ASSESSMENT OF AMBIENT AIR QUALITY OF LUCKNOW CITY DURING PRE-MONSOON, 2015

FINDINGS OF A RANDOM SURVEY

Presented on

WORLD ENVIRONMENT DAY, 2015

ENVIRONMENTAL MONITORING DIVISION
CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH
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5th June 2015

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CONTENTS

Salient Features of the Study

- **Geographical Position** : 26^{o} 52' N Latitude
  80^{o} 56' E Longitude
  128 m above Sea Level
- **Area** : 310 sq. km.
- **Population** : 28,15033 as per 2011 Census
- **Projected Population** : 45 lakhs as per *Master Plan 2021*
- **Climate** : Subtropical climate, cool dry winter (Dec.- Feb.) & summer (Mar - Jun.). Temperature about 45^{0}C in summer to 3^{0}C in winter. Average annual rainfall about 100 cm.
- **Total Vehicular Population in Lucknow city as on 31/03/2015** : 17,09,662
- **Growth of Vehicle over 2013-2014** : 10.08%
- **Total No. of Filling Stations (Petrol/Diesel/CNG)** : 101
- **Consumption of Petrol** : 1,49,281 KL
- **Consumption of Diesel** : 1,58,534 KL
- **Consumption of CNG** : 2,77,40,909 Kg
- **Major Sources of Pollution** : Automobiles, D. G. sets, Civil Constructions
- **Parameters Monitored** : PM_{10}, $PM_{2.5}$, SO_2, NO_X, trace metals and noise level.
- **Study Conducted by** : Environmental Monitoring Division CSIR- IITR, Lucknow

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CSIR- Indian Institute of Toxicology Research
M.G. Marg, Lucknow

1.0 SUMMARY

The study was carried out during the months of April-May, 2015 to assess the status of air quality by monitoring and assessment of some selected air pollutants namely Respirable Particulate Matter (RSPM or PM_{10}), Fine particles ($PM_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen (NOx) and trace metals-Lead (Pb) and Nickel (Ni) and noise level at 9 representative locations, categorized as residential (four), commercial (four) and industrial (one) areas in Lucknow city. The results revealed the 24 hours concentration of PM_{10} to be in the range of 119.8 to 316.7 $\mu g/m^3$ with an average of 197.6 $\mu g/m^3$. The 24 hours concentration of $PM_{2.5}$ was found to be in the range of 62.6 to 163.4 $\mu g/m^3$ with an average of 97.3 $\mu g/m^3$.The average values of PM_{10} and $PM_{2.5}$ irrespective of locations were found to be above the permissible limit (100 $\mu g/m^3$ for PM_{10} and 60 $\mu g/m^3$ for $PM_{2.5}$ prescribed by MoEF). 24 hours concentration of SO_2 and NOx were found to be in the range of 8.4 to 22.8 and 24.8 to 96.7 $\mu g/m^3$ with an average concentration of 13.5 and 53.0 $\mu g/m^3$ respectively and all the values were below the permissible limits (80 $\mu g/m^3$). The mean level of trace metals were Ni = 24.3 and Pb = 136.1 ng/m^3. *Noise levels during day and night time were found to be in the range of 68.9 to 74.8 dB (A) and 51.7 to 69.4 dB (A) respectively which was above the respective permissible limits except in industrial area.*

1.1 INTRODUCTION

Common people living in urban areas, have now-a-days started talking about air pollution because of public awareness and as a large number of people are suffering from different air pollution induced respiratory and pulmonary disease with higher morbidity and mortality. Normally the initial symptoms show decrease in lung function, asthma, coughing and difficulty in breathing, etc. In urban areas, sources of air pollution are vehicular pollution, burning of solid waste, use of genset during power cut, etc. The health effects of air pollution depend on the nature and level of air pollutants in breathing air which mainly depends on the pollution source. In general, vehicles use petrol, diesel and natural gas. Combustion of these fuels generates air pollutants like Particulate matter (different size), SO_2, NOx, CO, CO_2, trace metals, organic pollutants and different types of methane and non-methane volatile organic compounds. These are the common pollutants reported in different scientific studies carried out throughout the world. The adverse effects are dependent on the concentrations, but sometimes the pollutants affect synergistically at lower concentrations and longer exposure durations. Besides, health effects, another major area of concern is the green house gases (GHG's) namely CO_2, and methane which are responsible for the global warming.

With advancement of technology, the efficiency of vehicular engine and quality of fuel have increased which has led to reduction of air pollutant level in ambient air with respect to per unit of fuel used and travel. On the other hand, increase in volume of fuel consumption and the number of vehicular population are the major concerns in respect of keeping of the air pollutants at a safe level. Now-a-days, it is desirable for people to think about sustainable development as well as the rational use of natural resources for betterment of their own health and environment.

Lucknow is a fast growing city. In 1951, area of Lucknow was 48 sq km which has now increased to 310 sq.km in 2011. The city witnessed development of new areas like Mahanagar, Indira Nagar, Aliganj, Gomti Nagar towards the end of the 20^{th} century. During the last 20 years, rapid development has taken place in the city and practically most of the open space available has been occupied for the construction of residential, commercial and office buildings. In the meantime, trend of multistoried apartments have also picked up in the city. The density of population in the central

part has increased to a great extent which has put considerable pressure on management of services, facilities and amenities. Thus new spaces for city expansion are being hunted for by development authorities and even private developers on the roads connecting neighboring areas. Lucknow Development Authority has developed many residential townships along Kanpur Road, Hardoi Road, Kursi Road, Faizabaad Road, Sultanpur Road, Raibareli Road. Also, uncontrolled construction of unauthorized residential colonies on agricultural land has taken place over the years. As a result there has been an increase in air pollution levels of the city.

In view of the above facts, it is need of the hour to look into the air quality of our city Lucknow, the capital of Uttar Pradesh which has a population of 28.15 Lakh (Municipal corporation + Cantonment) as per 2011 census and an area of 310 sq. km. Vehicular traffic is the main source of particulate air pollution in Lucknow city. The number of different categories of vehicles registered with RTO (Regional Transport Office) Lucknow is **:** 17,09,662 as on 31.03.2015 which is 10.08% higher over the last year (Table 1). Uttar Pradesh State Road Transport Corporation (UPSRTC) introduced bus services under the banner "*Lucknow City Transport Services Limited*" on different routes of Lucknow city. The details of bus routes and number of buses plying as on 31.03.2015 are given in Table 2. In Lucknow city there are 101 filling stations for petrol, diesel and CNG operated by different oil and gas companies (Table 3).

