

A RESEARCH PAPER ON AIR QUALITY ASSESSMENT OF MEERUT CITY USING AQI INDEX

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Abstract: Air pollution has become an important factor of environmental degradation. Release of smoke from the chimneys of the industries, burning of fuels like coal, wood as well as the exhausts from automobiles leads to air pollution. In modern times, rapid industrialization and use of automobiles for transport to cope with the growing demand of the growing human population have become the major sources of air pollution. In India air pollution or air quality is calculated according to the guideline given by pollution control board of India in this thesis we recalculate the AQI result of Meerut city which is situated in Uttar Pradesh we recalculate the AQI data from last three years data according to our study on Air Quality Assessment of Meerut city by using AQI index we seems that AQI will rise in the month of festivals like diwali, holi etc. in these month AQI lies between the range of category poor and very poor of Meerut city. which is very dangerous for human being and our environment.

KEYWORDS- AQI, PM10, PM2.5, NO2, SO2 NAAQS (National Ambient Air Quality Index)

1 INTRODUCTION

The Air Quality Index (AQI) is an important indicator to reflect and evaluate air quality According to the Chinese Standard GB3095-2012., AQI is calculated by six major pollutants: fine particulate matter (PM2.5), ozone (O3), sulfur dioxides (SO2), inhalable particles (PM10), nitrogen dioxides (NO2), and carbon monoxide (CO). The AQI measures the overall quality of the air on a scale between the range of 0 to 500 that is divided into six levels (good, moderate, lightly polluted, moderately polluted, heavily polluted, and severely polluted); these levels show the impact on human health and provide a good reference for people's outdoor activities in a numerical form. A low number means good air quality, while a higher number means worse air quality, which has ramifications for people's outdoor activities.

In India the ambient atmospheric conditions have progressively deteriorated due to urbanization, industrial development, lack of awareness, poor maintenance of motor vehicles and poor road conditions (Shrinivas.J

2011). Transport vehicles and industrial emissions are the major sources of pollutants in the Vapi atmosphere. So, there is a need to evaluate the air quality improvement in Meerut which is 90 among the list of most polluted areas in the world.

AQI is a tool introduced by the Environmental Protection Agency (EPA) in the USA to measure the levels of pollution due to major air pollutants. An AQI is defined as an overall scheme that transforms weighted values of individual air pollution related parameters into a single number or set of numbers (Mukesh Sharma, 2003). In the present study the AQI was calculated using

IND-AQI specified by CPCB. The index has been developed based on the dose-response relationship of various pollutants. AQI concept transforms weighted values of individual air pollutants into a single number or set of numbers which may be widely used for air quality communication and decision making. This IND-AQI has 6 categories.

Table - 1:
Various Categories of IND-AQI (National Air Quality Index, CPCB, October 2014)

<i>Category</i>	<i>Range</i>
Good	0-50
Satisfactory	51-100
Moderately polluted	101-200
Poor	201-300
Very poor	301-400
Severe	401-500

1.1 AIR QUALITY STANDARDS

NAAQS is adopted by CPCB. It has given some guidelines for measuring pollutants which is responsible for air quality. The present National Ambient Air Quality Standards (NAAQS) is given below

Table 2: National Ambient Air Quality Standards (NAAQS)
– 2009 (Units: $\mu\text{g}/\text{m}^3$ Source: CPCB)

Pollutants	Time Weighted Average	Standard limits as per WHO guidelines ($\mu\text{g}/\text{m}^3$)	Methods of measurement	
Sulphur dioxide(SO_2)	Annual 24hr	50 80	Improved West and Gaeke/ Ultraviolet fluorescence	
Nitrogen dioxide(NO_2)	Annual 24hr	40 80	Modified Jacob &Hochheiser / chemiluminescence	
Particulate matter($<10\mu\text{m}$) Or PM_{10}	Annual 24hr	60 100	Gravimetric/ T OEM/Beta attenuation	
Particulate matter($<2.5\mu\text{m}$) Or $\text{PM}_{2.5}$	Annual 24hr	40 60	Gravimetric/ T OEM/Beta attenuation	

