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Assessment of ambient air quality of New Delhi

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Abstract

National capital territory of Delhi can be considered as a victim of the air pollution and its consequent impacts. The lack of integrated approach in Delhi for risk governance makes the governance process multifaceted and a challenging task. From this study it can be stated that emerging public health concern due to air pollution and its governance, have not kept an equal pace even with the backing of legislative measures and intervention of court of law. Right to life and right to a healthy environment are being violated by increasing air pollution levels in the city time and again. As the levels of air quality continues to be poor, good governance for reducing air pollution is need of the hour.

This paper presents pollutants ($PM_{10,}$ $PM_{2.5,}$ $SO_{2,}$ $NO_{X,}$ CO, & O_3) Level in Delhi. The study was undertaken to investigate the air quality of Delhi in industrial, commercial, and residential area.The data collected from 4 locations. The primary pollutants such as SO_2 and NO_X were found within the standard limit. PM_{10} & $PM_{2.5}$ values exceedes the standard values prescribed by CPCB New Delhi. The result revealed that air quality of Delhi is deteriorated by particulate matter & least by gaseous pollutants.

Key word - Air pollution, $PM_{10,}$ $PM_{2.5,}$ CO, O_3.

INTRODUCTION

Air pollution in cities has a negative impact on both the environment and human health. Repeated human exposure to air pollutants over a long period of time can cause several respiratory, cardiovascular, reproductive and gastrointestinal health **problems (Last et al., 1994; Elsom, 1996; WHO, 2000; Brauer et al., 2002; Wright et al., 2014)**. Similarly, as seen in vegetation, continuous exposure to high concentrations of air pollutants can cause various plant deficiencies such as photosynthesis inhibition, genetic mutations, protein synthesis inhibition and choruses **(Bamniya et al., 2011)**. Poor air quality in cities is a result of several factors that collectively promote the presence of air pollutants in the atmosphere and this is generally driven by local meteorology, political and socioeconomic structures and their subsequent influence on human activities that are associated with the release of pollutants into the atmosphere **(Held et al., 1996; Wu et al., 2011).**

Key anthropogenic drivers of air pollution are as a consequence of rapid urbanization, development and population growth, increases in economic activity and demand, agriculture, transport and industrial activities and expansion. These have an important role in the distribution and diffusion of air pollutants in a city **(Clarke, 2002; Ryu et al., 2012)**. Areas susceptible to poor air quality are subject to the right combination of meteorological conditions, terrain characteristics and emission sources that collectively promote air pollution. In the larger context air pollution has an imperative role in global climate change. Since the industrial revolution in the 19th century greenhouse gases (GHG) have increased and enhanced the greenhouse effect.

According to the Indian Department of Environmental Affairs, New Delhi is considered an air pollution hot spot area Anand vihar and Dwarka (India, 2020). An air pollution hot spot area is considered to have a degraded air shed which is characteristic of poor air quality where ambient air pollutant concentrations frequently exceed the Indian air quality standards. Since the Greening New Delhi project was launched in 2020 many degraded open spaces have been transformed into urban green, vibrant parks and thousands of trees have been planted. The urban parks are believed to serve several environmental benefits; one of which includes the improvement in local ambient air quality. However, there has been no air quality monitoring conducted on a small scale in the urban parks of New Delhi to investigate if urban parks are associated with lower air quality pollutants compared to the surrounding urban environment through these initiatives.

Air pollutants by definition are identified substances that exist in the atmosphere in concentrations which negatively impact on human health and environmental quality. Components of poor air quality are considered in two categories, primary and secondary pollutants. Primary pollutants are emitted directly into the atmosphere, mostly from combustion sources such as vehicle exhaust emissions, industrial stacks and mining activities **(Harrison et al., 2014).** Secondary pollutants are formed in the atmosphere as a result of complex atmospheric chemical reactions amongst primary precursors, for example the photo-oxidation of NOx to form O_3 **(Saini et al., 2008; Harrison et al., 2014).**

Study Area:-

New Delhi has total area of 15,039 sq(11,724squarekm) with the average population density of 680sq.Delhi the capital and third largest city of india, ranks third in population among other Indian cities, estimated among 8.5 mollion(Crowther et al., 1990). Rapid urbanization and the unprecedented industrial and economic development during the last three decades have increased the vehicular population of Delhi by several folds. Delhi on the geographical coordinate of N 24.58^0E 73.68^0 and covers area of 4,527sq km. The romantic city of New Delhi has a legend behind its origin and it goes like this Once Maharana udai shingh happened to meet a holy sage when he was on his hunting expedition in the Aravali hills.

