International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Status of Ambient Air Pollution in Patancheru, Sangareddy District, Telangana

R. Parvathi[1], P. Veeranna[2], D. Nageshwar Rao[3], A. Narsing Rao[4]

Department of Environmental Science, Osmania University, Hyderabad

Abstract

Air pollution has come to known as the most serius problem over the water pollution from the past 2 decades in Hyderabad, and its Surrounding areas resulting in Increase in number of Asthama cases and cardio vascular diseases. Urbanisation of rural areas, Establishment and expansion of different types of industries, Deforestation, mining activities and increased vehicular movement are mainly contributing towards increase in the ambient temperatures and poor air quality in the areas. Patancheru of Sangareddy district located at northwest corner to the Hyderabad is one among them. The area is selected to study the air quality under 3 zones namely the Commercial cum Residential zone, Industrial zone Sensitive zone and is compared with respect to the Background Zone. The study is carried out to assess the status of pollution from the past one decade. The trends in the air quality is observed covering all the three seasons i.e., Rainy, Early winter and winter season, Early summer and Summer seasons. Data for Meteorological parameters like temperature, relative humidity, wind speed and rainfall during the sampling period is taken from Continuous Ambient Air Quality Monitoring Stations (CAAQMS). Monthly and seasonal variation of these pollutants have been observed and recorded from June-2023 to May-2024. The annual average values have been calculated. It is observed that the concentrations of the pollutants are high in winter in comparison to the summer or the monsoon seasons. The study reports that particulate matter and gaseous emissions from industries, road dust from vehicular movement, less ambient temperatures prevailing during winters and low wind speed in comparision to the other zones at industrial area are responsible for the high concentration of pollutants in the area. In the present study, it was noticed that the PM_{10} levels are found to be in the order of Industrial area> residential cum commercial area > Sensitive zone. The particulate matter and gaseous pollutants i.e., NO_2 levels exceeds in the industrial zone with respect to the prescribed limits as stipulated by Central Pollution Control Board (CPCB) New Delhi, India. The Air Quality Index is also calculated and discussed for all the zones.

Keywords: Ambient air, Particulate matter and gaseous pollutants, Metrological Parameters, CPCB guidelines.

Introduction

One of the reason for decrease of life span of Human beings is Environmental pollution along with climatic changes. Regular monitoring of air quality , identification of polluting sources and adoption of preventive measures are required to maintain air quality. Patancheru is a host to more than 400 Bulkdrug industries and has an expansion of the IT Industry from Hyderabad towards West corridor and, fast

growing construction activities towards west and north corridors, widening and laying of roads (urbanization) , cutting roadside trees and vehicular movement has resulted in release of heavy dust particles of various sizes into the ambient air thus causing air pollution throughout all seasons. In the present paper, About 60 samples were collected at 5 sampling sites and Four criterian pollutants were assessed i.e.,Patrticulate matter PM_{10} (RSPM), PM2.5, gaseous pollutants like oxides of nitrogen (NO_x) and sulphur dioxide(SO_2) at 4 different zones i.e., Back ground Zone at, Gachibowli, Industrial zones at Bollaram and Pashmylaram, Commercial cum Residential zone at Ramachandrapuram and Sensitive Zone at Kandi, Sangareddy District. The Respirable suspended particulate matter(RSPM) samples were collected using High volume sampler, model 430 dxn at all the 5 sites. The data for PM2.5, SO2, NOx and Ozone and Meteorological parameters like temperature, relative humidity, wind speed and rainfall during the sampling period is obtained from Continuous Ambient Air Quality Monitoring Stations(CAAQMS). The levels of pollution is quantified for Monthly and seasonal variations during the study period from June-2023 to May-2024. The annual average trend for PM 10 levels from 2016 to 2023 is also studied. It has been observed that the concentrations of the pollutants are high in winter in comparison to the summer or the monsoon seasons. The study reports that particulate matter and gaseous emissions from industries, road dust from vehicular movement, etc. at industrial area are responsible for the high concentration of pollutants in the area. The horizontal dispersion of the particulate matter emitted from the industrial stacks in the industrial area due to low temperatures prevailing during winter season has increased the PM_{10} levels and it was noticed that the PM_{10} levels obtained are in the order of Industrial area> residential cum commercial area> Sensitive zone. The particulate matter and gaseous pollutants i.e., SO_2 and NO_x levels exceeds in the Industrial zone with respect to the prescribed limits as stipulated by Central Pollution Control Board (CPCB) New Delhi, India.. and the SO_2 and NO_x levels in residential, and commercial areas remain under prescribed limits of CPCB. The main objective of this study is to understand the zonal wise dispersion of pollutants with respect to the metrological parameters. It also provides valuable information to the policy makers for environmental management in Industrial, Urban and Semi-urban regions.

Materials & Methods

Study area

This study was conducted in three regions of Patancheru area of 30 Kilometers radius, Sangareddy District. These three regions were Pashmylaram and Bollaram (industrial zones), ICRISAT (residential cum commercial zone), and IIT, Kandi (sensitive zone) and Hyderabad Central University as the Back ground zone as such a total of 5 sampling sites were selected which cover the industrial zone, residential cum commercial zone, and sensitive zone.

