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REGIONAL AND SEASONAL VARIATION OF PM10 CONCENTRATION IN MEERUT CITY BEFORE AND DURING COVID-19 LOCKDOWN.

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Abstract : Air Pollution, seen as contamination of indoor and outdoor Environment, has become a major problem to ‘Developing Nations’ and their cities. The various air pollutants like PM10, PM2.5 etc are causing diseases like lower respiratory infections and lung cancer. The worse victim of this scenario are the children. In this respect , this paper gives the analysis of seasonal variation of PM10 concentration in commercial and residential areas of Meerut City, India for over the past five years. The secondary data depicts the 2020 as an ironical year with the lowest PM10 values during COVID 19 lockdown and the highest value post lockdown as compared to values of past four years. The Seasonal variation in the PM10 values for commercial and residential areas throw light on air pollution encroaching our households now with an increasing value and bridging gap between PM10 concentration in commercial and residential areas during Winter season , which has come down to almost negligible level during COVID 19 Lockdown.

Keywords: PM10, PM2.5, winter pollution, air pollution in COVID-19 lockdown, household pollution.

INTRODUCTION

Air Pollution defined as the presence of toxic chemicals or compounds in the air , at levels that pose a health risk. Mainly caused by human activities such as mining , construction, transportation , industrial work etc. **Particulate Matter (PM)**, particles of variable but very small diameter, penetrate the respiratory system via inhalation, causing respiratory and central nervous system dysfunctions and cancer.

What are Particulate Matters?

Particulate Matters are common proxy indicator of air pollution. The major components of PM are sulfate, nitrates, ammonia, black carbon. It affects more people than any other pollutant. They include:

1. PM₁₀: Inhalable Particles, with diameters that are generally 10 micrometers and smaller.

2. PM_{2.5}: Fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

[2.5 micrometers can be compared with hair from your head, which is about 70 micrometers in diameter-making it **30 times** larger than the largest fine particle.]

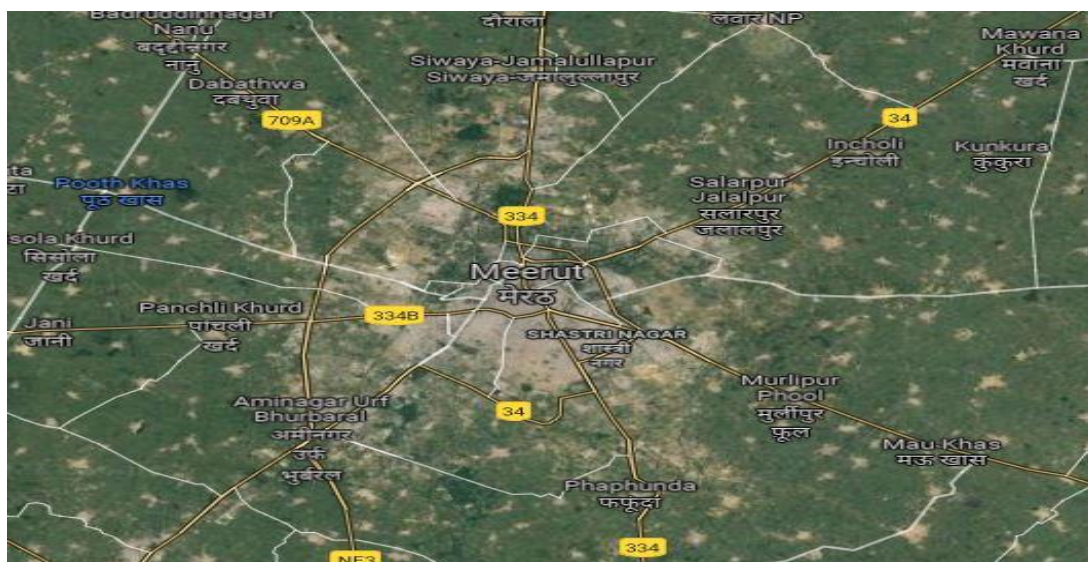
SOURCES OF PM

1. Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires.

2. Most Particles form in the atmosphere as a result of complex reactions of chemicals such as sulphur dioxide, and nitrogen oxides which are Pollutants emitted from power plants, industries and automobiles.

