International Journal of Research Publication and Reviews

Assessment of Air Quality Index for Greater Bengaluru Area

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A B S T R A C T

Air contamination has become one of the riskiest worldwide worries, killing an expected 7 million individuals overall consistently. Bengaluru, the city of India's innovative industry has been growing financially increasing the extravagances of carrying on with way of life. Because of the quick advancement of this metropolitan city, it has been confronting crumbling natural circumstances. The sole goal of this paper is to basically examine the air contamination pattern from 2020-2022 at different modern, private, delicate, and moderate areas in Bengaluru on different elements that add to air contamination.

Keywords: AirPollution,Bengaluru, Transport

1. INTRODUCTION

Assortment of specific contaminations in the air which counter influences the soundness of a prosperity human, creature and vegetation is known as air contamination. As per the World Health Organization (WHO); 1.4 million passings from strokes consistently, 2.4 million passings from heart infections consistently, 1.8 million passings because of lung sickness and disease consistently and 7 million unexpected losses consistently are owing to air contamination. Air is all over as is its impact contaminated air can unfavourably influence the human wellbeing, structures, landmarks, plants, environments, and the rundown is interminable. Contaminated air has been connected to environment as particulate matter ingests or mirrors daylight and influence cloud development and precipitation example of a spot.

Contaminations such sulphur dioxide, nitrogen dioxide and carbon monoxide are delivered into the air through different ignition processes; consuming of petroleum derivatives, for example, coal, oil, flammable gas, and gas are the primary wellsprings of these poisons. Particulate matter poisons are a combination of strong particles and fluid drops that are added high up by dust debris, fly debris, sediment, smoke, spray, and consolidating fumes suspended in the environment for longer timeframes.

Bengaluru is much of the time appeared through the difficult fights that are battled by the residents to save the city. The IT capital of the nation has a consistently developing populace, presently assessed to be over 1.2 crore. The ascend in the populace is straightforwardly connected with the ascent in the quantity of vehicles, around 1750 new vehicles are getting enlisted in the city consistently and the vehicle populace in Bengaluru has crossed 80.45 lakhs. This meaningfully affects the city's encompassing air quality and wellbeing. This paper is an endeavour to break down the basic contaminations, for example, SO2, NO2 and RSPM, together comprising the Air Quality Index, utilizing this data this paper likewise attempts to investigate the overall wellbeing impacts these poisons cause on both long and transient openness. Due to the financial and natural difficulties related with quick urbanization, it is associated with expanding levels of surrounding grouping of air contamination. Fundamental giver of air contaminations in Bengaluru is the vehicle area.

In the year 2018, there has been a report that the quantity of vehicles in Bangalore has crossed 80 lakhs, by this number we can gauge how much exceptional discharge high up that will dirty the air up by and large. Expansion in number of non-transport vehicles (generally bikes) is caused because of the fast extension of city without improvement of legitimate framework. These vehicles not just goal outflow of RSPM, SO2 and NO2 yet additionally HC and CO which has prompted expansion in their focus in air. Diesel utilization in vehicles emanates SO2 and particulate matter of all size. Particulate matter of size under 2.5 and 1 μm is supposed to have expanded because of expansion in utilization of diesel. High convergence of RSPM level because of development action can be overseen assuming legitimate consideration is taken during development.

On a worldwide point of view, the impact particulate matter has demonstrated that ladies are at a more serious gamble and furthermore in some cases lethal because of conspicuous impact of particulate matter. Ladies showed a relative gamble for deadly CHD of 1.42, 1.38, and 1.22 with each increment of 10 micrograms for every cubic meter (μg/m3) of airborne PM2.5, PM10 - 2.5, and PM10, separately, in the air contamination they experienced during

the four years going before death. Postmenopausal ladies showed higher relative dangers of 1.49, 1.61, and 1.30 for every 10 μg/m3 expansion in PM2.5, PM10-2.5, and PM10, separately. Neither O3, SO2, nor NO2 was related with deadly CHD all alone. O3 and less significantly SO2 (however not NO2) expanded the impact of all sizes of PM.

