ASSESSMENT OF AMBIENT AIR QUALITY INDEX (AQI) IN BHUBANESWAR, THE CAPITAL CITY OF ODISHA

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ABSTRACT

The main objective of the study is to find out the seasonal variation of air quality parameters such as Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter(RSPM), Sulphur dioxide(SO_2) and Oxides of Nitrogen(NO_x).Construction & demolition of roads and buildings, combustion of Fossil fuels, materials handling and processing, automobiles have led to significant degradation of air quality in Bhubaneswar City of Odisha. The pollutant concentrations were used to calculate the air quality index. This study helps us to identify the sources of air pollution. The major cause for the degradation of air quality was mainly due to industrial activities, construction & demolition of buildings and roads, exhaust gases from automobiles and combustion of fossil fuels. This degraded environmental air demands appropriate management strategy for curbing the pollution levels within permissible limit. The seasonal range and annual average of particulate matter as well as gaseous pollutants from all the locations were calculated and compared with the Ambient Air Quality Standards(NAAQMS,2004) Excess air pollution load considerably deteriorates the air quality and subsequently responsible for harmful consequence of the exposed population. It is now high time to undertake an integrated air pollution management program which includes appropriate measures at the polluting sources, development of dust control measures adopted in the capital city of Bhubaneswar .

Key words: Ambient air, Air quality index, Air quality parameters (viz: SPM ,RSPM , NO_x and SO_2)

I INTRODUCTION

Rapi durbanization & industrial development during last decade have provoked some serious concerns for the Ambient air quality of capital city of Bhubaneswar , Odisha, The concentration levels of air quality parameters like particulate matter i.e. suspended particulate matter, Respirable suspended particulate matter, sulfur dioxide, and oxides of nitrogen continue to pose a serious public health risk. The air quality of Bhubaneswar area is progressively deteriorating due to urbanization, industrial development, lack of awareness, poor maintenance of motor vehicles and construction and demolition of buildings and roads. The WHO,UNEP (1992) report reveals that 23 major cities of India are among the most air polluted cities of the world. Fine dust particles emitted from automobiles exhaust having diameter less than 10µg/m^3(PM_{10})can reach the lungs and provoke serious respiratory

problems while the particles less than 2.5µg/m^3 reach bronchial alveoli and have long residence time which causes lung cancer and severe respiratory diseases. The gaseous pollutants like sulfur dioxide(SO_2), oxides of nitrogen(NO_3) etc. have much more adverse health impact on human, animal and plants. Therefore, it is necessary to access the impact on air quality due to rapid urbanization ,vehicular traffic & industrial activities and suggest proper abatement control measures for air pollution.

II MATERIAL AND METHOD

This city is located between Latitude 20°21′N to 20°25′N and Longitude 85°44′E to 85°55′E and an elevation of about 45 meters above mean sea level (MSL). . The population of Bhubaneswar is about more than seven lacs as reported in census 2001.The ambient air quality monitoring was carried out at six selected stations at Bhubaneswar. For analyzing the air quality of the study area, systematic monitoring of the air quality parameters i.e. suspended particulate matter(SPM), Respirable suspended particulate matter(RSPM),sulfur dioxide and oxides of nitrogen were done as per the standard procedures prescribed by the Central pollution control Board(CPCB)/APHA(1998).All these air quality parameters i.e SPM,RSPM,SO_2&NOx were collected every first week of the month from all six sampling stations by high volume sampler/Respirable dust sampler (Envirotechmade Model,APM460)with attached glass fiber filter paper and thermoelectrically cooled impinge attachment for gaseous sampling .Ambient air samples were collected at different locations for SPM, RSPM, SO_2 & NO_x on 24 hourly basis. These samplers were operated at an average flow rate of 1.1 to1.2 m^3/min for sampling or collection of SPM & RSPM levels. Measurement of SO_2 was done by drawing the gases and vapors in a known volume of air in separate attachment of high volume sampler and gases was passed through the absorbing medium. i.e. sodium Tetrachloromercurate (0.1N)with bleached pararosaniline, formaldehyde(West Gaeke method).Similarly the oxides of nitrogen was determined by absorbing in sodium hydroxide-sodium arsenite(modified Jacob and Hochheiser method)