As per Indian Oil Corporation (IOC), the consumption/sale of petrol and diesel was 1,49,281 and 1,58,534 KL as on 31-03-2015. It is observed that petroleum sale has increased by 7.6% whereas sale of diesel has increased by 2.13%. (Table 4). In Lucknow there are six CNG filling stations and consumption of CNG in the last year was approximately 2,77,40,909 kg (2014-15) which was 5.66% higher than the previous year (2013-14) (Green Gas Limited, Lucknow). Distribution and number of CNG vehicles in Lucknow is summarized in Table 5. Considering the above, assessment of ambient air quality of Lucknow city was carried out at 9 locations during pre monsoon (April-May), 2015 with respect to PM_{10}, $PM_{2.5}$, SO_2, NO_x, Trace metals and Noise level with the following aims and objectives.

- *To assess the ambient air quality with respect to PM_{10}, $PM_{2.5}$, SO_2, NOx, and trace metals (Ni and Pb) associated with PM_{10}.*

- *To study trends of pollutants over a period of time.*
- *To assess day and night time noise to ensure compliance of permissible noise levels*
- *To create a database for future use.*
- *To create public awareness about environmental pollution.*

Table 1. Vehicles Registered with R.T.O. Lucknow during 2013-14 and 2014-15

Sl. No.	Type of Vehicle	Number of Registered Vehicles on 31st March		% Change
		2013-14	2014-15	
1	Multi Articulated	2974	3514	18.15
2	Light, Medium and Heavy weight Vehicles (Four wheeler)	18430	20930	13.56
3	Light commercial vehicles (Three wheeler)	3225	3413	5.82
4	Buses	3249	3306	1.7
5	Taxi	7797	9153	17.39
6	Light Motor Vehicles (Passenger)	7743	7562	-2.3
7	Two wheelers	1238691	1361787	9.9
8	Car	221019	244121	10.45
9	Jeep	22175	26019	17.33
10	Tractor	22010	23679	7.58
11	Trailors	1469	1580	7.55
12	Others	4283	4598	7.35
Total		**1553065**	**1709662**	**10.08**

Source: RTO, Lucknow

Table 2. Details of Lucknow City Bus Service, 2015

Sl. No.	Route No.	To and Fro	No. of Buses	Frequency
1	11	BBD -Chinhat-Gomti Nagar-Alambagh	18	10 minutes interval
		Malhaur railway station-Gomtinagar-Dalibagh-Charbagh		
		Charbagh-Alambagh-Avadh hospital-SGPGI		
		Charbagh- Alambagh -Sardar Patel Dental college		
		BBD-Chinhat- Avadh hospital		
		Charbagh- Alambagh- BBAU		
		Charbagh-Alambagh- Gopesh Kunj-Kalindi Park		
		Khargapur-Patrakarpuram-Alambagh		
2	12	BBD- Chinhat- Charbagh- Alambagh-Scooter India	16	15 minutes interval
		Samarpan college- Chinhat-Charbagh- Alambagh- Scooter India		
		BBD-Charbagh- Alambagh- Paasi Kila		
3	13	Charbagh –Mobaiya-Alambagh thana-Teri Phulia-Alambagh-bus stand-Awadh Hospital-Krishnanar thana-Natherganj – Scooter India-Koti Bagia.	06	12 minutes interval
3	23	Gudamba – Vikasnagar- Alambagh- Rajnikhand	22	10 minutes interval
		Gudamba –Badshanagar – Avadh hospital		
4	24	Engineering College-Indiranagar-Charbagh-Alambagh-Paasi Kila	10	15 minutes interval
		Manas Bihar colony- Scooter India		
		Munshipulia- Alambagh-Kasiram Yojna-Avadh hospital		
6	31	Alambagh – IIM	02	60 minutes interval
7	33	Engineering College-Charbagh-Alambagh-Scooter India	16	10 minutes interval
8	45	Virajkhand-Gomtinagar-Charbagh-Alambagh-Paasi Kila	17	
		Total	107	15 minutes interval

Source: Lucknow City Transport Services Limited.

Table 3. Fuel Outlets in Lucknow City

Sl. No.	Agency	Number of outlets
		31st March 2015
1	Indian Oil Corporation (IOC)	48
2	Bharat Petroleum Corporation Ltd. (BPCL)	22
3	Hindustan Petroleum Corporation Ltd. (HPCL)	25
4	Compressed Natural Gas Stations (CNG)	6
	Total	**101**

Source: Indian Oil Corporation (IOC), Lucknow

Table 4. Consumption of Fuel (in KL) in Lucknow

Sl. No.	Agency	Petrol in KL			High Speed Diesel in KL			*CNG in Kg		
		Apr. 13 to Mar. 14	Apr. 14 to Mar. 15	% Change	Apr. 13 to Mar. 14	Apr. 14 to Mar. 15	% Change	Apr. 13 to Mar. 14	Apr. 14 to Mar. 15	% Change
1	IOC	77693	82951	6.80	88234	86092	-2.40	---		
2	BPCL	34178	37673	8.10	31497	34179	10.10	---		
3	HPCL	26884	28657	9.20	35495	38263	6.40	---		
4	Green Gas	--			--		--	26255742	27740909	5.65
Total		**138755**	**149281**	**7.60**	**155226**	**158534**	**2.13**	**26255742**	**27740,909**	**5.66**

*Source: Indian Oil Corporation (IOC), Lucknow, * CNG Source: Green Gas Limited, Lucknow*

Table 5. Distribution of CNG vehicles

Sl. No.	Vehicles	Number		% of change
		2013-14	2014-15	
1	Auto Rickshaws	4343	4343	0
2	Tempo Taxi	2575	2575	0
3	Buses (UPSRTC)	260	262	7.69
4	Buses (Private)	36	34	-5.55
5	School Buses	985	1033	4.87
6	School Van	962	1154	19.95
7	Private Vehicles	205	258	25.85
8	Private Cars	7943	8940	12.55
	Total	**17309**	**18599**	**7.45**

Source: Green Gas Limited and RTO, Lucknow

1.2 MONITORING LOCATIONS AND METHODOLOGY

Nine air quality monitoring locations representing different activities/areas i.e., four in residential, four in commercial cum traffic and one industrial area were selected for the study as summarized in Table 6. Brief description of each location is given in our earlier reports (Pre and Post monsoon, 2010) and parameters along with methodology are given in Table 7.