Sampling Points in the Up wind direction:
Hyderabad Central University (HCU),
Gachibowli – Control station (Background Zone)

Sampling Points in the Cross wind direction:
Bollaram Industrial Zone.

Sampling Points in the Downwind direction

ICRISAT
Pashamailaram Industrial Area
IIT Kandi (Educational Institute)

Impact zone (includes population in IIT, Kandi, and Sangareddy) – Sensitive Zone

IIT Kandi, (Educational institute) Sangareddy. – Sensitive Zone

In the present study, Five No.s of CAAQMS are covered. The details of the stations and the date of data available are as follows:

S. No	location	Zone of study	Data collected from
1.	Hyderabad Central university, Gachbowli.	Background	2015
2.	ICRISAT, Ramachandrapuram.	Commercial / Residential	2016 (as per the availability of data)
3.	Pashamylaram Fire station.	Industrial	2015
4.	Bollaram, Kennedy School, Bachupally.	Industrial	2016
5.	IIT Hyderabad, Kandi, Sangareddy Dist.	Sensitive	2022, April to May, 2024.

Status of ambient air quality
The Telangana State Pollution Control Board has a wide network of Continuous Ambient Air quality (CAAQMS), Online Stations throughout the Hyderabad and Sangareddy Districts. The Trends of Particulate matter, PM10 is studied from the years, 2016 to 2023 from Annual average data collected from January to December.

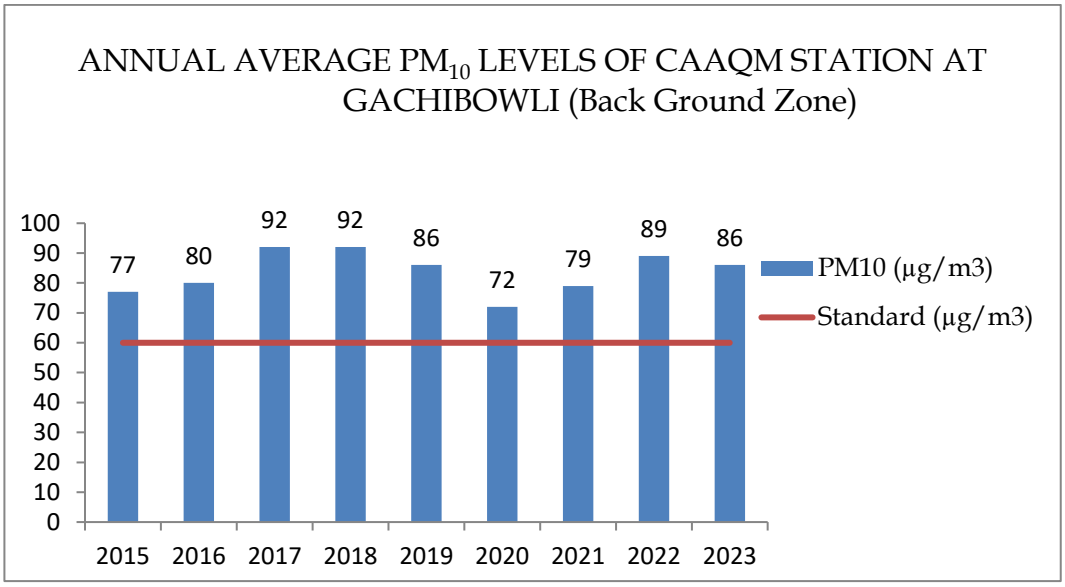

Fig-1. Shows the PM10 levels from 2015 to 2023 , data collected from CAAQM station at Hyderabad Central University , Gachibowli, selected under Back ground Zone. All the PM 10 levels obtained are above the standard value of 60 µg/m^3.