III AIR QUALITY INDEX

An air quality index (AQI) is a number used by government agencies to communicate, the public how polluted the air is currently or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience severe adverse health effects. So it is a measure of the condition of air relative to the requirements of one or more biotic species or to any human need or purpose. The index of specific pollutant is derived mainly from the physical measurement of pollutants like SPM,RSPM, SO_2 & NO_x. these are several methods and equation used for determining the AQI (Inhaber, 1974).The Oak Ridge National Air Quality (ORNAQ) can be considered for the relative ranking of an overall air quality status at different location in the study area.AQI has been estimated with the help of a mathematical equation developed by the Oak Ridge National Laboratory(ORNL), USA as given below:

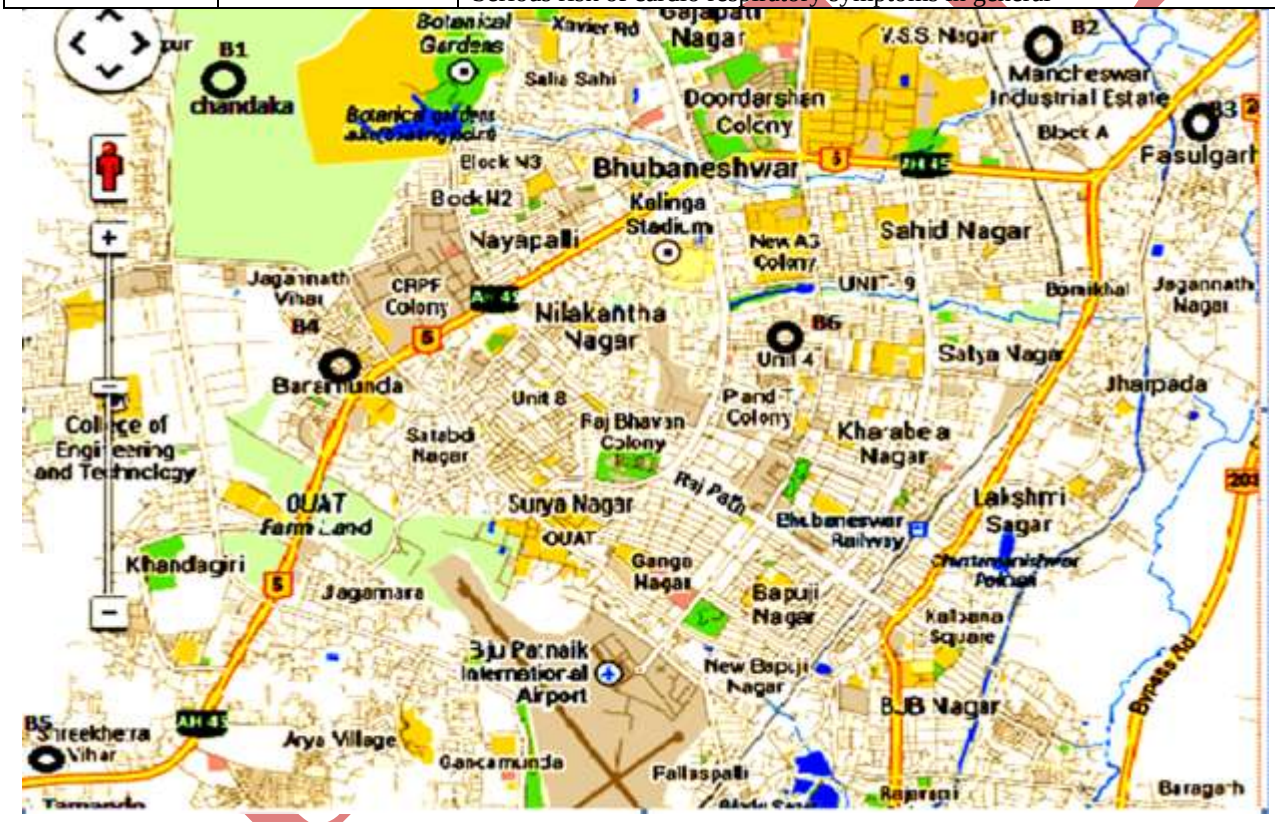
$$AQI = \frac{39.02Xi}{Xs} 0.967$$

Where, Xi = value of air quality parameters (like SPM,RSPM,SO_2&NO_x)

Xs=standard and prescribed for Air quality parameters.

