

Air Pollution and Its Impact on Human Health – A Geospatial Analysis of Hyderabad

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Abstract

Although a number of physical activities (volcanoes, fire, etc.) may release different pollutants in the environment, anthropogenic activities are the major cause of environmental air pollution. Hazardous chemicals can escape to the environment by accident, but a number of air pollutants are released from industrial facilities and other activities and may cause adverse effects on human health and the environment. By definition, an air pollutant is any substance which may harm humans, animals, vegetation or material. As far as humans are concerned an air pollutant may cause or contribute to an increase in mortality or serious illness or may pose a present or potential hazard to human health. The main change in the atmospheric composition is primarily due to the combustion of fossil fuels, used for the generation of energy and transportation. Variant air pollutants have been reported, differing in their chemical composition, reaction properties, emission, persistence in the environment, ability to be transported in long or short distances and their eventual impacts on human and/or animal health. Hyderabad shares the same dilemma as that of other mega city in India. It has started to take action to control air pollution and seen results. While the particulate pollution continues to be the primary concern other pollutants – especially ozone – have also begun to rise. Studies have predicted significant lives savings if air pollution is controlled. The city needs aggressive and sustained action to protect public health.

Keywords: Environment, Mortality, Emission, Health, Pollutants

1.1 Introduction

Hyderabad, a 400 year old city is the state capital of Andhra Pradesh. It lies on the

Deccan Plateau, 541 meters (1776 ft) above sea level, over an area of approximately 625 sq.km. Hyderabad, along with its twin city of Secunderabad, is the fifth largest city in India, with a population nearing 7 million. Due to its prominence as a major high-tech center, it is one of the fastest growing with a population density of ~17,000 persons per sq.km. The rapid rate of urbanization with increased economic activity has encouraged migration to the twin cities, which led to an increase of personal, public, and para - transit vehicles, industrial output, and increasing burden on the city's infrastructure. Hyderabad along with the surrounding ten Municipalities constitutes the Hyderabad Urban Development Area (HUDA) and has been growing at an average rate of 9%. The air we breathe contains emissions from many different sources: industry, motor vehicles, heating and commercial sources, household fuels as well as tobacco smoke. Air pollution harms human health and particularly is harmful for those who are already vulnerable because of their age as children and older people or existing health problems. Air

pollution is a growing health hazard in the city. Among the many sources of pollution, the transport sector is contributing a significant amount, with a direct correlation to increasing particulate matter pollution. Quite often, people raise a lot of hue and cry over the increasing automobile pollution in the urban areas causing severe health hazards, but little do they know that the worst sufferers of the pollution are the traffic police personnel. Here's an alarming revelation: Urban Hyderabad has been registering a 20-25% rise in pulmonary ailments every year.

While sinus, asthma and allergies continue to take away the 'top honours' (read: most rampant), city physicians observe that acute lung infections like bronchitis too, are fast becoming commonplace among the younger lot of Hyderabadis. Air pollution occurs when chemicals and particles mix with the air we breathe. These include carbon monoxide, sulfur dioxide and tobacco smoke and others. Air pollution is caused by vehicle emissions, tire fragmentation, road dust, industrial and residential combustion, power generation, smelting, construction and demolition, molds, forest fires and other causes. In Hyderabad 32 per cent of the traffic police personnel are suffering from lung-related disorders like pneumonia and bronchitis because of severe

air pollution, 12% of the force complained of eye problems, while 25 per cent of them are facing hearing impairment due to high-level of noise pollution and another 7 per cent of the traffic cops are complaining about eye-related problems due to dust particles. Air pollution irritate our respiratory system, causing inflammation of the lungs, reduce our lung function, making it harder to breathe, aggravate asthma and Chronic Obstructive Pulmonary Disease (COPD), angina (ischemic or coronary heart disease), congestive heart failure (heart failure), asthma, chronic obstructive pulmonary disease (bronchitis, emphysema), lung infections. The study tries to assess the increase of air pollution and its effect on human health, also tries to locate the more air polluted zones and its causes.

OBJECTIVES

The main objectives of the study are

1. To study the air pollutants levels in Hyderabad
2. To study the air pollutants impact on human health.

METHODOLOGY

The methodology adopted in the study is based on secondary data from various govt. sources namely; Census of India, Directorate of Health, A.P.V.V.P, Ministry of Transport, Hyderabad Traffic Police, Road Transport Authority etc, the study is also based on

primary survey where data was collected through observation and survey methods. Hyderabad region have been taken in different areas those are Balanagar, Punjagutta, Uppal, and Nacharam (Industrial Areas), ABIDS Circle, Charminar, JubleeHills, and Paradise (Residential Areas) and Zoo Park (Sensitive Areas) etc.

1.2 STUDY AREA

Levels of air pollution in Hyderabad are shooting up rapidly because of the exponential rise in the number of vehicles. On an average, 600 new vehicles are coming on to the roads every day. This is causing the air pollution to go beyond acceptable levels. The total suspended particulate matter (TSPM) in the air should be 200 milligram per cubic meter but the average value being recorded in the twin cities is 280 milligram per cubic meter.

The traffic-intensive areas like Panjagutta, Charminar, Paradise Circle and Abids have recorded a staggering TSPM rate of 300-400 on any given day. According to experts, vehicles contribute 50 per cent of the total air pollution in urban areas while the dust on

roads is the next major culprit and contributes 25 per cent. Burning of refuse and vegetation is resulting in 15 per cent air pollution while industries are responsible for the remaining 10 per cent. The number of vehicles in twin cities shot up from 10.91 lakh in 2001 to 18.47 lakh by the end of 2007. Adding another 7.94 lakh vehicles registered in Ranga Reddy district, the total number of vehicles goes up to 26,42,337 in Greater Hyderabad region. If the vehicles registered in other districts and used in the city are also taken into account, the number crosses 27 lakh. The total number of vehicles in Hyderabad increased by 1,66,129 with cars\jeeps rising by 33,986 and two-wheelers by 1,16,511 during 2006 and 2007. At present, as many as 2,61,850 cars and 13,81,861 two-wheelers operate in the twin cities. The city buses of the APSRTC, the Setwin services, cabs, Aeroexpress buses being run by the Hyderabad International Airport and autorickshaws add further to the air pollution. The level of respirable suspended particulate matter (RSPM), is more dangerous than the TSPM and has been steadily increasing

Table-1 Showing number of vehicles in Hyderabad

Vehicle category	2010	2011
Two-wheelers	1,929,000	2,145,000
Cars and jeeps	446,000	501,000
Buses (local carriages)	23,000	25,500
Buses (omni—long distance)	23,000	26,000
Taxis	26,500	30,000
Light duty (passengers—3-seater)	82,500	90,500
Light duty (passengers - 4-6-seater)	3,000	3,000
Light duty (goods—3-wheeled)	16,500	19,500
Light duty (goods—4-wheeled)	60,000	65,500
Heavy duty vehicles	107,000	115,000
Tractors and Trailers	8,000	8,500
Others	6,500	7,000
Total	2,731,000	3,036,500