Table 6. Monitoring Locations

Sl . No.	Locations	Activities
1	Aliganj	Residential
2	Vikas Nagar	Residential
3	Indira Nagar	Residential
4	Gomti Nagar	Residential
5	Charbagh	Commercial cum traffic
6	Alambagh	Commercial cum traffic
7	Aminabad	Commercial cum traffic
8	Chowk	Commercial cum traffic
9	Amausi	Industrial

”

Table 7. Parameters and Methodology for Air Quality Monitoring

Sl. No.	Parameters	Time Weighted average	Methods of Measurement
1	Particulate Matter- PM_{10}	24 hours	Gravimetric
2	Fine Particles ($PM_{2.5}$)	24 hours	Gravimetric
3	Sulphur dioxide (SO_2)	24 hours	Improved West Gaeke
4	Nitrogen Dioxide(NO_2)	24 hours	Modified Jacob & Hochhesier (Na-Arsenite)
5.	Trace Metals - (Pb & Ni)	24 hours	AAS method after sampling on EPM 2000.
6	Noise Level	1 hour	The measurement of noise level was carried out during the day (6 AM to 10 PM) and night time (10 PM to 6 AM) by Noise level Meter.

1.3 RESULTS

The detailed results of air quality monitoring are presented in Table 8 and Fig. 1.

1.3.1 Respirable Suspended Particulate Matter (RSPM or PM_{10})

In residential areas (Aliganj, Vikas Nagar, Indira Nagar and Gomti Nagar), the 24 hours average concentrations of PM_{10} were in the range of 171.6 to 197.5 $\mu g/m^3$ with an average of 182.5 $\mu g/m^3$. In commercial areas (Charbagh, Alambagh, Aminabad and Chowk) the average concentrations of PM_{10} were in the range of 174.7 to 240.9 $\mu g/m^3$ with an average of 212.4 $\mu g/m^3$ respectively. In industrial area (Amausi), the average concentrations of PM_{10} was 199.4 $\mu g/m^3$.

The maximum 24 hours mean concentration of PM_{10} was observed in Indira Nagar (197.5 $\mu g/m^3$) in residential area and Charbagh (240.9 $\mu g/m^3$) in commercial areas.

All the values of PM_{10} were above the prescribed National Ambient Air Quality Standard (NAAQS) of 100 $\mu g/m^3$ for industrial, residential, rural and other areas respectively.

1.3.2 Fine Particulate Matter ($PM_{2.5}$)

In residential areas (Aliganj, Vikas Nagar, Indira Nagar and Gomti Nagar), the 24 hours average concentrations of $PM_{2.5}$ were in the range of 76.8 to 100.9 $\mu g/m^3$ with an average of 90.0 $\mu g/m^3$. In commercial areas (Charbagh, Alambagh, Aminabad and Chowk) the average concentrations of $PM_{2,5}$ were in the range of 83.2 to 116.5 $\mu g/m^3$ with an average of 104.8 $\mu g/m^3$ respectively. In industrial area (Amausi), the average concentrations of $PM_{2.5}$ was 96.9 $\mu g/m^3$.

The maximum 24 hours mean concentration of $PM_{2.5}$ was observed in Indira Nagar (100.9 $\mu g/m^3$) in residential area and Charbagh (116.5 $\mu g/m^3$) in commercial area.

All the values of $PM_{2.5}$ were above the prescribed National Ambient Air Quality Standard (NAAQS) of 60 $\mu g/m^3$ for industrial, residential, rural and other areas.

1.3.3 Sulphur dioxide (SO_2)

In residential areas (Aliganj, Vikas Nagar, Indira Nagar and Gomti Nagar) the mean levels of SO_2 were in the range of 10.8 to 15.1 $\mu g/m^3$ with an average of 13.1 $\mu g/m^3$. In commercial areas (Charbagh, Alambagh, Aminabad and Chowk) the

average concentrations of SO_2 were in the range of 11.6 to 16.6 µg/m^3 with an average of 14.7 µg/m^3. In industrial area (Amausi) the mean level of SO_2 was 10.2 µg/m^3.

All the values of SO_2 were well below the prescribed NAAQS of 80 µg/m^3 for all the locations.

1.3.4 Oxides of Nitrogen (NOx)

In residential areas (Aliganj, Vikas Nagar, Indira Nagar and Gomti Nagar) the 24 hours average concentrations of NO_X were found in the range of 38.3 to 48.0 µg/m^3 with an average of 43.3 µg/m^3. In commercial areas (Charbagh, Alambagh, Aminabad and Chowk) the average concentrations of NO_X were found in the range of 48.8 to 71.6 µg/m^3 with an average of 62.3 µg/m^3. In industrial areas Amausi) the average concentration was 54.4µg/m^3

All the values of NO_x were within the prescribed NAAQS of 80 µg/m^3 for all the monitoring locations.

Table 8: Concentration (µg/m^3) of PM_{10}, $PM_{2.5}$, SO_2 and NOx during Pre monsoon 2015

Location	PM_{10} (RSPM)			$PM_{2.5}$			SO_2			NOx		
Residential	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	16.1	12.6	24.8	51.2	38.3
Vikas Nagar	119.8	243.0	177.5	72.5	123.2	98.7	8.6	14.3	10.8	31.7	48.4	40.4
Indira Nagar	150.1	261.2	197.5	64.8	142.6	100.9	10.7	22.8	15.1	34.3	57.0	48.0
Gomti Nagar	130.5	244.5	183.2	68.2	105.2	83.6	8.4	19.1	14.1	33.4	69.4	46.5
Commercial												
Charbagh	151.6	316.7	240.9	78.8	163.4	116.5	10.0	21.1	16.6	37.0	96.7	71.6
Alambagh	171.5	275.8	224.8	66.8	135.8	114.8	8.7	20.1	16.0	46.8.	80.9	66.7
Aminabad	133.3	232.3	174.7	62.6	115.2	92.3	9.2	14.2	11.6	32.8	65.9	48.8
Chowk	159.6	260.1	209.1	76.1	136.1	95.4	12.5	17.1	14.8	45.0	77.2	62.3
Industrial												
Amausi	148.0	279.5	199.4	63.0	182.9	96.9	8.6	11.5	10.2	50.9	60.1	54.4
NAAQS	100			60			80			80		
WHO Guidelines	50			25			20*			40*		