Table 3: AQI Standard Range, Pollutants Break Points
(Units: $\mu\text{g}/\text{m}^3$ Source: CBSE Oct 2014)

AQI Category (Range)	PM_{10}	$\text{PM}_{2.5}$	NO_2	SO_2
Good (0-50)	0-50	0-30	0-40	0-40
Satisfactory (51-100)	51-100	31-60	41-80	41-80
Moderately	101-250	61-90	81-180	81-380

polluted (100-200)				
Poor (201-300)	251-350	91-120	181-280	381-800
Very Poor (301-400)	351-430	121-250	281-400	801-1600
Severe (401-500)	430+	251+	400+	1600+

2 .MATERIALS AND METHODOLOGY

•Methods Used For Air Quality Index (AQI) Calculation:

Based on IND-AQI It can be illustrated mathematically:

$$I_p = \left(\frac{I_{HI} - I_{LO}}{BP_{HI} - BP_{LO}} \times (C_p - BR_{LO}) \right) + I_{LO}$$

Where

- I_p .is AQI for pollutant “P” (Rounded to the nearest integer).
- C_p the actual ambient concentration of pollutant “P”.
- BP_{HI} the upper end breakpoint concentration that is greater than equal to C_p .
- BP_{LO} the lower end breakpoint concentration that is less than or equal to C_p
- I_{HI} is the sub index value corresponding to BP_{HI}
- I_{LO} is the sub index value corresponding to BP_{LO}

2.1 STUDY AREA

Meerut is a city in the western part of the Indian state of Uttar Pradesh. The city lies 70 km (43 mi) northeast of the national capital New Delhi, within the National Capital Region and 485 km (301 mi) west of the state capital Lucknow. The Population of Meerut is 1,420,902. City is also an education hub in

western Uttar Pradesh, and also known as the "Sports City Of India".The city is famous for being the starting point of the 1857 rebellion against British colonial rule.

2.2 SELECTION OF SAMPLING LOCATIONS

In Meerut city there is three location available which measure AQI of Meerut city and these locations are Ganga nagar,Gokal puri and Pallavpuram phase-2.out of these three locations we select two locations for our study and these locations are Ganga nagar and Gokal puri.



FIG (2.2) STUDY AREA OF MEERUT CITY

These two selected locations measure the AQI of Begum bridge and kesar ganj.whis is commercial and residential respectively.