Source: RTA

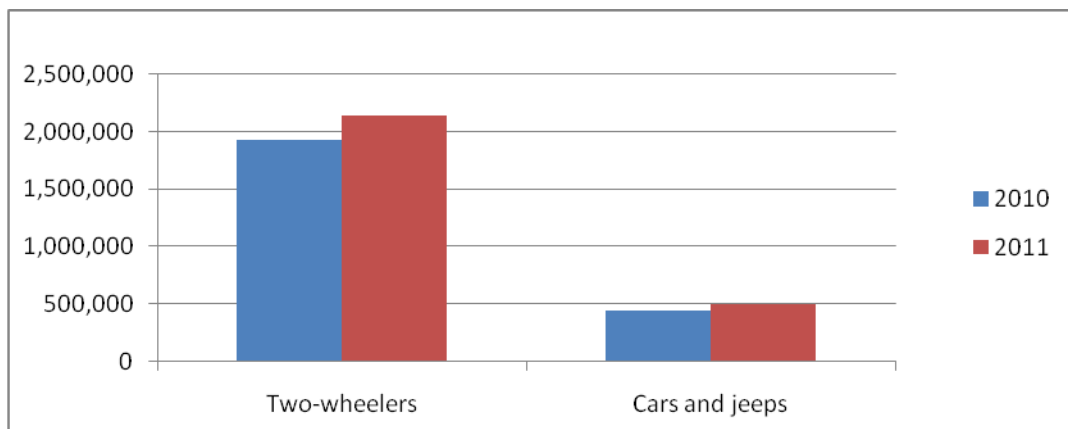


Fig: 1 Showing number of vehicles (2 wheelers & 4 Wheelers)

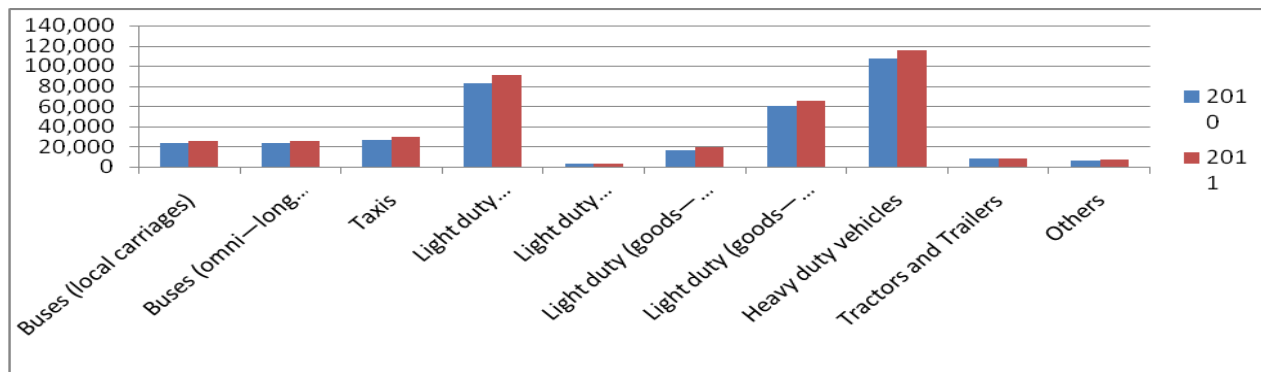


Fig: 1.a Showing number of all vehicles

The lethal effects of Hyderabad's highly polluted air are distinctly highlighted in a report compiled by the New Delhi-based Centre for Science and Environment (CSE). Titled 'Citizen's Report: Air Quality and Mobility Challenges in Hyderabad', the survey quotes scientists of having found "a high level of oxidative stress, lung function impairment, respiratory ailments due to air pollution", among residents, which has led to an increase in "drug sales related to respiratory symptoms in key locations of Hyderabad". Not surprising that the sale of these medicines, as per the CSE study, is found to be the highest in and around Punjagutta and Abids. The two zones, according to latest data available with the Andhra Pradesh Pollution Control Board (APPCB), register the highest count of RSPM (Respirable Suspended Particulate Matter), between 120 and 140 mg per cubic metre, in the city. These critically-polluted pockets also 'boast' of a significantly high sulphur dioxide and oxides of Nitrogen presence both

considered killer pollutants. "Apart from releasing statistics on rising pollution levels, we also need to analyse its impact on public health at regular intervals. Unfortunately, however, it isn't part of the PCB's mandate and is, therefore, completely ignored.

APPCB was over a decade ago, between 1998 and 2000. That the survey even then showed a rise in 'ventilatory defects' in residents near traffic areas and "high prevalence of heart attacks (among people) in the 30-40 age group" is another story. But while the composition of pollutants in the city has undergone a fair transformation (there are more life-threatening toxins in the air now), one thing has remained unchanged: the plight of the traffic police. Even now, these men are faced with a higher occupational risk owing to their extensive exposure to air pollution. And the entry of carcinogenic elements has only made matter worse.

Table-2 Showing Air Pollutants in Hyderabad

Industrial estate	SPM (kg/h)	SO ₂ (kg/h)	NO _x (kg/h)	Coal (ton/day)	Biomass (ton/day)	Gas (kg/day)	Diesel (lit/day)	Furnace oil (lit/day)
Azamabad	1.92± 1.28	0.44± 0.28	0.24 ± 0.14	275	–	–	–	700
Balanagar	0.31± 0.45	0.36± 0.22	0.18 ± 0.17	20	–	–	886	1,300
Gaganpahad	1.05± 0.58	0.45± 0.40	0.43 ± 0.54	74	88	–	40	8,800
Jeedimetla	0.64± 0.90	0.70± 1.71	0.54 ± 1.26	174	–	–	2,750	28,900
Kattedan	1.47± 0.51	0.50± 0.55	1.60 ± 1.71	15	37	–	40	–
Mallapur	0.35± 0.32	0.29± 0.33	0.20 ± 0.30	4	6	–	1,060	40
Medchal	0.25± 0.27	0.70± 0.43	0.20 ± 0.19	25	4	400	2,710	5,900
Nacharam	0.72± 0.73	0.60± 0.67	0.57 ± 0.97	23	13	–	1,495	15,555
Qutubullapur	0.27± 0.34	0.51± 0.31	0.13 ± 0.09	14	5	–	2,851	11,376
Uppal	1.50± 1.06	0.75± 0.73	1.07 ± 1.39	9	3	–	770	4,440
All estates (including small estates)	0.84± 1.07	0.67± 1.22	0.47 ± 0.94	819	406	400	44,532	126,475

