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# Significant Fine Dust in the Air of Rajshahi City Corporation

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**Abstract:** This research article reports on a study conducted on 2022 and 2023 to measure air quality in five selected locations in Rajshahi, Bangladesh. According to air pollution control rules in Bangladesh, yearly and daily average concentration of $PM_{2.5}$ in ambient air should be maximum 35 µg/m$^3$ and 65 µg/m$^3$. Similarly yearly and daily average concentration of $PM_{10}$ in ambient air should be maximum 50 µg/m$^3$ and 150 µg/m$^3$. $PM_{2.5}$ concentration was found significantly higher in all locations. Maximum $PM_{2.5}$ was found at Talaimari, 75 µg/m$^3$. Average high concentration of $PM_{2.5}$ and $PM_{10}$ in Rajshahi city was 90 µg/m$^3$ and 231 µg/m$^3$ November, dry season. The study highlights the need for regulations to control air pollution in Bangladesh.

***Keywords:*** *Dust; Air pollution; Rajshahi City Corporation; Sustainable Development;*

## 1. Introduction

Air pollution is one of the greatest environmental risks to health (Manisalidis *et al*. 2020; Hossain *et al.,* 2023). By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma (Anyanwu *et al*. 2024). Outdoor air pollution is a major environmental health problem affecting everyone in low, middle, and high-income countries (Rentschler & Leonova, 2023; Badida *et al*. 2023). Among all pollutants, Particulate matter (PM) is a common proxy indicator for air pollution. There is strong evidence for the negative health impacts associated with exposure to this pollutant. The major components of PM are sulfates, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water (Raza *et al*. 2021). Particulate matter found in air having less than a diameter of 2.5µm are defined as fine dust, $PM_{2.5}$. On the other hand, coarse particulate matter, $PM_{10}$ has an aerodynamic diameter ranging from 2.5 to 10µm.

Air pollution as the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans and also damage other living organisms such as food crops, or damage the natural environment or built environment (Chan and Yao, 2008). Air pollution for a major cause of premature death and disease, and is the largest environmental health threat globally (Lelieveld *et al.,* 2015). Unplanned construction, unfit vehicles, industries, brick fields and solid waste open dumping are adding huge number of pollutants to air every day. According to Sustainable Development Goals (SDG) for household energy of WHO in 2020 called for reduction of the burden of deaths and diseases from air pollution. WHO predicted in premature deaths worldwide due to ambient air pollution in 2019 that ambient air pollution from $PM_{2.5}$ caused 4.2 million premature

deaths globally. Previously few studies on air pollution were carried out in Bangladesh. Characteristics of the Air pollution in the Dhaka, Bangladesh was accomplished in winter 1995-1996 (Azad and Kitada, 1998). Air pollution in Chittagong, Bangladesh was accomplished from 1996 to 2003 and suggested that the environment of the city was moderately polluted with average high concentration of suspended particulate matter and possibility of a severe pollution in future. (Sattar and Uddin, 2005). In Asia, concentration of $PM_{2.5}$ in ambient air is affected by emission changes (Rafaj *et al.,* 2021). In China, $PM_{2.5}$ is going to be reduced the burden on human health by policy action to decrease its concentrations in air (Wang et al., 2022). Air pollution is a dynamic phenomenon and pollutants concentrations are highly variable in space and time, especially in urban areas due to many concurrent phenomena (Gozzi et al., 2017).

According to S.R.O. 255-law/2022 on air pollution control rules in Bangladesh, yearly and daily average concentration of $PM_{2.5}$ in ambient air should be maximum 35 µg/m$^3$ and 65 µg/m$^3$. Similarly yearly and daily average concentration of $PM_{10}$ in ambient air should be maximum 50 µg/m$^3$ and 150 µg/m$^3$. Now air pollution is one of the burning environmental problems of Bangladesh. Air pollution by dust is a major concern for Rajshahi City Corporation. $PM_{2.5}$ and $PM_{10}$ was measured during dry season and wet season in 2022 and 2023 during this study. Map of Rajshahi city corporation is shown in below figure 1.


**Figure 1.** Map of Rajshahi City Corporation
(source: https://en.banglapedia.org/images/4/45/RajshahiCityCorporation.jpg)

The core focus of the study was based on the measurement of air quality in Rajshahi City Corporation. In this regard, objective of this research are:

- To assess the dust in air quality in selected location.
- To recommend remediation.
- To summarize present knowledge, knowledge gaps and directions for future research.

The study can lead towards mitigation measure to control dust level in Rajshahi City Corporation.