The objective study

1- To assess the ambient air quality at various selected stations
2- To assess the concentration of PM_{10}, $PM_{2.5}$ SO_2, NO_X, CO, O_3
3- To compared to the various parameters with standard.

Methodology

This research intended to examine the differences in air pollutant concentrations between four urban sites types by comparing older industries and younger industries sites in close proximity. Furthermore, this study wished to assess whether ambient concentrations of the selected criteria air pollutants (CO, NO_2, O_3, SO_2, PM_{10} and $PM_{2.5}$) were within the Indian National Air Quality Standards for the period of monitoring. For the study four sampling stations were selected namely Delhi cant, Punjabi bagh, Dwarka, Anand vihar.Delhi cant was selected as residential ite Punjabi bagh a commercial site, dwarka & anand vihar as industrial site. PM_{10}, $PM_{2.5}$, SO_X, NO_X, CO , O_3 were studied at all the selected stations as per standard method.

Table- 1 Showing sampling stations for ambient air quality monitoring

S. No.	Name of Location	Date of sampling	Type of Station
1.	Delhi Cant	February 2020	Commercial
2.	Panjabi Bagh	February 2020	Residential
3.	Dwarka	February 2020	Industrial
4.	Anand Vihar	February 2020	Industrial

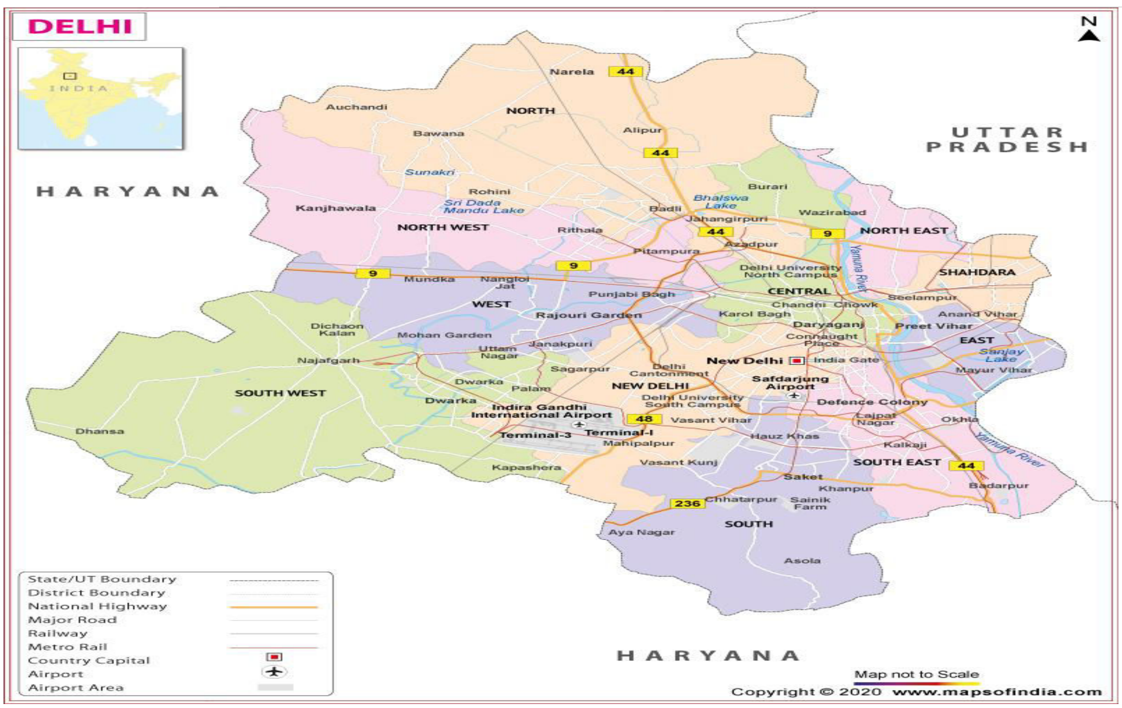


Fig-1. Map showing various sampling stations (Delhi cant, Panjabi bagh, Dwarka, and Anand vihar).

RESULT AND DISCUSSION

Ambient air quality of New Delhi was measured at four sampling site. Site were categorized in to residential, commercial & industrial site.PM_{10} was measured at all the four stations with the help of Reparable Dust Sampler (RDS). The maximum ground level concentration (GLC) was found 338.78 $\mu g/m^3$ at

Anand vihar industrial site followed by Dwarka industrial site 259.6 5 µg/m3. From table – 2 it clear that PM_{10} values at all the sampling site were higher than permissible limit (100 µg/m^3) (Table – 3) Fig-2.