Source: APCCB

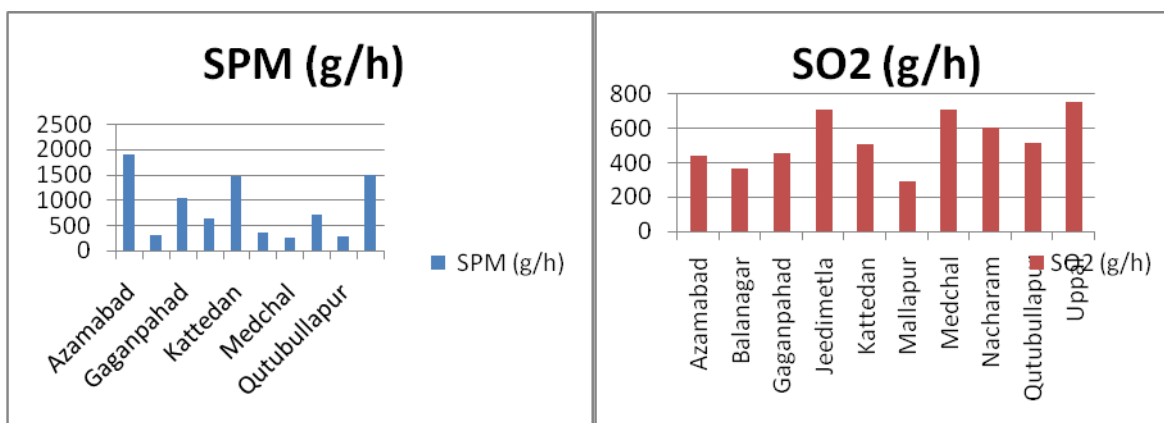


Fig: 2 Showing Air pollution levels in Hyderabad

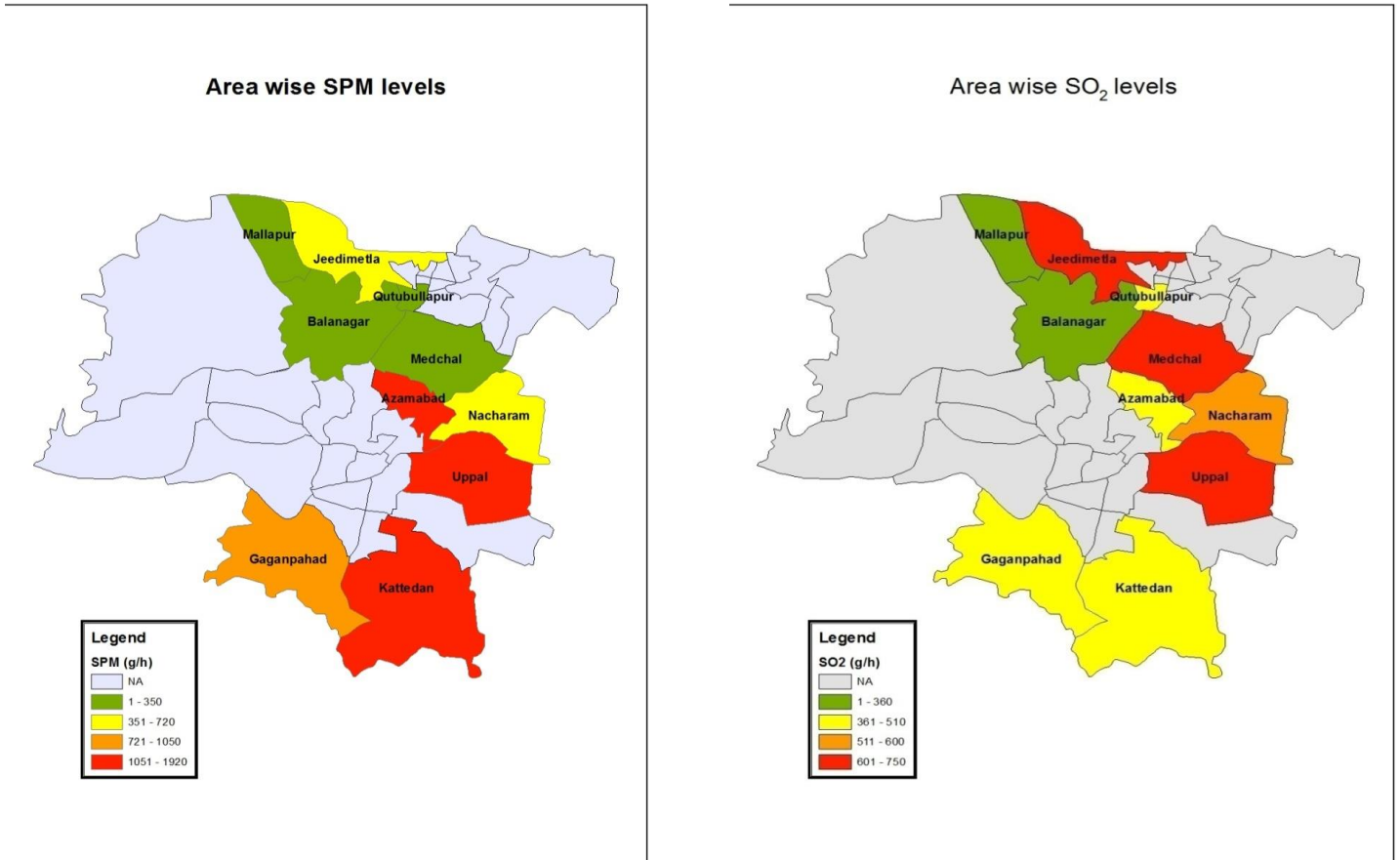


Fig: 2a. Showing Air pollution levels in Hyderabad

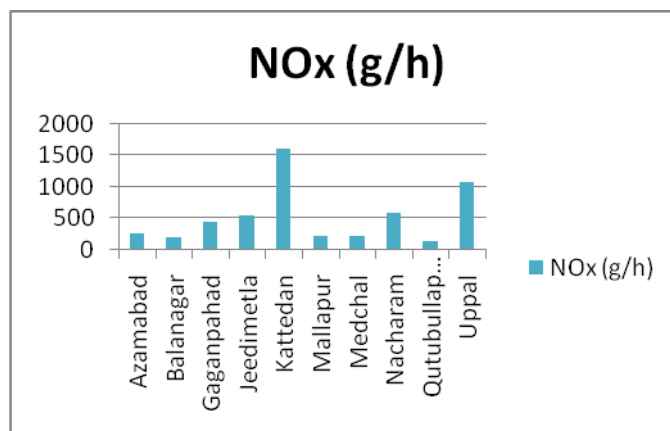