Populace increment causes a critical positive effect on encompassing air contamination. Interest for land, food, transport, energy, regular assets, and natural frameworks increments with the populace rise and biological equilibrium is upset which thusly increments human and financial exercises prompting expansion in surrounding air contamination. Spine of financial improvement is energy utilization. Anyway, natural contamination and its corruption are brought about by unreasonable creation and utilization designs. Decrease in future and expanding mortality is fundamentally brought about by expanded encompassing air contamination. Notwithstanding, supported monetary turn of events, alongside energy effectiveness are possible choices for diminishing surrounding air contamination while working on personal satisfaction and ecological manageability. By assessing all the investigation done by different scientists, RSPM contributes the most to the air contamination all through the world. In the new past the wide range of various vaporous parts is by all accounts taken care of except for the degrees of RSPM.

MATERIALS AND METHODS

FIELD SAMPLING

Under National Ambient Air Quality Monitoring Program (N.A.M.P), Karnataka State Pollution Control Board is checking Ambient Air Quality at 7 (Graphite India Limited, KHB Indl Area, Peenya Industrial region, VictoriaHospital, Amco batteries, Yeshwanthpur Police Station, and International Machine devices embellishments at Peenya) areas utilizing ' Respirable Dust Sampler' (RDS) in Bangalore City by Conventional strategy. Four air poisons viz., Sulphur Dioxide (SO2), Oxides of Nitrogen as NO2 and Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM10), have been distinguished for customary checking at every one of the areas. The checking of contaminations is done for 24 hours (4-hourly testing for vaporous poisons and 8-hourly examining for particulate matter) with a recurrence of two times per week, to have 104 perceptions in a year.

DATA QUALITY

A larger part of the air contamination checking stations the nation over is worked physically and it is indistinct the way in which the 8-h tests are utilized for administrative motivations behind surveying whether areas are meeting the 24-h NAAQS, since an 8-h test just catches a depiction of the genuine levels. Further, almost certainly, particular contamination episodes are either not represented, or affect the estimations coming about in under-or over-revealing of PM10 fixations. Manual checking likewise brings about a postpone in information assortment, transmission, and accessibility, albeit the rising number of CAAQMS are permitting information to be gushed to the CPCB site in close to ongoing conquering a portion of the previously mentioned concerns.

CALCULATION OF AQI

On the Field Data Log, fill in the top portion of the form including: thedate/timeofvisit,thesiteidentification,sampleridentification,site name, filter ID number, sample start and stop dates and times, andfield operator initials.

10^3=unit conversion factor for milligrams (mg) to micrograms(μg)

The index of specific pollutant is derived mainly from the physical measurement of pollutants like SPM, RSPM, SO2 and NOx. There are several methods and equations used for determining the AQI. In the present study AQI for each location in the study area has been estimated with the help of a mathematical equation given below.

$$AQI = \frac{1}{3}\left[\left\{SO_2/SSO_2\right\} + \left\{NOX/SNOX\right\} + \left\{RSPM/SRSPM\right\}\right] \times 100$$

Were,

SO$_2$=IndividualValuesofsulphur dioxide

NOX=Individualvaluesofoxidesofnitrogen

RSPM= Individual values of Respirable suspended particulate matter and

SSO$_2$, SNO$_2$ and SRSPM=Standards of ambient air quality of sulphur dioxide, oxides of nitrogen, Respirable suspended particulate matter.

Statistical Analysis

ThestatisticalanalysiswasperformedusingMicrosoftExcel2020to obtain graphs with respect to the trends that are being observed in the obtaineddatafromKSPCB.

Under the National Ambient Air Quality Programme (NAMP), the Karnataka State Pollution Control Board (KSPCB) has installed pollution recording apparatus at various locations throughout the city. In this paper, the following locations are used for the analysis:

- SILK BOARD (Traffic Belt)

- JAYANAGAR 5TH BLOCK (RESIDENTIAL AREA)

- PEENYA (INDUSTRIAL AREA)

- CITY RAILWAY STATION (CITY CENTRE)

Also, the Central Pollution Control Board (CPCB) developed a formula known as the Exceedance Factor (EF) so that it is easy for everyone to understand the pollution level.