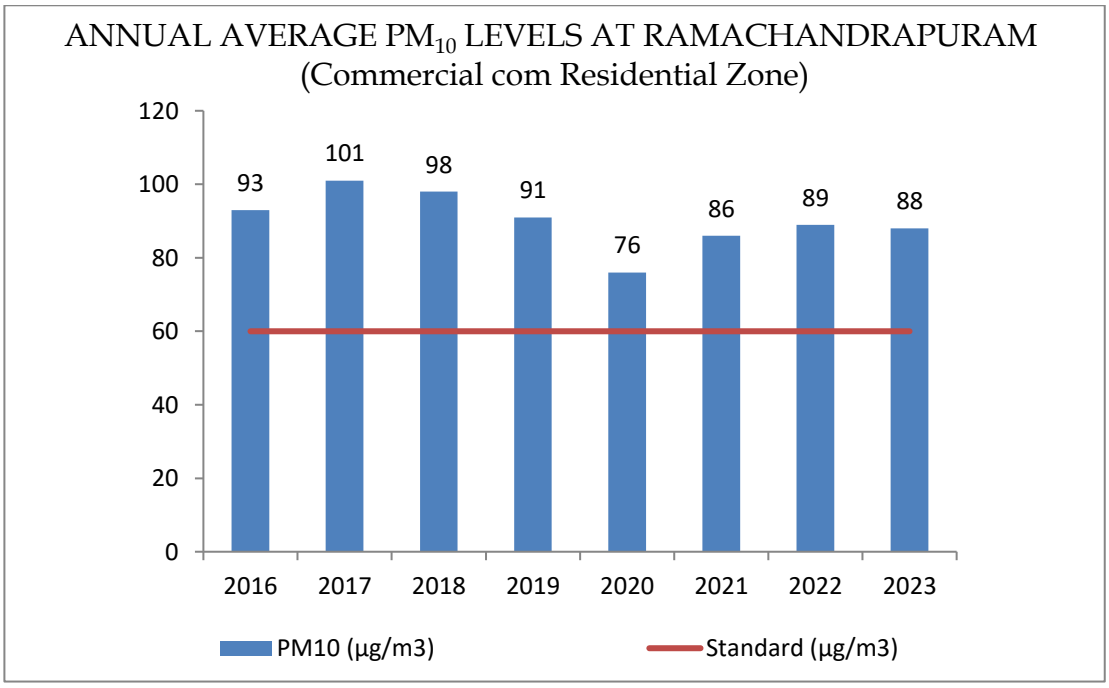

Fig-2. Shows the Pm10 levels from 2016 to 2023 , data collected from CAAQM station at ICRISAT, Ramachandrapuram, selected under Commercial cum Residential Zone. All the PM10 levels obtained are above the standard value of 60 µg/m3.

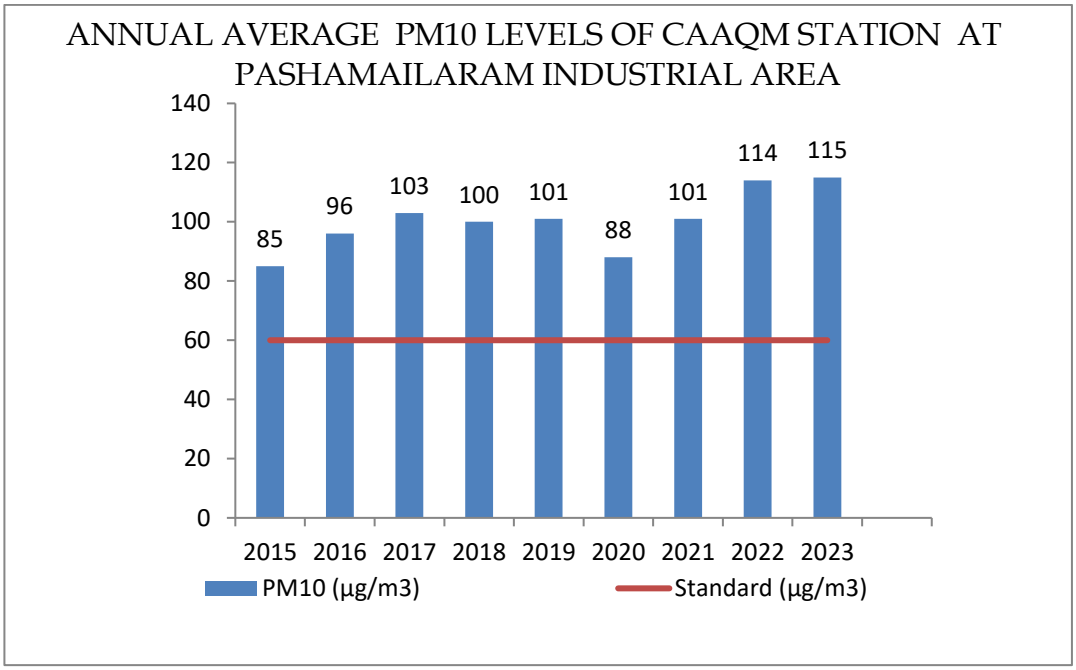

Fig-3. Shows the Pm10 levels from 2015 to 2023 , data collected from CAAQM station at Pashmailaram Industrial area, selected under Industrial Zone. All the PM10 levels obtained are above the standard value of 60 µg/m3.