Fig: 3 Showing Air pollution levels in Hyderabad

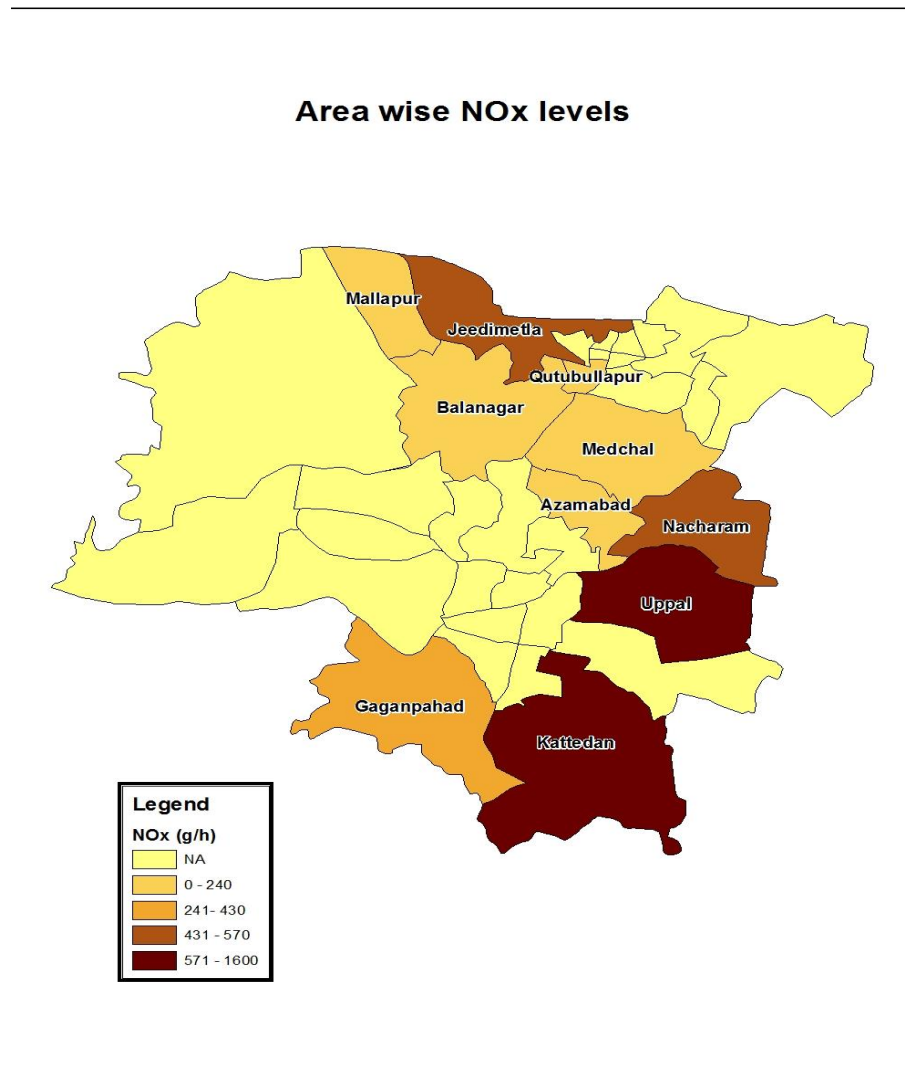


Fig: 3a. Showing Air pollution levels in Hyderabad

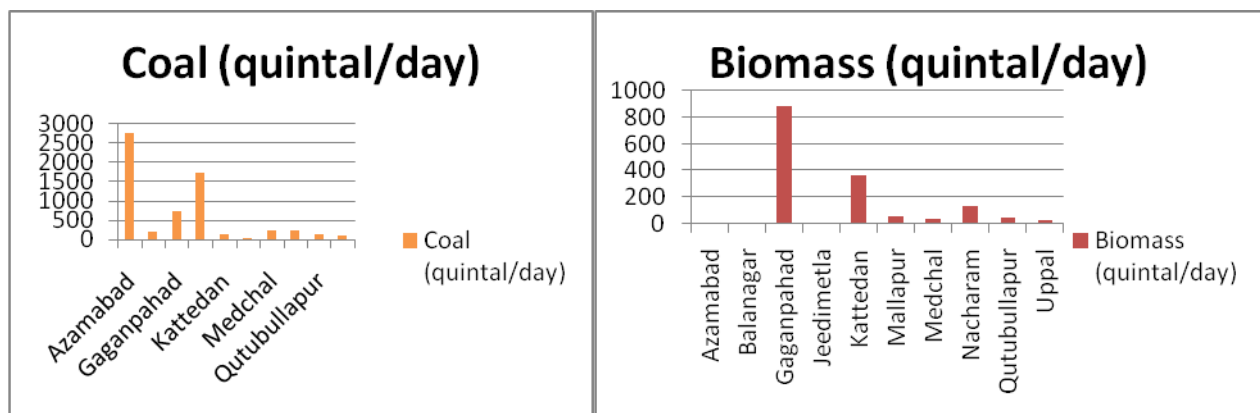
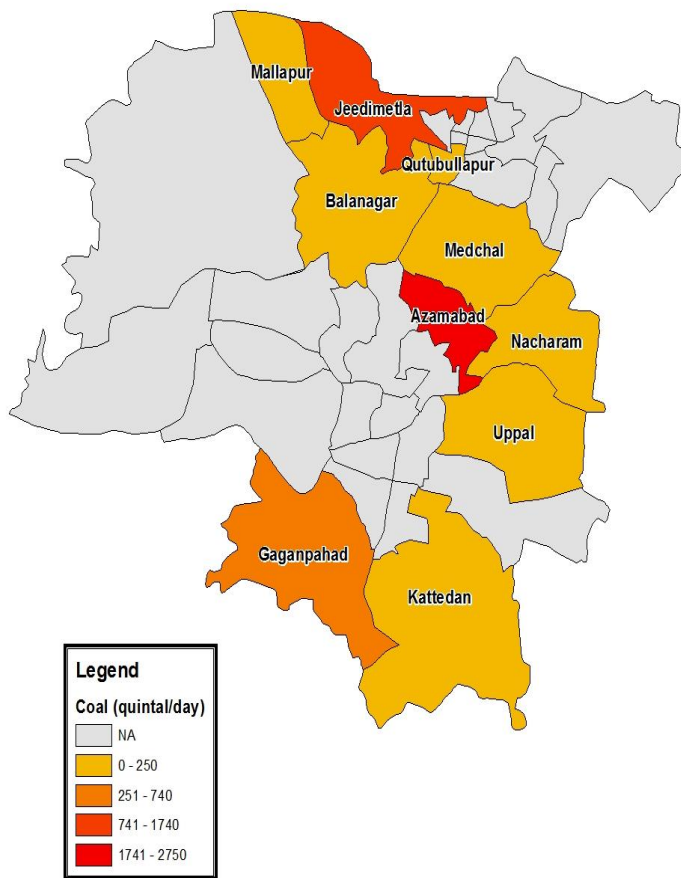