EF= Observed Annual Mean of Criteria Pollutants/Annual Standard for Respective Pollutant Therefore, Air Quality can be classified into the following:

- CriticalPollution (C):EF>1.5
- HighPollution(H):EFbelongsto (1.0-1.5)
- ModeratePollution(M):EFbelongsto (0.5-1.0)
- LowPollution(L):EF< (0.5-1.0)

Sl. No	Name of the Station	SO₂ µg/m³	NO₂ µg/m³	PM₁₀ µg/m³	PM₂.₅ µg/m³	NH₃ µg/m³	Pb µg/m³	O3 µg/m³	CO mg/m³	AQI	Category
1	Export promotional Park, ITPL, Whitefield Industrial Area	2.0	24.9	82.7	28.7	24.6	*	*	*	83	Satisfactory
2	Rail Wheel Factory, Yelahanka	2.0	23.6	81.4	30.6	23.5	*	*	*	81	Satisfactory
3	Yeshwanthpura Police Station	2.0	25.5	75.0	31.6	24.4	*	*	*	75	Satisfactory
4	Central Silk Board, Hosur Road	2.0	26.0	90.1	33.2	23.6	*	*	*	90	Satisfactory
5	Rajeev Gandhi Institute of Chest Diseases, NIMHANS (CAAQMS)	7.6	15.5	60.0	25.0	13.7	*	47.3	6.0	60	Satisfactory
6	Central Silk Board (CAAQMS)	4.1	34.3	80.1	31.2	14.1	*	31.6	9.6	80	Satisfactory
7	Urban Ecopark Peenya	2.0	25.0	96.3	36.6	23.5	*	*	*	96	Satisfactory
8	Swan Silk Pvt. Ltd , Peenya	2.0	25.8	86.4	39.2	24.8	*	*	*	86	Satisfactory
9	AMCO Batteries, Mysore Road	2.0	25.6	84.0	32.2	23.7	*	*	*	84	Satisfactory
10	Banaswadi police station	2.0	20.7	93.3	*	19.3	*	*	*	93	Satisfactory
11	Kavika, Mysore Road(CAAQMS)	5.4	35.5	71.2	33.6	16.0	*	40.1	4.5	71	Satisfactory
12	Kajisonnenahalli	2.0	22.9	78.7	27.5	22.4	*	*	*	79	Satisfactory
13	TERI Office, Domlur	2.0	25.4	96.5	28.3	24.2	*	*	*	97	Satisfactory
14	UVCE, K.R Circle	2.0	22.5	82.5	19.5	22.4	*	*	*	83	Satisfactory
15	Victoria Hospital Bangalore	2.0	23.5	59.5	25.4	22.8	*	*	*	60	Satisfactory
16	Indira Gandhi Child Health Care Centre	2.0	23.5	56.5	23.0	22.5	*	*	*	57	Satisfactory
17	Veternary College, Hebbal (CAAQMS)	6.9	20.0	62.3	27.8	9.9	*	33.5	5.5	62	Satisfactory
18	Jayanagara 5th Block (CAAQMS)	3.4	32.0	72.1	28.8	11.6	*	36.8	4.3	72	Satisfactory

AQI FOR THE YEAR 2020

Sl. No	Name of the Station	SO₂ µg/m³	NO₂ µg/m³	PM 10 µg/m³	PM 2.5 µg/m³	NH₃ µg/m³	Pb µg/m³	O3 µg/m³	CO mg/m³
1	Export promotional Park, ITPL, Whitefield Industrial Area	2.0	21.0	73.0	33.0	17.0	*	*	*
2	Rail Wheel Factory, Yelahanka	2.0	22.0	113.0	38.0	17.0	*	*	*
3	Yeshwanthpura Police Station	2.0	20.0	59.0	30.0	17.0	*	*	*
4	Central Silk Board, Hosur Road	2.0	22.0	69.0	52.0	19.0	*	*	*
5	Rajeev Gandhi Institute of Chest Diseases, NIMHANS (CAAQMS)	10.3	15.5	53.2	24.8	7.9	*	36.2	0.6
6	Central Silk Board (CAAQMS)	3.5	23.2	63.0	26.9	10.5	*	31.9	0.6
7	Urban Ecopark, Peenya	2.0	21.0	79.0	30.0	18.0	*	*	*
8	Ace Designers Ltd., Peenya	2.0	22.0	62.0	26.0	19.0	*	*	*
9	AMCO Batteries, Mysore Road	2.0	23.0	68.0	35.0	19.0	*	*	*
10	Banaswadi police station	*	*	*	*	*	*	*	*
11	KAVIKA, Mysore Road(CAAQMS)	9.5	28.5	67.6	34.5	11.1	*	27.8	0.6
12	Kajisonnenahalli	3.0	21.0	68.0	33.0	18.0	*	*	*
13	TERI Office, Domlur	2.0	21.0	69.0	32.0	19.0	*	*	*
14	Govt. SKSJ Technology Institute	2.0	17.0	116.0	*	19.0	*	*	*
15	Victoria Hospital, Bangalore	2.0	24.0	56.0	27.0	14.0	*	*	*
16	Indira Gandhi Child Health Care Centre	*	*	*	*	*	*	*	*
17	Veternary College, Hebbal (CAAQMS)	8.4	20.5	63.3	27.8	6.2	*	23.6	0.5
18	Jayanagara 5th Block (CAAQMS)	4.3	18.1	64.3	33.9	9.6	*	33.7	0.5
19	S.G.Halli, Nisarga Bhavan (CAAQMS)	4.5	22.3	39.9	*	*	*	*	0.6
20	City Railway Station (CAAQMS)	7.9	39.8	95.8	*	*	*	*	1.2
	Standards	50.0	40.0	60.0	40.0	100.0	0.500	100.0	2.0
	Note: * Monitoring not carried out								