## 2. Methodology

Main objectives of this study were to measure dust in air from five selected locations in Rajshahi city and to investigate the reason of air pollution. In order to achieve this, a literature review was conducted to compile reliable information on air quality in urban areas. The analyses were carried out using a dust level meter, which is a widely accepted device for measuring $PM_{2.5}$ and $PM_{10}$ in air in environmental studies. The study was conducted within the area of Rajshahi City Corporation, which is one of the largest and most populous cities in Bangladesh.

To measure the air quality, five sampling locations were selected and shown in figure 2. These locations were AQ1, AQ2, AQ3, AQ4, and AQ5, and their GPS coordinates were recorded, shown in table 1.

**Table 1.** Selected Air Quality Measurement Locations with GPS Coordinates

| SN | Sampling Locations ID | Name of the Location | GPS Coordinates of Sampling Locations | |
|---|---|---|---|---|
| 1 | AQ 1 | Talaimari | 24°21'42.35"N | 88°37'37.41"E |
| 2 | AQ 2 | Railgate | 24°22'28.76"N | 88°36'15.14"E |
| 3 | AQ 3 | BSCIC | 24°23'15.97"N | 88°36'12.41"E |
| 4 | AQ 4 | Laxmipur | 24°22'18.83"N | 88°34'57.03"E |
| 5 | AQ 5 | Zero Point Shaheb Bazar | 24°21'55.20"N | 88°36'0.58"E |

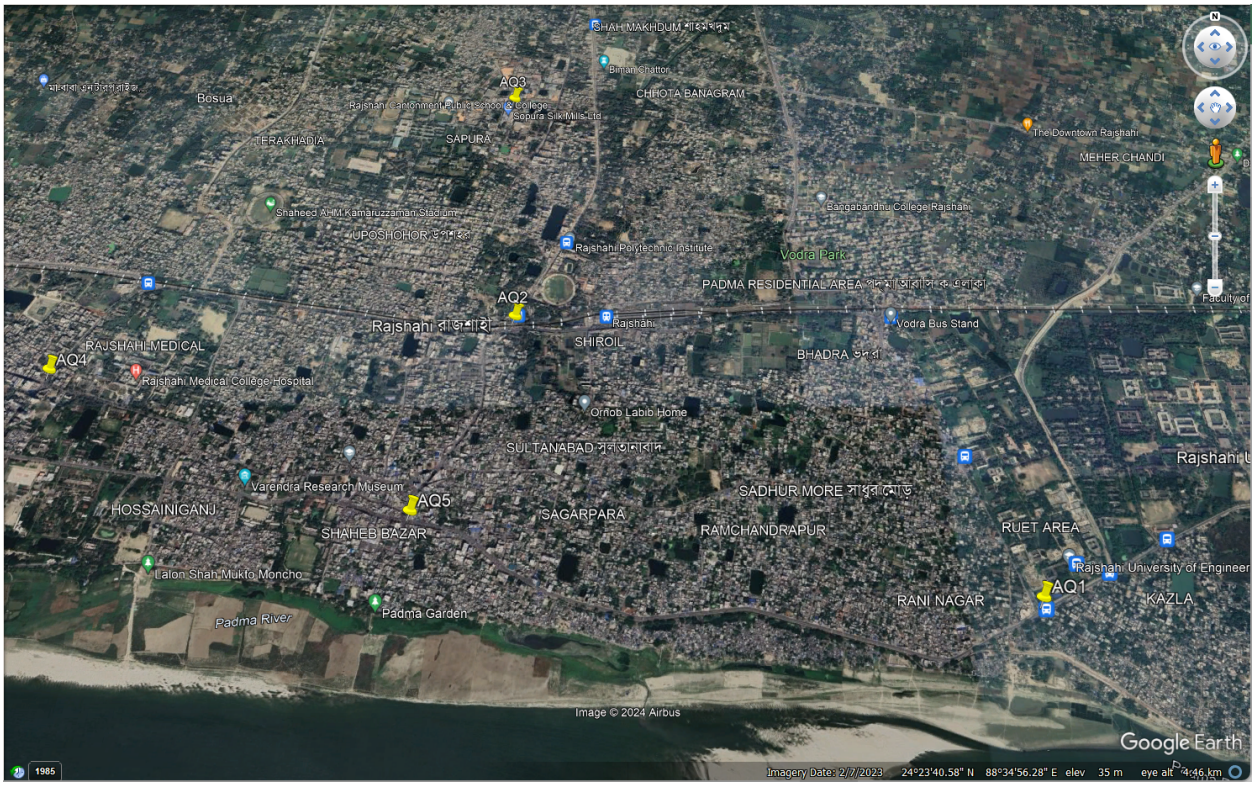


**Figure 2.** Air Quality Sampling Locations

Dust level was measured in dry season and wet season in 2022 and 2023 at each location for a period of 30 minutes, and the average value was calculated. Also, average combined value of air quality was calculated for dry season and wet season in 2022 and 2023 for Rajshahi city from collected data. This was done to present current $PM_{2.5}$ and $PM_{10}$ in air in Rajshahi city. This research methodology aimed to measure the air quality in selected locations in Rajshahi city. The use of a dust level meter

