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Research Article

Evaluation of Ambient Air Quality In and Around Balgopalpur Industrial Estate, Odisha, India

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Abstract

The present study is to evaluate the quality of Ambient Air in the Balgopalpur industrial estate. Ambient Air Quality (AAQ) with respect to SPM, RPM, SO_2, NO_X and CO have been monitored in different sensitive area like Kurunia village, Near SBI Bank area, Near Jagannath Temple area, Near residential colony, F.M.University campus, Nuapadhi village and Mukhura village. Monitoring was conducted over a period of one year viz. 2011-2012 seasonally with the aim of analyzing air pollutants levels. Maximum, minimum, mean and Standard Deviation values were calculated for the monitoring parameters for each station and the results were discussed in the present study. It was revealed that all the concentration of SPM, RPM, SO_2, NO_X and CO in the winter season shown high results than the summer season and rainy season. Most of the air pollutants have their concentrations above the permissible limits. The higher AAQ standard revealed that the Air environment becoming polluted due to industrial activities.

Key words: *Air Pollutants, AAQ, Permissible Limit, Balgopalpur Industrial Area.*

1. Introduction

Air is one of the five basic natural ingredients of life system. Air pollution may be described as the presence of air pollutants in the atmosphere to such an extent that they cause deleterious effect. Rapid industrialization year after year, introduction of faster mode of transport and sprouting up large crowed cities or urbanisation are the main outcome of the modern civilisation. These are contributing to environmental pollution (Sharma, 2004). Primary air pollutants are emitted directly into the atmosphere and secondary air pollutants are formed in the atmosphere by reactions among two or more pollutants. The concentration of air pollutants depends not only on the quantities that are emitted directly from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions along with the various physical and chemical dissipation processes liable to remove pollutants through self purification process. During transportation of the industrial products and vehicular movement on non-metal led roads, fine dust particles settled on the ground gets airborne and cause diseases. Transportation is the prime source of mobility in urban society. Vehicular transportation vitiates the environment by emanating obnoxious and toxic pollutants in the surrounding atmosphere which results in serious health hazards to community and objects. Air pollution is posing disastrous health problems in some of the biggest cities of the world and has now become an inescapable part of urban life everywhere (De, 1993). As we know air pollution is basically the presence of undesirable foreign substances which can produce harmful effects on man and his environment (Bardhwar et al., 2004). The exhaust fumes of vehicle contain major pollutants such as Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Hydrocarbons and Particulate Matter. Many power plants are accompanied with severe air pollution problems. CO_2, SO_2, NO_X and fly ash are the four major pollutants of concern in thermal power plants emissions. Hence the present study was proposed to estimate the air pollution load in term of SPM, RPM, CO, Oxides of Nitrogen and Oxides of Sulphur at different stages in and around Balgopalpur Industrial Estate.

2. Study Area

The area selected for the present study is Balgopalpur Industrial Estate which is 12km away from Balasore town. Balasore is one of the coastal district of Odisha lies on the northern part of the state. This region is bounded by latitude 21^0 32' 30"N and longitude 86^0 49' 37"E (District Statistics Hand Book, Balasore, 2007). Balasore city started industrialization after 1980 and the rapid industrialisation is due to the easy availability of land,

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communication, man power and water. The Balasore town is divided into four industrial sectors such as Balgopalpur, Ganeswarpur, Chhanpur and Somnathpur. The Balgopalpur industrial estate has two major industries namely Balasore Alloys Ltd. and Emami Paper Mills Pvt. Ltd. and also the area covered 12 crushers with a daily crushing capacity of about 30 tones. The Balasore Alloys Ltd is a metal ferrous unit producing 95000 MT bulks of Ferro alloys per annum. The Emami Paper Mills Pvt. Ltd has two units. It has producing 145000 MT of different quality of papers per year and also producing 20 MW power from the captive power plant. The studies are experiences moderate type of monsoon climate. Rainfall is observed between June to September and normal rainfall was reported to be 1600mm. The relative humidity is 55% during June to September, 28% in October to March and 20% during April to May. The highest temperature in the summer season is 45^0C to 48^0C and lowest temperature is 15^0C in the Month of January (DSHB, Balasore, 2007). The soil quality of Balasore is reported as transported alluvial soil. The soil is highly suitable for paddy cultivation. Hence the main crop of the area is paddy.