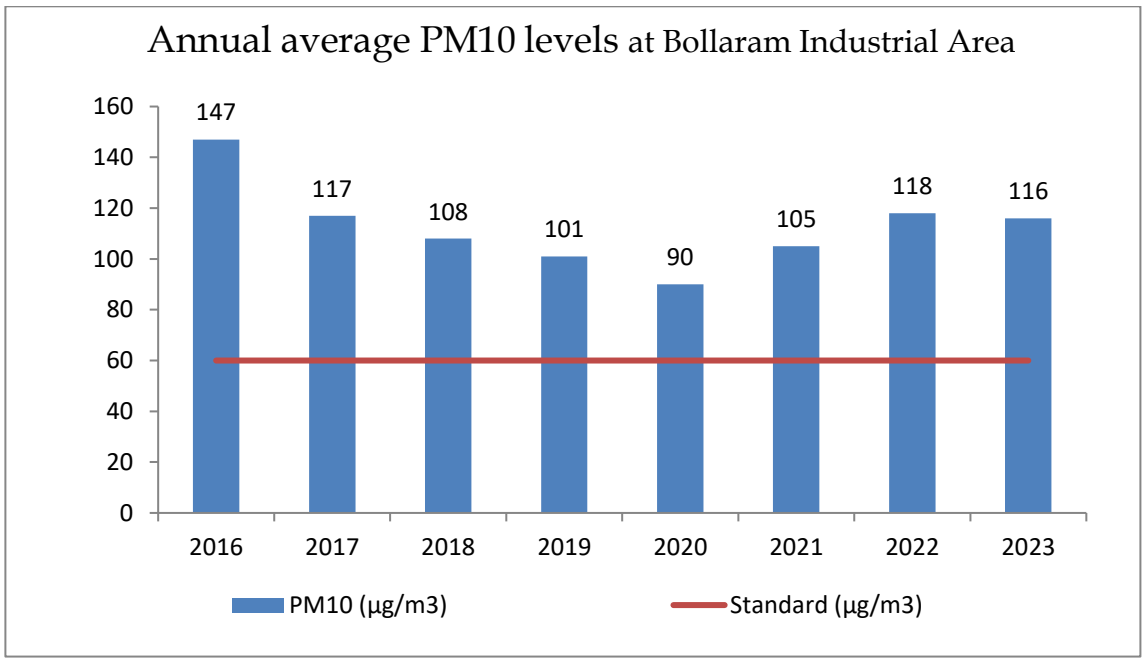

Fig-4. Shows the Pm10 levels from 2015 to 2023 , data collected from CAAQM station at Bollaram Industrial area, , selected under Industrial Zone. All the PM10 levels obtained are above the standard value of 60 µg/m3.

In all the above figures from fig-1 to fig-4, PM10 levels in the year 2020 is found to be low due to COVID period.

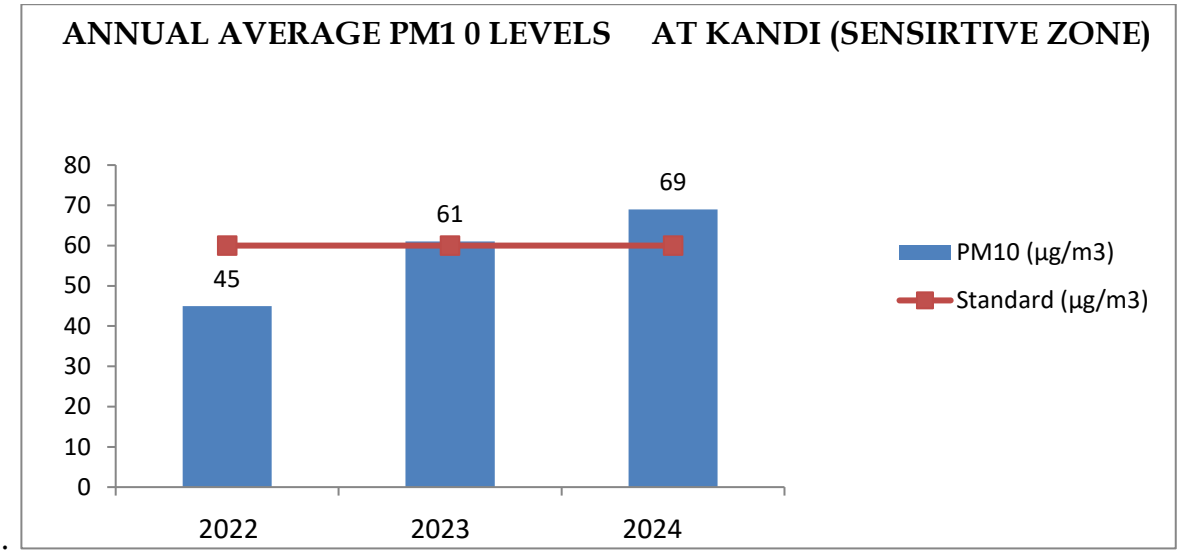

Fig-5. Shows the Pm10 levels from 2022, (April to December), 2023 ,2024(January to May), data collected from CAAQM station at IIT, Hyderabad, Kandi, Sangareddy District.selected under Sensitive Zone. The PM10 levels obtained during 2022 is below the annual standard and during 2023 an 2024 are above thel annua standard value of 60 µg/m3.

Data collection during study period

The most commonly used devices are a) The high volume sampler, which consists essentially of a blower and a filter, and which is usually operated in a standard shelter to collect a 24-h samples. The Respirable dust sampler No. APM – 460 – DXNL, Sl.No.298 R 186 – DTK – 2013 and its series, Make Envirotech instruments, New Delhi is used for collection of particulate matter. B) Weather station coupled to Continuous Ambient Air Monitoring Station, consisting of sensors for determination of Ambient Temperature and relative humidity, Rainfall, Wind speed sensor (3-Cup type), Wind direction Sensor (Vane type), Barometric Pressure sensor, Solar Radiation Sensor, Pyrometer(Thermometer for measurement of Solar Radiation). The data from the weather station is sent to computer automatically. The system also has the option for drawing Windrose diagram . Windrose diagrams for the three seasons i.e., Rainy, Winter and Summer is drawn for Ramachandrapuram area (commercial cum residential area) to study the direction of dispersion of pollutants in the study area. **The RDS instruments were placed at the CAAQMS stations to make convenient to study the Metrological Parameters. The RSPM samples are collected manually.**

