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Assesment of Air Pollutiion in Transgomti Areas in Lucknow, Uttar Pradesh

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Abstract

Researchers from the city have studied various aspects of air pollution during the last one and half decade, identified particulate matter as the main air pollutant in city .The objective of this article is to analyze the air pollution status of city, associated environmental and health impacts and possible control measures presented in studies on transgomti areas in Lucknow from the available literature.

Particulate fractions viz.; PM2.5, PM10 and SPM were reported to be exceeded the National Ambient Air Quality Standards (NAAQS)limits in most of the studies but oxides of sulphur and nitrogen (SO_2 and NO_2) were within the limit of 80µg/m3. Lack of dispersion of pollutants in winter season was reported to be the main reason for highest air pollution during this season and minimum in monsoon due to washout by rains. Vehicular traffic was identified the major source of air pollution in the city. Particulates and associated toxic chemicals (metals and PAHs) and gaseous pollutant have found to be toxic to human and plants in Lucknow. The exposure of these pollutants is associated with cardiovascular and respiratory diseases, neurological impairments, increased risk of preterm birth and even mortality and morbidity. Air Quality Index with changing seasons, was studied and air monitoring was carried out at different road intersections selected in transgomti areas in Lucknow on the basis of levels of different pollutants in the ambience, the Air Quality Index was calculated to categorize the sites from very clean to polluted range.

Keywords: Air Pollution, Health Effects, Control Measures, Pollutants, Temporal Variation, Particulate Matter.

Introduction

Air pollution is a gas (or a liquid or solid dispersed through ordinary air) released in a big enough quantity to harm the health of people or other animals, kill plants or stop them growing properly, damage or disrupt some other aspect of the environment (such as making buildings crumble), or cause some other kind of nuisance (reduced visibility, perhaps, or an unpleasant odor).

Cause

Most common air pollutants in the urban environment are sulphurdioxide, Nitrogn dioxide; Carbon monoxide suspended particulate matter and ozone (D'Amato, 1999).

Smog (a combination of the words "smoke" and "fog") forms when sunlight acts on a cocktail of pollutant gases such as nitrogen and sulfur oxides, unburned hydrocarbons, and carbon monoxide; that's why it's sometimes called photochemical smog (the energy in light causes the chemical reaction that makes smog.)

Impact on Health

At elevated levels, all the pollutants including metals have adverse effects on human and environmental health. Accumulation of pollutants in the human body through inhalation of air is an important route. Results of the present study revealed that higher level of particulate matter**.** Depending on the level of exposure and the type of pollutant inhaled, these effects can vary, ranging from simple symptoms like coughing and the irritation of the respiratory tract to acute conditions like asthma and chronic lung diseases. Skin problems and irritations can develop due to prolonged exposure to several air pollutants, and a variety of cancer forms may develop after inhaling air contaminants. During 2001-2011, city recorded a growth of approximately 17, 25 and 160% in terms of area, population and number of vehicles. (Verma A..K.et al 2015).

Material and Methods

The meteorological data of the study site during measurement period have been presented in Table 1 .In order to evaluate the present status of the ambient air quality of Lucknow city, the whole city was divided in to three geographical regions i.e. trans-Gomti, central and southern regions. In each region, different road intersections, representing low to high traffic density, were selected for the purpose of air monitoring in different seasons. In the trans-Gomti region, 12 sites were selected as Kukrail forest picnic spot, Chhanilal crossing, HAL crossing, Gomti nagar police station intersection, Badshah nagar intersection, Vikas nagar intersection, Engineering college crossing, Picup bhawan intersection, Purania crossing, Munshipulia crossing, Sitapur road intersection and IT crossing and designated as T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11 and T12, respectively for convenience (Verma and Singh 2014)

A dichotomous high volume sampler (Envirotech make – APM460), especially designed to filter coarser particles (larger than 10 m size) from air stream on 0.5 m pore size watman GF/A filter paper, was used for monitoring of Suspended Paticulate Matter (SPM). For gaseous pollutants, an attachment device (make APM 411) with the high volume sampler was used to bubble air in glass impingers filled with absorbing solutions for monitoring of different gaseous pollutants like SO_2, NO_2 and O_3. During air monitoring, air stream was drawn in the impingers on the roadside from the respirable zone i.e. a height of 1.5 meter above the ground. The gaseous samples were collected by bubbling air in glass impingers filled with 25 ml of different absorbing solutions for different air pollutants i.e. potassium tetra chloromercurate (TCM) for SO_2,sodiumhydroxide sodium arsenite solution for NO_2 and potassium iodide solution for O_3, at the flow rate of 1.5 L/min. The samples were brought to the laboratory and analysed within reasonable time, following the standard methods i.e. West and Gaeke (1956) method for SO_2, Jacobs and Hochheiser (1958) for NO_2 and Byers and Saltzman (1958) for O_3. Air quality index was calculated, following the method of Verma et al. (2003) and on the basis of AQI, quality of ambient air in different locally ties was adjudged. Firstly, air quality rating of each parameter used for monitoring is calculated separately by the formula as under:

$$q = 100 \times V/Vs$$

where q stands for quality rating, V stands for observed value of the parameter and Vs for standard value recommended for that parameter.