AIR POLLUTION IN MEERUT CITY

Meerut city is the administrative headquarters of Meerut district of Uttar Pradesh. Meerut city is the part of Upper Ganga Yamuna doab, which lies between 28 degree 47 minutes and 29 degree 18 minutes north latitudes and between 77 degree 7 minutes and 78 degree 7 minutes East longitudes. The city is situated at a distance of only 70 kms from the National Capital of India. **pollution level here exceeds 2-4 times.**



SEASONAL VARIATION OF PM₁₀ CONCENTRATION IN MEERUT CITY(2016-2019)

The data is analysed seasonally as follows; Summer Season (March to May), Post Monsoon Season (November to December) and Winter season (January to February). The Data is taken for the city's Commercial area (**Begum Bridge**) and residential area (**Kasarganj Road**). While for the year 2016 graph (fig1) shows a wide range of PM₁₀ from 170 to 190 $\mu\text{g}/\text{m}^3$, with a zigzag line, the time period from 2017 to 2019 shows a more uniform range of PM₁₀ concentration in the city (between 150 to 250 $\mu\text{g}/\text{m}^3$). Therefore, a rapidly increasing trend is seen in PM₁₀ concentration from 2016 to 2019.

1. SUMMER SEASON : This season measures the lowest PM₁₀ concentration in the month of March and April for the year 2016 and 2019 respectively. The maximum concentration seen in the summer for given time period is 227.20 $\mu\text{g}/\text{m}^3$ in May 2019 for Commercial Area and for Residential Area is 202 $\mu\text{g}/\text{m}^3$ in the same.

The attention to be made on the fact that the overall PM₁₀ Concentration saw an increasing trend from 2016 to 2019, except for the summer of 2017 where downfall is seen in PM₁₀ Concentration from 2016 levels, with an increasing trend for 2018-2019. The Summer has been less polluted as compared to winter season and post monsoon season except for the year 2016, where Summer Season witnessed PM₁₀ concentration 186.7 $\mu\text{g}/\text{m}^3$ which is more than that of

Winter Season i.e $180.5\mu\text{g}/\text{m}^3$.

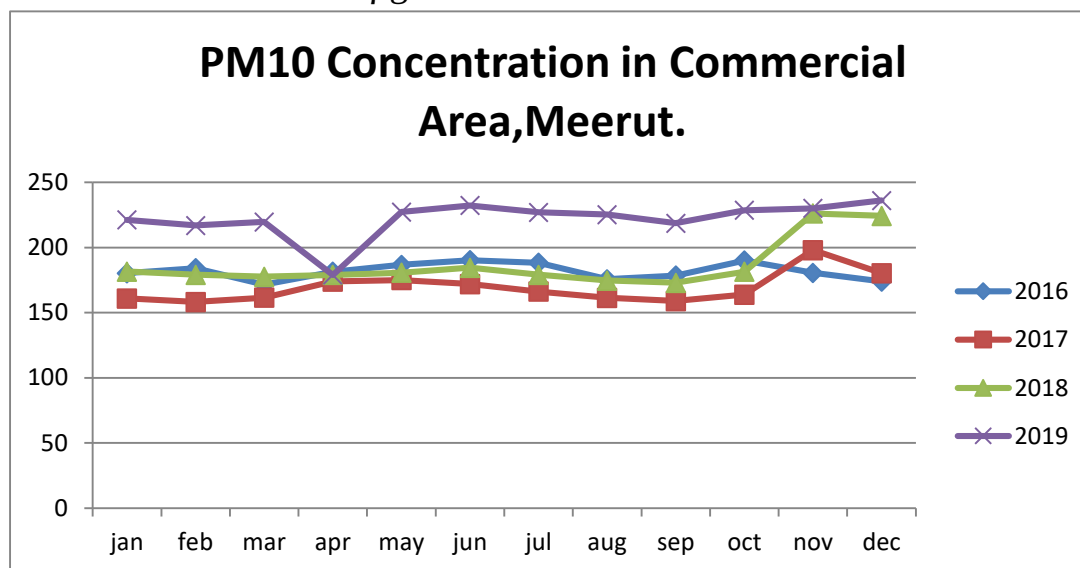


Fig 1

Similar trend is seen in Delhi also in 2007 [**Summers in Delhi are now more Polluted than Winters, Reason being the nature of Vehicular and Domestic emissions has been changed ,leading to production of more oxides of nitrogen the culprits that trigger heightened chemical reactions in the summer Heat**].