PM10 (µg/m^3) Values at study area during the period JUNE-2023 to May_2024						
Month	**Gachibowli_ HCU (back Ground Zone)**	**Ramachadrapuram (commercial residential)**	**Pashamylaaram (Industrial Zone)**	**Bollaram (Industrial Zone)**	**IIT_Kandi (Sensitive Zone)**	**Std for 24 hrs (µg/m3**
Jun-23	72	84	92	98	66	100
Jul-23	67	72	80	90	58	100
Aug-23	70	74	84	86	64	100
Sep-23	66	81	86	84	60	100
Oct-23	82	90	96	110	68	100
Nov-2023	86	92	102	178	72	100
Dec-2023	89	110	126	190	102	100
Jan-2024	85	108	117	164	95	100
Feb -2024	80	97	120	150	78	100
Mar-2024	78	90	102	135	72	100
Apr-2024	75	96	94	140	67	100
May-2024	69	86	86	154	65	100

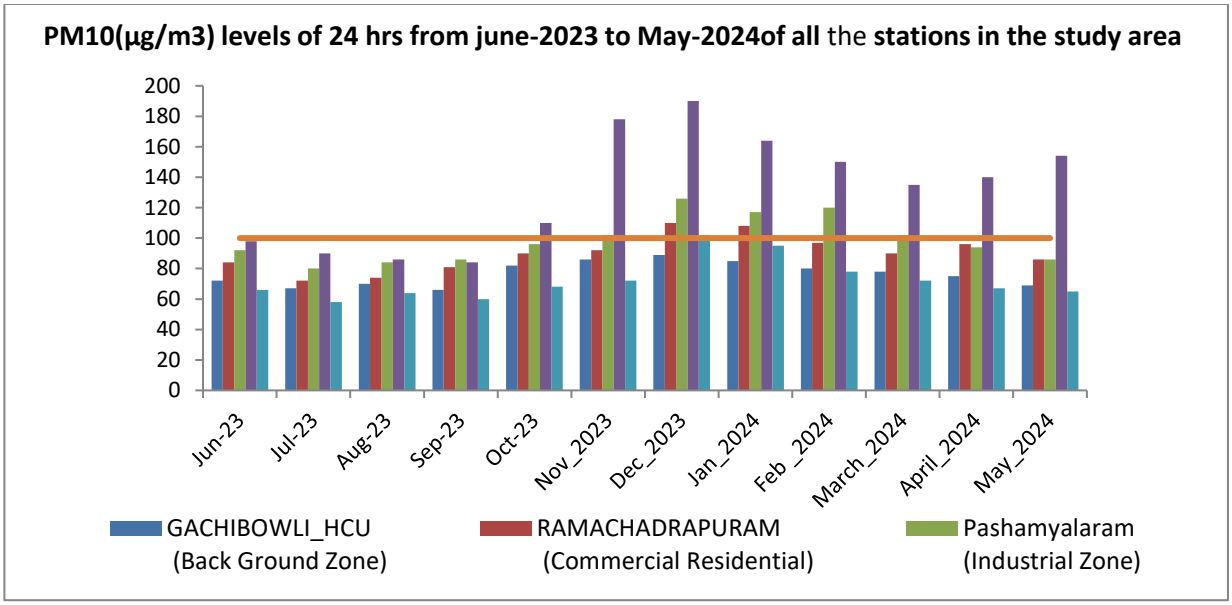

Fig-6. Shows the PM10 levels from June,2023 to May, 2024, and the data is collected manually at Gachibowli, (Background Zone), Ramachandra Puram, (Commercial cum Residential Zone), Pashmailaram,(Industrial Zone), Bollaram Industrial area, , selected under Industrial Zone and station at IIT,Hyderabad, Kandi, Sangareddy District. selected under Sensitive Zone.

All the PM10 levels obtained are above the standard value of 60 µg/m^3. The PM 2.5 levels over the dates collected manually in the study area is found to be less than 24hrs standard of 40 µg/m^3. Hence the

monthly average data from CAAQM stations is taken for data analysis and to understand the Air Quality during the study period from June-2023 to May 2024 .