$PM_{2.5}$ was measured at all site with the help of RDS. The results obtained are given in table -2 (Fig- 3). The higher values of $PM_{2.5}$ was found 157.75 µg/m^3 at Anand vihar industrial site followed by 123.32 µg/m^3 at Dwarka industrial site. In residential & commercial site it was found 109.56 & 109.98 µg/m^3 respectively.This parameter was higher than the limit (60 µg/m^3) at all the sampling site.

The values of SO_2 , NO_X , CO and O_3 were found within the permissible limits (Table-3)(Fig – 2-3) at all residential, commercial & industrial site (table-2) all these parameters through within permissible limit highest values observed at industrial site followed by commercial & industrial site.

Table-2: Indian National Ambient Air Quality Standards (Government Gazette, 2009).

S.NO.	Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive area (notified by central Govt.)	
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide(SO_2) µg/m^3	Annual	50	20	➢ Improved West and Geake • Ultraviolet fluorescence
		24 hours	80	80	
2	Nitrogen Dioxide(NO_2) µg/m^3	Annual	40	30	➢ Modified Jacob & Hochheiser (Na- Arsenite) • Chemiluminescence
		24 hours	80	80	
3	Particulate Matter(PM_{10})µg/m^3	Annual	60	60	➢ Gravimetric ➢ TOEM • Beta attenuation
		24 hours	100	100	
4	Particulate Matter($PM_{2.5}$)µg/m^3	Annual	40	40	➢ Gravimetric ➢ TOEM • Beta attenuation
		24 hours	60	60	
5	Carbon Monoxide(CO)mg/m^3	8 hours	2	2	➢ Non Dispersive Infra RED (NDIR) Spectroscopy
		1 hours	4	4	
6	Ozone(O_3)µg/m^3	8 hours	100	100	➢ UV Photometric Chemiluminescence ➢ Chemical method
		1 hours	180	180	
7	Lead(Pb)	Annual	1	1	➢ ASS/ICP Method after sampling on EPM 2000 or equivalent filter paper • ED - XRF using Teflon filter
		24 hours	1	1	
8	Ammonia(NH_3)	Annual	100	100	• Chemiluminescence ➢ Indophenol blue method
		24 hours	400	400	
9	Benzene(C_6H_6)	Annual	5	5	➢ Gas chromatography based continuous analyser Adsorption and desorption followed by GC analyser
10	Benzo (a) Pyrene (BaP) - Particulate phase only	Annual	1	1	➢ Solvent extraction followed by HPLC / GC analyser
11	Arsenic (As)	Annual	6	6	➢ AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni)	Annual	20	20	➢ AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

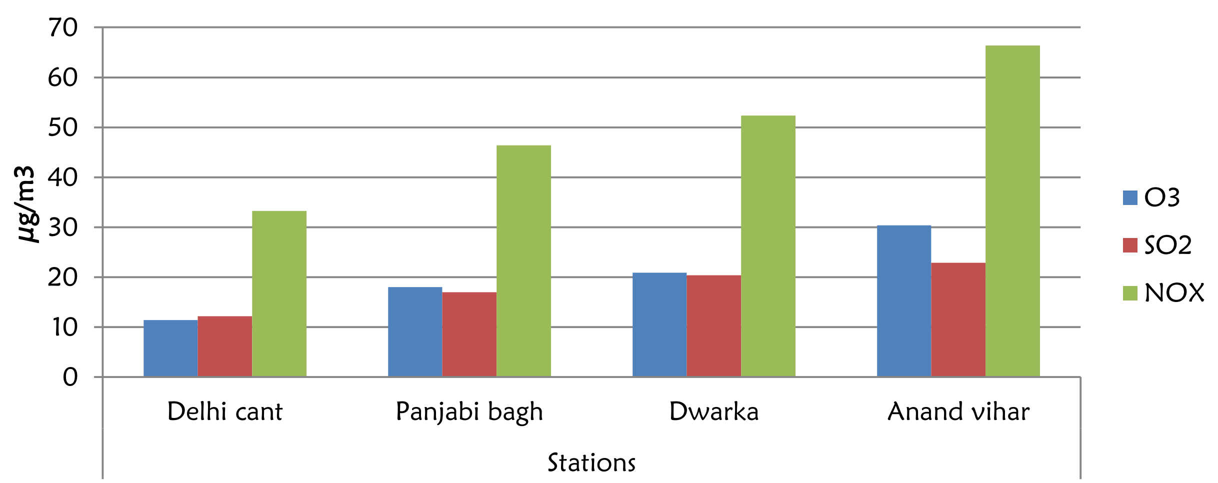
* Annual arithmetic mean of minimum 104 measurement in a year at a particular site taken twice a week 24 hourly at uniform intervals
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring.