N=6, *= Annual Average, NAAQS=National Ambient Air Quality Standards

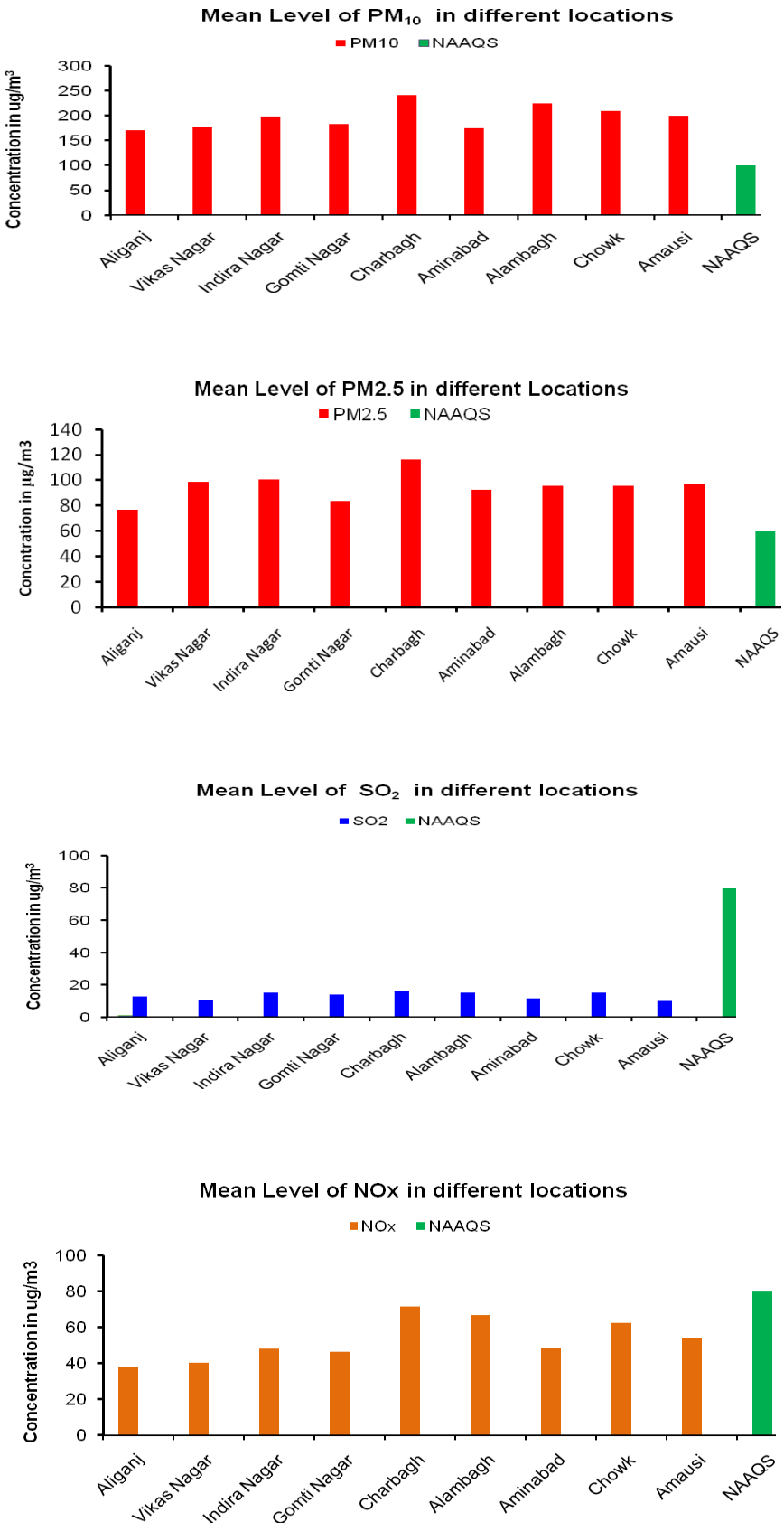

Fig 1: Concentration (µg/m^3) of PM_{10}, $PM_{2.5}$, SO_2 and NO_x in different areas of Lucknow city during pre monsoon season (2015) and compared with prescribed National Ambient Air Quality Standard (NAAQS)

1.3.5 Trace Metals in Ambient Air (RSPM)

The trace metals (Pb and Ni) were estimated in ambient air associated with PM_{10} at 9 monitoring locations. The results are present in Table 9.

The 24 hr mean concentration of metals were found to be Pb = 136.09 (64.23 -269.7) and Ni = 24.30 (11.69 – 39.28) ng/m^3.

Table -9 : Metal Concentration in ng/m^3 associated with PM_{10}

Sl. No.	Location	Lead(Pb)	Nickel (Ni)
1	Aliganj	64.23	18.41
2	Vikas Nagar	102.6	11.69
3	Indira Nagar	178.0	24.09
4	Gomti Nagar	156.0	14.14
5	Charbagh	129.2	39.28
6	Alambagh	269.7	37.42
7	Aminabad	119.0	30.52
8	Chowk	92.2	25.36
9	Amousi	113.9	17.76
Mean		**136.09**	**24.29**
NAAQS		**1000**	**20***

N= 1, *=Annual Average

1.3.6 Noise

The monitoring data recorded during the pre monsoon period (May, 2015) is presented in Table 10.

In residential areas, the day and night time noise levels were recorded between 68.9 to 74.1 and 57.3 to 60.1 dB(A) respectively. All the values were higher than the prescribed limit of 55 and 45 dB (A) for day and night time respectively.

In commercial and traffic area, the day and night time noise levels were recorded between 69.2 to 74.8 and 51.7 to 69.4 dB(A) respectively. Noise level at all the commercial sites during day and night time were found above the prescribed limits of 65 and 55 dB (A) respectively.

In industrial area Amausi, the day and night time noise levels were recorded 72.5 and 66.1 dB (A) respectively. Noise levels at all industrial locations in the day and night time was found below the prescribed limits of 75.0 and 70.0 dB(A) respectively.

Table 10. Noise Level dB (A) during Day and Night Time

Sl. No.	Area	Location	Noise level dB(A)	
			Day	Night
1	**Residential**	Aliganj	68.9	59.5
		Vikas Nagar	70.5	57.3
		Indira Nagar	74.1	60.1
		Gomti Nagar	71.5	58.1
		Standard	**55.0**	**45.0**
2	**Commercial**	Charbagh	74.8	69.4
		Alambagh	74.1	66.2
		Aminabad	71.3	51.7
		Chowk	69.2	60.6
		Standard	**65.0**	**55.0**
3	**Industrial**	Amausi	72.5	66.1
		Standard	**75.0**	**70.0**

1.4 TRENDS OF AMBIENT AIR QUALITY IN LUCKNOW CITY

The observed PM_{10}, SO_2 and NO_x for 3 years data have been compared to find out the prevailing trend of air pollution in Lucknow city (Fig. 2-4). A slight change in the values may be attributed to some local environmental and climatic factors.

1.4.1 Respirable Suspended Particulate Matter (RSPM or PM_{10})

In the residential areas, comparatively lower values were found at all the residential areas whereas lower values were also observed in all the commercial areas (except Alambagh) and one industrial area when compared to the data of the previous year. All the values are higher than the NAAQS (Fig. 2).

1.4.2 Sulphur dioxide (SO_2)

The level of SO_2 during pre monsoon since 2012 is presented in Fig. 3 for all the locations.

In residential areas, lower values of concentration of SO_2 was found compared to that the previous year at all the locations. Among the commercial areas, SO_2 values showed decreasing trend over the last year. Amausi, industrial area also showed decreasing trend over the last year. All the values of the present study were found to be lower than the NAAQS (Fig. 3).