Fig: 4 Showing Air pollution levels in Hyderabad

Area wise Coal consumption



Area wise Biomass consumption

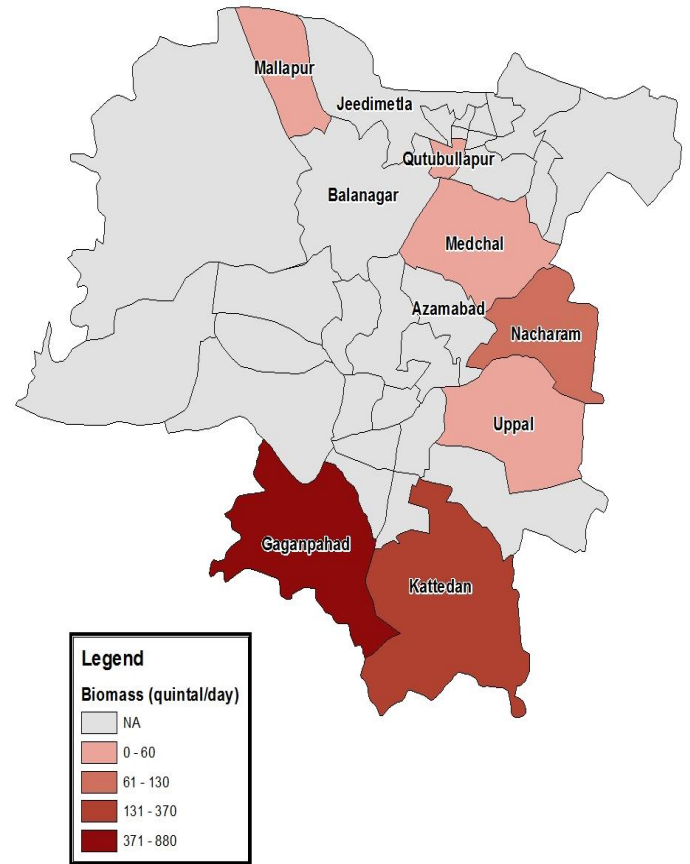


Fig: 4a. Showing Air pollution levels in Hyderabad

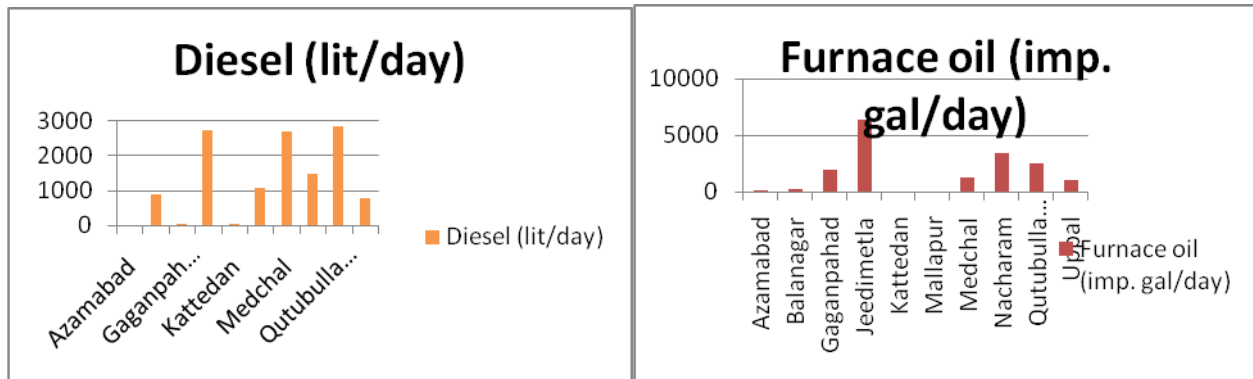


Fig: 5 Showing Air pollution levels in Hyderabad

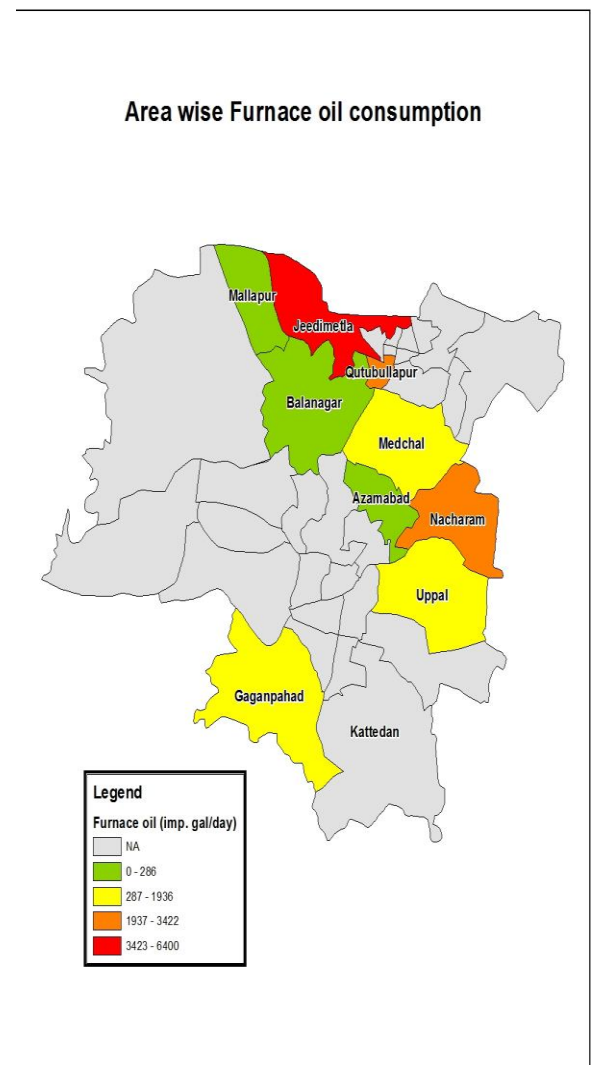
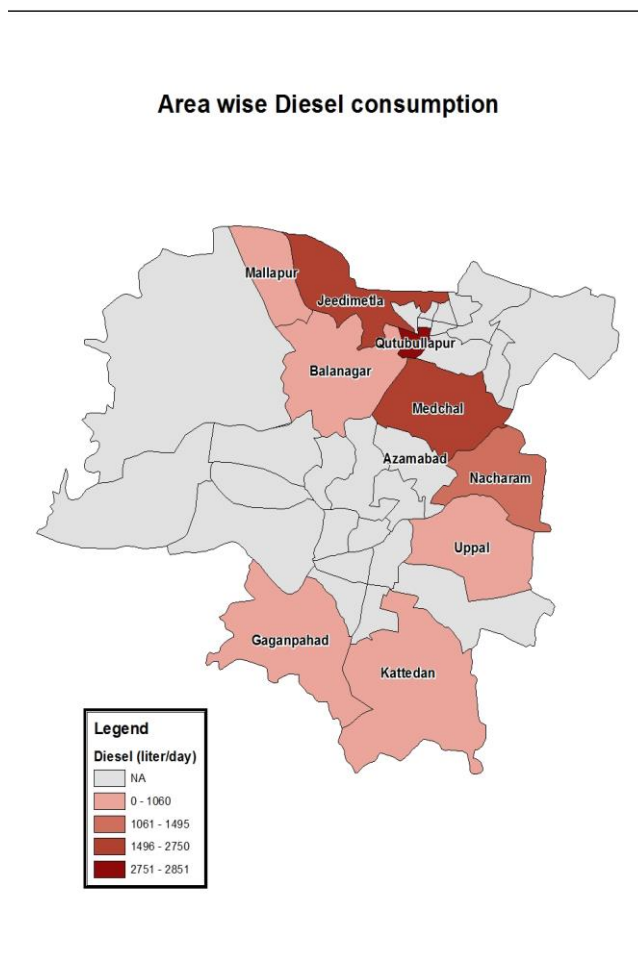