AQI FOR THE YEAR 2021

SO2

Sulphur dioxide (SO2) is a noxious gas that is dismal and has an impactful smell. It is created when non-renewable energy sources like coal, oil, diesel, and different oils are scorched. Sulphur dioxide is delivered in any event when different mixtures containing sulphur are scorched. Power stations, metal handling and refining industrial facilities, and vehicles that sudden spike in demand for petroleum derivatives are among the sources. Sulphur dioxide outflows from diesel vehicles and gear have for quite some time been a major issue.

Overall air contamination is the reason for some unexpected losses as it influences human wellbeing in different ways. Sulphur dioxide can bother respiratory ailment by making breathing more troublesome, especially in youths, the older, and individuals with previous problems. When presented to it, it additionally disturbs the eyes. Longer openings can bother an assortment of lung issues, including hacking, asthma, persistent bronchitis, and respiratory lot diseases, as well as cause cardiovascular impacts.
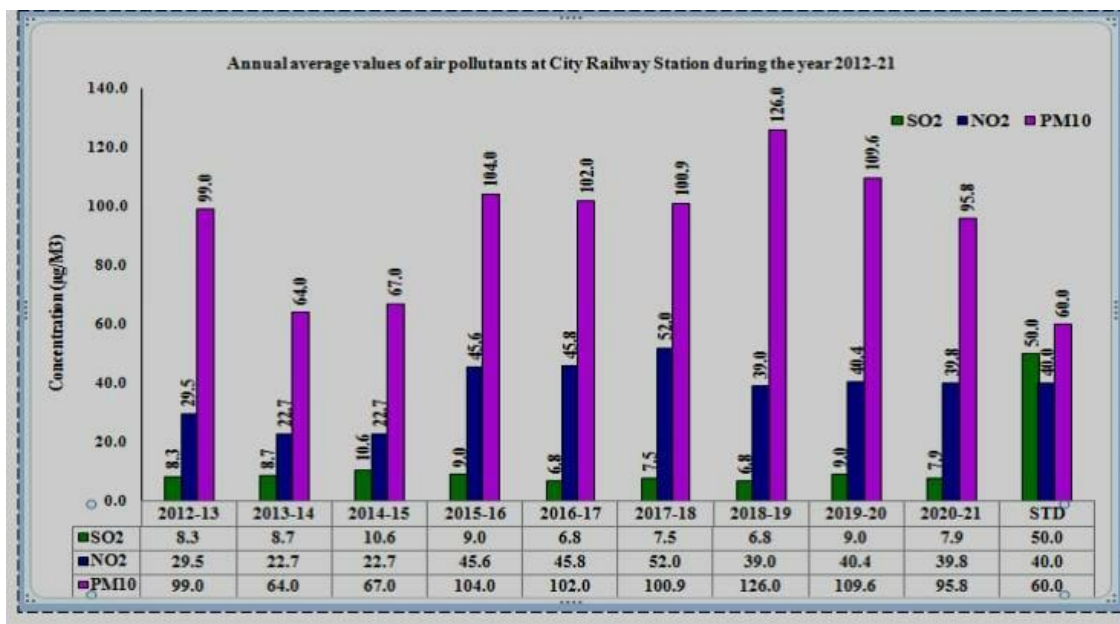
NO2

NO2 in lower atmosphere is one of the key elements which decide the air quality and has serious ramifications on human wellbeing and plant development. Photochemical exhaust cloud, corrosive downpour and nitrate spray are the negative impacts related with more significant level of NO2 focus. It is likewise notable for its backhanded commitment to environmental change by delivering tropospheric ozone which influences the worldwide ozone harming substance spending plan through their impact on theenvironment and overflow of OH extremists.