1.4.3 Oxides of Nitrogen (NO_x)

The level of NOx during pre monsoon since 2012 is presented in Fig. 4 for all the locations. Among the residential areas all the locations showed increasing trend at all the locations, where in commercial areas all the locations also showed increasing trend and the only industrial area Amausi showed higher value when compared with the previous year data. All the values of the present study were found to be lower than the NAAQS (Fig. 4).

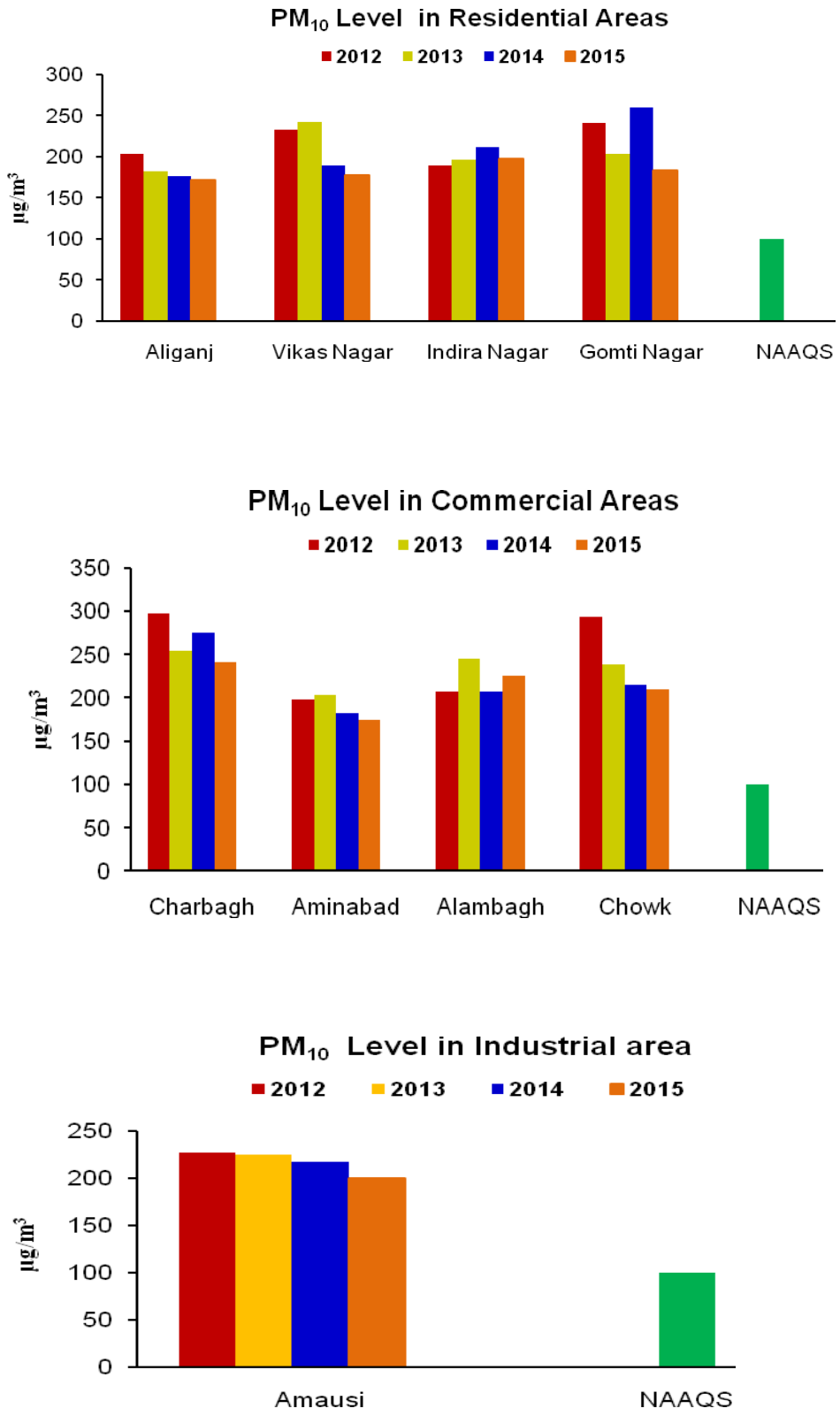

Fig 2: Concentration (µg/m^3) of PM_{10} **(**RSPM**)** in Residential, Commercial and Industrial areas of Lucknow city during 2012 to 2015 and compared with prescribed National Ambient Air Quality Standard (NAAQS)