TABLE-1: Relative AQI and Scale

INDEX VALUE	DESCRIPTION	HEALTH EFFECT
0-25	Clean air	None or minimal health effect
26-50	Light air pollution	Possible respiratory or cardiac effect for most sensitive individuals
51-75	Moderate air pollution	Increasing like hood of respiratory &cardio vascular systems & illness
76-100	Heavy air pollution	Aggravation of heart lung diseases. Increased risk of death in children. Increased effect in general population
> 100	Severe air pollution	Serious aggravation heart or lungs diseases; increased risk of premature death. Serious risk of cardio respiratory symptoms in general



B_1-Chandaka, Ind. B_2-Mancheswar Ind ,B_3-Rasulgarh,B_4-Baramunda,B_5-Tamando,B_6-Unit-4.

Table-2 Brief Description of the Sampling Locations at Bhubaneswar

Sl.No.	Name of the location	Area type	Code	Surrounding activities
1	Chandaka Ind. Estate	Industrial	B-1	Industrial, residential & Vehicular
2	Mancheswar Ind. Estate	Industrial	B-2	Industrial, residential & Vehicular
3	Rasulgarh	Residential	B-3	Vehicular, residential & NH-5 passing near by
4	Baramunda	Residential	B-4	Vehicular, residential & NH-5 passing near by
5	Tamando	Residential	B-5	Vehicular, residential & NH-5 passing near by

6	Unit-4 Area	Residential & Commercial	B-6	Vehicular, commercial & residential

Table- 3 Methods of Measurement for Different Parameters

Sl.No.	Parameters	Methods of Measurement
1.	SO_2 µg /m^3	Improved West & Gaeke method.
2.	NO_X µg/m^3	Modified Jacob & Hochheiser method.
3.	SPM µg/m^3	Gravimetric.
4.	RSPM µg/m^3	Gravimetric.

Table- 4 Concentration of Pollutants in (Mg/M3) At Bhubaneswar during Pre-Monsoon 2013

Sl.No.	Location	Particular Matter		Gaseous pollutants	
		SPM	RSPM	SO_2	NO_X
1	B-1	264.3	90.6	2.01	11.8
2	B-2	265.4	96.4	2.3	9.6
3	B-3	244.1	110.2	2.3	12.7
4	B-4	268.5	107.0	2.03	8.4
5	B-5	280.6	103.0	2.02	8.5
6	B-6	238.0	91.8	2.01	9.2

Table- 5 Concentration of Pollutants in (Mg/M3) At Bhubaneswar during Monsoon, 2013

Sl.No.	Location	Particular Matter		Gaseous pollutants	
		SPM	RSPM	SO_2	NO_X
1	B-1	156.7	80.4	2.0	8.1
2	B-2	157.8	99.0	2.1	8.5
3	B-3	212.4	97.0	2.0	8.4
4	B-4	198.2	94.8	2.0	8.0
5	B-5	186.1	98.6	2.1	8.0
6	B-6	188.7	87.6	2.0	8.4

Table- 6 Concentration of Pollutants In (Mg/M3) At Bhubaneswar During Post-Monsoon, 2013

Sl.No.	Location	Particular Matter		Gaseous pollutants	
		SPM	RSPM	SO_2	NO_X
1	B-1	278.4	95.4	2.1	12.1
2	B-2	280.6	103.1	2.4	13.1
3	B-3	278.3	107.8	2.4	11.9
4	B-4	273.6	110.1	2.2	11.8
5	B-5	284.5	104.1	2.2	12.1

6	B-6	248.7	101.2	2.2	15.1

Table-7: Average Concentration of Different Air Quality Parameters in (Mg/M3) of the Study Area-2013