and the selection of multiple sampling locations ensured that the data collected was reliable and representative of the dust levels in the study area.

## 3. Results and Discussion

$PM_{2.5}$ and $PM_{10}$ in the air in Rajshahi city was measured on 5 March 2022, 20 August 2022, 8 April 2023 and 11 November 2023. These measuring periods presents both dry and wet seasons during the study period. Air quality was measured at five different locations, namely AQ1 to AQ5, during the day. AQ1 was within 100m of Rajshahi University of Engineering and Technology, AQ2 was in a busy area with several markets and shops, AQ3 was located within BSCIC area, there were several private hospitals within 100m of AQ4 and AQ5 was also in a busy area with markets and shops. Average $PM_{2.5}$ and $PM_{10}$ in all measured locations is shown in below figure 3.

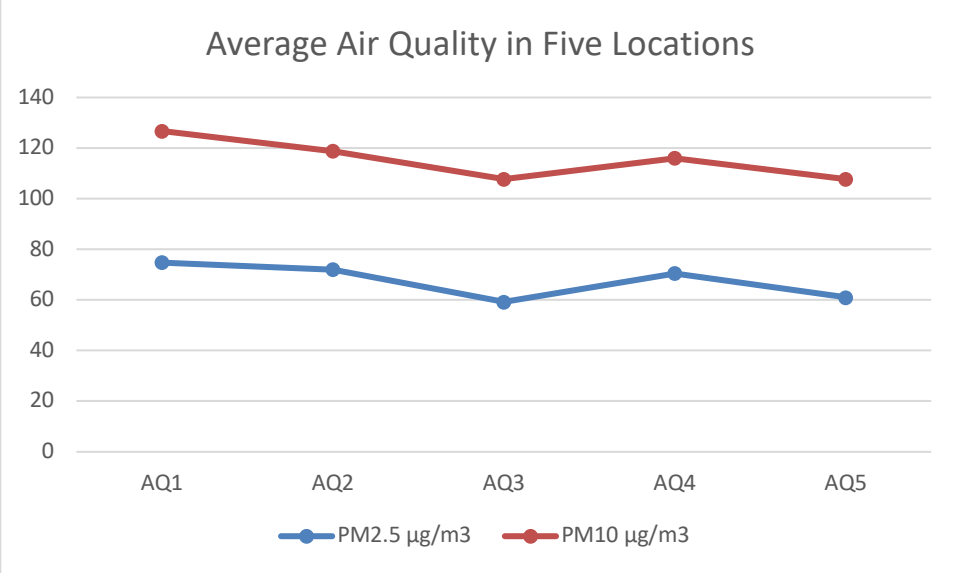


**Figure 3.** Average $PM_{2.5}$ and $PM_{10}$ in Selected Locations

From above figure 3, it was found that, average $PM_{2.5}$ concentration in air in all five locations in 2022-2023 were at a range of 59 µg/m$^3$ to 75 µg/m$^3$. This average was considered from the measured value of 5 March 2022, 20 August 2022, 8 April 2023 and 11 November 2023. On the other hand, $PM_{10}$ concentration in all five locations were found at a range of 108 µg/m$^3$ to 127 µg/m$^3$. From above analysis, it was found that, average concentration of $PM_{2.5}$ was significantly higher in most of the locations, exceeded the standard of Bangladesh Air Pollution Control Rules 2022. Highest average concentration of $PM_{2.5}$ was detected at Talaimari, 75 µg/m$^3$. This value is almost 15% higher than Bangladesh Ambient Quality Standard for $PM_{2.5}$. Second and third average highest were in Railgate and Laxmipur area, 72 µg/m$^3$ and 71 µg/m$^3$. Highest average concentration of $PM_{10}$ was also detected at Talaimari, 127 µg/m$^3$. But average concentration of $PM_{10}$ did not exceed daily average of Bangladesh Air Pollution Control Rules 2022. Higher values are found by Khan *et al.,* in Dakha and neighboring cities (Khan *et al.,* 2023); $PM_{2.5}$ and $PM_{10}$ are 477 and 715 µg/m$^3$ are explained by the presence of many sources of air pollution such as fossil fuel burning from vehicles, construction activities, and brick kiln operations. During study period, massive road construction work was going on at Talaimari and Railgate areas. Also, it was notable vehicle movement in Railgate and Laxmipur area. Average combined value of dust in air quality in Rajshahi city was also calculated for dry season and wet season, shown in below figure 4. This figure was plotted to understand the variation of concentration of $PM_{2.5}$ and PM10 in different season.