Fig: 5a Showing Air pollution levels in Hyderabad

WHO Health Reports, air pollution at current levels in European cities is responsible for a significant burden of deaths, hospital admissions and exacerbation of symptoms, especially for cardiovascular disease. Because of the tremendous number of people affected, the impact of air pollution on cardiovascular disease represents a serious public health problem. Results from research studies have demonstrated a strong relationship between levels of airborne particles, sulfur dioxide and other fossil fuel emissions and risk of early death from heart disease. People with pre-existing conditions such as high blood pressure, previous heart disease, diabetes, respiratory disease and high cholesterol have been shown to be especially vulnerable.

RESULTS AND DISCUSSIONS

The results of a long-term study on influence of common air pollutants on health of US residents showed that individuals living in the more polluted cities had a higher risk of hospitalization and early death from pulmonary and heart diseases as compared to

those living in the less polluted cities. The study focused on the health effects of gaseous pollutants such as sulfur dioxide, which are produced mainly by coal-burning power plants and fine particle air pollution, particles with a diameter of less than $2.5\mu\text{m}$ that come from power plant emissions and motor vehicle exhaust. The relationship between air pollution and mortality was much stronger for the fine particle component than for the gaseous pollutants. Exposure to PM is associated with increased hospital admissions and mortality in adults. The risk increases linearly with the concentration of pollution and there is no evidence to suggest a threshold for PM below which no adverse health effects would occur. When inhaled, PM_{10} particles (with a diameter of less than $10\mu\text{m}$) penetrate deep into the respiratory system. Finer particles (with a diameter of less than $2.5\mu\text{m}$) then go on to penetrate the lungs and pass into the bloodstream and are carried into other body organs. Concerned that these particle cause a wide range of health impacts.

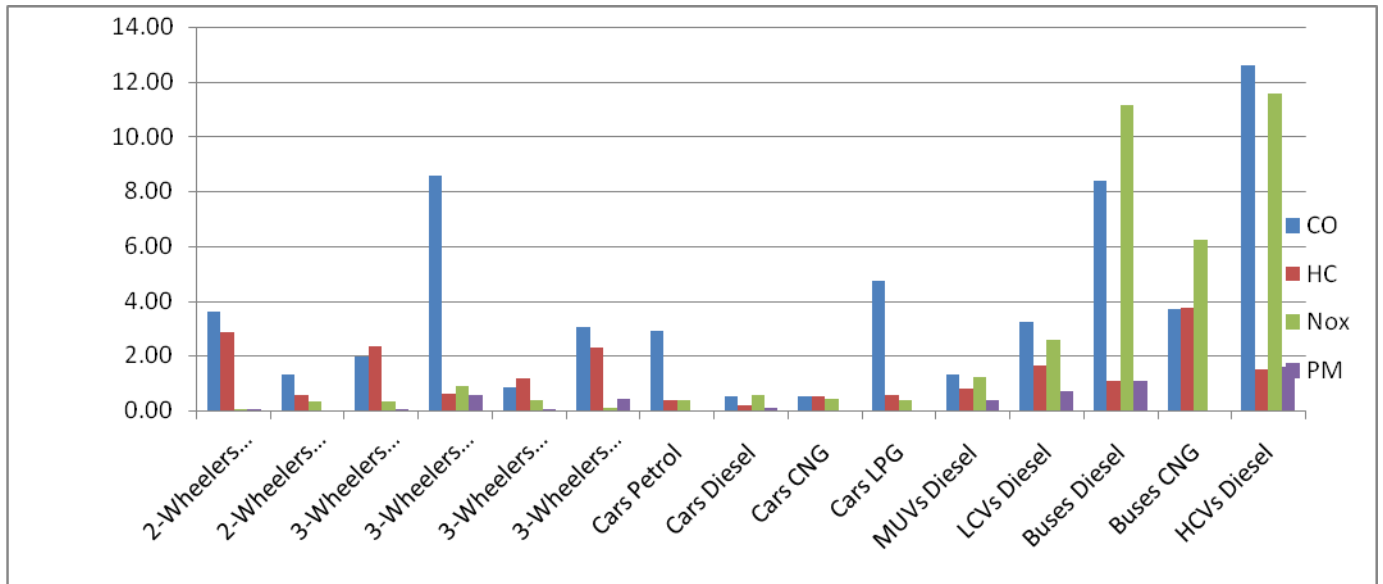


Fig 6 Showing Air pollutants in Hyderabad According to Fuel Type

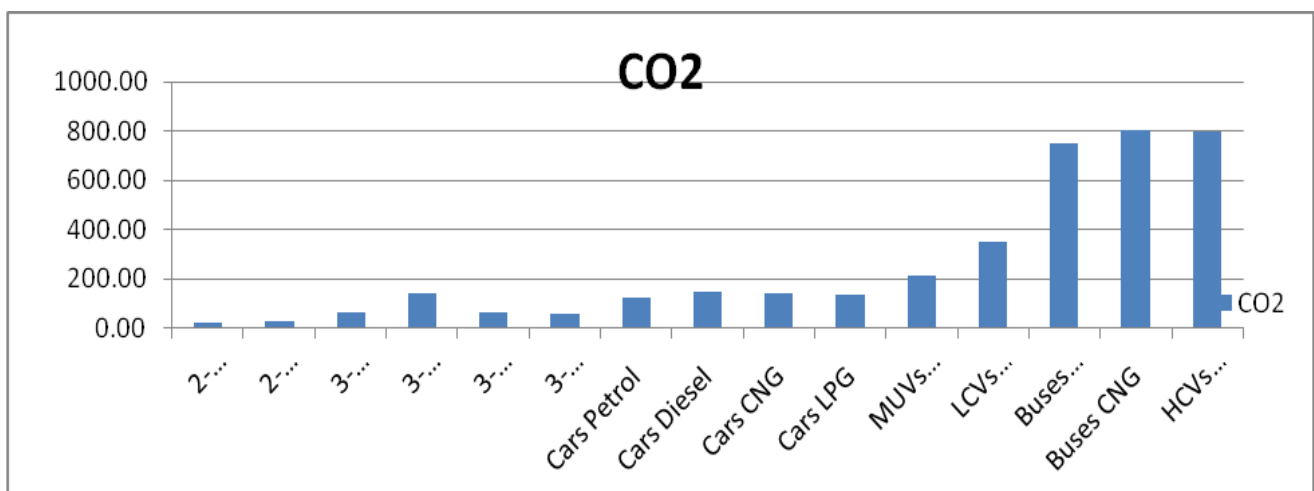


Fig: 6a. Showing Air pollutants in Hyderabad According to Fuel Type

Table-4 Showing Different Levels of Pollution, Locality wise.