A new study by **IIT Delhi** says nature of emissions has changed primarily due to imposition of control measures like implementation of CNG norms and significant shift to LPG use in households. **The study was Published in the Journal of Environmental Monitoring and Assessment(January 23,2007).**

Cause for Summer Pollution : During Summer ,the atmosphere is highly unstable (turbulent) because of increased solar radiation ,wind speed and frequent changes in wind directions . This also results in an increase in mixing height and so enhances the dispersion of PM emissions . **Pohjola et al.(2002) reported the similar temporal variation of PM10 and PM 2.5 concentration in the Helsinki metropolitan area.**

Residential Area: It saw the similar rapidly increasing trend of PM10 Concentration from 2017-2019(fig2).

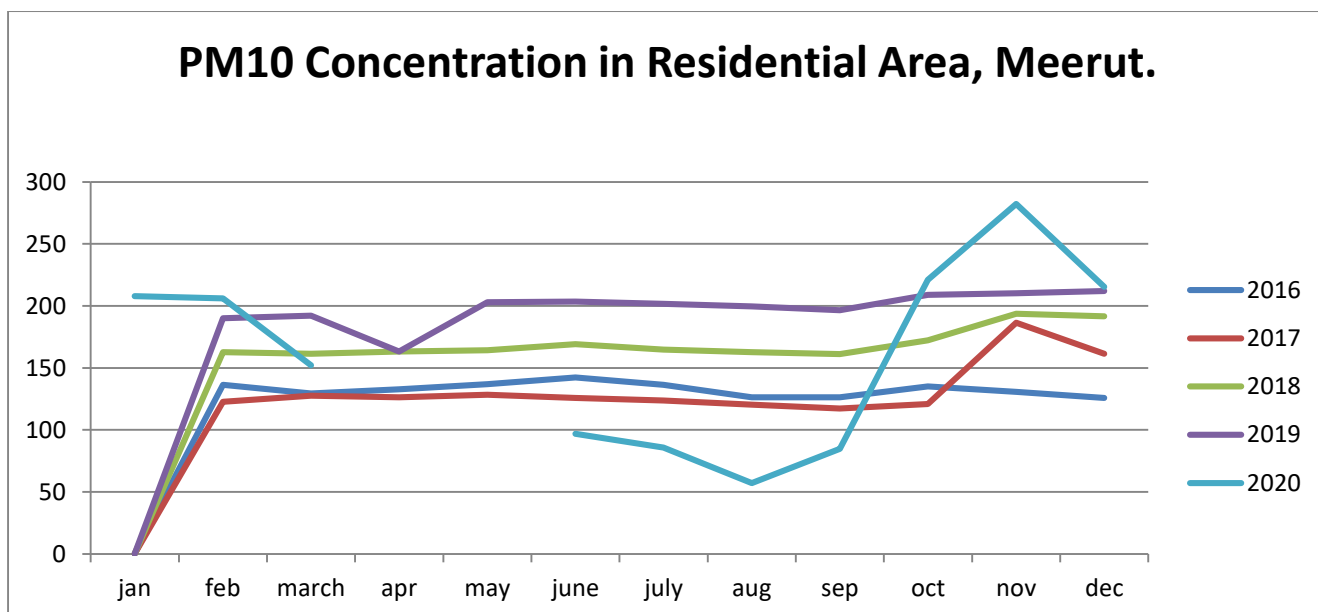


Fig 2

2. POST MONSOON SEASON

In this Season PM10 concentration has been consistently seeing maximum level from 2016-2019 than summer and winter season. The maximum value recorded between 2016-2019 is 236.10 µg/m³ on December 2019. But usually its November 2016-2018. The reason being Fall in Temperature during November which limits the Dispersion condition and traps the fine PM10 emissions.

3. WINTER SEASON

During winter season PM10 concentration remains high ranging between 158-221 µg/m³ in Commercial area and 122-190.80 for Residential Area. The reason begin in winter months the pollutants which resulted from both natural and anthropogenic sources are trapped in the boundary layer due to frequent temperature inversions.

During Winter months, the atmospheric conditions are different, lower average wind speeds, lower temperatures, and lack of precipitations reduce surface vertical mixing which leads to limited **Dilution** and **Dispersion**.

Table (1) PM 10 concentration in Commercial Area (in µg/m³)

Year	2016	2017	2018	2019	2020
Minimum	171.6	158.2	172.19	178.93	58.58
Maximum	180.5	197.98	226.10	230	391.2

Table (2)PM10 concentration in Residential Area(in $\mu\text{g}/\text{m}^3$)

Year	2016	2017	2018	2019	2020
Minimum	126.2	117.27	161.2	163.21	57.20
Maximum	190.3	197.98	193.6	212.10	282.30

SEASONAL VARIATION OF PM10 CONCENTRATION IN MEERUT CITY IN THE YEAR 2020.