Fig.1. Location Map of Study Area

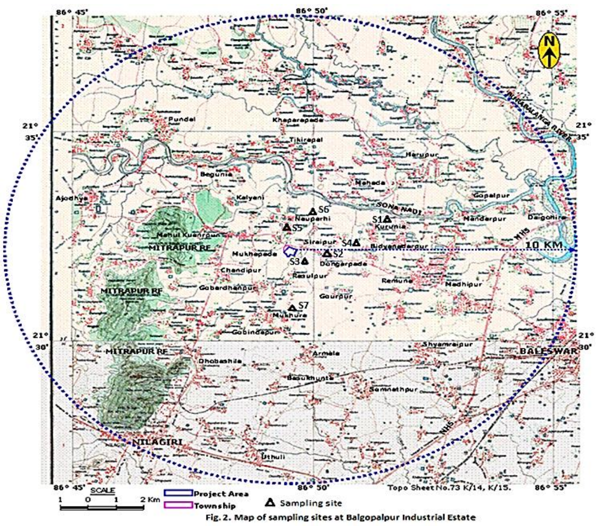

Fig.2. Map of sampling sites can be viewed

Table 1: Name and location of the sampling site

S. No.	Sampling stations	Abbreviated form	Description of area
1	Kurunia Village	S1	5km away from study area and situated in the way of wind direction
2	Near SBI Bank	S2	Very near to study area
3	Near Jagannath Temple	S3	Very near to study area
4	Near residential colony	S4	Very near to study area
5	F.M.University campus	S5	2km away from study area
6	Nuapadhi village	S6	3km away from the study area
7	Mukhura village (Reference Point)	S7	The site is situated in the opposite of wind direction from the study area

Table 2: Air quality parameters used in the present study

Sl. No.	Parameters	CPCB Standards (µg/m^3)
01	SPM	100
02	RPM	60
03	SO_2	80
04	NO_x	80
05	CO	4000

3. Materials and Methods

Air quality monitoring stations were selected keeping in view, point source of pollution generation and dominant wind direction prevailing in the area (Chowgale, 2007; Subhramanium et al., 2007). Monitoring is carried out to study the existing air quality status from selected monitoring stations. Continuous monitoring of SPM, RPM, NO_X, SO_2 and CO is done for a period of one month in three seasons (monsoon, winter and summer) in the year 2011-2012. During each season monitoring is carried out for four weeks at the rate of 24 hours per samples, twice in a week in the three seasons of the study period (Sastry et al., 2004). For monitoring Ambient Air Quality, High Volume Air Sampler APM-415 (Environtech make) and Respirable Dust Sampler APM-460 (Environtech make) have been used. GF/A glass micro filter paper have been used for monitoring of SPM (Suspended Particulate Matter) and RPM (Respirable Particulate Matter). The SO_2 and NO_X have been monitored through High Volume Air Sampler attached with gas sampler. The SO_2 pollutant has been monitored through sodium tetra chloro mercurate and analyzed by spectrophotometric method. Similarly NO_X

Table 3: Meteorological parameters (Average) during the year 2011-12

Sampling Stations	Monsoon			Winter			Summer		
	Temp. (°C) Min. – Max.	Relative Humidity (%)	Wind speed (m/s)	Temp. (°C) Min. – Max.	Relative Humidity (%)	Wind speed (m/s)	Temp. (°C) Min. – Max.	Relative Humidity (%)	Wind speed (m/s)
S1	26.1-34.4	76.5	1.8	23.1-31.2	79.5	1.9	21.0-33.9	63.5	2.9
S2	25.6-31.7	83	2.5	17.9-29.4	70	2.1	24.4-36.5	67.5	2.7
S3	25.7-31.5	84	2.1	14.0-27.2	65.5	2.3	26.0-36.5	71	3.1
S4	25.3-31.6	83.5	1.9	13.9-27.1	64	1.8	25.3-36.9	65.5	3
S5	25.5-32.6	82	2.5	16.8-30.0	62	3.2	26.2-38.0	61.5	2.9
S6	24.9-31.8	82.5	3.1	15.6-28.4	63.5	2.9	27.1-37.6	62.5	3.4
S7	25.5-32.8	79.5	3.6	14.7-29.1	62	3.5	25.2-36.4	64	3.2