Station	Type	2006		2008		2010	
		PM10	NOx	PM10	NOx	PM10	NOx
Abids	Commercial	103.8 ± 19.2	31.9 ± 3.1	112.2 ± 11.0	31.7 ± 3.1	97.5 ± 7.8	28.0 ± 1.6
Paradise	Commercial	107.4 ± 18.1	34.3 ± 3.2	113.5 ± 9.3	35.5 ± 4.1	99.5 ± 6.6	29.1 ± 2.4
Charminar	Commercial	98.3 ± 15.6	30.4 ± 3.7	113.0 ± 10.1	34.8 ± 2.8	99.9 ± 8.8	28.3 ± 1.9
Chikkadpally	Commercial	71.6 ± 17.1	17.5 ± 1.9	79.2 ± 22.7	26.0 ± 3.4	66.9 ± 10.7	24.2 ± 3.3
Imlibun	Commercial	74.2 ± 17.9	23.1 ± 6.1	81.8 ± 7.6	27.6 ± 4.6	74.0 ± 7.7	23.4 ± 1.2
Punjagutta	Commercial	104.1 ± 14.7	32.4 ± 3.0	117.4 ± 9.8	34.3 ± 3.8	108.0 ± 3.6	30.2 ± 2.7
Shameerpet	Commercial	57.9 ± 12.8	16.2 ± 0.7	51.2 ± 14.0	18.5 ± 3.1	52.5 ± 11.8	20.2 ± 2.1
Rajendra Nagar	Commercial	49.2 ± 19.6	15.2 ± 1.5	41.2 ± 11.5	16.1 ± 2.0	38.9 ± 6.3	16.7 ± 1.9
Kukatpally	Commercial	72.8 ± 13.0	16.7 ± 1.7	84.9 ± 15.7	26.2 ± 3.1	92.2 ± 12.8	24.0 ± 1.5
Langar House	Commercial	121.8 ± 30.6	17.9 ± 2.4	103.8 ± 19.3	26.9 ± 5.3	105.9 ± 20.3	26.4 ± 2.6
Balanagar	Industrial	101.5 ± 28.2	34.6 ± 5.8	106.0 ± 8.3	36.6 ± 4.2	99.4 ± 9.7	28.7 ± 3.4
Jeedimetla	Industrial	98.2 ± 16.0	21.6 ± 2.2	92.3 ± 14.3	27.2 ± 3.4	96.5 ± 14.3	25.5 ± 2.8
Uppal	Industrial	100.7 ± 24.7	31.9 ± 1.4	107.5 ± 10.4	34.6 ± 2.8	92.8 ± 12.1	27.0 ± 2.6
Sainikpuri	Residential	66.5 ± 11.1	16.0 ± 1.2	58.8 ± 12.6	18.4 ± 2.9	58.1 ± 14.0	18.7 ± 1.3
Jublee Hills	Residential	57.7 ± 14.0	16.4 ± 1.2	58.4 ± 9.6	17.3 ± 2.6	54.1 ± 10.8	16.6 ± 0.9
Madhapur	Residential	70.2 ± 41.3	16.2 ± 5.1	70.8 ± 14.6	18.8 ± 3.0	81.4 ± 26.1	22.3 ± 1.7
Nacharam	Residential	76.1 ± 25.4	17.5 ± 6.4	87.1 ± 18.7	27.7 ± 5.6	83.8 ± 7.7	24.5 ± 2.3
University of Hyderabad	Residential	54.7 ± 9.5	16.3 ± 1.1	41.6 ± 13.9	28.5 ± 4.7	44.1 ± 6.7	16.1 ± 1.2
KBRN Park	Sensitive	46.1 ± 13.5	14.1 ± 0.9	49.5 ± 8.0	14.9 ± 0.8	49.4 ± 15.3	15.3 ± 0.7
Zoo Park	Sensitive	52.5 ± 14.6	14.8 ± 0.7	54.7 ± 7.1	17.5 ± 1.9	57.9 ± 17.0	16.3 ± 0.5

Source: APPCB

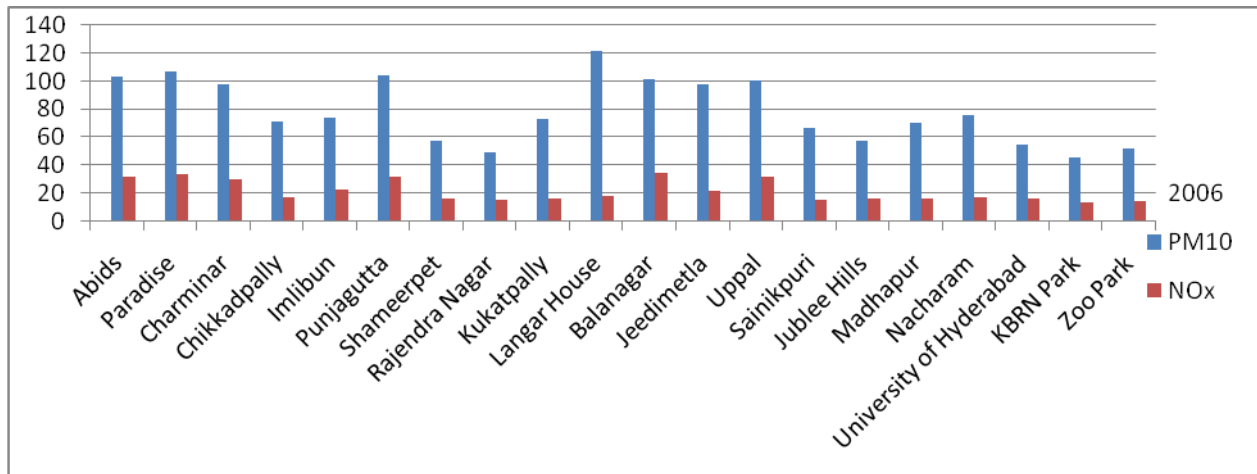


Fig: 7. Showing Different Levels of Pollution, Locality wise.