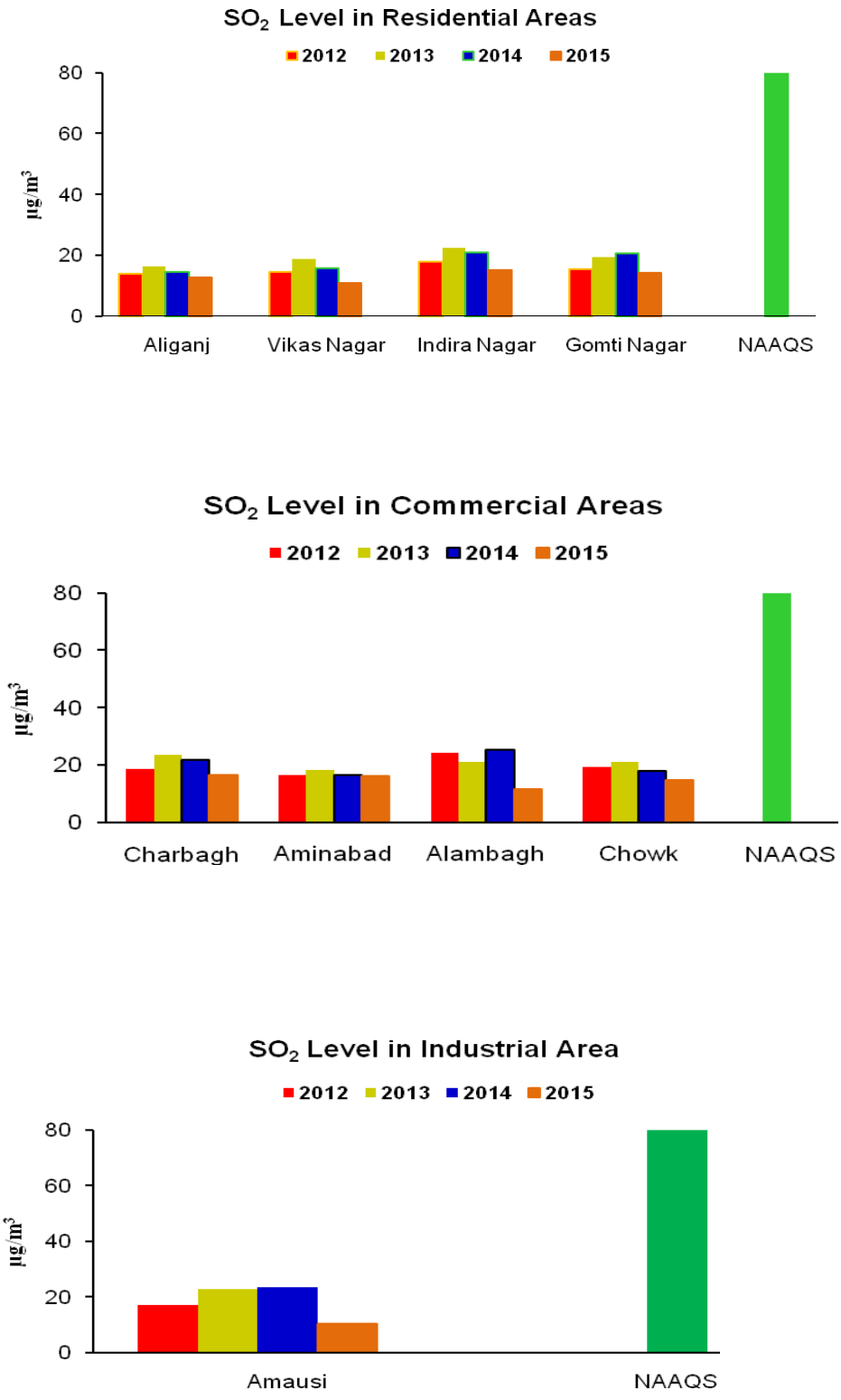

Fig 3: Concentration (µg/m^3) of SO_2 in Residential, Commercial and Industrial areas of Lucknow city during 2012 to 2015 and compared with prescribed National Ambient Air Quality Standard (NAAQS)

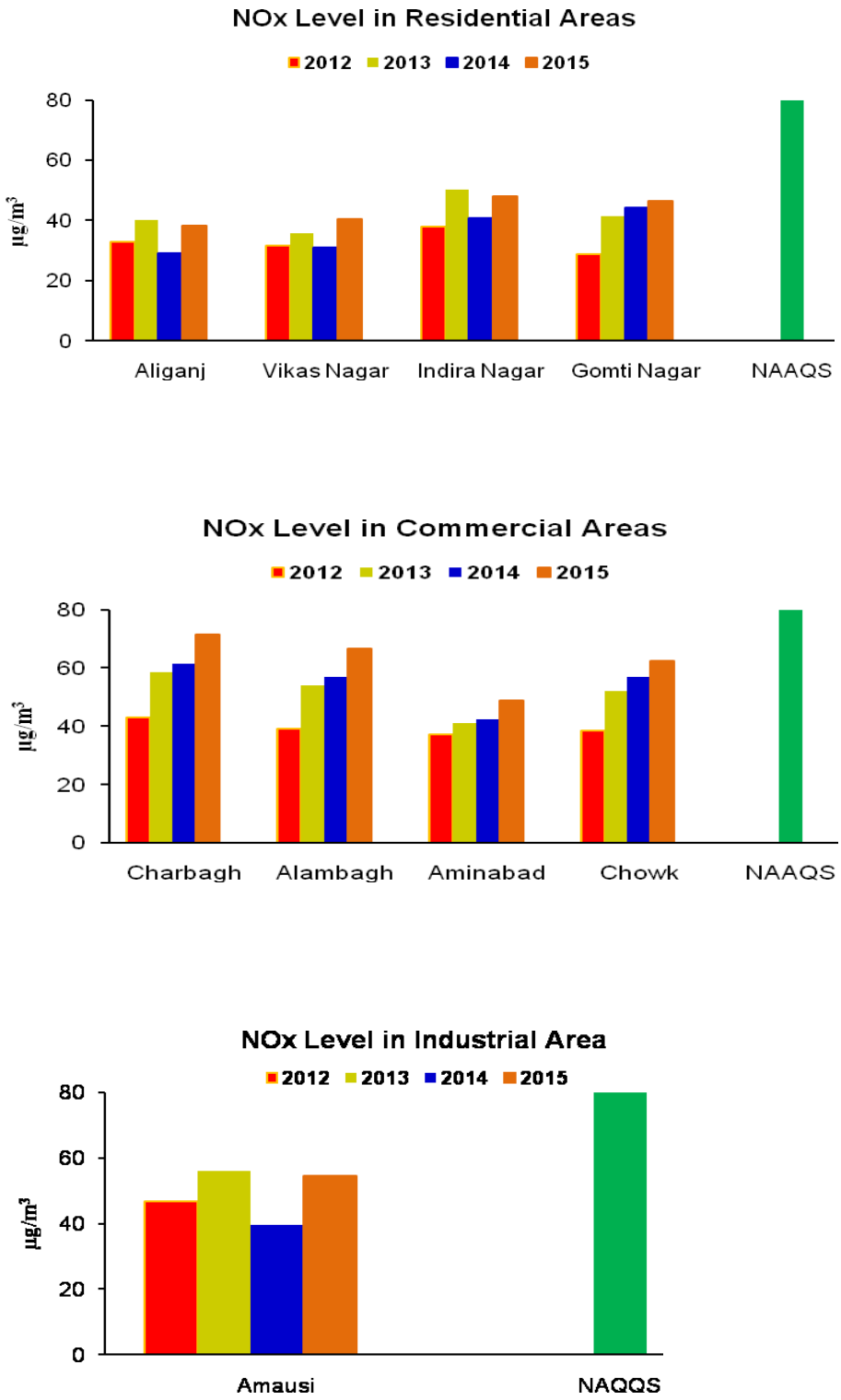

Fig 4: Concentration (µg/m^3) of NO_x in Residential, Commercial and Industrial areas of Lucknow city during 2012 to 2015 and compared with prescribed National Ambient Air Quality Standard (NAAQS)

1.4.4 Noise Level

Current year's noise data has been compared with the corresponding data of the previous three years (2012 to 2015) and are presented in Fig. 5 and 6. The comparative noise levels in residential, commercial and industrial areas are described below:

1.4.4.1 Day time Noise Level

In residential areas, all the locations showed slightly increasing trend over that of the previous year except Indira Nagar. In commercial cum traffic areas, noise level was found to be on the higher side at all the locations were recorded compared to that of previous year, except at Alambagh. In industrial area, Amausi the noise level was slightly lower than that of the previous year. The comparative data are presented in (Fig.5).

1.4.4.2 Night time Noise Level

Residential areas showed slightly higher level than that of the last year except Indira Nagar and Vikas Nagar. In commercial areas, little variation was recorded and the only industrial area showed slightly lower value than that of the previous year. The comparative data are presented in (Fig. 6).