has been monitored through sodium arsenate solution as absorbent and analyzed by using phosphoric acid, sulphanilamide, hydrogen peroxide and NEDA (1-napthyl ethylene diamine dihydro chloride) through spectrophotometer (APHA, 1977). Ambient Air Quality monitoring was carried out for three seasons; monsoon (June-September), winter (October-February) and summer (March-May). The results were compared by calculating maximum, minimum, mean and standard deviation. Similarly in each season (all stations) monitoring of meteorological parameters like temperature, relative humidity and wind speed were carried out simultaneously during the sampling of air quality parameters due to their influence on the status of air quality. For measurement of minimum and maximum temperature, a flat 'U' type horizontal thermometer (London made) has been used which give the reading with the expansion and contraction of mercury in the 'U' tube. During the present study, a hygrometer (Barigo-German made) has been deployed for the measurement of Relative Humidity (RH) which works on the principle of dry and wet temperature of the atmosphere and giving the reading of RH in percentage. In the present study, an anemometer has been used for monitoring of wind speed.

It is to be noted that the dominant wind directions were south east to north east and the weather conditions were suitable during sampling at most of the stations of the present investigation.

4. Result and Discussion

Experimental estimation of the levels of the SPM, RPM, SO_2, NO_x and CO at seven sampling sites in the Balgopalpur Industrial Estate has been carried out during the period July 2011 to May 2012 systematically. The results of the investigation shows that the concentrations of SPM of such seven stations ranged from 43 µg/m^3 to 298 µg/m^3, 87 µg/m^3 to 578 µg/m^3 and 54 µg/m^3 to 459 µg/m^3 in monsoon, winter and summer respectively (Fig.3.). The mean values of seven monitored stations ranged from 46.62 to 239.62, 91.62 to 558.12 and 68.5 to 439 µg/m^3 in monsoon, winter and summer respectively. Similarly, the calculated standard deviation values for the above mentioned average values ranged from 2.87 to 3.50 µg/m^3, 2.55 to14.85 µg/m^3 and 8.36 to 13.06 µg/m^3. The SPM values of monitoring stations S1, S2, S3 and S4 were exceeding the permissible limit 100 declared by CPCB (Table-2). But in monitoring stations S5 and S6, the SPM concentration is high only in winter season where as in summer and monsoon, the SPM concentrations are well within the prescribed limit. The SPM concentration is very high at two stations namely S2 (near SBI bank) and S3 (near Jagannath temple) in all seasons indicating the pollution load of that area.

The average RPM concentration of seven monitored stations ranged from 35.75±5.49 to 133.62±3.11 µg/m^3, 56.87±4.42 to 193.12±1.80 µg/m^3 and 45.25±2.37 to 172.5±2.92 µg/m^3 in monsoon, winter and summer respectively. The sources of this pollutant may be transportation, industries and high rate of combustion of conventional fuels. The sand along the sides of the roads, which is dusty in nature, is not removed periodically. The traffic turbulence may resuspend the particulate matter from the sand and this may also be in the recorded SPM and RPM concentrations (Suresh et.al, 2007). It is observed that the RPM concentrations exceed the National Ambient Air Quality Standards set by CPCB for residential areas (60µg/m^3) at all the sampling stations of present investigation except station-S7 in winter and summer (CPCB report, 2009). But in rainy season the RPM concentration is high except stations S5, S6 and S79 (Fig.4.).

The recorded average SO_2 concentration of seven monitored stations ranged from 10.27±0.12 to 12.35±0.20 µg/m^3, 14.25±1.78 to 23.18±1.12 µg/m^3 and 10.57±0.21 to 16.11±0.61 µg/m^3 in rainy, winter and summer seasons respectively in the year 2011-12 (Fig.5.). As there is major industrial sources of SO_2 in that area, the recorded concentrations attributed directly to the natural fossil fuels used by the industries. The calculated SO_2 concentrations in all seven sampling stations are well within the prescribed limit set by CPCB (80µg/m^3). The estimated NO_x concentration of seven sampling stations vary between 15.35±0.22 to 16.63±0.26 µg/m^3, 16.5±1.07 to