Location	Season	Particular Matter		Gaseous pollutants		AQI
		SPM	RSPM	SO_2	NO_X	
B-1	Pre-monsoon	264.3	90.6	2.01	11.8	90.6
	Monsoon	156.7	80.4	2.0	8.1	64.7
	Post-monsoon	278.4	95.4	2.1	12.1	95.2
B-2	Pre-monsoon	265.4	96.4	2.3	9.6	92.1
	Monsoon	157.8	99.0	2.1	8.5	72.1
	Post-monsoon	280.6	103.1	2.4	13.1	99.2
B-3	Pre-monsoon	244.1	110.2	2.3	12.7	94.7
	Monsoon	212.4	97.0	2.0	8.4	81.6
	Post-monsoon	278.3	107.8	2.4	11.9	99.9
B-4	Pre-monsoon	268.5	107	2.03	8.4	95.9
	Monsoon	198.2	94.8	2.0	8.0	77.9
	Post-monsoon	273.6	110.1	2.2	11.8	99.8
B-5	Pre-monsoon	280.6	103	2.02	8.5	96.8
	Monsoon	186.1	98.6	2.1	8.0	77.1
	Post-monsoon	284.5	104.1	2.2	12.1	99.7
B-6	Pre-monsoon	238	91.8	2.01	9.2	84.8
	Monsoon	188.7	87.6	2.0	8.4	73.6
	Post-monsoon	248.7	101.2	2.2	15.1	93.3