PM10

Particulate Matter are inhalable pollutant particles with a diameter less than 10 micrometres. Particles that are larger than 2.5 micrometres can be deposited in airways, resulting in health issues. Exposure can result in eye and throat irritation, coughing or difficulty breathing, and aggravated asthma. More frequent and excessive exposure can result in more serious health effects.
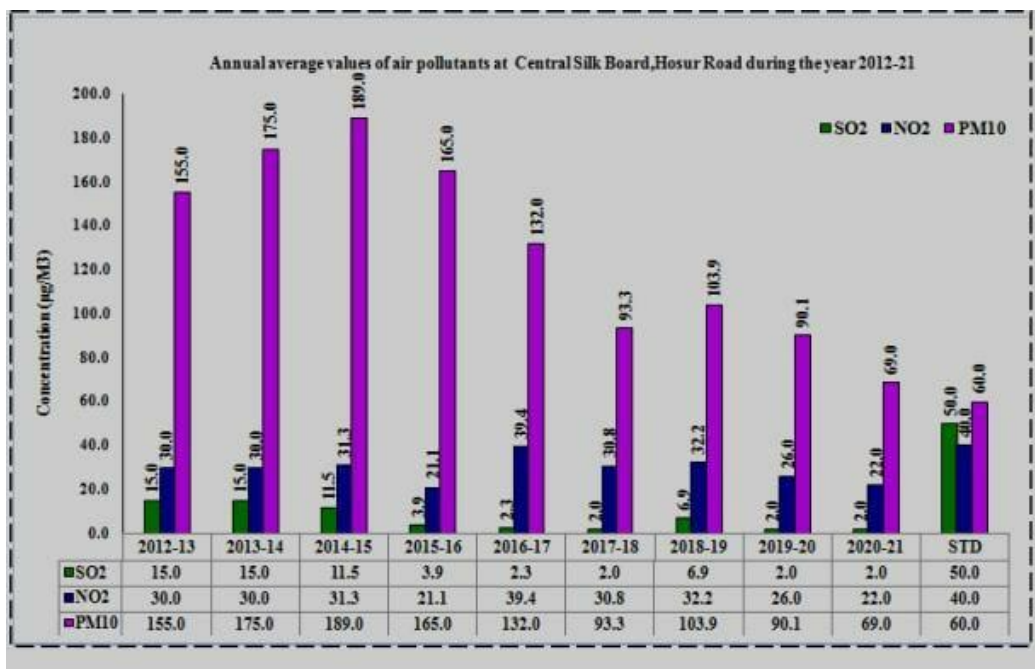
REVIEW OF THE STATIONS

CITY RAILWAY STATION, BENGALURU

Annual average values of air pollutants at City Railway Station during the year 2012-21