The analysis use data for 2020 when Lockdown existed. The trend witnessed a drastic fall of PM10 concentration upto $58\mu\text{g}/\text{m}^3$ in the month of August and highest being $391.2\mu\text{g}/\text{m}^3$ in the month of November.

1.SUMMER SEASON

This season had the months of complete lockdown recorded $171.50 \mu\text{g}/\text{m}^3$,PM10 in March 2020 which is lower than the past two years of 177.59 and 219.60 in March of 2018,2019 respectively. Hence ,the trend of Summer Season having the minimum PM10 concentration took a turnaround ,as spring recorded $58.58\mu\text{g}/\text{m}^3$ which is the lowest in the 1st Five Years in Commercial Area ,while Residential Area also witnessed it's minimum PM10 concentration in the same month.

2.POST MONSOON SEASON

This is the time when even partial lockdown was removed in the city and it went to record the last five Years highest PM10 Concentration of $391.20\mu\text{g}/\text{m}^3$ in November for both Commercial as well as Residential Area.

This season is the spectator to 46% increase in PM10 concentration in 2020 from 2016 levels ,while it was just 1%increase in summer season when Lockdown existed in the city.

3.WINTER SEASON

This season seems a rapidly increasing PM10 concentration from 2017 -2020. The reason for this being the same as mentioned previously .