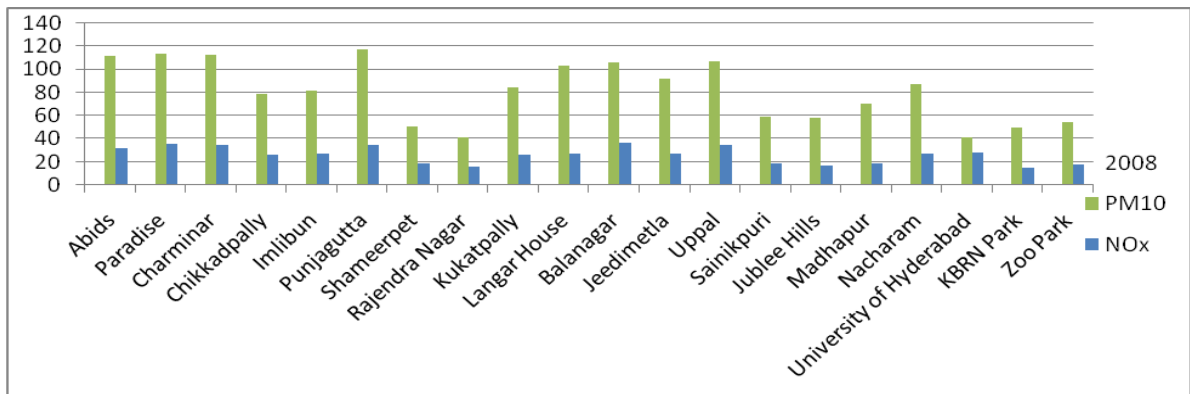


Fig: 7a. Showing Different Levels of Pollution, Locality wise

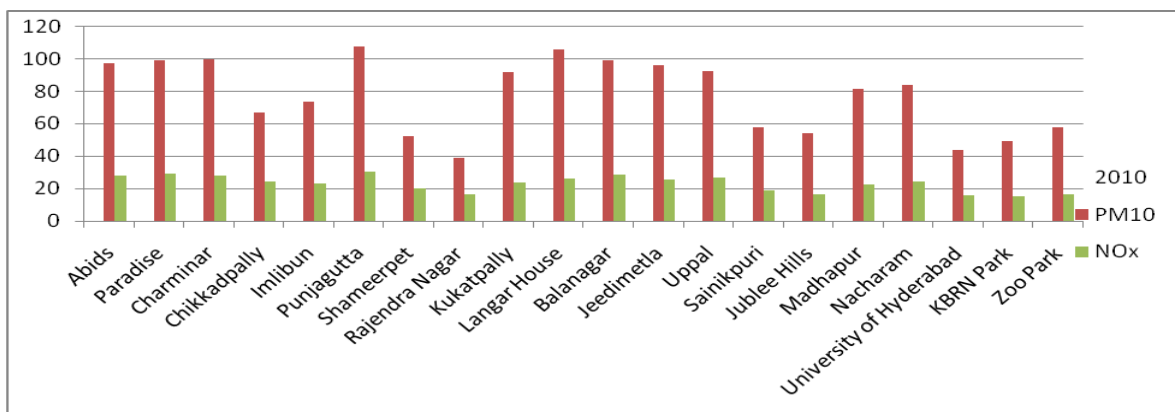


Fig:7b. Showing Different Levels of Pollution, Locality wise

S.No	Station Name	2011		2012		2013		2014	
		PM ₁₀ ug/m ³	No _x ug/m ³	PM ₁₀ ug/m ³	No _x ug/m ³	PM ₁₀ ug/m ³	No _x ug/m ³	PM ₁₀ ug/m ³	No _x ug/m ³
1	Balanagar - Industrial	100	27.9	127	27.4	144	28.6	135	32.0
2	Uppal - Industrial	97	26.2	109	25.3	90	24.3	99	26.5
3	Jubilee Hills - Residential	78	18.0	83	17.7	72	17.4	80	19.6
4	Jeedimetla - Industrial	108	27.4	97	25.3	92	25.0	107	29.5
5	Paradise - Commercial	99	31.7	93	25.9	84	23.9	120	28.3
6	Charminar - Commercial	105	26.9	110	24.1	95	24.2	112	27.7
7	Zoopark - Sensitive	60	14.6	68	13.6	73	13.6	73	16.6
8	BPPA - Industrial	61	21.8	72	20.1	54	18.8	68	19.5
9	MGBS - Res/Com	66	21.1	66	19.6	79	18.8	69	22.1
10	Chikkadapally - Res/Com	87	23.5	87	19.9	79	19.6	84	21.9
11	Langar House - Res/Com	99	21.9	105	23.3	104	20.2	91	22.4
12	Madhapur - Res	47	15.8	82	14.3	88	14.8	66	18.9
13	Shameerpet - Res/Com	59	16.5	68	18.5	74	17.4	79	19.0
14	Kukatpally - Res/Com	100	23.4	117	23.4	137	21.5	114	26.9
15	Sainikpuri - Res	72	16.3	85	18.3	113	17.1	92	19.2
16	Rajendranagar - Res/Com	35	16.4	43	13.2	42	12.4	33	14.2
17	Uni.of Hyd - Res	40	14.3	39	13.5	55	13.2	71	45.9
18	Nacharam - Res	86	26.2	85	24.0	74	20.6	94	23.0
19	Abids - Res/Com	98	27.0	99	26.2	81	24.4	104	27.8
20	Panjagutta - Res/Com	99	28.2	122	31.9	120	34.0	117	40.3
	Standards	60	40	60	40	60	40	60	40

CONCLUSION

The source apportionment study in Hyderabad listed transportation, industries, and waste burning as critical sources of particulate matter (PM) pollution in the city. In this paper, we present sector-specific emissions for 2010–2011 for the Greater Hyderabad Municipal Corporation region, accounting for 42,600 t of PM₁₀ (PM size <10 μm), 24,500 t of PM_{2.5} (PM size <2.5 μm), 11,000 t of sulfur dioxide, 127,000 t of nitrogen oxides, 431,000 t of carbon monoxide, 113,400 t of non-methane volatile organic compounds, and 25.2 million tons of carbon dioxide emissions. The inventory is spatially disaggregated at 0.01° resolution on a GIS platform, for use in a chemical transport model (ATMoS). The modeled concentrations for the urban area are $105.2 \pm 28.6 \mu\text{g}/\text{m}^3$ for PM₁₀ and $72.6 \pm 18.0 \mu\text{g}/\text{m}^3$ for PM_{2.5}, when overlaid on gridded population, resulted in estimated 3,700 premature deaths and 280,000 asthma attacks for 2010–2011. The analysis shows that aggressive pollution control measures are imperative to control pollution in Hyderabad and reduce excess exposure levels on the roads and in the residential areas. The planning and implementation of measures like advancing the public transportation systems, integrating the road and metro-rail services, promotion of walking and cycling, introduction of cleaner brick production technologies, encouraging

efficient technologies for the old and the new industries, and better waste management systems to control garbage burning need to take priority, as these measures are expected to result in health benefits, which surpass any of the institutional, technical, and economic costs.

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