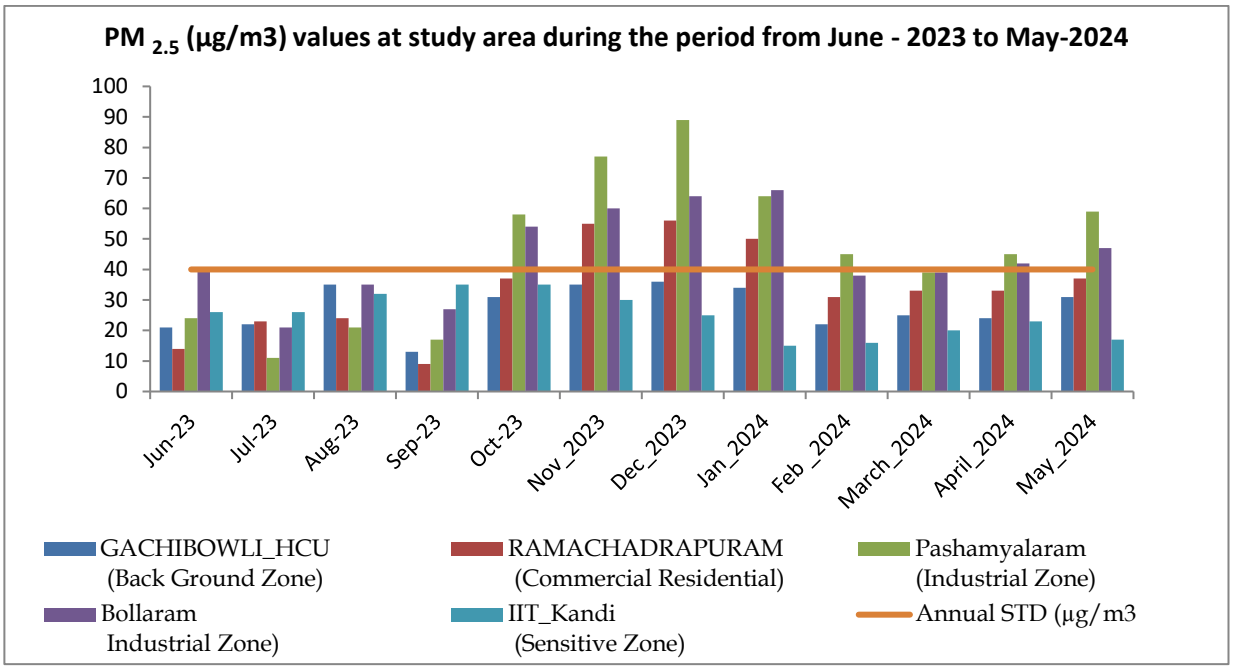

Fig-7. Shows the monthly average PM 2.5 levels from June,2023 to May, 2024, and the data is collected from CAAQM stations at Gachibowli, (Background Zone), Ramachandrapuram, Pashmailaram, Bollaram Industrial area, selected under Industrial Zone and station at IIT, Hyderabad, Kandi, Sangareddy District .selected under Sensitive Zone.

From the above figure it is observed that the PM2.5 levels at Bollaram and Pashmailaram Industrial Zones is observed to be greater than the annual average standard of 40 µg/m^3 mostly during the Winter season from October-2023 to January -2024 may be due to the less dispersion of the pollutants due to prevailing low Ambient temperatures and less intensity of wind speed. Also small increase during the month of May -2024 may be attributed to sudden increase in the intensity of wind speed prior to the onset of Rainy season.

The PM 2.5 levels at Ramachandrapuram, selected under commercial cum Residential Zone is observed to be greater than the annual average standard of 40 µg/m3 mostly during the Winter season from November-2023 to January -2024 may be due to the negligible dispersion of the pollutants due to prevailing low Ambient temperatures and less intensity of wind speed from NORTH WEST TO SOUTH EAST.

The trends of all pollutants are studied seasonally and the concentrations of the pollutants are compared with National Ambient air Quality Standards (2009) as per the guidelines of CPCB.

NAAQS Monitoring & Analysis as per the CPCB Guidelines Volume-I

NATIONAL AMBIENT AIR QUALITY STANDARDS (2009)				
Pollutants	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO_2) µg/m^3	Annual 24 Hours	50 80	20 80	Improved West and Geake Ultraviolet flourescence
Nitrogen Dioxide (NO_2) µg/m^3	Annual 24 Hours	40 80	30 80	Modified Jacob & Hochheiser (N2-Arsenite) Chemiluminescense
Particulate Matter (Less than 10 µm) or PM_{10} µg/m^3	Annual 24 Hours	60 100	60 100	Gravimetric TOEM Beta attenuation
Particulate Matter(Size Less than 2.5µm) or , $PM_{2.5}$µg/m^3	Annual 24 hours	40 60	40 60	Gravimetric TOEM Beta attenuation
Carbon Monoxide (CO) µg/m^3	8 Hours 1 Hour	02 04	02 04	Non Dispersive Infra Red (NDIR) spectroscopy.
Ozone (O_3) µg/m^3	8 Hours 1 Hour	100 180	100 180	UV photometric Chemiluminescence Chemical method.

Results and Discussions:

In the present study, of Ambient air quality, the monthly averages of metrological parameters and gaseous pollutants are collected from June 2023 to May 2024 from the CAAQM stations in the study area . It is observed that the 4 different zones i,e., Background Zone, Commercial cum Residential Zone, Industrial zone and Sensitive zone have shown variations in the metrological parameters as well as gaseous pollutants concentration under study in three different seasons.

Observations: 1. Ambient Temperature:

During Rainy season: During the months of July, August, September, and October, 2023 (considered under early winter), the ambient temperatures are found between 25.6 and 26.4 in the Background zone, Between 26.3 and 26.9 in the Commercial cum Residential Zone, Between 23.8 and 26.3 in Pashmailaram Industrial Zone,, Between 28.8 and 30.4 in the Bollaram Industrial area and Between 25.0 an 26.3 in Sensitive zone.

