

## **A Case Study of Seasonal Variation of Air Pollutant (PM<sub>2.5</sub>) at Dhaka City, Bangladesh**

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### **Abstract**

Bangladesh is a developing country, due to anthropogenic activities pollutants are introduced in our environment moreover development actions progress in full swing. Construction sites, two and four-stroke engines, brick fields, burning of fossil fuel are the prime causes for the pollution of air in Dhaka city. This study is conducted, seasonal variation of the particulate matter (PM) especially PM<sub>2.5</sub> from 2016 to 2020 in Dhaka city using secondary data collected from the US embassy, Dhaka. The maximum yield of PM<sub>2.5</sub> was 160.25 based on Air Quality Index (AQI) at 2018 whereas the minimum results were 133.93 AQI in 2016 on the other hand for another consecutive year of 2017, 2019, and 2020 the PM<sub>2.5</sub> AQI was remain unchanged numerically the AQI was 145. The AQI results drastically fell during the rainy season and the average AQI during April to August for all over the experimental year is 105.06. Hence in the dry season, the average AQI result reached in the worst position numbered 178.96 in Dhaka city. In January 2018 the AQI was the maximum 257 among the period as well as 77 is the minimum value found in august 2019. Due to COVID- 19 the AQI was decreased which is further increased after the lockdown period.

**Keywords:** *Particulate matter; Air Quality Index; anthropogenic activities; fall down; remain unchanged.*

## 1. Introduction

Dhaka is the capital and densely populated city of Bangladesh and over 200 million peoples are staying in the small city along with lack of facilities due to earn their livelihood (Population Dynamics, UN, 2018). The growth rate city population is an alarming rate 3.4 (World Bank, 2016). Over population results different air pollution sources such as huge number of two strokes- four stroke engine, burning of fossil fuels, construction sites, brick and stone crusher and so many anthropogenic activities (Poschl, 2005). These elements emits noxious gases such as carbon monoxides (CO), sulphur dioxides (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), ozone (O<sub>3</sub>) and particulate matters (PM<sub>2.5</sub> and PM<sub>10</sub>) which causes different acute and chronic diseases to the human being (Kampa and Castanas 2008). Bangladesh cannot produce lead free gasoline by the single refinery station thus results high concentration of lead in our air moreover black fume- partial combustion of fuel released by unfitted vehicles also increase pollution load in Dhaka (Karim et al., 1997). Rapid urbanization, roads and highway development projects, construction of high rising apartment's demands myriad of bricks thus results unplanned, unsecured brick fields here and there around Dhaka and instead of modern technology till practicing primitive method for brick manufacturing (Daraina et al., 2013). Brick manufacturing is an energy consuming process, during dry season around six months the brick kiln burns fossil fuels such as coal, wooden fuel which consequences huge amount of greenhouse gases (Croitoru and Sarraf, 2010; Narasimha and Nagesha, 2013). Deficiency of environmental facilities, uncontrolled rules and regulations results air pollutants in our Dhaka city air (Haque et al., 2017). Developing countries like southern part of Asia for example Bangladesh, India, Pakistan, high amount of particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) is the foremost apprehension due to morbidity and early mortality (Kojima et al., 2000).

Air pollutant has chronic effect and long term exposers suffer different respiratory disorders, various cardiovascular illness as well as cancer which cause death of huge number of people globally. (Rumana et al., 2014; Yamamoto et al., 2014; Zhang et al., 2014; Brucker 2014; Biggeri et al., 2004; Vermaelen et al., 2013; Kan et al., 2010).

This study is conducted, seasonal variation of the particulate matter (PM) especially PM<sub>2.5</sub> from 2016 to 2020 in Dhaka city using secondary data collected from the US embassy, Dhaka.

## 2. Materials and Methods

### 2.1 Sampling Location and Sample Collection

Dhaka is one of the worst cities by air quality in the world. Dhaka is selected for observing the change of air quality concerning season. The PM<sub>2.5</sub> concentrations based on Air Quality Index (AQI) are collected from US embassy, Dhaka all data are collected since January 2016 to December 2020. Figure 1 depicts Geographic Information System (GIS) based map of the sampling location: Dhaka city among Bangladesh.

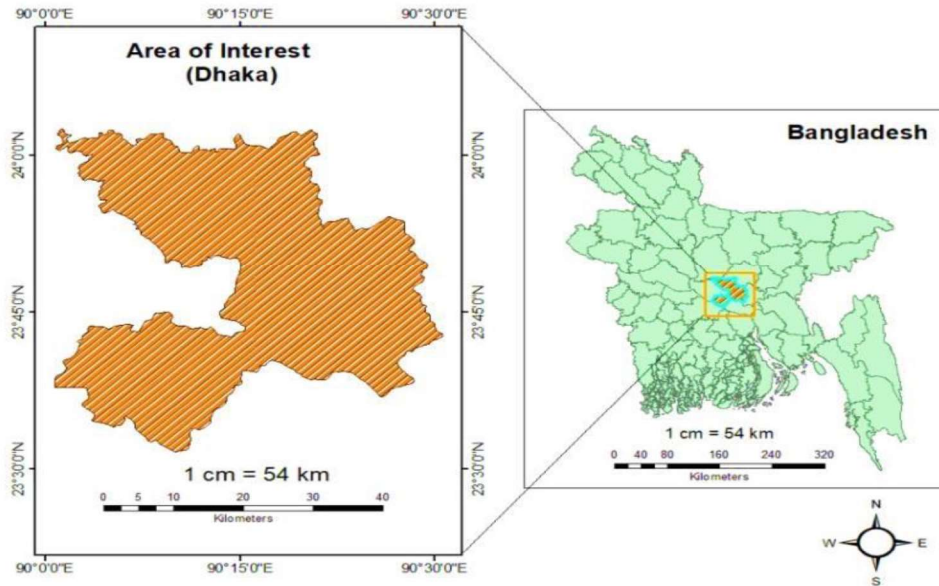


Figure 1. GIS based graphical representation of Dhaka, Bangladesh

## 2.2 Flowchart of Methodology

PM<sub>2.5</sub> concentrations for the last years are collected from US embassy, Dhaka as a secondary data. Based on collected data sampling map are created using GIS software. All data are processed based on air quality index and data are analyzed. At a glance research methodology are given in figure 2.