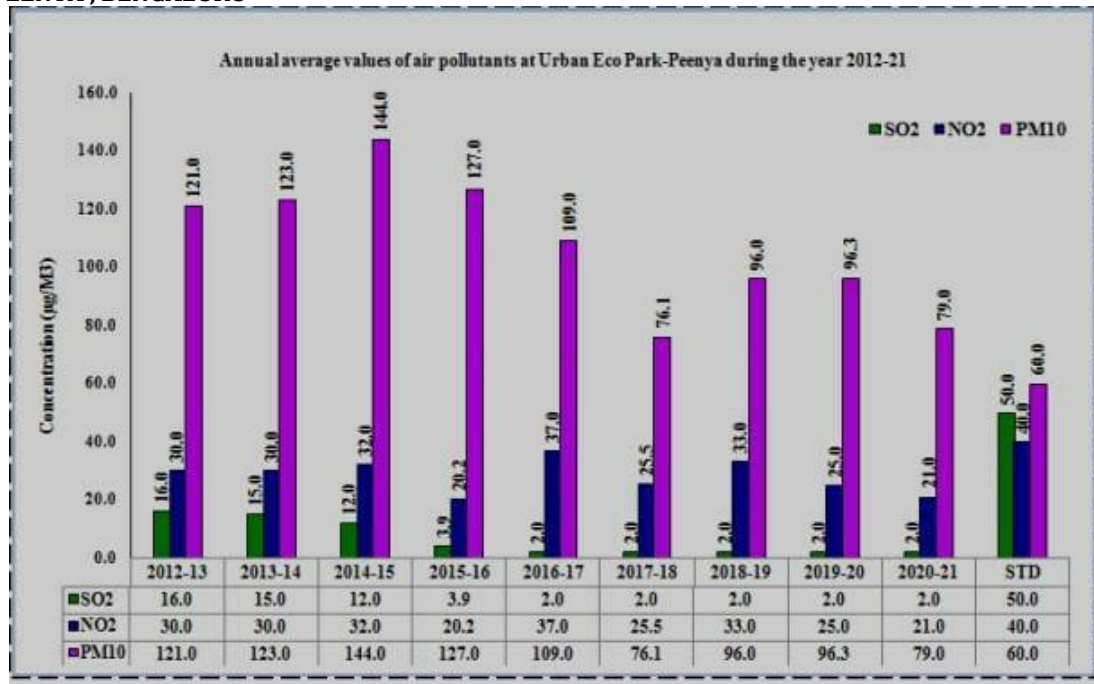|	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	STD
SO2	8.3	8.7	10.6	9.0	6.8	7.5	6.8	9.0	7.9	50.0
NO2	29.5	22.7	22.7	45.6	45.8	52.0	39.0	40.4	39.8	40.0
PM10	99.0	64.0	67.0	104.0	102.0	100.9	126.0	109.6	95.8	60.0

The PM10 concentration values are exceeded the national ambient air quality standards 60.0μg/m3 for the years 2012-19 and concentration of NO2 values are within the national limit of40.0 μg/m3 for the years from 2012-13 to 2014-2015, 2018-19 & 2020-21 except for the year

2015-16 to 2017-18. The SO2 concentration values are well within the NAAQM standards(50.0 μg/m3) during all measured year 2012-2021. At the city Railway station flyoverconstruction is under progress, hence, PM10 concentration has exceeded the national limit.Vehicular traffic has decreased as the buses are moving towards satellite bus stand, Peenya,Mysore Road and Shanthinagar. Hence the concentrations of pollutants like SO2, NO2, PM10are showing decreasing trend compared to 2019-20.

CENTRAL SILK BOARD, BENGALURU

Annual average values of air pollutants at Central Silk Board,Hosur Road during the year 2012-21

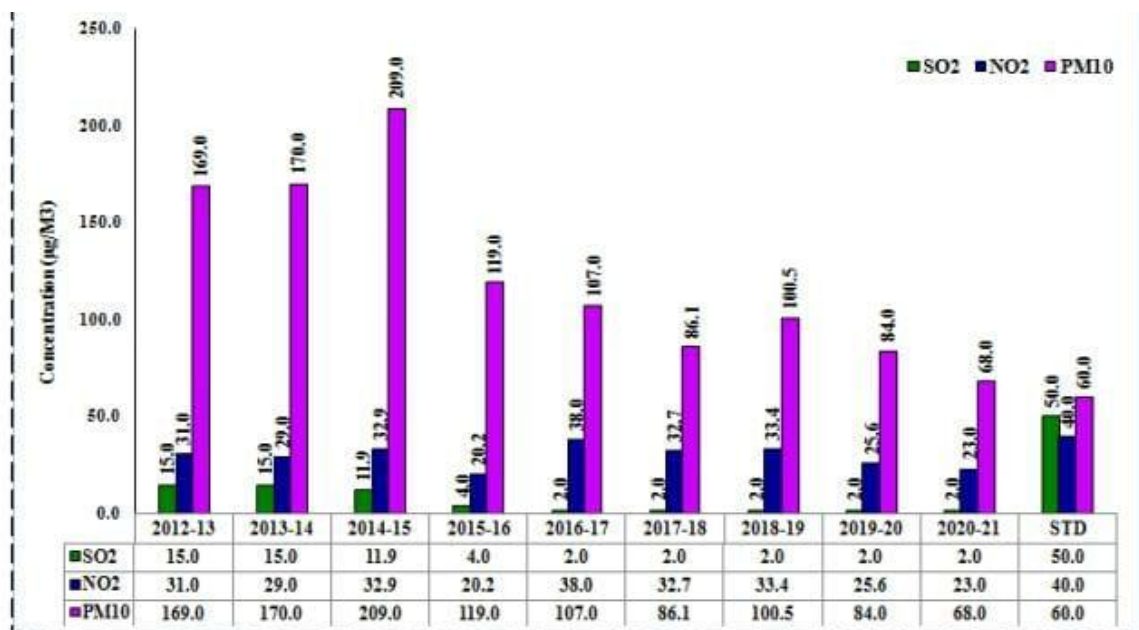|	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	STD
SO2	15.0	15.0	11.5	3.9	2.3	2.0	6.9	2.0	2.0	50.0
NO2	30.0	30.0	31.3	21.1	39.4	30.8	32.2	26.0	22.0	40.0
PM10	155.0	175.0	189.0	165.0	132.0	93.3	103.9	90.1	69.0	60.0

