Seasonal variation in concentration of $PM_{2.5}$ in Agra and its relation with metrological parameters

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***Abstract*—As it is known the particulate matter ($PM_{2.5}$) is one of the major contributors which effects visibility, health etc. It is known that the many factors including, increase in population, deforestation, stubble burning, are responsible for the concentration increase of particulate matter. In this study we analyzed the seasonal variation in concentration of $PM_{2.5}$ at Sanjay place in Agra. The data was collected from 2021 to 2022 at Sanjay place and meteorological data was taken from central pollution control board. The $PM_{2.5}$ data was collected by using low volume sampler. The concentration of $PM_{2.5}$ was lowest in summer while the concentration of $PM_{2.5}$ highest in autumn. The concentration of $PM_{2.5}$ in atmosphere has a huge impact on atmospheric visibility. The meteorological parameter like temperature, humidity and wind speed also impacts the concentration of $PM_{2.5}$. The temperature was highest in summer while concentration of $PM_{2.5}$ was lowest. Wind speed was lowest in autumn while concentration of $PM_{2.5}$ was highest. Relative humidity was lowest in spring while concentration of $PM_{2.5}$ was moderate. Hence the meteorological parameters have a huge impact of concentration of $PM_{2.5}$.**

***Index Terms*—PM2.5, Meteorological parameters, atmospheric visibility, health**

I. INTRODUCTION

The majority of publications related to air quality impacts have focused on health risk, and the conclusions indicate that air pollution is closely related to increase in premature mortality, incidence rate and hospitalization induced by respiratory disease or other disease [1]-[5].

Air quality is a severe environmental concern, particularly in rapid urbanizing areas like Agra, India, where industrialization and vehicular emissions contribute the most in air pollution. Among various pollutants, fine particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$) is of matter of concern due to its adverse health impact and visibility impairment [6].

In India, premature death cases occurred due to outdoor air pollution about 0.62 million in 2005 and 0.69 million in 2010 [7]. The total economic cost of health impacts due to outdoor air pollution was about 5.7 % of Indian GDP. The cost of serious health consequences due to burning of fossil fuel, was amounted about 3% [8]. The major source of ambient particulate matter pollution is coal burning for thermal power production, industry emission, construction activity and brick kilns, transport vehicle, road dust, residential and commercial biomass burning, waste burning, agricultural stubble burning, and diesel generators [9]-[11]

This research focuses on investigating diurnal and seasonal variation in visibility and their relationship with $PM_{2.5}$ concentration at Sanjay place in Agra. Agra, home to the iconic Taj Mahal and various industrial establishments, experiences significant hike in air pollution level throughout the year. The air quality of Agra is influenced by various factors, including vehicular emissions, industrial activities, construction dust, and agricultural burning. Understanding the temporal variations in visibility and its relationship with PM2.5 concentrations is crucial for developing targeted interventions to mitigate air pollution and protect public health [12].

$PM_{2.5}$, being a major component among the all-air pollutants and has a adverse impact on human health, including respiratory as well as cardiovascular disease. The public is become more concerned about environmental issues, and the same time new regulations are being forced to control the deterioration of ambient air quality.

In many countries, the manual and automatic both observations were set up for the monitoring of air quality, in china the manual visibility observations were exchanged to automatic observations beginnings

in 2014 [13]. There are many examples of countries, which are taking forward steps to encounter air pollution.

Overall, this study will aim to provide valuable insight into the relationship between concentration of PM2.5 with metrological parameters, contributing to comprehensive air quality analysis and strategies for sustainable development in urban area and to curb pollution [14].

II. EXPERIMENTAL ARRANGEMENT

1.1 Sampling site:

Agra is a major city in India. According to the census 2011 the population of Agra is 1.6 million. The location of sampling site was Sanjay place whose coordinates are 27.18 N 78.02 E. Agra has subtropic climate having long hot summer and short cold winters. The season of Agra is divided into spring, summer, autumn and winter. The site was a building in Sanjay place having a height of 30 feet. The site was chosen such that it was free from obstacle.

1.2 Data collection:

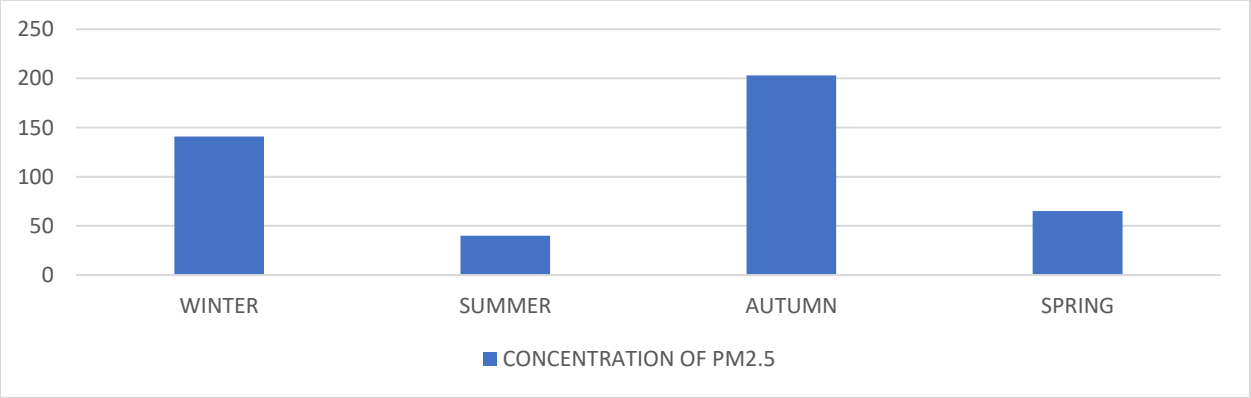
The data of $PM_{2.5}$ was taken from July 2021 to 2022 July by using a low volume sampler. The data was collected three times a day like morning, afternoon and evening. Meterological data was collected from central pollution control board office at Sanjay place.

