



An Analysis of Ambient Air Quality and Categorization of Exceedence Factor of Pollutants in Different Locations of Assam

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ABSTRACT

This paper tries to find out effect of air quality of five places in eight different locations in the state of Assam. The study is to analyse the air pollution concentration in the State. Basically, sulphur dioxide (SO₂), nitrogen dioxide (NO₂), respirable suspended particulate matter (RSPM), suspended particulate matter (SPM) for three consecutive years 2007, 2008, 2009 were critically analysed. The annual average and Exceedence factor were also calculated in all different locations. In this study, it is observed that RSPM and SPM are high in four locations in 2007, five in 2008, and five in 2009. In critical category, we see two locations in 2007, three locations in 2008 and four locations in 2009. But, it is seen that the concentrations of SO₂ and NO₂ are below the prescribed limit of NAAQS of CPCB in all three consecutive years in all locations.

INTRODUCTION

Air pollution is a major environmental risk to health, and WHO (2005) air quality guidelines reveal that burden of diseases is due to air pollution. It is estimated to cause approximately 2 million premature deaths worldwide per year, which can be attributed to the effect of urban outdoor pollution. The indoor particulate pollution may pose greater risk to health if proper ventilation provisions are not available. In the developing countries like India, a large segment of rural population and slum dwellers of the city areas receive a large contribution of particulate matter from biomass burning, coal combustion and road dust (WHO 2005).

The fine particulate matters are found in fuel combustion, power plant, industrial processes, wood burning and diesel motors. Hosmani (2012) studied that increased level of fine particulate in air are linked to various health hazards. Among the particulates whose median diameters > 10µm, are stopped in upper part of respiratory tract but whose median diameters < 10µm (PM₁₀), they can penetrate into the innermost part of the lungs and causes health problems including bronchitis, acute and chronic respiratory diseases such as breathing problem and painful breathing (Achary et al. 2012). The sources of air pollution include vehicular, industrial, domestic and natural. Also, the increase in RSPM values, in general, may be attributed to adverse meteorological conditions, means substantial decrease in temperature (CPCB Deepawali 2010). The presence of air pollutants in the ambient air adversely affects the health of the population.

Assam is the one of the States of seven sisters including Sikkim of north eastern India, which was almost an

environmental friendly region with large number of green trees. But, at present with the growth of industry, number of vehicles, population of human, the concentration of various pollutants in the atmosphere has increased. This study tries to find out the air quality and Exceedence factor in five major towns of Assam.

In the present analysis, ambient air quality parameters selected are sulphur dioxide (SO₂), nitrogen dioxide (NO₂), respirable particulate matter (RSPM) and suspended particulate matter (SPM).

LOCATIONS

In finding the air quality of Assam in India, five different places in eight different locations were selected for present study. These places are Guwahati, Dibrugarh, Golaghat, Tezpur and Bongaigaon. These places were selected to analyse the air quality of residential and commercial areas of town/cities of Assam. The eight locations include three in Guwahati, one each in Dibrugarh, Golaghat, Tezpur and two in Bongaigaon. These five places have significant contribution to present air pollution load. The places and locations are given in Table 1.

MATERIALS AND METHODS

According to CPCB Annual Report (2008-2009) assessment of air quality has been made based on the data received from various air quality monitoring stations. This study is based on various secondary sources of data of air pollutants (SO₂, NO₂, RSPM, SPM), which were collected from various sources including Pollution Control Board, Assam. The data

Table 1: Places and locations of the study.

Place	Location
1. Guwahati	i. Bamunimaidam (Head Office), Guwahati, Assam
	ii. ITI Building (Gopinath Nagar), Guwahati, Assam
	iii. Santipur (Near Pragjyotish College), Guwahati, Assam
2. Dibrugarh	i. Dibrugarh Office Building, Dibrugarh RO, Assam
3. Golaghat	i. Golaghat Office Building, Golaghat RO Assam
4. Tezpur	i. Tezpur Building, Tezpur RLO PCBA Office, Assam
5. Bongaigaon	i. Barpara Office Building, Bongaigaon, Assam
	ii. Campus of Oil India Ltd. PS-6, Bongaigaon, Assam

Table 2: Annual yearly average, maximum value of SO₂ (µg/m³) for the years 2007, 2008 and 2009. R stands for residential and other areas.