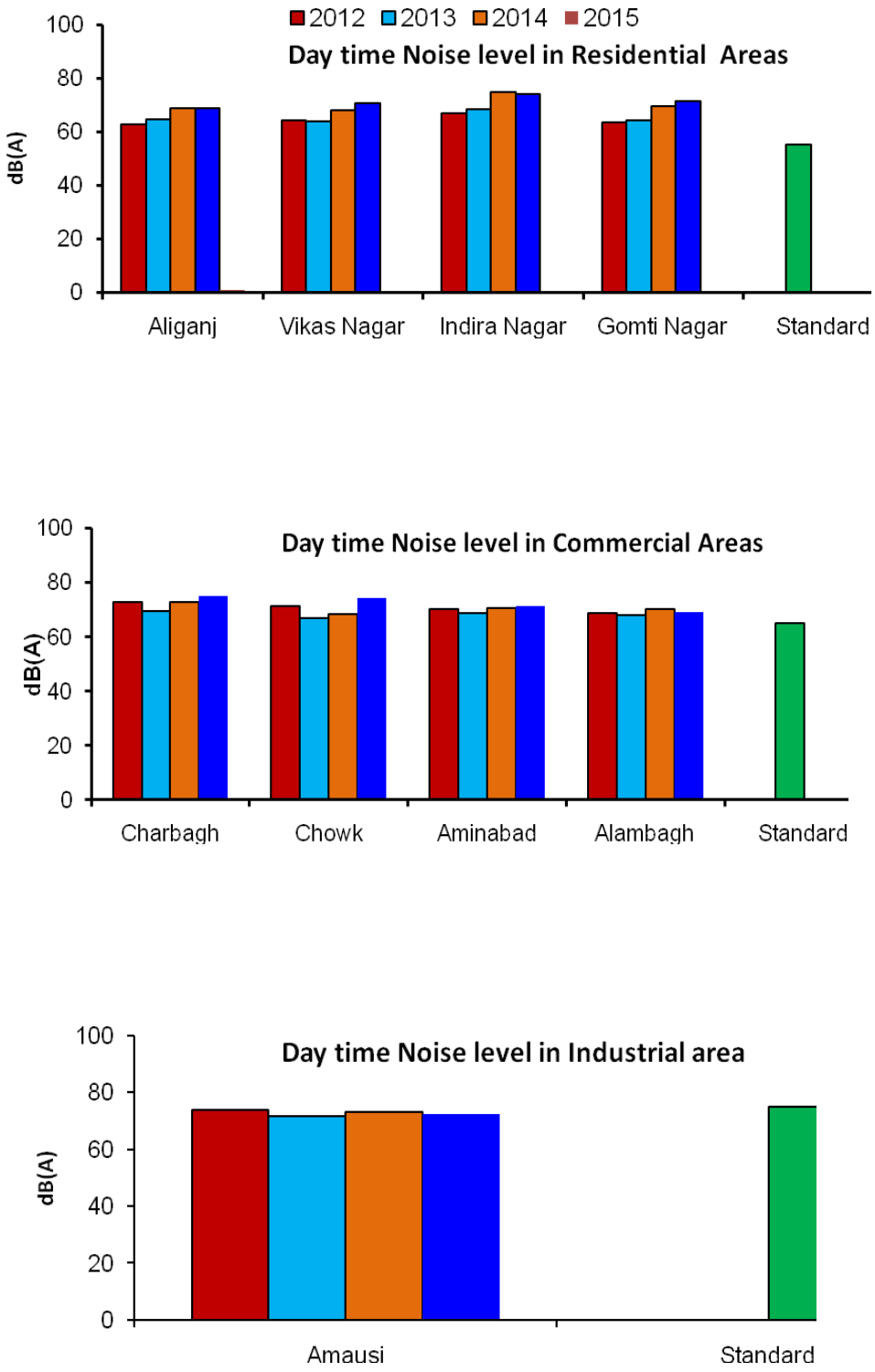

Fig 5: Comparison of day time Noise Level dB(A) in different areas of Lucknow city (2012-2015)