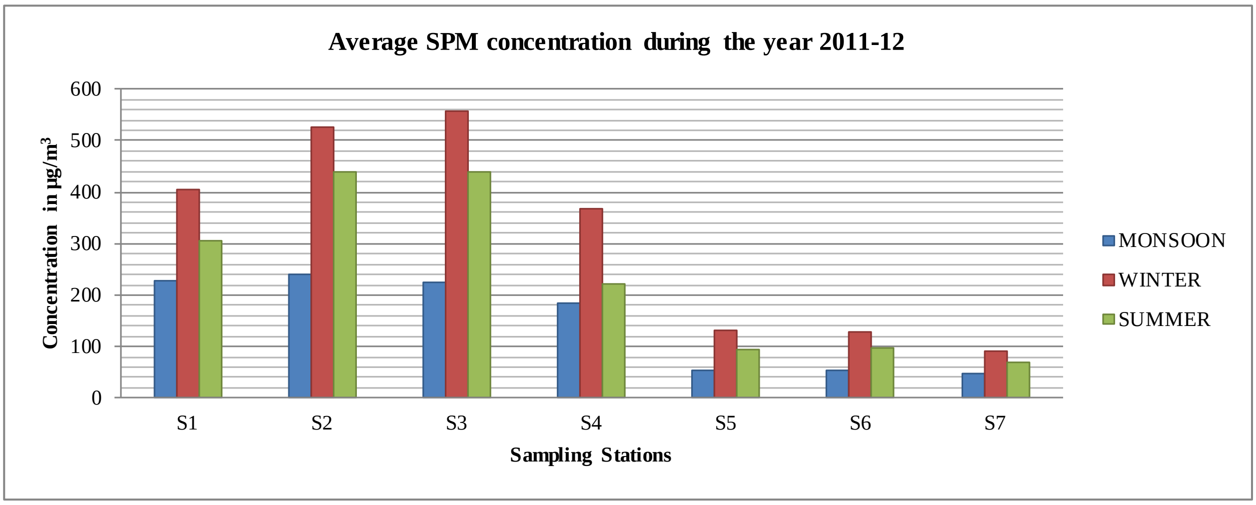

Fig.3. Average SPM concentration in three seasons

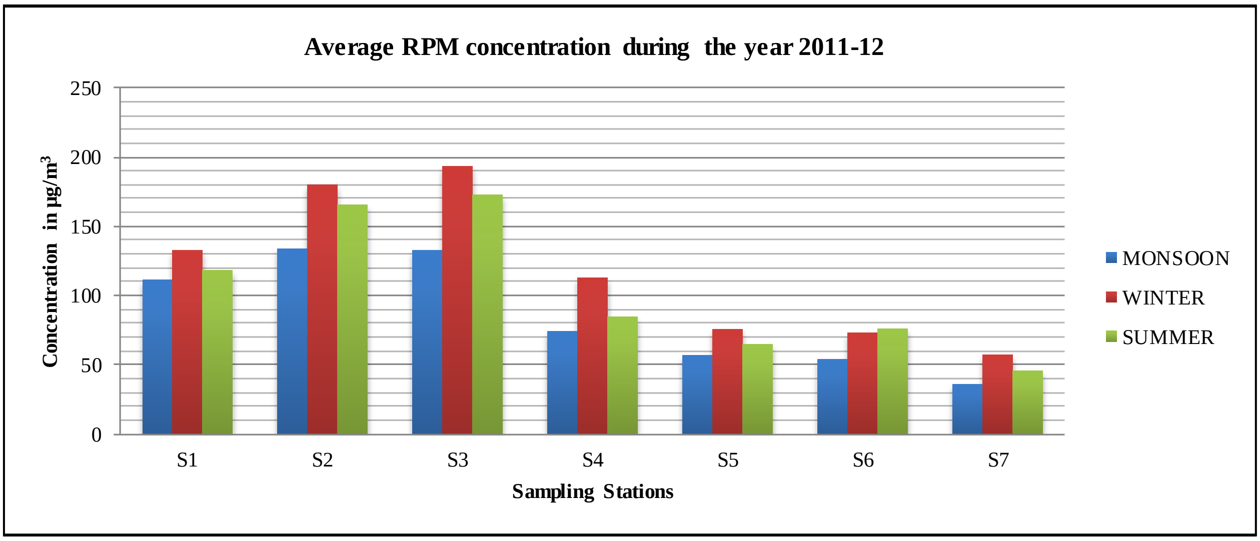

Fig.4. Average RPM concentration in three seasons

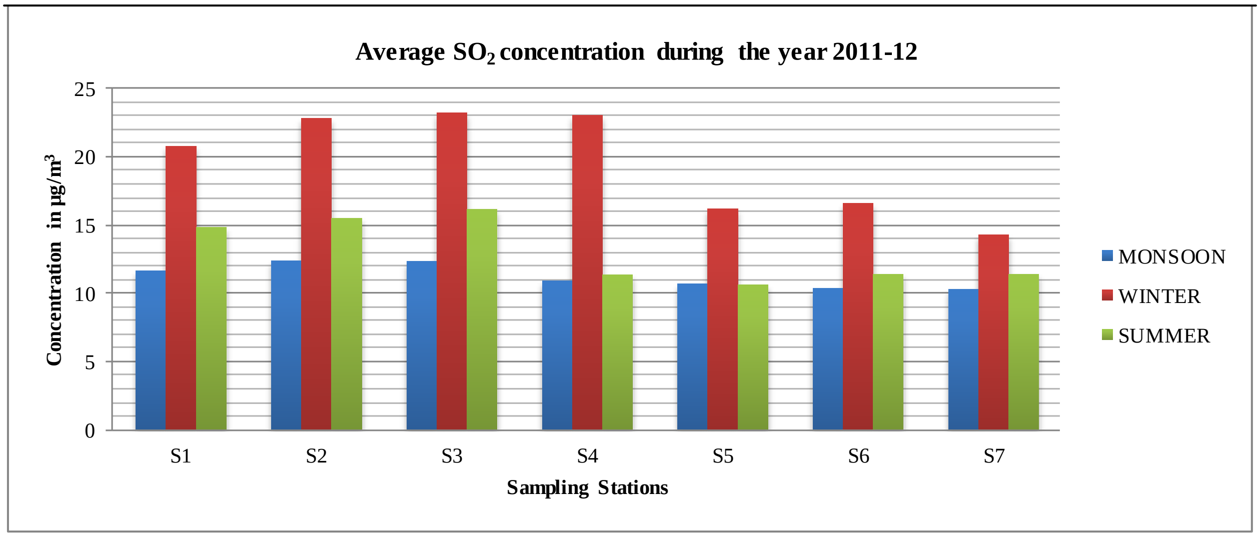

Fig.5. Average SO_2 concentration in three seasons

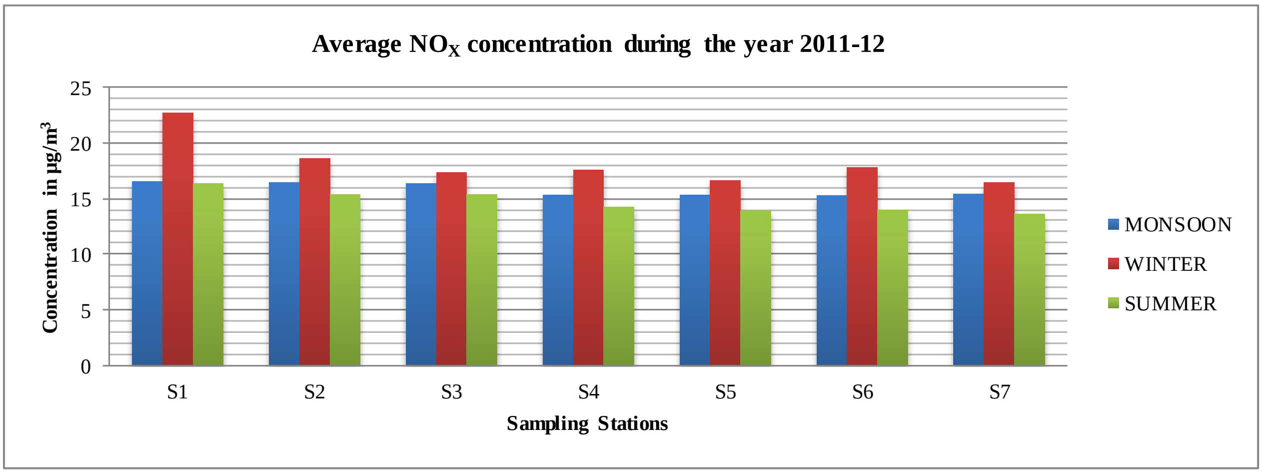

Fig.6. Average NO_X concentration in three seasons

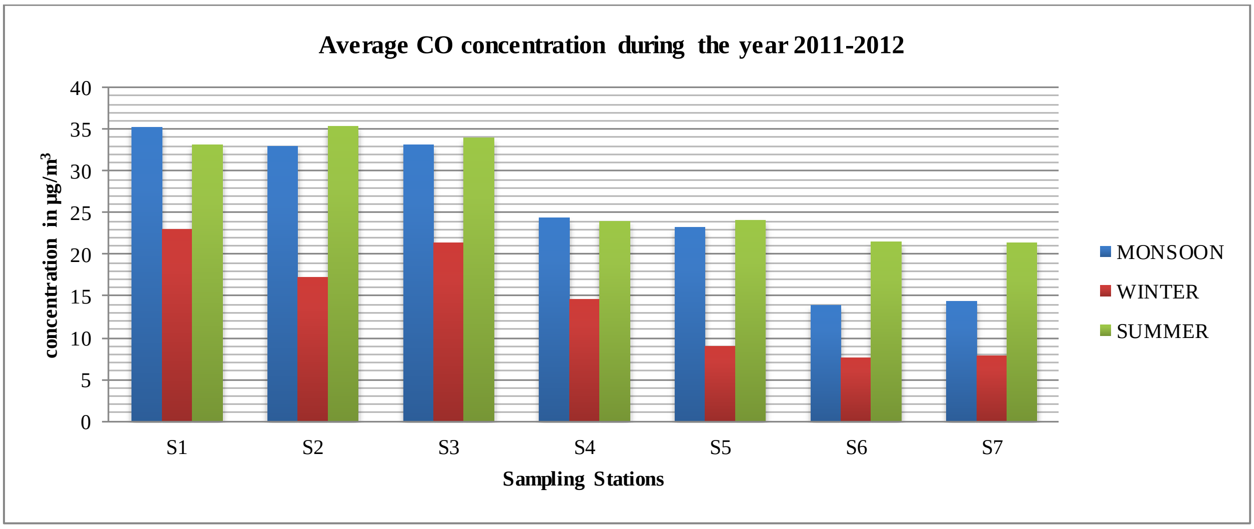

Fig.7. Average CO concentration in three seasons

22.76±0.79 µg/m^3 and 13.66±0.31 to 16.42±0.26 µg/m^3 in rainy, winter and summer seasons respectively during the year 2011-12 (Fig.6.). As far as CO is concerned, the ambient concentrations of carbon monoxide vary from 13.87±3.79 to 35.25±2.81 µg/m^3, 7.62±2.26 to 23±2 µg/m^3 and 21.37±1.18 to 35.37±2.38 µg/m^3 in monsoon, winter and summer respectively (Fig.7.). The recorded NO_x and CO concentrations of all sampling stations in all seasons are well within the prescribed limit set by CPCB (CPCB report, 2009). The result of the investigation shows that the concentrations of SPM, RPM, SO_2, NO_X and CO are found to vary with the