If total 'n' no of parameters were considered for air monitoring, geometric mean of these 'n' number of quality ratings is calculated in the following way:

$$g = \text{anti}-\log n\,(\log a + \log b + \log c + \ldots + \log x)$$

where g= geometric mean, a,b,c,d,x= different values of quality rating, n= numbers of values of quality rating, log = logarithm.

A relationship between the

Gb concentration of different pollutants and traffic density was calculated statistically with the help of coefficient of correlation (Gomez and Gomez, 1984).

Review of Literature

The reviewed papers suggested that the inhalation of polluted air induces irritation of respiratory tract and may lead to accumulation in human body. Air pollutants exposure may lead to the substantial burden of disease. Premature death number and mass concentration, shape, size, composition of particulates and presence of co-pollutants determines their detrimental effects The estimated high values of excess cancer risk for metals associated with PM10and PM 2.5 in a study suggest the potential risk to cancer. Fine particulates less than 2.5 micron are the carriers of metals and are loaded with reactive species.which can pierce the present review, based on the studies conducted in Lucknow , identified particulate matter as the main air pollutant in the city. Most of the time particulate fractions (PM2.5, PM10, SPM) exceeded the NAAQS limits. Gaseous pollutants sulphur dioxide and nitrogen dioxide although remained within the NAAQS limits but were high enough to cause substantial damage to human and plant health.

Aim of the Study

India needs to generate regular information on the ambient concentration levels of repairable particulates and take urgent steps to control their emissions .There is an urgent need to adopt suitable strategies for air quality control to improve urban air quality. Epidemiological studies should be taken up to show how ambient air pollution is affecting people's health and quantify this information in order to provide policy tools for air quality planning. Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and local levels.

Results and Discussion

The ambient levels of gaseous and particulate pollutants in different localities of transgomti regions of Lucknow city in different seasons have been reflected in Tables 1to3 (Verma and Singh 2014). Air monitoring data indicate a wide variation in the levels of gaseous and particulate pollutants in different localities of trans-Gomti area of the city in different seasons. Among the 12 road transactions where the air monitoring was undertaken, the air was contaminated maximum with both gaseous and particulate pollutants at site T12, while at site T1, the air was least polluted. It was observed that during winter and summer seasons, SPM level was higher than the permissible limit of 200 µg/m3 at all the sites except at site T1 and ranged between 80.28 to 995.30µg/m3(Tables 1 and 2). The highest SPM level i.e. 995µg/m 3 was recorded during winter season at the site T12 with the maximum traffic density (6723 vehicles). However, during the rainy season, the SPM level was reduced significantly at all the selected sites of trans-Gomti region (Table 3). The ambient range of SPM load during this season was from 60.09 µg/m 3at site T1 to 641.22µg/m3 at site T12.Except at 4 sites T1, T2, T4 and T8, where the SPM level was found below the permissible limit of 200 µg/m3 (60.09,189.87, 198.34 and183.54 µg/m 3,

respectively), it was alarmingly higher at other sites than the permissible limit fixed by CPCB.As far as the atmospheric concentration of gaseous primary pollutants was concerned, SO_2 and NO_2 levels were also maximum i.e. 41.92 and 38.24 µg/m3, respectively, at site T12 during the winter season, while SO_2 was not detected and NO_2 was measured only 3.20 µg/m3at site T1 during the rainy season (Tables 2 and 4) (verma and singh ,2014). It was interesting to note that at no site, the level of SO_2 or NO_2 was higher than the permissible limit of 60 µg/m3 fixed by the CPCB for residential-cum-commercial area. However, O_3, which is a secondary pollutant, did not show any specific seasonal pattern in its concentration, but its concentration was generally higher in the summer season. The range of O_3 concentrations was between 3.87µg/m3(at site T2) and 28.59 µg/m3at site T8 during summer season (Table 2). Thus, it appears that the levels of gaseous pollutants were not alarming at any site in the trans-Gomti area even in winter season,when the concentrations of these pollutants were maximum.