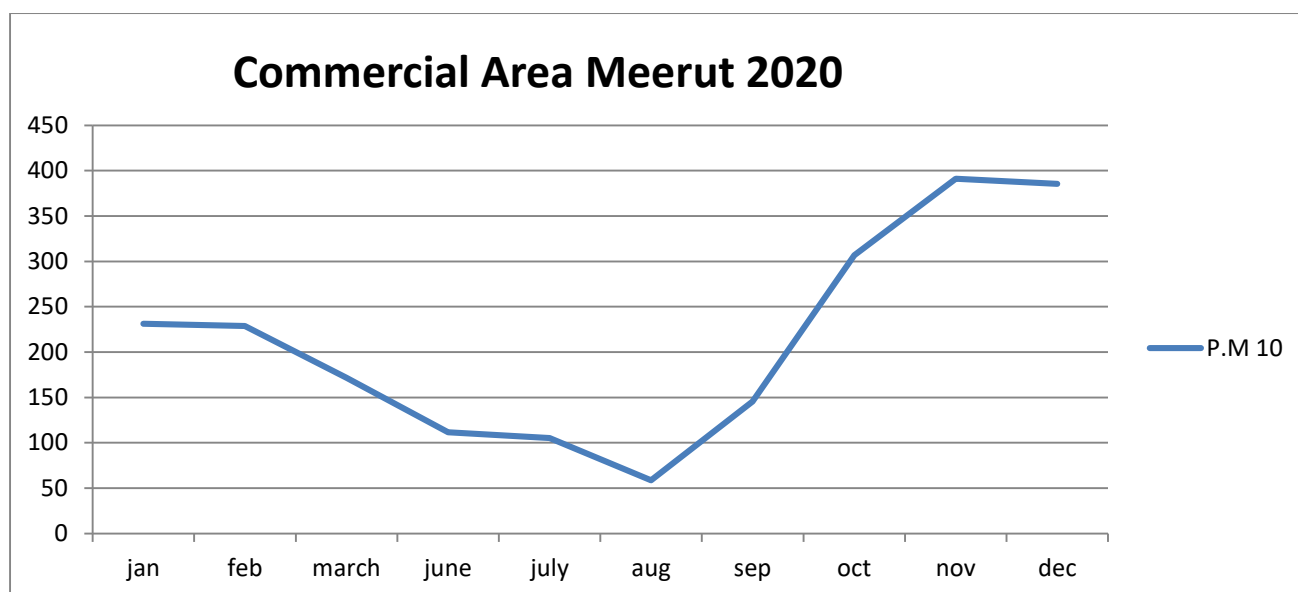


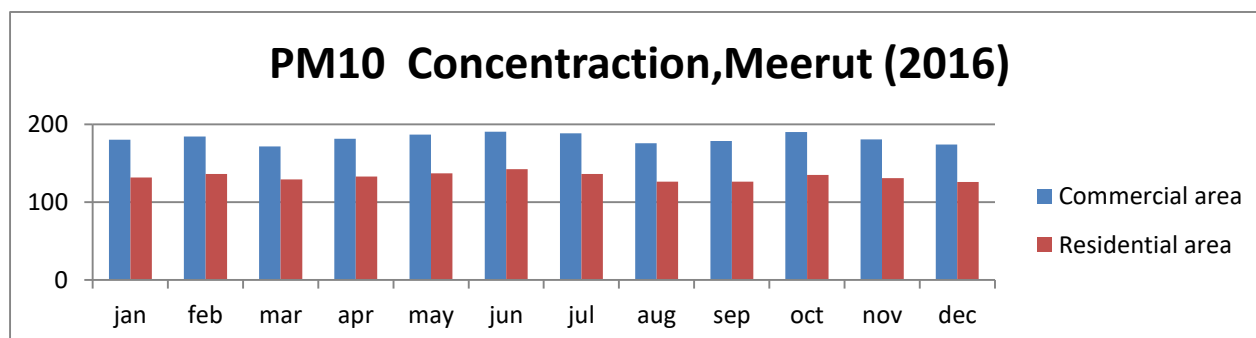
Fig3

COMPARATIVE ANALYSIS OF PM10 LEVELS in COMMERCIAL AND RESIDENTIAL AREA'S(2016-2020)

A significant correlation was also found between seasonal variation of PM 10 levels in Commercial Area and Residential Area during the period 2016-2020.

The Residential area consistently recorded lower PM10 levels than the Commercial area except for August 2020 where both have almost same PM10 values $57.20\mu\text{g}/\text{m}^3$ and $58.58\mu\text{g}/\text{m}^3$ respectively.

As per figure7 a decreasing Gap of PM10 between Commercial area and Residential area could be seen which is an alarming stage, conforming the air pollution has penetrated to our House Streets. Though post Lockdown effects shows widening gap.