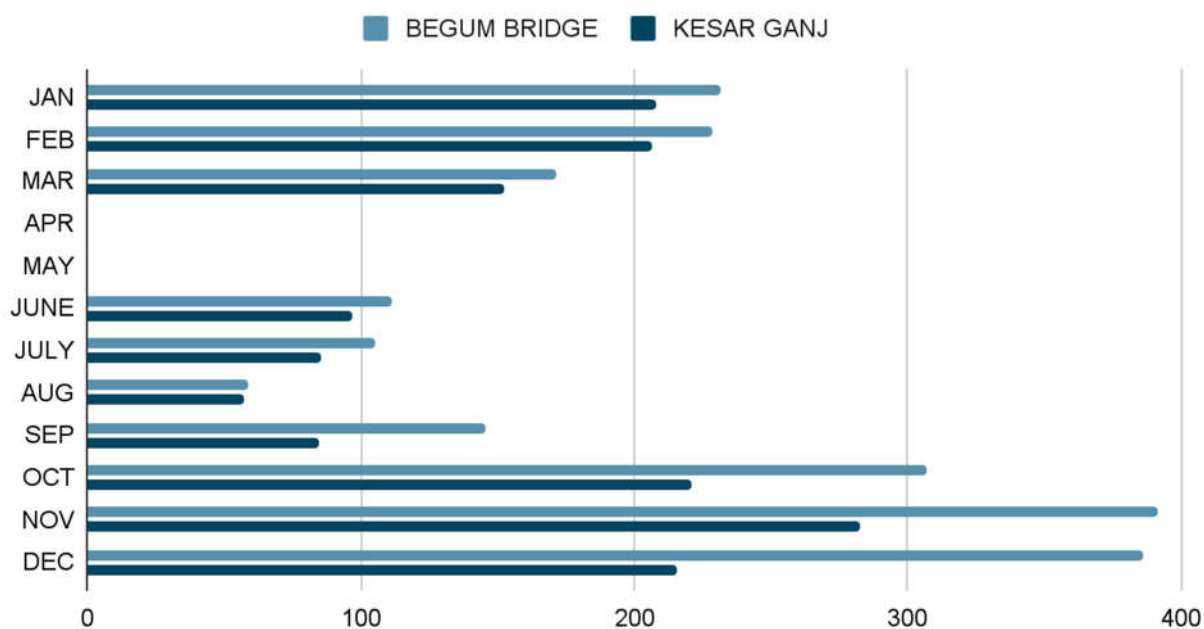
2.3 PARAMETERS CONSIDERED AND DURATION

The pollutant parameter is considered based on the availability of data of pollutants for the studied period. Thus four air quality parameters with 24 hour average concentration studied pollutants are taken for the analysis purpose.They are PM10.PM2.5, NO2 and SO2.These pollutants are measured in 24hr.

3 RESULT AND DISCUSSION

Meerut is located 70 kilometres to the east of the Indian capital, New Delhi. It is in the western part of Uttar Pradesh province. In 2016 it had an estimated population level of just over 1.5 million in its metropolitan area. At the start of 2021, Meerut was experiencing some very poor quality air with a US AQI reading of 215 which classifies it as “Very Unhealthy” according to the World Health Organisation’s (WHO) recommendations. The recorded concentration of PM_{2.5} was 164.2 $\mu\text{g}/\text{m}^3$.