Table 1 - Vehicular Traffic Density and Pollution Level in Transgomti T1-T12 Region of Lucknow City in Winter Season

	Sites Traffic Density (vehicle)			SO_2	NO_2	O_3	SPM
	Diesel	Petrol	Total	µg/m^3	µg/m^3	µg/m^3	µg/m^3
T1	42 ± 6	10 ± 1	52±7	42 ± 6	14.03	4.39	444.40
T2	1639 ± 64	160 ± 31	1799±75	42 ± 6	14.03	4.39	444.40
T3	1437 ± 59	390 ± 31	1827±90	26.32	25.08	4.87	438.80
T4	656 ± 44	97 ± 11	753 ±55	24.58	16.66	9.79	287.03
T5	2657 ± 60	321 ± 30	2987 ±90	34.52	16.57	4.87	458.0
T6	546 ± 31	177 ± 19	723 ±50	26.51	18.50	22.93	495.37
T7	497 ± 33	321 ± 37	818±70	20.0	26.73	14.14	671.29
T8	2289 ± 72	363 ± 22	2652±94	38.48	21.66	27.56	427.70
T9	1730 ± 62	166 ± 27	1896±89	26.39	23.50	18.78	643.50
T10	917 ± 50	440 ± 33	1357±83	34.42	29.38	20.75	430.54
T11	1369 ± 63	703 ± 46	2072 ±109	35.46	26.13	23.68	550.92
T12	4552 ± 190	2171 ± 89	6723 ± 279	41.92	38.24	13.90	995.30

Values are mean ± S.D.(n=5)

Table 2 Traffic Density and Pollution Level in Transgomti Region of Lucknow City in Summer Season

Sites	Traffic Density (Vehicle)			SO_2	NO_2	O_3	SPM
	Diesel	Petrol	Total	µg/m^3	µg/m^3	µg/m^3	µg/m^3
T1	50 ± 6	3 ± 1	53±7	Not detected	09.58	28.54	80.28
T2	1758 ± 52	195 ± 16	1953±68	25.12	15.28	03.87	348.52
T3	1289 ± 54	451 ± 39	1640±93	25.28	20.54	12.85	587.98
T4	714 ± 39	102 ± 9	816 ±48	23.58	12.35	10.28	349.75
T5	2280 ± 78	286 ± 20	2566 ±98	35.85	15.08	14.52	648.34
T6	550 ± 22	165 ± 18	715 ±40	87.54	15.82	19.85	359.18
T7	512 ± 40	295 ± 20	807±60	21.85	37.45	11.37	784.46
T8	2560 ± 81	412 ± 34	2972±94	40.00	20.23	28.59	312.12
T9	1697 ± 68	257 ± 21	1954±89	22.86	22.52	22.78	487.29
T10	892 ± 42	485 ± 19	1377±83	40.43	30.25	15.83	512.45
T11	1562 ± 60	785 ± 29	2347 ±89	30.28	25.84	20.41	780.27
T12	4268 ± 89	1529 ± 55	5797 ± 144	39.29	29.22	18.27	957.59

Table 3 Ttraffic Density and Pollution Level in Transgomti Region of Lucknow City in Rainy Season

Sites	Traffic density (vehicle)			SO_2	NO_2	O_3	SPM
	Diesel	Petrol	Total	µg/m^3	µg/m^3	µg/m^3	µg/m^3
T1	23 ± 3	3 ± 1	25±4	N.D.	3.20	15.86	60.09
T2	1265 ± 21	151 ± 12	1416±68	18.96	9..64	5.23	189.87
T3	1024 ± 68	320 ± 16	1640±93	12.36	11.80	6.59	312.12
T4	497 ± 11	100 ± 8	1344 ±48	15.78	8.26	5.94	198.34
T5	2058 ± 71	219 ± 12	597 ±98	28.95	9.22	8.26	416.38
T6	428 ± 12	150 ± 18	578 ±27	16.85	9.54	11.24	248.84
T7	318 ± 11	284 ± 19	807±30	12.58	21.05	6.82	518.95

T8	1892 ± 68	320 ± 16	2972±84	28.54	13.08	14.29	183.54
T9	1492 ± 33	148 ± 14	1954±47	19.52	15.27	13.50	286.20
T10	802 ± 27	321 ± 18	1377±45	30.00	30.25	11.00	214.85
T11	1257 ± 40	615 ± 26	2347 ±66	21.53	19.82	9.18	487.28
T12	4025 ± 84	1582 ± 43	5607 ± 127	35.42	27.46	12.05	641.22s

Values are mean±S.D. (n=5),N.D. Not detected.