During winter Season : During the months of November & December, 2023 and January,2024 & February (considered under early summer), of 2024, the ambient temperatures are found between 23.5 and 24.4 and 26.1 in February in the Background zone, Between 24.1 and 25.2 and 26.8 in February in the Commercial cum Residential Zone, Between 24.2 and 25.1 and 26.8 in February in Pashmailaram Industrial Zone,, Between 23,5 and 25.2 and 26.1 in February in Bollaram Industrial area and Between 21.4 and 25.5 and 25.9 in February in the Sensitive zone.

Ambient temperature during Sunmmer season: During the months of March, April and May of 2024, the ambient temperatures were found to be between 28.1 and 32.2 in the Background zone, Between 28.7 and 32.2 in the Commercial cum Residential Zone, Between 28.7 and 30.9 in Pashmailaram Industrial Zone, Between 29.0 and 33.7 in the Bollaram Industrial area and Between 29.0 an 31.9 in sensitive zone.

2.Wind speed and Wind Direction:

During Rainy season: During the months of July, August, September the Wind speed is found between 1.3m/s and 1.8m/s, from East to West direction and in October(considered under early winter), the wind speed is found to be 0.9 and Wind direction is observed from North West to Sourth East. in the Background zone, In the Commercial cum Residential Zone, Wind speed is found decreased from 0.8m/s to 0.5m/s and Wind direction if found from North West to Sourth East. Iin Pashmailaram Industrial Zone the Wind speed is found between 0.9m/s and 1.6m/s, from Southt to North direction and in October(considered under early winter), the wind speed is found to be 0.9 and Wind direction is observed from North West to Sourth East. In the Bollaram Industrial area, Wind speed is found with less intensity between 0.3m/s and 0.5m/s, and wind direction from South to North direction, the same is observed in October(considered under early winter) also. In sensitive zone at Kandi, Sangareddy district, the wind speed is found between 0.9m/s and 1.6m/s and Wind direction is observed from South West to North East.

During Winter season: During the months of November & December, 2023 and January & February(considered under early summer), of 2024, Wind speed is found between 0.8 m/s and 1.3 m/s and wind blows from North West to South East. in the Background zone, In the Commercial cum Residential Zone, Wind speed is found from 0.5 m/s to 0.6 m/s and Wind direction if found from North West to Sourth East. in Pashmailaram Industrial Zone the Wind speed is found between 0.7 m/s and 0.9 m/s and the wind direction is from South west to North East. In the Bollaram Industrial area, Wind speed is found with less intensity between 1.0 m/s and 1.1 m/s, and wind direction from South to North direction, the same is observed in October (considered under early winter) also. In sensitive zone at Kandi, Sangareddy district, the wind speed is found between 0.4m/s and 0.7m/s and Wind direction is observd from South East to North West.

During Summer season: During the months of March, April and May of 2024, Wind speed is found between 1.0m/s and 1.1m/s,and wind blows from North West to South East. in the Background zone, In the Commercial cum Residential Zone, Wind speed is found from 0.4m/s and 0.5m/s and Wind direction is found from North West to South East. In Pashmailaram Industrial Zone the Wind speed is found above 1,0m/s and the wind direction is from South west to North East. In the Bollaram Industrial area, Wind speed is found with less intensity constantly at 0.4 m/s , and wind direction from North West to South East.. In sensitive zone at Kandi, Sangareddy district, the wind speed is found between 0.7 m/s and 0.9 m/s and Wind direction is observd from South East to North West.

3. Gaseous pollutants:

Sulphur Dioxide (SO_2):

Sulphur Dioxide Concentration is found within the CPCB standards of Annual average of 50 µg/m^3 during the study period from June 2023 to May 2024. in Industrial area and Commercial cum Residential area. The values ranged between 4.7 µg/m^3 to 32.5 µg/m^3 (during the month of May) in Pashmailaram Industrial area, between 5.0 µg/m3 and 38 µg/m^3 in the Bollaram Industrial area with 7.2 µg/m^3 during the month of September and between 6.0 µg/m^3 and 24µg/m^3 in the Commercial cum Residential area. The Ecologically sensitive areas have shown below the Annual average of 20 µg/m^3 as per the CPCB standard and ranged between 4.2 µg/m^3 to 9.0 µg/m^3 in the Background zone and between 3.0 µg/m^3 and 10.3 µg/m^3 in sensitive zone at Kandi, Sangareddy district, .