Points scored

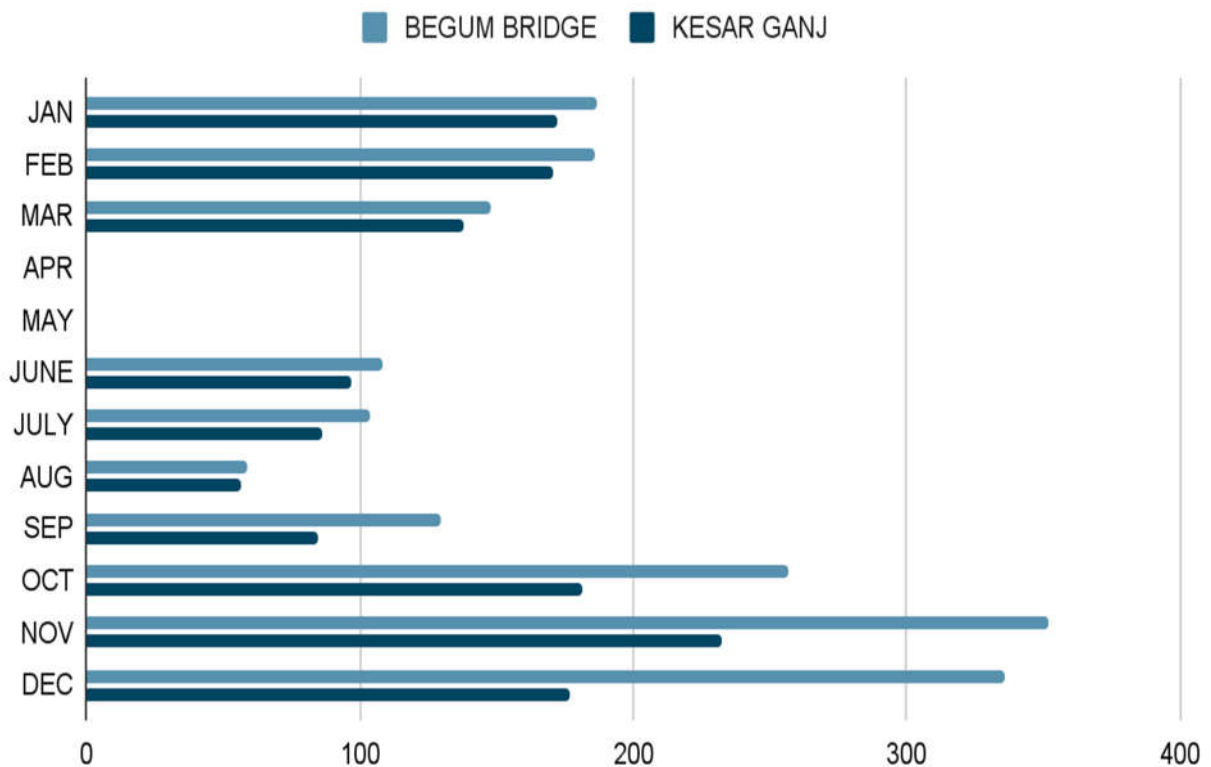


GRAPH (3.1) MONTH WISE RATE OF PM10 IN 2020

This graph(3.1) represents the month wise rate of PM10 in Meerut city in the year of 2020.it also Show How PM 10 is Increase or Decrease Month Wise .In The Year of Summer AQI is Low But In the Season of Winter AQI will be increase Which Also Shown In The Fig In The Season of summer Air Quality Is Good Due Heat or Temperature Due To heat the pollutants is flow easily But in the season of winter AQI worst Due To Cold air traps pollutants close to the ground dust storms, crop fires, burning of solid fuels for heating, as well as firecracker-related pollution during Diwali also increases winter pollution.

In the month of November and December PM10 levels are very high; it is 395.2µg/m3 and 385.6µg/m3 respectively.Begum bridge is in the range of very poor (301-400) according to NAAQS.