It was observed that the concentrations of these pollutants were at their peak during the winter season and minimum during the rainy season at all the road intersections. At the most polluted site of trans-Gomti region i.e. site T12, the concentration of SO_2 was found to be 41.92 in winter season, 39.29 in summer season and 35.42 µg/m3 in rainy season, the NO_2 concentrations was 38.24 in winter season, 29.22 in summer season and 27.46 µg/m3 in rainy season and SPM concentration was 995.30 g/m3 during winter season, 957.59 µg/m3 during summer season and 641.22 µg/m3 during rainy season. However, O_3 concentration was 18.27 in summer season, 13.90 in winter season, and 12.05 µg/m3 in rainy season (Table 1to3) .It was noted that in trans-Gomti region, maximum decrease in SO_2 level was at site T3 (53%); in NsO_2 at site T3 (53%) and in SPM at site T8 (57%), whereas, minimum decrease in SO_2, NO_2 and SPM pollutants was of the order of 12.8% (at site T10), 2.1% (at site T10) and 9% (at site T5), respectively. No specific trend in decline of ozone concentration was observed with respect to different seasons.Cu, Fe, Mn, Ni, Pb and Zn in all the seasons. The results of the study indicate marked SS Particulate fraction PM10 assessed for heavy metals showed the presence of Cd, Cr, variations in the metal contents from different locations and differ significantly in different seasons(.Neha Mumtaz etal (2017).

The Detailed Result of Air Quality Monitoring Collect by IITR during 26th Sep. to 26th Oct. 2015

Location	RSPMPM10			PM2.5			SO_2			NOx		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Aliganj	144.9	217.9	171.6	61.1	92.8	76.8	9.7	16.6	12.6	24.8	51.2	38.3
VikasNagar	119.8	302.7	177.5	72.5	123.2	98.7	8.6	14.3	10.8	31.7	48.4	40.4
Gomti Nagar	130.5	244.5	183.2	68.2	105.2	83.6	8.4	19.1	14.1	33.9	69.4	46.5

The Detailed Result of air Quality Monitoring Collect by IITR during 26th Sep. to 26th Oct. 2016

L0cation	RSPMPM10			PM2.5			SO_2			NOx		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Aliganj	84.4	260.2	162.8	45.3	108.2	79.6	8.8	22.6	17.8	26.5	65.2	52.8
VikasNagar	60.1	302.7	175.0	38.8	134.5	87.5	8.3	18.9	16.2	23.9	60.7	47.9
Gomti Nagar	62.6	266.6	168.8	36.6	119.7	82.1	7.6	23.9	17.5	28.7	67.8	55.7

Conclusion

In trans-Gomti region, a maximum index value (68.42) was observed for site T12 during winter season, whereas minimum index value (2.77) was noted for site T1 during rainy season. On the basis of Air Quality Index the quality of ambient air in different localities was adjudged and it was found that during winter season, the site T1 was of very clear category; sites T2, T3, T4, T5, T6 and T7 came under fairly clean category, while, sites T8, T9, T10, T11 and T12 were moderately polluted . During summer season, the site T1 was very clean, sites T2, T3, T4, T5, T6, and T9 were under fairly clean category, and under moderately polluted category, were placed sites T7, T8, T10, T11 and T12 .In the same way, during rainy season, again site T1 was found to be very clean; sites T2, T3 and T4 were under clean category; sites T5, T6, T7, T8, T9, T10 and T11 were put under fairly clean category and only one site i.e. T12, fell under moderately polluted category.(verma and singh 2014).

These result shows that air concentration is reaching an alarming level in a locality.This could include health advisories to advice citizens or susceptible individuals to limit their certain activities.

Lucknow has witnessed significant growth during the last one and half decades and recorded similar trends of air pollution to other cities located in northern Indo Gangetic plains of India. Lucknow has a complex mix of air pollution like any other urban centers. The present review, based on the studies conducted in Lucknow, identified particulate matter as the main air pollutant in the city. Most of the time particulate fractions (PM2.5, PM10, SPM) exceeded the NAAQS limits. Gaseous pollutants sulphur dioxide and nitrogen dioxide although remained within the NAAQS limits, but were high enough to cause substantial damage to human and plant health.

The pollution levels in the city have increased in time and space. High traffic densities and abnormal meteorological factors adversely influenced the ambient air quality of Lucknow. Degraded air quality has adverse effects on building, materials, human health and plants. Air pollutants exposure may lead to the substantial burden of disease and premature death. Number and mass concentration, shape, size, composition of particulates and presence of co-pollutants determines their detrimental effect.

To make the city cleaner the education and awareness among the people is the first and most important step that should be taken.

Make strict rules and policies to check air pollution.Metro is boon, beside car pool even .cycle for short distance although..Planting trees and

avoiding burning plastic is I think few things we can do easily .

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