Fig-1 at location B_1 during pre-monsoon

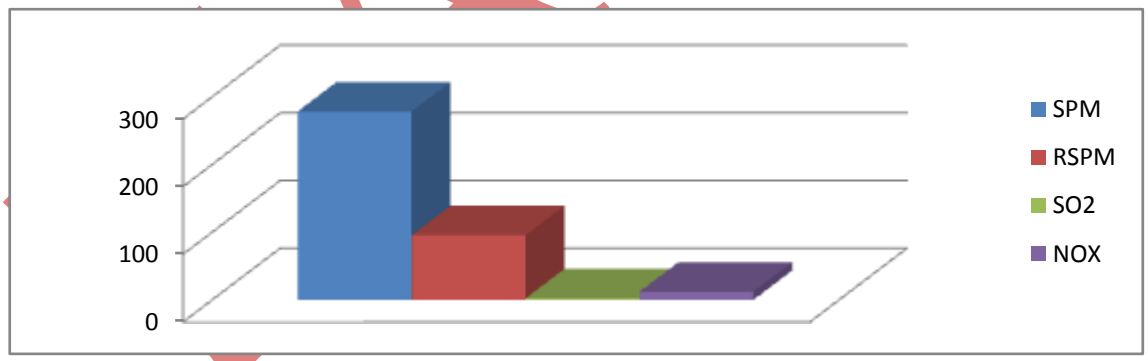


Fig-2 at Location B1 during Monsoon

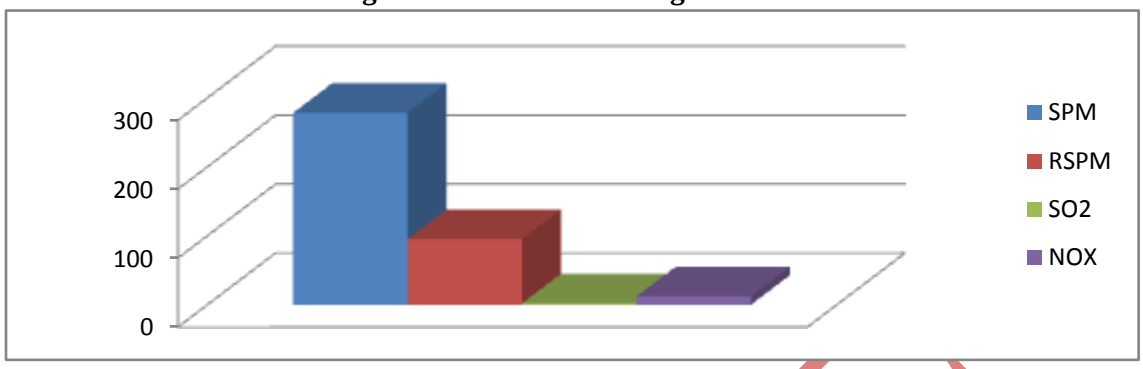
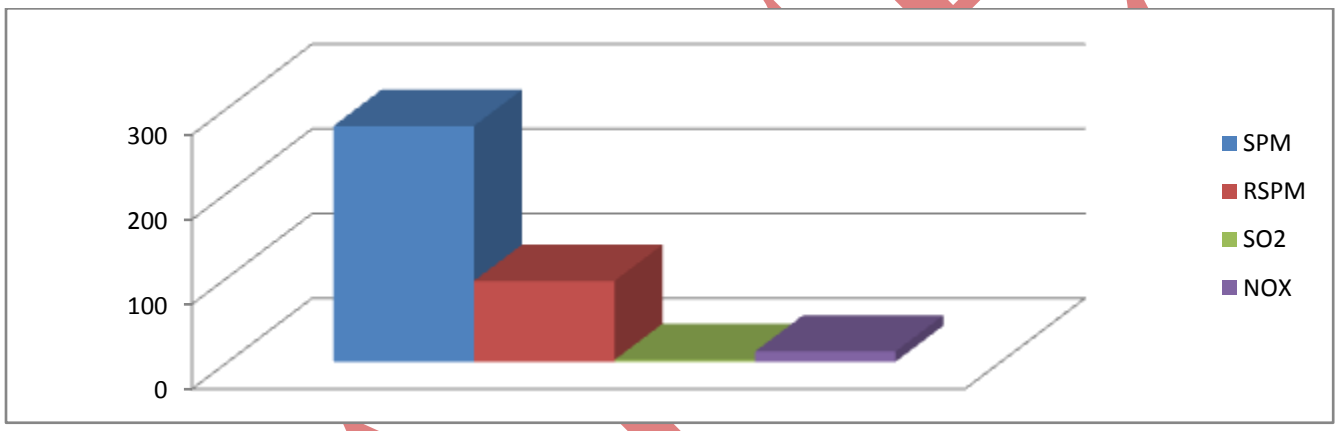


Fig-3 at location B1 during post-monsoon



IV RESULT AND DISCUSSION

Comparison of seasonal variation of ambient air quality with respect to SPM, RSPM, SO2 & NO_x during the period of Feb -2013 to January2014 as shown in the figure 1,2,3. In this period SPM value ranged from 156.7 µg/$m^3$to 280.6µg/m^3at Bhubaneswar area in different sampling station. The higher value were found in the pre & post monsoon season. Similarly, the RSPM value ranged from 80.4 µg/m^3to110.1 µg/$m^3$with higher concentration in the pre & post monsoon season. The lower concentration values of SO_2 &NO_X are 2.4 µg/m^3 &8.4 µg/m^3 & the higher concentration values are 2..4µg/m^3&15.1µg/m^3 respectively. The higher concentration values of SO2&NOx were found in pre monsoon & post monsoon season. The higher value of SPM &RSPM were found during the month of winter and summer in the Bhubaneswar area. Similarly SO_2 and NO_x concentration were found to be little higher in the township areas and industrial areas. In all the other sampling station it was found that SPM &RSPM values were nearly close or slightly exceeding the standard values set by the CPCB. But the SO_2&NO_x concentration were in the permissible limit as stated by CPCB(NAAQS-2004).The average AQI value gives us an idea that Bhubaneswar is moderately polluted but it is nearer to the range of heavy air polluted region. It was found from the above studies and measurements that the high SPM concentration in the residential area as per ISI standard in the particular locality is disquieting.

V CONCLUSION

Pollution of Ambient air is measured in terms of Air Quality Index which is used to provide a meaningful assessement of air pollution in the common man perception. It may be concluded that SO_2 and NO_x were within the permissible limit but SPM and RSPM in the entire study area are nearly close or excess to the permissible limit as specified by CPCB. It is found that SPM and RSPM in $\mu g/m^3$ are higher in most location in the pre-monsoon and post monsoon seasons. The air quality of Bhubaneswar city has deteriorated significantly due to rapid urbanization ,vehicular traffic & industrial activities . Excess air pollution load considerably deteriorates the air quality and subsequently responsible for harmful consequence of the exposed population. It is now high time to undertake an integrated air pollution management program which includes appropriate measures at the polluting sources, development of dust control measures adopted in the capital city of Bhubaneswar .

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