Nitrogen oxides NO_x

The Annual average for NO_2 as per the CPCB standard is 40 µg/m^3. The data for NO_2 (Nitrogen di oxide) in Industrial area ranges from 2.6 µg/m^3 to 17,6 µg/m^3 during Rainy season and shows 80.1 µg/m3 during the Early winters and between 64.2 µg/m^3 and 97.7 µg/m^3 in Winter season and between 49 µg/m^3 and 72.4 µg/m^3 during Summer season from February to May at Pashmailaram IDA. In Bollaram industrial area the concentration ranged between 25 µg/m^3 and 38 µg/m^3 during the study period. The Commercial cum Residential area has shown between 10 µg/m^3 and 19 µg/m^3. The Ecologically sensitive areas have shown below the Annual average of 30 µg/m^3 as per the CPCB standard and ranged between 38.6 µg/m3 and 39 during Rainy season Early winter in October showing 40µg/m^3 and between 26.9 µg/m^3 and 33.1 µg/m^3 during winter season and ranging between 23.7 µg/m^3 and 23.7µg/m3 in Summer season with an exception of 35.4 (in the month of May) in the Background zone with and between 0.7 µg/m^3 and 13.8 µg/m^3 in sensitive zone at Kandi, Sangareddy district, .

Carbon Monoxide (CO):

The prescribed limit for CO is 4 mg/m^3. The CO levels are found between 0.6 mg/m^3 to 1.15 mg/m^3 in Pasmailaram IDA, Between 0.4 mg/m^3 and 0.7 mg/m^3 in Bollaram IDA, Between 0.2 mg/m^3 and 1.3 mg/m^3 in Commercial cum Residential area, Between 0.3 mg/m^3 and 1.0 in Background zone at Gachibowli and between 0.3 mg/m^3 and 0.7 mg/m^3 m Sensitive zone at Kandi, Sangareddy district

Ozone (O_3)

The prescribed limit for Ozone(O3) is **100** µg/m^3 for 8 hrs and 180 µg/m^3 for 1hr. The Ozone values ranged between 3.3 µg/m^3 and 5.8 µg/m^3 in Pasmailaram IDA, Between 12µg/m3 and 38µg/m3 in Bollaram IDA, Between 8.8 µg/m^3 and 65.4 µg/m^3 in Commercial cum Residential area, Between 3.3 µg/m^3 and 28.9µg/m^3 in Background zone at Gachibowli and between 15.0 µg/m^3 and 39.0 µg/m^3 m Sensitive zone at Kandi, Sangareddy district

Air Quality Index (AQI):

The AQI is categorized into Good, Satisfactory, Moderately polluted, Poor, very Poor and severe. Each category is decided based on the calculation of Sub-Index for different ambient air pollutants levels and their likely health impacts(known as health break points). The AQI is evaluated with a minimum of three pollutants and one of them should be PM 10 or PM 2.5. The pollutants being PM10. PM2.5. SO_2 NO_2 CO, O_3 & NH_3. The AQI is studied for different zones during the period from June 2023 to May 2024 covering all the 3 seasons. It is observed that the AQI at Background zone at GachiBowli is found to be satisfactory during all the three seasons. The AQI at commercial cum Residential area at Ramachandrapuram is found to be satisfactory during Rainy and Summer seasons and moderately polluted during winter season, the AQI being 102 which is nearer to the threshold value of 100 for moderately polluted AQI due to the high level of Particulate matter (PM 10). The AQI at Pashmailaram Industrial area is found to be satisfactory during Rainy and Summer seasons and moderately polluted during winter season due to the high level of Particulate matter (PM10). The AQI at Bollaram Industrial area is found to be satisfactory during Rainy and moderately polluted during winter season as well as Summer Season due to the high levels of Particulate matter (PM10). The AQI in Sensitive zone at Kandi, Sangareddy District is found to be satisfactory during all the three seasons .

Conclusions

Ambient temperatures during the study period are observed in the order of Summer>Rainy> winter season in all the zones indicating that the less dispersion and high concentration of Pollutants in the winter season. The wind speed is observed in the order of Bollaram industrial area<Commercial cum Residential area<Background Zone causes the spread of horizontal wind and less dispersion and high concentrations of pollutants in Industrial area , is due to the Industrial emissions as well as vehicular emissions and in Commercial cum residential area as well as Background zone, may be due to vehicular emissions.Air quality Index(AQI) at Bollaram is found to be moderately polluted during both the Winter and Summer season where as Pashmailaram IDA and Commercial cum Residential area at Ramachandrapuram have shown Moderately polluated in the winter seasons due the prevailing low wind speed and less dispersion of Particulate matter thus alarming for health issues. The Air Quality index at Background zone and Sensitive zone is found to be satisfactory. The variations in AQI in other stations along the wind direction is due to the emissions from Indstrial activity, vehicular activity and other domestic pollution generating activities. NO2 at Pashmailaram Industrial area is observed to be greater than the prescribed limit of annual average of 40µg/m3 during Winter and Summer seasons, is due to the high vehicular movement and low wind speed carrying the pollutants with higher concentrations whereas

in summer, high temperatures will increase the concentration of the pollutant.

References

1. Status of Air Pollution in Hyderabad city, Telangana State by N.Raveendhar, TSPCB Scientist and K.Venkateswar Rao, JCEE, APPCB.
2. Application of Wind Rose model in Environmental Impact Assessment of Air Quality in Amravati, Sangita Ingole, Manisha Jane, Dept. of Environmental Science, Shri Shivaji Science College, Amravati, India.
3. Investigating the impacts of some meterological parameters on Air Pollution in Balikesar,Turkey, Nadir Ilten, A.Tulay Selici.