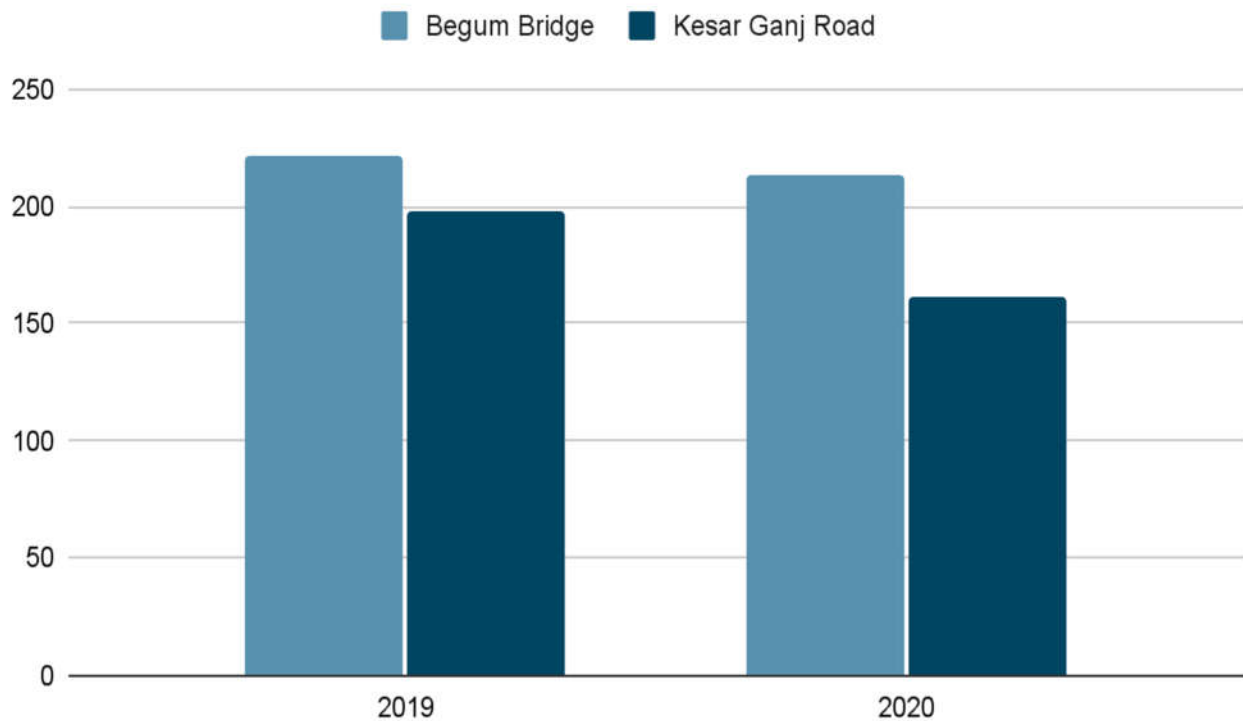
Points scored



GRAPH (3.2) MONTH WISE RATE OF AQI IN 2020

As shown in the above graph (3.2) we can clearly see that AQI is very high in the month of winter (November and December) and highest AQI shows at the location of Begum Bridge which is a commercial location that means AQI will be high at that location where traffic is more.

Due to decrease in the temperature and increase in pressure of water vapours and gasses near the earth's surface the polluted gasses from vehicle and factory and indoor pollution, cannot go upward and thus they are trapped in an region and increased the AQI level of that area.

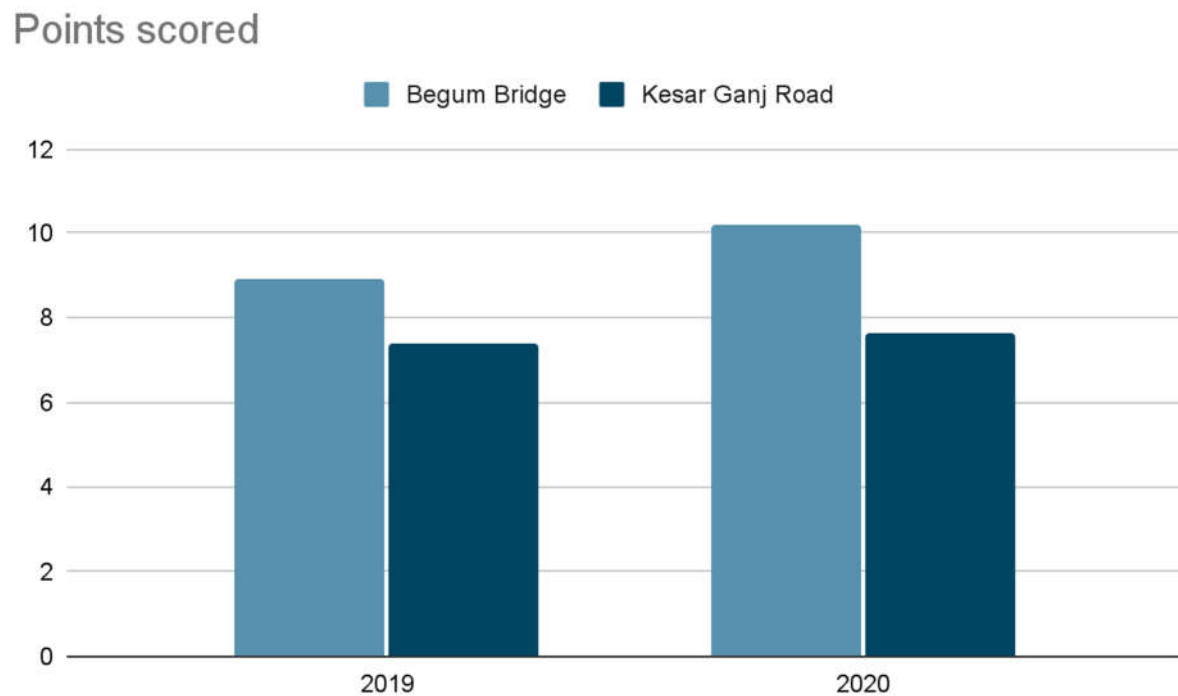


GRAPH (3.3) ANNUAL PM10 LEVELS OF MEERUT

Technically, there isn't a safe level of PM10, as any amount of particulate matter in the air isn't a good thing. Keeping exposure to PM10 concentrations below $54.0 \mu\text{g}/\text{m}^3$.