III. RESULT AND DISCUSSIONS

2.1 Statistical data

Table 1 provides a detail of the statistical data that was examined from year 2021 to 2022. The table also includes the information of the chosen air pollutant $PM_{2.5}$ in different seasons.

Seasons	Concentration of $PM_{2.5}$ (in$\mu g/m^3$)
Winter	141
Summer	40
Autumn	203
Spring	65

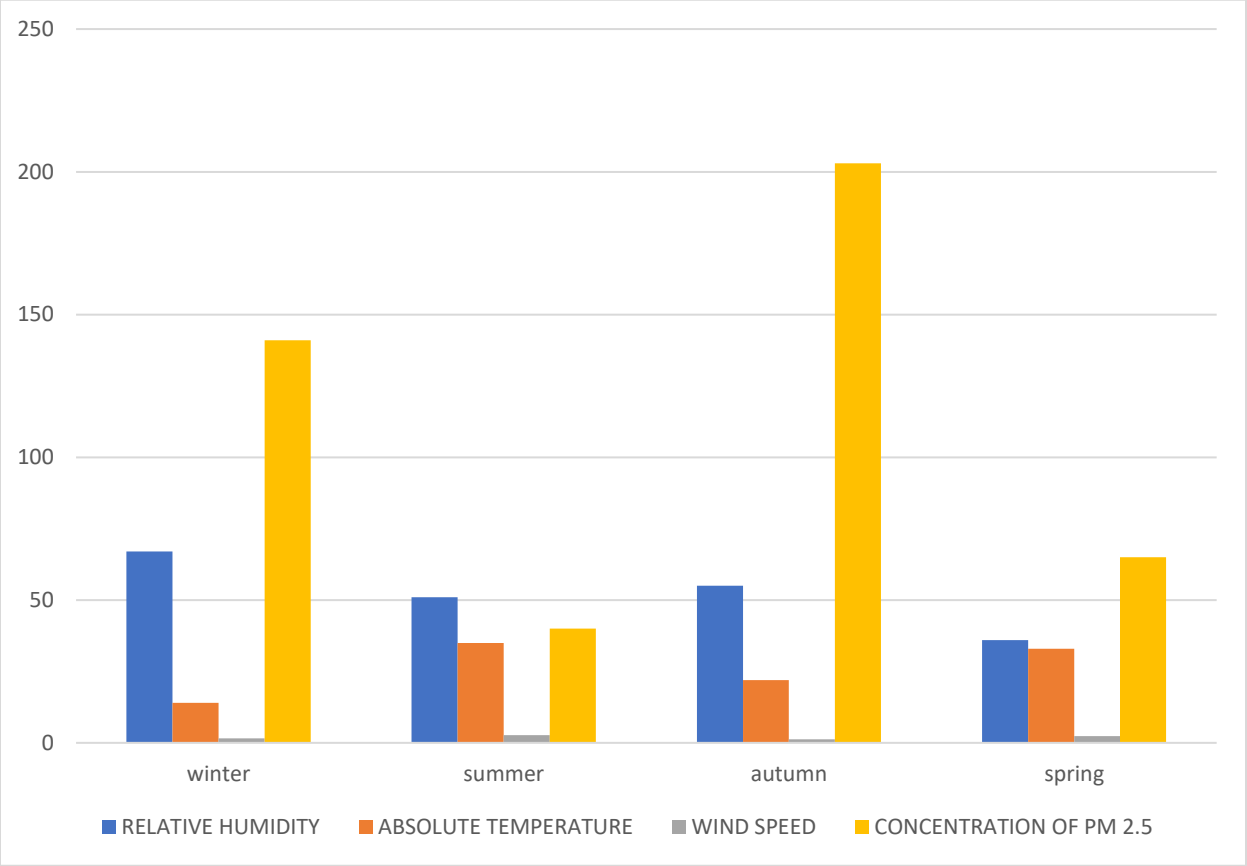


As we can see the concentration of PM2.5 was higher in autumn in all among seasons, which was due to slow wind speed.

2.2 PM2.5 concentration with meterological parameters

Table 2 provides a detail of statistical data that was examined from year 2021 to 2022. The table includes the information of metrological data in different seasons [15].

Season	Relative Humidity (%)	Absolute Temperature (^{0}c)	Wind Speed (M/S)	Concentration Of $Pm_{2.5}$ ($\mu Gm/M^3$)
Winter	67	14	1.6	141
Summer	51	35	2.7	40
Autumn	55	22	1.2	203
Spring	36	33	2.4	65



IV. CONCLUSIONS

The recent research from 2021 to 2022 used simulation methodologies to replicate the seasonal variation in concentration of $PM_{2.5}$ at sanjay place in Agra. The research was done at site which is one of the busy places in Agra. This study provides a relationship in concentration of $PM_{2.5}$ with the meterological parameters. Wind speed plays a vital role in sweeping the air pollutants.

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