sampling stations. This dissimilar degree of air pollution with different types and concentrations of air pollutants may be due to diverse sources of air pollution in the sampling stations and the varied micrometeorological conditions (Table-3).

5. Conclusion

In the present investigation, the pollution level is not acute at the sampling site S7 (Mukhura village) which is in the opposite direction of wind rose and undisturbed area. Hence the site is taken as reference sampling point. In the F.M University campus (S5-2.5 km away from study area) and Nuapadhi village (S6-3km away from study area), the air quality is moderate. In the SBI bank area (S2) and Jagannath Temple area (S3) which are very near to study area, the SPM and RPM values were always found to be higher than the CPCB standard (CPCB report, 2009). In Kurunia village and residential colony, the values were also exceeding the CPCB norm in the year 2011-12. As a number of epidemiological studies demonstrate that the respirable particulate matter and suspended particulate matter in the urban atmospheric environment has a positive correlation with the hospitalizations as a consequence of respiratory, pulmonary and cardiac disease responses and mortalities (Schwartz et al., 1996; Xavier Querol et al., 2001), it is concluded that long term monitoring of air quality with special reference to SPM and RPM should be done to watch the pollution level. The heavy pollution creating industries should practice effective Environmental Management Systems (EMS) and should use the pollution control devices like Electrostatic precipitator (ESP), Wet scrubber, Venturi scrubber, Wet filter, Cyclo-filter etc. to check or to lower the pollution level. Particularly the captive power plant of Emami Paper Mills Pvt. Ltd. Shall not be allowed to run without Electrostatic precipitator. Running of old vehicles around that area should be banned (R.B. Panda et.al, 2011). Epidemiological investigations have to be taken up to implement effective air quality management and air pollution abatement for safeguarding the health of the floating population of Balgopalpur Industrial Estate.

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