In Meerut. Begum bridge region pollutant PM10 crossed the 200 and kesar ganj road was just near to 200.

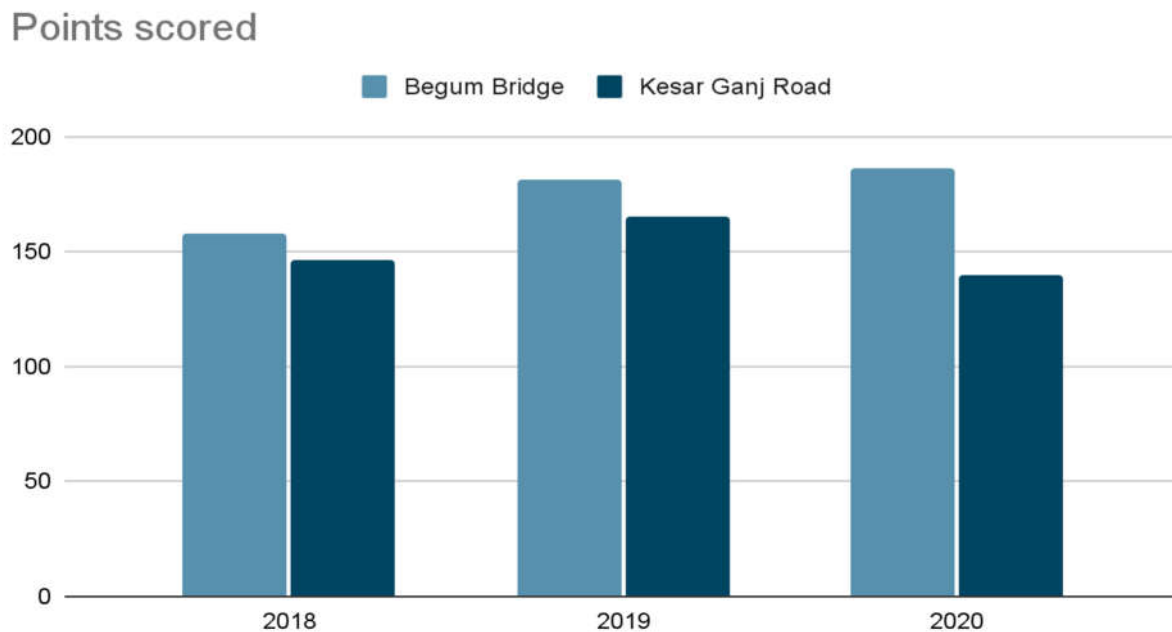
And in the previous year that is 2020 PM10 of Begum bridge was above 200 and Kesar Ganj Road decreased as of previous year but a little bit ,and recorded as 150.



**GRAPH (3.4) ANNUAL SO₂ RATE OF MEERUT CITY
IN THE YEAR OF 2019 AND 2020**

Above graph (3.4) shows the annual rate of SO₂ in this graph with clearly seen that the rate of SO₂ is in the range of “good (0-50)” in the year of 2020 at the both locations of study

The annual SO₂ rate of Begum bridge and Kesar ganj is 10.18 and 7.63 respectively during the study period of 2020. the comparison between annual SO₂ rate in the year of 2019 and 2020 of Meerut city is shown in above graph the SO₂ rate of 2020 is greater than the SO₂ rate of 2019.



GRAPH (3.5) ANNUAL AQI LEVELS IN MEERUT

This graph (3.5) shows the AQI level of four monitoring stations. In this graph, the AQI level of 2020 is higher as compared to other years' AQI levels. The year 2020 is a pandemic year after the month of March. In an annual comparison of AQI, the one station Begum bridge and Kesar ganj both are found in the range of "Moderately polluted" (AQI 101-200). The Annual AQI of Begum bridge and Kesar ganj is respectively 186.7 and 139.6 in the year of 2020.

The annual comparison of the year 2018, 2019, and 2020 are shown in the above graph (3.5).

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