Place	Location	Type of Area	Max.	2007			2008			2009		
				Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.
Guwahati	Bamunimaidam	R	20.25	9.37	3.125	20.75	8.72	3.976	30.75	8.85	3.866	
	ITI building	R	19	9.88	3.33	12.25	6.45	3.084	20.25	7.3	2.88	
	Santipur	R	13.5	7.05	2.554	12	7.1	2.478	29.5	7.47	3.164	
Dibrugarh	Dibrugarh	R	11.25	4.88	3.318	8.5	4.62	2.179	8	5.31	1.903	
Golaghat	Golaghat	R	8.75	4.89	2.358	7.5	4.28	2.07	20	5.8	2.671	
Tezpur	Tezpur	R	7	3.72	1.773	13.5	4.46	2.076	10.25	5.68	2.02	
Bongaigaon	Borpara office	R	9.67	3.76	1.997	10	4.93	2.225	12	5.78	2.027	
	Campus of Oil India	R	9.75	3.87	1.811	8.5	4.29	1.929	11	6.17	2.178	

Table 3: Annual yearly average, maximum value of NO₂ (µg/m³) for the years 2007, 2008 and 2009. R stands for residential and other areas.

Place	Location	Type of Area	Max.	2007			2008			2009		
				Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.
Guwahati~	Bamunimaidam	R	29.25	17.51	4.719	5.999	5.999	5.999	5.999	5.999	5.999	
	ITI building	R	32	17.24	4.86	4.375	4.375	4.375	4.375	4.375	4.375	
~	santipur	R	26.63	13.48	4.474	5.061	5.061	5.061	5.061	5.061	5.061	
Dibrugarh	Dibrugarh	R	18.5	11.31	3.668	21.5	11.15	3.815	19.5	13.25	2.898	
Golaghat	Golaghat	R	20.75	12.43	3.98	17.75	12.15	4.092	32.5	14.23	3.685	
Tezpur	Tezpur	R	20.25	10.13	3.603	18.75	11.7	4.368	31.25	13.21	2.958	
Bongaigaon	Borpara office	R	14.25	9.15	4.303	22.63	10.98	4.53	50.5	14.8	5.272	
	Campus of Oil India	R	15.25	10.04	3.444	17	10.06	3.99	33.25	15.24	3.828	

of three consecutive years from 2007 to 2009 were collected and critically analysed. In data, annual arithmetic mean of minimum 104 measurements in a year were taken twice a week, 24 hourly at uniform interval. In the Tables R stands for residential and other areas.

RESULTS AND DISCUSSION

The results of the study are given in Tables 2 to 8.

Sulphur dioxide (SO₂): The concentration of sulphur dioxide in annual average was 3.72µg/m³ in Tezpur and 9.88 µg/m³ in ITI building, Guwahati with the maximum value of 20.25 µg/m³ at Bamunimaidam in 2007. In 2008, annual average was 4.28µg/m³ to 8.72µg/m³ at the same places with maximum value of 20.75 µg/m³ in Bamunimaidam. In 2009, the annual average values were 5.31 µg/m³ and 8.55µg/m³

with maximum value 30.75 µg/m³ in Bamunimaidam. Sulphur dioxide is one of the important air pollutants, which is produced mainly from combustion of fuel. However, during 2007 to 2009 in all the eight locations the concentration of SO₂ was below the prescribed limit of NAAQS (CPCB 2011) and its exceedence factors are categorized in low (L). But with increasing number of vehicles and growing industrialization there is a possibility of increasing SO₂ in the atmosphere.

Nitrogen dioxide (NO₂): In all locations, the annual average of NO₂ varied from 14.25µg/m³ to 29.25µg/m³ in 2007, 10.06 µg/m³ to 17.57µg/m³ in 2008 and 13.25µg/m³ to 18.37µg/m³ in 2009. But in all these periods maximum concentration was found in the location of Bamunimaidam. The concentration in the Guwahati is higher than the other places

Table 4: Annual yearly average, maximum value of RSPM ($\mu\text{g}/\text{m}^3$) for the years 2007, 2008 and 2009. R stands for residential and other areas.

Place	Location	Type of Area	2007			2008			2009		
			Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.
Guwahati	Bamunimaidam	R	484.5	112.97	49.789	355	149.57	80.55	789.5	139.74	66.18
	ITI building	R	257	97.86	38.31	332.5	102.24	43.549	721.5	111.32	57.804
~	santipur	R	241.5	86.67	37.665	290.5	94.74	46.049	643	114.94	61.215
Dibrugarh	Dibrugarh	R	183.5	58.4	27.91	150	53.88	22.595	124	43.6	32.347
Golaghat	Golaghat	R	208.5	71.35	35.689	90.05	67.74	29.767	213.5	61.2	32.501
Tezpur	Tezpur	R	194.5	53.41	34.17	192.5	79.62	34.79	346.5	74.94	34.999
Bongaigaon	Borpara office	R	165.57	47.3	19.588	191	56.09	23.832	209	68.49	33.294
	Campus of Oil India	R	155.5	49.8	21.504	215	72	32.062	490	97.5	59.432

Table 5: Annual yearly average maximum value, of SPM ($\mu\text{g}/\text{m}^3$) for the years 2007, 2008 and 2009. R stands for residential and other areas.