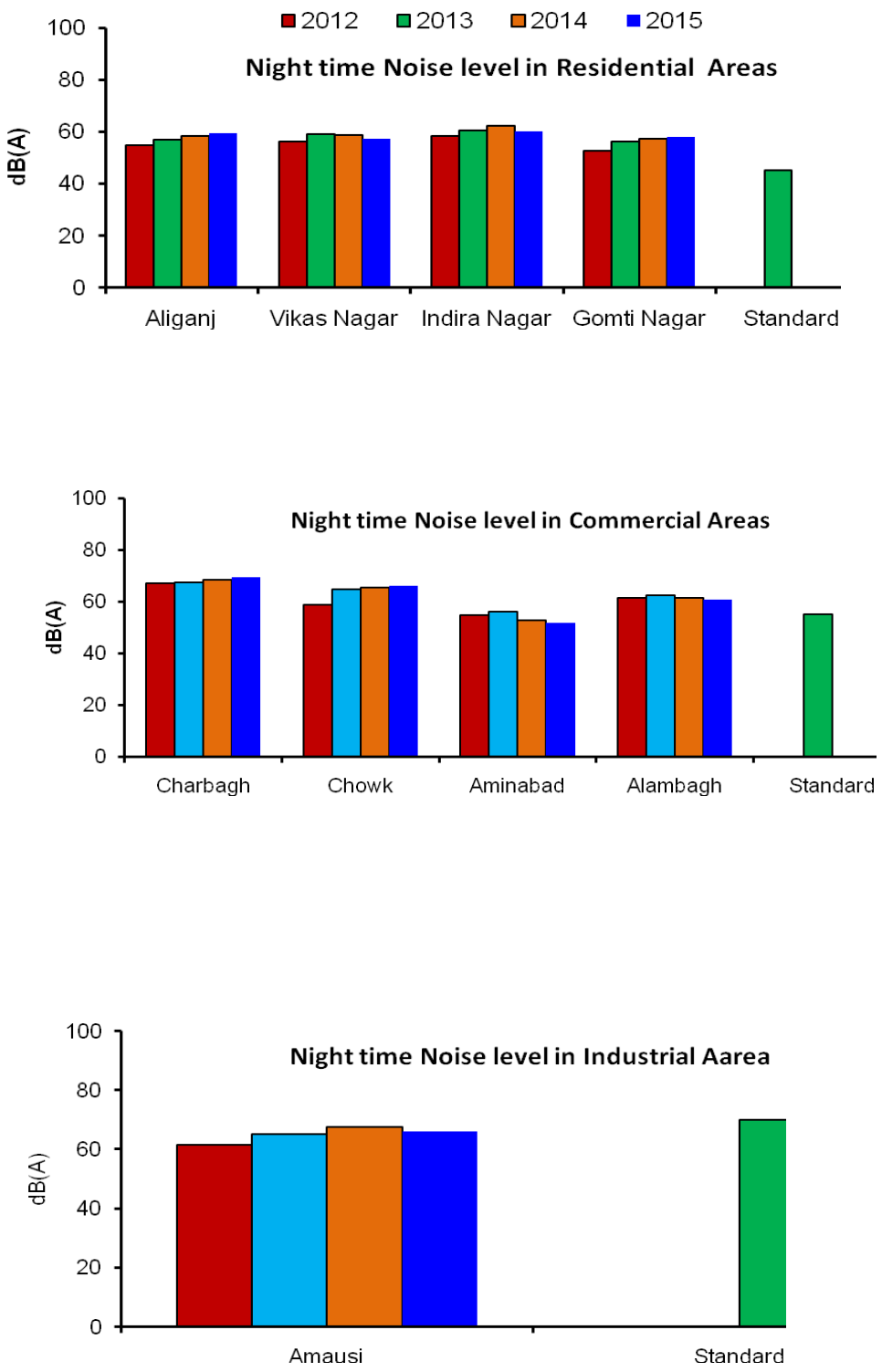

Fig 6: Comparison of night time Noise Level dB(A) in different areas of Lucknow city (2012-2015)

1.5 HEALTH EFFECTS

The adverse effect mainly depends on the nature and concentration of air pollutants and the status of the receptor. 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 (PM_{10} and $PM_{2.5}$) at all the monitoring locations may be responsible for several cardiovascular and respiratory diseases such as asthma, bronchitis, reproductive impairment, increased risk of preterm birth and even mortality and morbidity rate.

Human exposure to particulate air pollution has been identified as a risk factor for human mortality and morbidity and many countries have revised the limits for PM_{10} and $PM_{2.5}$. Nevertheless, PM threshold levels to which exposure does not lead to adverse effects on human health have not yet been clearly identified and there is substantial inter-individual variability in exposure and in the response and it is difficult to establish a standard or guideline value that will lead to complete protection of every individual against all possible adverse health effects of particulate matter.

The effect of PM depends on the mass and number concentration, shape and size and the composition and concentration of other inorganic and organic pollutants associated with it. We also estimated the trace metals associated with PM_{10}. The inorganic components constitute a small portion by mass of the particulates. The high level of Pb can induce severe neurological and hematological effects on the exposed population especially children, whereas Ni is known for inducing carcinogenic effects in humans through inhalation.

In the present study, the concentration of SO_2 and NOx were found to be below permissible limit (80 $\mu g/m^3$) of NAAQS (MoEF 2009), but there are several reports suggesting that gaseous pollutants are related with respiratory diseases and reproductive and developmental effect even at low concentrations. Vehicular traffic and NO_2 are associated with significantly higher risk of lung cancer.

1.6 CONCLUSIONS

During pre monsoon (April-May), 2015 we have monitored air pollutants such as PM_{10}, $PM_{2.5}$, SO_2, NOx and trace metals for assessment of ambient air quality. Besides, we have also monitored noise level during day and night time at 9 locations. The results revealed as follows-

- The RSPM (PM_{10}) level at all the monitoring locations of residential, commercial and industrial areas were higher than the NAAQS.

- The mean level of Fine particles ($PM_{2.5}$) level at all the monitoring locations of residential, commercial and industrial areas were higher than the NAAQS.

- The concentration of gaseous pollutants, SO_2 and NO_x were below the prescribed NAAQS (80 $\mu g/m^3$) at all the locations but showed slightly mixed trend.

- The noise level at all the locations except in industrial area during day and night time showed higher level than their respective permissible limits.

- Overall results indicate that PM_{10} and $PM_{2.5}$ and associated metals are one of the major causes for deterioration of ambient air quality.

Unlimited growth of number of vehicles, their technological development and release of invisible tailpipe pollutant emissions are serious debatable issues even for the policy makers. Use of different types of fuels namely petrol, diesel, LPG and CNG make the environment more complex regarding the air quality and their synergistic effects on the human health. .

The higher level of air pollution in the city was also attributed to the construction of a number of large parks and memorials, construction of new roads pavements and their repair and maintenance, construction of multistoried buildings and movements of heavy vehicles carrying construction materials, garbage dumps in the city and movement of garbage trucks etc,.

Lucknow is not an industrial town but scattered industries in the industrial areas of the city and small workshops are also adding to the air pollution to some extent. At present, Metro rail section from Airport to Charbagh railway station on Kanpur Roads is under progress. This activity may affect air quality of the area due to

construction activities as well as traffic congestion. On this route for the above mentioned activities, many trees on the side of roads have been cut down by authorities, reducing the sink available to absorb the air pollution in the city. In addition to this, abnormal metrological conditions of the city also adversely influences the ambient air quality of the city.

Overall, continuous accumulation of different types of pollutants and their exposure to human beings needs immediate attention of the policy maker, researchers and regulatory agencies

The present study suggests that it is necessary to monitor the air quality as well as the health effects at regular intervals at strategic locations. Our pre monsoon monitoring survey might be of help to focus on the pollution level in Lucknow city and its probable consequences. Our database since 1997 would help the planners for sustainable development of the city.

1.7 RECOMMENDATIONS

- Subsidized public mass transport (Metro, Monorail etc.) must be introduced/strengthened to minimize use of personal vehicles.
- Improvement in traffic management.
- All encroachment should be removed for the smooth flow of traffic.
- Public awareness programme for reduction of automobile pollution.
- Pressure horns to be removed from all vehicles and avoid use of horn/minimise.
- Government should increase the parking charges on hourly basis to discourage the use of personal vehicles.
- Restore foot path for pedestrians

Acknowledgements: We the Members of Environmental Monitoring Division are grateful to Dr. C. S. Nautiyal, Director, IITR and Dr. Mukul Das, Chief Scientist, IITR, B. D. Bhattacharji, Senior Principal Scientist, IITR for permission for this study and continuous encouragement. We also acknowledge Analytical Chemistry Division., IITR, for analytical and technical support. We express our sincere thanks to Mr. Sagir Ali Ansari, Regional Transport Officer and Ms. Ritu Singh ARTO, Administration, Transport Nagar, Lucknow, Mr Virendra Kumar Verma, Regional Manager, Lucknow City Transport Services Limited, Gomti Nagar, Lucknow, Mr. Jitendra Kumar Sinha, Dy. Manager, Indian Oil Corporation, Lucknow and Mr Surya Prakash Gupta, Manager Marketing, Green Gas Limited, Lucknow for providing us necessary vehicular and oil consumption data. We also express our sincere thanks to all who provided necessary facilities at different monitoring locations.