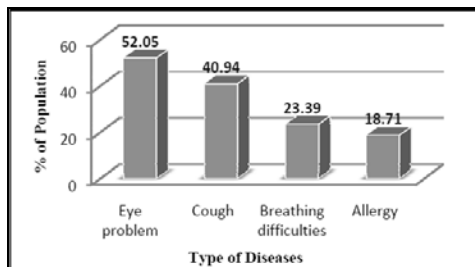


Figure 5: Distribution of diseases reported by roadside population

Finer particles are taken easily into breath and it goes to the deepest part of our respiratory tract creates many problems like collapsing the tract. Hygiene is one of the major problems. Dust makes body so dirty which is further causing different kinds of diseases like itching, allergy etc. The residents living beside roads facing extreme problems as dust fall on their foods. From Various data it found that feeling the irritation is one of the major problems that road side population reported and it found high which is 59.06%. [12]

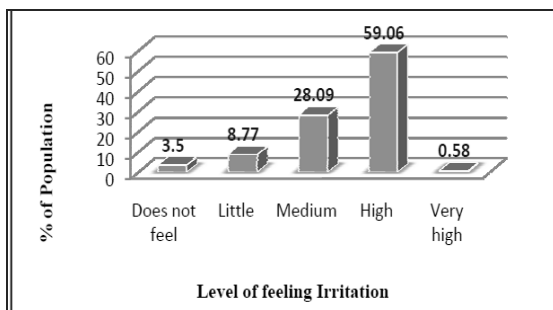


Figure 6: The percentage of rate of feeling Irritation by roadside population

Though the people are badly affected by Particulate matter concentrations, got severe diseases but they hardly go to hospital or receive any treatments. The percentage of receiving treatment of Particulate matter hazard victims is 8.77% only which will be the great health burden for Bangladesh in future. [13]

CONCLUSION

Bangladesh confronts extreme levels of air pollution, with resulting health problems for those who live in urban areas. The consequences of air pollution are severe that it is already a health burden for Bangladesh. The result of this study will be helpful to know the exposure of particulate matter on roadside population of Dhaka city and different policy intervention can be taken from the concern of this result. There are some initiatives taken to mitigate air pollution but proper implementation and management is essential to overcome this problem

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