Place	Location	Type of Area	2007			2008			2009		
			Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.	Max.	Annual Avg.	Avg. of Std. Dev.
Guwahati~	Bamunimaidam	R	951.5	189.33	76.368	797	230.33	117.908	1300	256.69	118.558
	ITI building	R	399.5	144.75	52.112	676	161.02	65.888	1300	196.93	97.984
~	santipur	R	341.5	133.06	51.84	695.5	148.9	66.594	1300	199.3	97.013
Dibrugarh	Dibrugarh	R	219	105.13	44.107	215	89.69	32.43	193.5	77.04	32.709
Golaghat	Golaghat	R	249.5	119.28	48.215	168	105.3	36.432	728.5	109.24	61.66
Tezpur	Tezpur	R	471	128.57	58.354	311.5	142.88	55.85	1096.5	201	84.163
Bongaigaon	Borpara office	R	212	83.13	31.051	270.5	98.63	34.371	683.5	136.85	72.418
	Campus of Oil India	R	295	97.57	39.275	268	109.6	41.824	568.5	152.3	73.697

Table 6: Exceedence Factor of SO₂ and NO₂ in different places for the years 2007, 2008 and 2009.

Place	Location	SO ₂			NO ₂		
		2007 Annual Avg.	2008 Annual Avg.	2009 Annual Avg.	2007 Annual Avg.	2008 Annual Avg.	2009 Annual Avg.
Guwahati~	Bamunimaidam	0.1561	0.1453	0.1475	0.2918	0.2928	0.3057
	ITI building	0.1647	0.1075	0.1217	0.2873	0.2277	0.2443
~	santipur	0.1175	0.1183	0.1245	0.2247	0.1688	0.2707
Dibrugarh	Dibrugarh	0.0813	0.0770	0.0885	0.1885	0.1858	0.2208
Golaghat	Golaghat	0.0620	0.0743	0.0947	0.1688	0.1950	0.2202
Tezpur	Tezpur	0.0815	0.0713	0.0967	0.2071	0.2025	0.2372
Bongaigaon	Borpara office	0.0627	0.0821	0.0963	0.1525	0.1830	0.2467
	Campus of Oil India	0.0645	0.0715	0.1028	0.1673	0.1677	0.2540

of Assam, but overall, the concentration of NO₂ in all the places was below the prescribed limit by NAAQS (CPCB 2011).

RSPM: The annual average of RSPM ranges from 58.4 $\mu\text{g}/\text{m}^3$ to 112.97 $\mu\text{g}/\text{m}^3$ in 2007, 53.88 $\mu\text{g}/\text{m}^3$ to 149.57 $\mu\text{g}/\text{m}^3$ in 2008 and 43.6 $\mu\text{g}/\text{m}^3$ to 139.74 $\mu\text{g}/\text{m}^3$ in 2009. The concentration at all the locations of Guwahati exceeds the prescribed limit of NAAQS (CPCB 2011). The maximum concentration of Bamunimaidam in 2009 was 789.5 $\mu\text{g}/\text{m}^3$. So, Bamunimaidam is highly polluted with respect to RSPM.

SPM: The annual average concentration varied from 83.13 $\mu\text{g}/\text{m}^3$ to 189.33 $\mu\text{g}/\text{m}^3$ in 2007, 89.69 $\mu\text{g}/\text{m}^3$ to 230.33 $\mu\text{g}/\text{m}^3$ in 2008 and 77.04 $\mu\text{g}/\text{m}^3$ to 256.69 $\mu\text{g}/\text{m}^3$ in 2009. The maximum value of SPM was 1300 $\mu\text{g}/\text{m}^3$ in 2009, 230.33 $\mu\text{g}/\text{m}^3$

in 2008 and 951.5 $\mu\text{g}/\text{m}^3$ in 2007. It can be seen from the Table 5 that the concentration is higher in 2009 and 2008 in Guwahati. The concentration of SPM is higher due to increase in industry and vehicles. The three years variation in the values of all the parameters does not conform to any specific pattern or trend.

Exceedence factor (EF): The ambient air quality of different places has been categorized based on the Exceedence factor (E. F.). It is one of the most important tools to analyse and represent the ambient air quality status.

$$E. F. = \frac{\text{Observed annual mean concentration}}{\text{Annual standard for the respective pollutant}}$$

The four air quality categories are:

Table 7: Exceedance factor of RSPM and SPM in different places for the year 2007, 2008 and 2009.