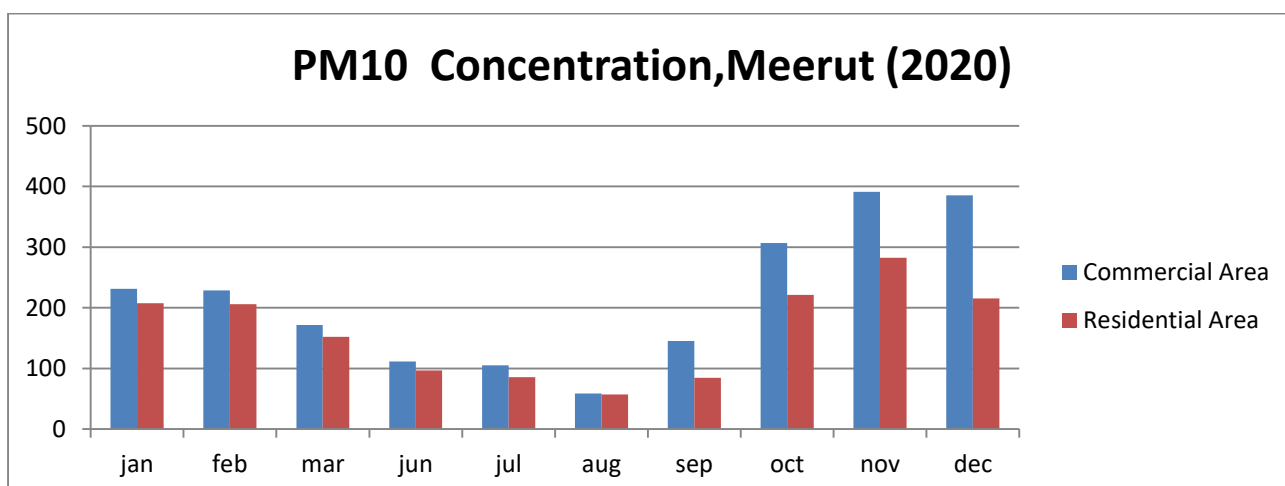
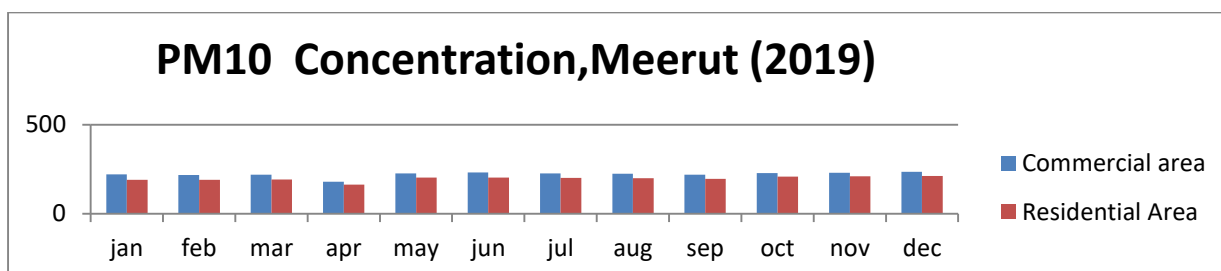
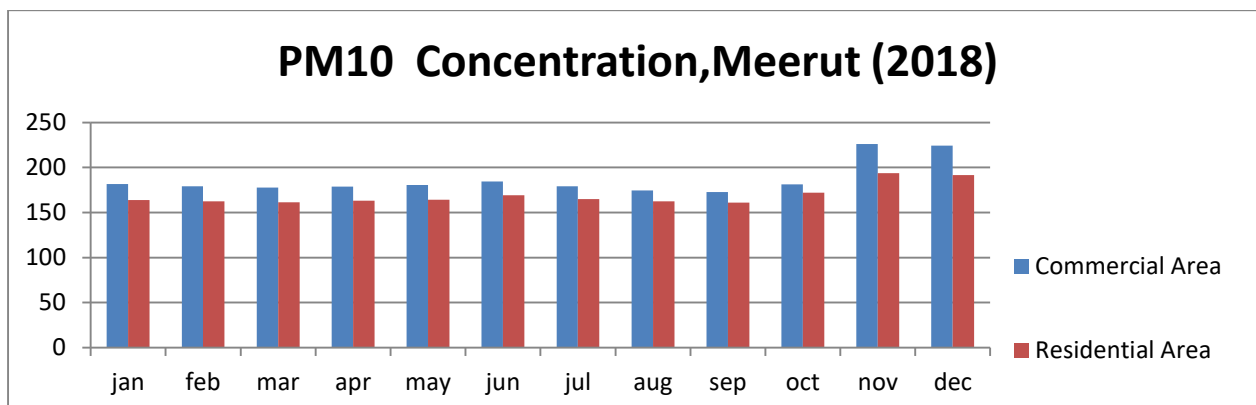
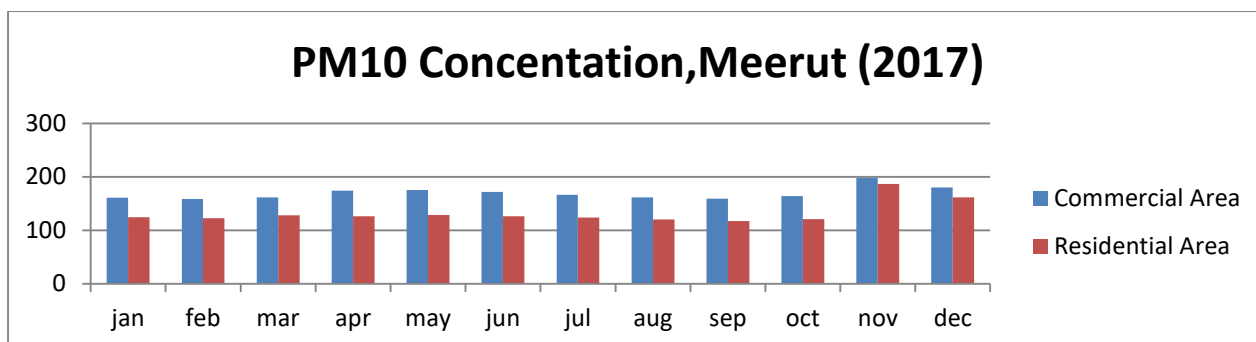


Fig 4 Comparative analysis of PM10 concentration in Commercial and Residential Area of Meerut City (2016-2020)

CONCLUSION

The analysis of Air Pollution in terms of seasonality can explicitly confirm the presence of elevated levels in winter months and during the heating season and low in summer months and during the Summer Season .The exception in this case is the Year 2016 where Summer Season has more PM10 Concentration recorded than Winter Season . Higher levels of Pm10 in winer months may also be associated with increased low emisssons from local home furnances ,as well as more frequent in these periods ,inversion of temperature resulting in SMOG events .The Lockdown having positive impact on the ENVIRONMENT but to curb it, stringent steps need to be taken in implementing **the “MEERUT CITY CLEAN AIR ACTION PLAN” OF POLLUTION CONTROL BOARD,UTTAR PRADESH GOVERNMENT proposed on September 2020.**

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