PM10 values have exceeded the national ambient air quality standard (60.0 μg/m3) in allmeasured years, due to the construction activities and vehicular movement and road dustwhereas SO2 and NO2 are within the national limit during 2012-21.

PEENYA , BENGALURU

Annual average values of air pollutants at Urban Eco Park-Peenya during the year 2012-21

	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	STD
SO2	16.0	15.0	12.0	3.9	2.0	2.0	2.0	2.0	2.0	50.0
NO2	30.0	30.0	32.0	20.2	37.0	25.5	33.0	25.0	21.0	40.0
PM10	121.0	123.0	144.0	127.0	109.0	76.1	96.0	96.3	79.0	60.0

PM10 values are exceeded the national ambient air quality standard (60.0 μg/m3) in all themeasured years due to the construction activities and vehicular movement and road dust .whereas SO2 and NO2 are within the national limit in all the measured years 2012-2021.

JAYANAGARA 5TH BLOCK, BENGALURU.

	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	STD
SO2	15.0	15.0	11.9	4.0	2.0	2.0	2.0	2.0	2.0	50.0
NO2	31.0	29.0	32.9	20.2	38.0	32.7	33.4	25.6	23.0	40.0
PM10	169.0	170.0	209.0	119.0	107.0	86.1	100.5	84.0	68.0	60.0

M10 values have exceeded the national ambient air quality limit (60.0 μg/m3) during the years2013-2021, due to the construction activities and vehicular movement and road dust. WhereasSO2 and NO2 are well within the national limit during the years 2013-2021.

ANALYSIS OF AQI OF OTHER MAJOR CITIES

Figure7:AnalysisofAQIofmetropolitancities
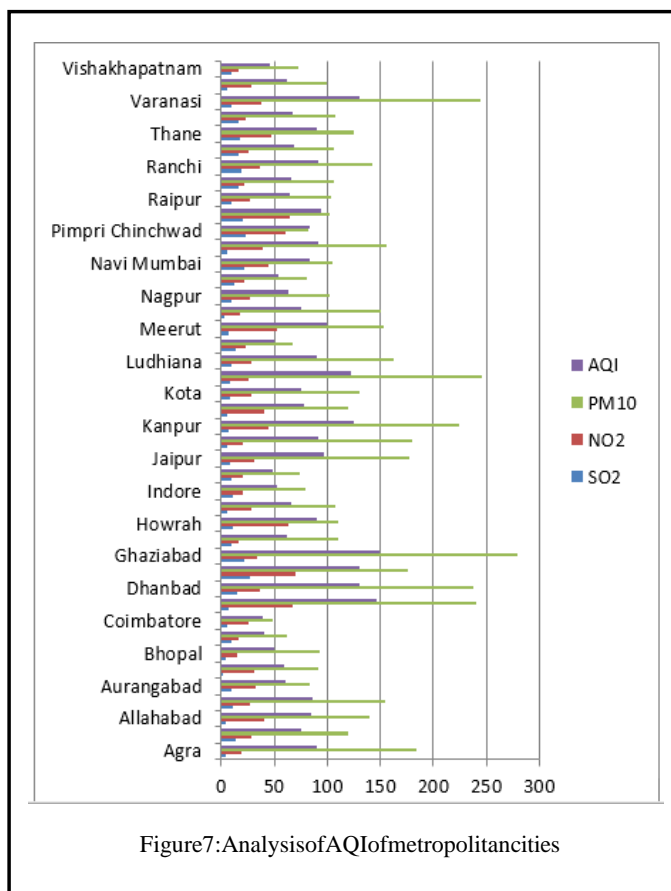
In every one of the metropolitan urban areas and famous traveller areas the particulate matter is wild (Figure 7). In metropolitan urban communities these levels are wild because of expanding populace on the grounds that the development the IT world in metro urban areas, which prompts expanding number of vehicles thusly driving gridlock. At vacationer areas, the expansion in particulate could be because of different elements, like traveller vehicles, and furthermore for instance, at Varanasi the ceremonies incorporate a great deal of consuming adding dust essentially into the climate which builds how much particulate matter. In the year 2018, there has been a report that the quantity of vehicles in Bangalore has crossed 80 Lakhs; by this number we can gauge how much extraordinary outflow high up that will contaminate the air up generally. As the portion from the article says that "Transport is the fundamental benefactor of air poisons in Bengaluru".