Place	Location	RSPM			SPM		
		2007 Annual Avg.	2008 Annual Avg.	2009 Annual Avg.	2007 Annual Avg.	2008 Annual Avg.	2009 Annual Avg.
Guwahati~	Bamunimaidam	1.883	2.492	2.329	1.352	1.6452	1.8335
	ITI building	1.631	1.704	1.8553	1.0339	1.1501	1.4066
	~ santipur	1.445	1.579	1.9157	0.9504	1.0635	1.4235
Dibrugarh	Dibrugarh	0.9733	0.898	0.7267	0.7509	0.6406	0.5502
Golaghat	Golaghat	0.8901	1.327	1.249	0.9183	1.0205	1.4357
Tezpur	Tezpur	1.1892	1.129	1.02	0.852	0.7521	0.7802
Bongaigaon	Borpara office	0.7883	0.9348	1.1415	0.5937	0.7045	0.9775
	Campus of Oil India	0.83	1.2	1.625	0.6969	0.7829	1.0879

Table 8: Exceedance factor in categorization for the years 2007, 2008 and 2009. R stands for residential and other areas.

Place	Location	Type of Area	2007				2008				2009			
			SO ₂	NO ₂	RSPM	SPM	SO ₂	NO ₂	RSPM	SPM	SO ₂	NO ₂	RSPM	SPM
Guwahati	Bamunim-aidam	R	L	L	C	H	L	L	C	C	L	L	C	C
	ITI building	R	L	L	C	H	L	L	C	H	L	L	C	H
	santipur	R	L	L	H	M	L	L	C	H	L	L	C	H
Dibrugarh	Office building	R	L	L	M	M	L	L	M	M	L	L	M	M
TEZPUR	Office building	R	L	L	M	M	L	L	H	H	L	L	H	H
Golaghat	Office building	R	L	L	H	M	L	L	H	M	L	L	H	M
Bongaigaon	Borpara office	R	L	L	M	M	L	L	M	M	L	L	H	M
	Campus of Oil India	R	L	L	M	M	L	L	H	M	L	L	C	H

- i. Critical pollution (C): Where EF is more than 1.5
- ii. High pollution (H): Where EF is between 1.0-1.5
- iii. Moderate pollution (M): Where EF is between 0.5 - 1.0
- iv. Low pollution (L): Where EF is less than 0.5

In present analysis, the Exceedance factors for SO₂, NO₂, RSPM and SPM were calculated at each of the eight location for three consecutive years and shown in Tables 6 and 7.

CONCLUSION

After analysis for the three consecutive years, data of ambient air quality of five places in eight locations, the following conclusion could be drawn.

The concentration of NO₂ and SO₂ at the monitoring station was below the prescribed maximum level by the National Ambient Air Quality Standard (NAAQS) of Central Pollution Control Board (CPCB 2011). The exceedance factors show that NO₂ and SO₂ are in low pollution category.

The annual average values of RSPM and SPM in almost all the locations are either in high or in critical condition as per exceedance factors.

The increase of RSPM and SPM may be due to prolonged dryness during the winter months, increasing the number of vehicles on roads, growing number of industries, construction and other human activities. Among the large number of vehicles on roads, major contribution in the State is the three wheeled Tempos, which release huge quantities

of air pollutants. Motor vehicles generated range of particulate matter through the dust produced from the brakes, clutch plates, tires, etc. One of the air pollution control strategies may be to reduce, collect, capture or retain the pollutants before they come in the atmosphere.

Thus, it is seen that the air quality in the State has not much deteriorated but the rapid growth of the cities and towns and subsequent increase in human activities are sure to enhance its deterioration in coming future. So, to improve the air quality and to protect the atmosphere, we need some rules and regulation to control the emissions. Therefore, a public awareness is necessary for improvement of the quality of the environment and there must be an action plan for restoration of air quality in the State with utmost priority.

REFERENCES

- Acharya, G., Sunpriya, S.K., Mohanty, Ramakant Sahoo and Pattanaik, Nishiprava 2012. Categorization of different locations at Bhubaneswar on the basis of Exceedance factor of the pollutant. *Indian J. Environmental Protection*, 32: 305-312.
- CPCB, Annual Report 2008-2009. Air and Water Quality Monitoring Network. Chapter V, pp. 13-72. Central Pollution Control Board, Delhi.
- CPCB, Deepawali 2010. Press Release, Ambient Air & Noise Pollution levels. Central Pollution Control Board, Delhi.
- CPCB 2011. Guidelines for the Measurement of Ambient Air Pollutants, Vol. 1, Central Pollution Control Board, Delhi.
- Hosmani, S.P. 2012. Air quality index in Mysore city, Karnataka state, India. *Nature Environment and Pollution Technology*, 11(2): 315-317.
- WHO 2005. Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulphur Dioxide. World Health Organization, Geneva.