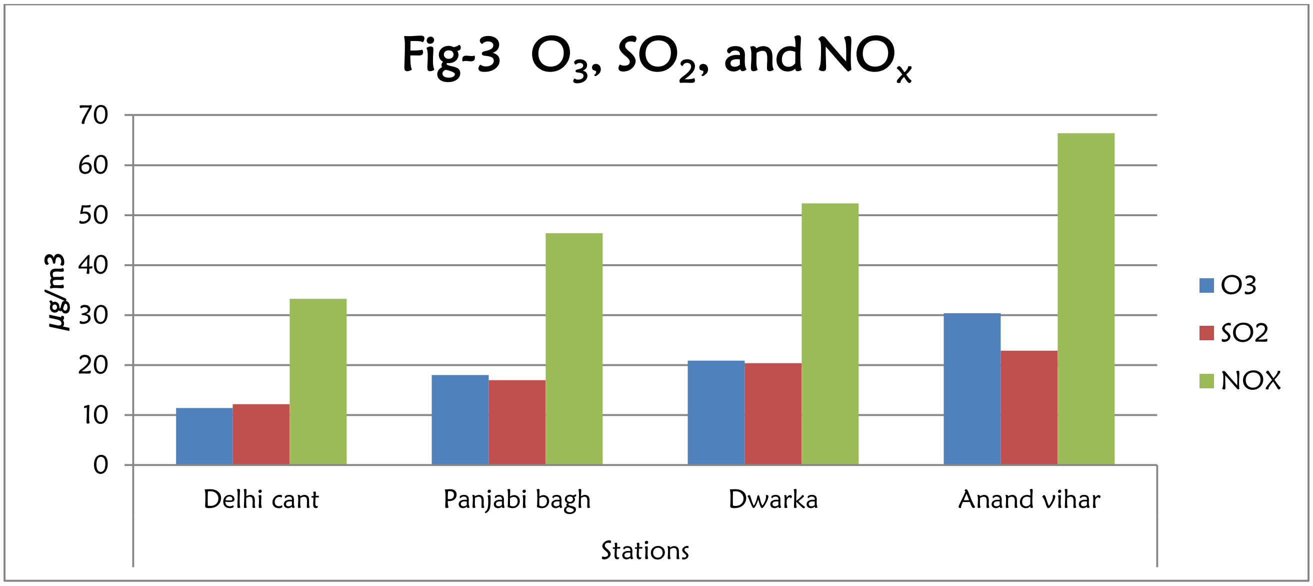
Note: whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

Table-3. Concentration of different air pollutant at selected stations.

Parameter	Stations			
	Delhi cant	**Panjabi bagh**	**Dwarka**	**Anand vihar**
	Residential site	**Commercial site**	**Industrial site**	**Industrial site**
PM_{10} (µg/m³)	188.07	223.73	259.65	338.78
$PM_{2.5}$ (µg/m³)	109.56	109.98	123.32	157.75
SO_2 (µg/m³)	12.18	16.96	20.35	22.84
NO_X (µg/m³)	33.27	46.39	52.37	66.40
CO (µg/m³)	1110.70	1305.07	1442.67	1556.10
O_3 (mg/m³)	11.39	17.98	20.88	30.36

Fig-2. PM_{10}, $PM_{2.5}$, & CO at different Stations





Conclusion

PM_{10} and $PM_{2.5}$ concentration was found highest in industrial area. All the selected site showing higher PM_{10} and $PM_{2.5}$ values than the standard.SO_X ,NO_X , CO and O_3 were found within the standard limit. Particulate problem may cause asthma and other respiratory disease to elderly people and children. Water sprinkler and plantation are the mitigation measure in order to minimize fugitive dust in the area.

Recommendations

1. Public transport must be strengthened to minimize use of personal vehicles.

2. Public awareness programmed should be conducted for highlighting harmful effects of vehicular/industrial/ air pollution.

3. Stop burning municipality waste, biomass, wood, leaves and solid waste.

4. Develop green belt area, market place, play grounds, especially in new area included in master plan.

5. Increase of monitoring station and regular monitoring of air quality.

6. Regular information of air quality data with minimum and maximum exposure period of the day and permissible limits to be shared with the public.

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