While the extended pace of populace increment might be discounted, even moderate populace development is probably going to prompt significant builds because of traveller and cargo travel interest in the city, because of presentation of Metro, Monorail, BRTS, fuel cost and so on. The rising geographic scattering of metropolitan populace is additionally liable to increment total transportation interest, since the more noteworthy number of excursions will likewise be longer and public vehicle will be less proficient and all inclusive [18]. Bengaluru being the third most crowded city in the nation is a stage for a ton of mechanical new companies and IT centres. Bengaluru has many driving Biotechnology organizations, with monstrous significance and backing to its innovative work fields. With 40% of India's IT industry situated in Bangalore, the city is among the most preferred objective for Itself and other informationbasedindustries.Thecity'sITandrelatedservicesaccountforabout 55% of Karnataka's state gross domestic product.

By assessing all the examination done by different scientists, RSPM contributes the most to the air contamination in Bangalore. In the new past the wide range of various vaporous parts is by all accounts taken care of aside from the degrees of RSPM

CONCLUSION

All through, we can examine that the degrees of RSPM are ending up risky to our current circumstance. By WHO, the principal supporters of this part is accounted for to be is dust, squander consuming, transport, Diesel Generator sets, Industries, homegrown cooking and warming. The standard furthest reaches of RSPM is 60µg/m3, and in the majority of the kept destinations this part in manifolds higher that as far as possible. Thus, through this paper we can reach determinations that there ought to be sufficient measure of mindfulness being spread among the patrons making them mindful of the risks being presented by this part.

Particulate matter
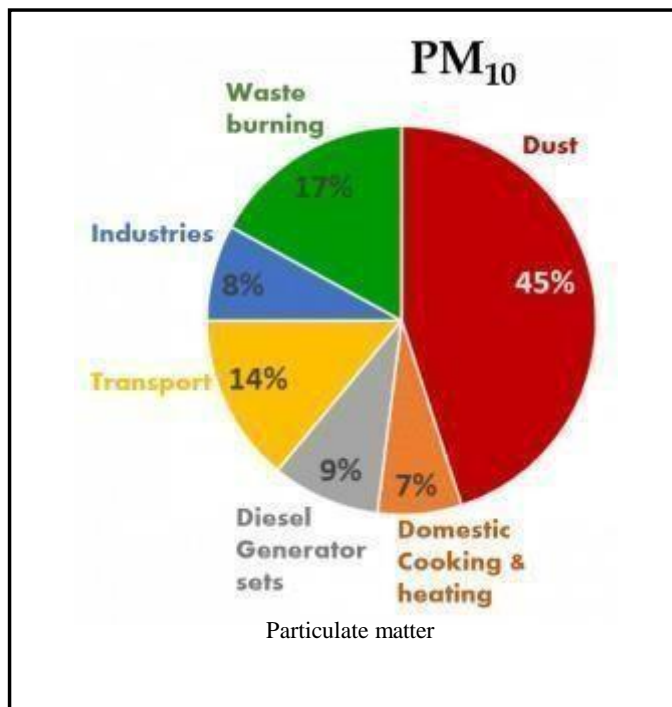
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