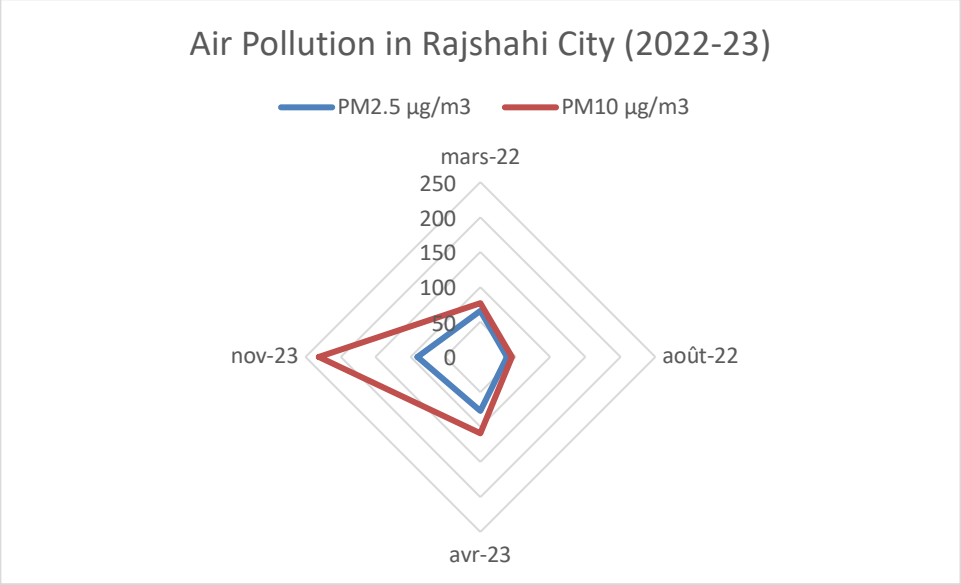


**Figure 4.** Average Combined Value of Air Quality

It was observed from above figure 4 that, high average concentration of $PM_{2.5}$ and $PM_{10}$ in Rajshahi city was 90 µg/m$^3$ and 231 µg/m$^3$, both were found in November. $PM_{2.5}$ and $PM_{10}$ concentration was found almost 38% and 54% higher than Bangladesh Ambient Quality Standard. Lowest average concentration of $PM_{2.5}$ and $PM_{10}$, 38 µg/m$^3$ and 45 µg/m$^3$ were detected in August. Second highest average concentration of $PM_{2.5}$ and $PM_{10}$ were 77 µg/m$^3$ and 109 µg/m$^3$ found in April and third highest average concentration of $PM_{2.5}$ and $PM_{10}$ were 66 µg/m$^3$and 77 µg/m$^3$ found in March. November is dry season in Bangladesh. Concentration of $PM_{2.5}$ and $PM_{10}$ significantly exceeded the standard of Bangladesh Air Pollution Control Rules 2022. August is rainy season in Bangladesh and dust in air quality was measured in a rainy day. March and April moths are considered as pre-monsoon season.

## Conclusion

Rajshahi city is known in Asia for its cleanliness and beauty. However, massive road construction and building construction is going on in this beautiful city as a part of urbanization. Lots of trees has been cut down in this city for artificial beautifications. Several ponds have been filled for construction of building and markets. Consider measured $PM_{2.5}$ concentration, health of the people of Rajshahi city is on threat. $PM_{2.5}$ is a stronger risk factor than the coarse part of $PM_{10}$. Particles in the $PM_{2.5}$ size range are able to travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. The impacts of ambient $PM_{2.5}$ on public health have become great concerns worldwide, especially in the developing countries. Fine particles, $PM_{2.5}$ in air contributes to a variety of adverse health effects, such as driving the initiation and progression of diabetes mellitus and eliciting adverse birth outcomes. $PM_{2.5}$ may still pose a hazard to public health even at very low levels of exposure. Therefore, it is essential to control unpanned development. Rajshahi City Corporation need to focus on sustainable development rather than artificial beautifications.

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