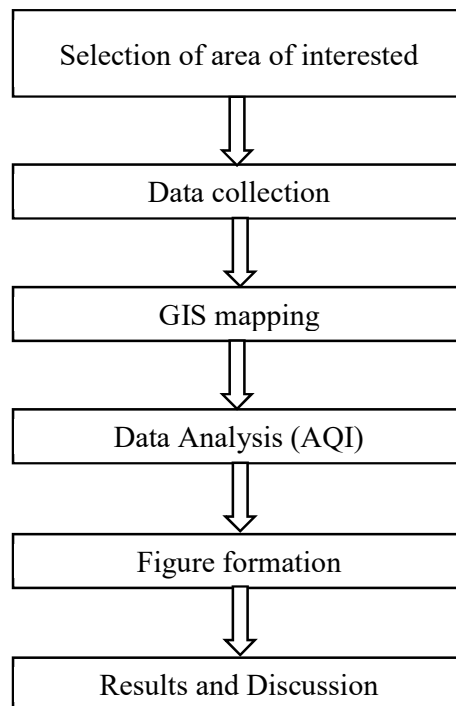


Figure 2. Flowchart of project work procedures

### 3. Results and Discussion

#### 3.1 Monthly $PM_{2.5}$ Concentration of Different Year

The following figure 3 illustrates the air quality of Dhaka city becomes very worst during dry season from October to March. Whereas in rainy season it turned into good and reduced pollutant three times than dry seasons which is common for all of the five consecutive years. In January 2018 the AQI of  $PM_{2.5}$  reached the highest numbered 257 and lowest concentration gained after COVID- 19 pandemic since July 2020. On the other hand, after finishing lockdown period pollution load increases in December 2020.

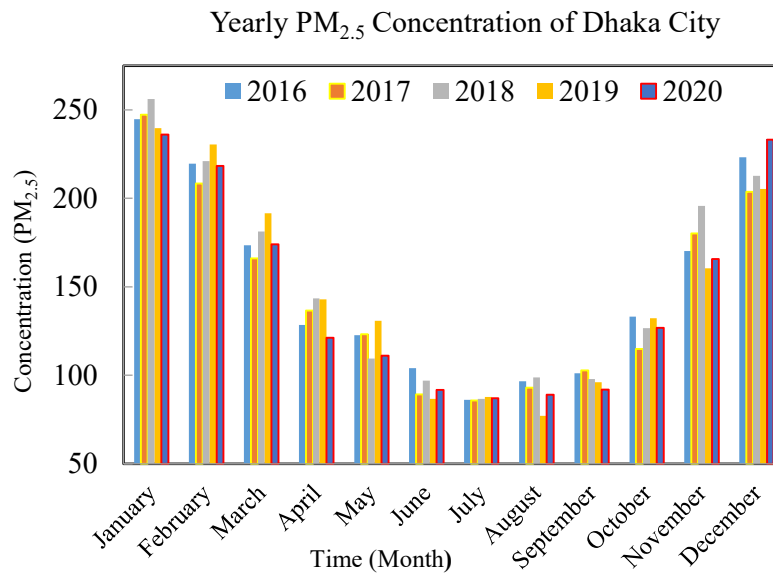


Figure 3. Monthly  $PM_{2.5}$  concentration of Dhaka for the consecutive five years

#### 3.2 Yearly $PM_{2.5}$ Concentration of Dhaka City

Due to metro rail project, unfitted vehicles and others anthropogenic activities results maximum PM concentration in 2018 whereas during COVID- 19 pandemic in 2020 the average PM concentration reduced remarkably 152.45 to 145.5 AQI. In 2016 carries the second most maximum PM concentration which is displayed well at the following figure 4. Hence pandemic period increases repeatedly the air quality improved gradually in Dhaka city.

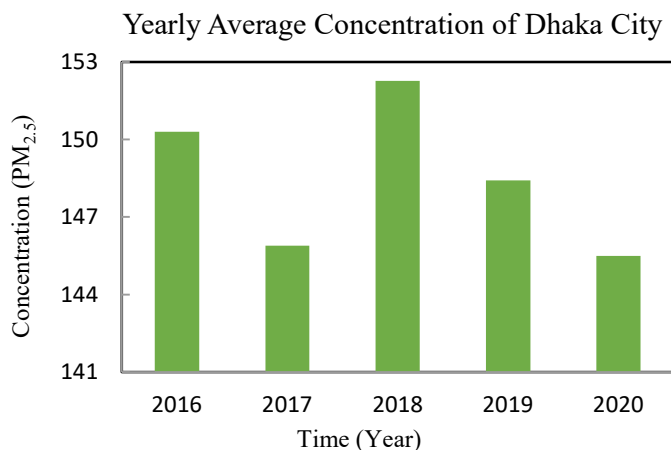


Figure 4. Average PM 2.5 concentration from 2016 to 2020 in Dhaka, Bangladesh

#### 4. Conclusion

During dry season since October to March the air quality of Dhaka turned worse and maximum PM concentration reached January 2018 whereas minimum AQI found August 2019. A big change is found before and after COVID- 19 lockdown period. At the middle of the year 2019 the AQI drastically fall in Dhaka which is regain same bad condition after lockdown period in 2020.

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