

## COMPARATIVE ANALYSIS OF AMBIENT AIR QUALITY STATUS IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL SETTLEMENTS IN BAYELSA STATE, NIGERIA.

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### Abstract

This work focused on the assessment of ambient air quality in Yenogoa, Bayelsa State, Nigeria. The study area was divided into three zones viz: Residential, Commercial and Industrial and Areas with sub-locations for air quality sampling. Ambient air quality is affected adversely by the emission of gaseous pollutants, which include: Oxides of Carbon (CO<sub>x</sub>), Oxides of Sulphur (SO<sub>x</sub>), Oxides of Nitrogen (NO<sub>x</sub>) and Particulate matter alongside temperature and relative humidity. The respective zones were measured at standard atmospheric pressure (1 atmosphere) and recorded. The collected data were statistically analysed using statistical tools such as: Mean (X), standard deviation (SD) and coefficient of variance (CV). The calculated values were correlated to the Environmental Protection Agency (EPA) Air Quality Index (AQI) to ascertain humans' health implication of each of the pollutants. Apart from the mean value of 64 μg m<sup>-3</sup> NO<sub>2</sub> that was below AQI, all other parameters affected human health in the area. Using DOE threshold, results of PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>2</sub> Residential, commercial and industrial were in order of - PM<sub>2.5</sub> > SO<sub>2</sub> > NO<sub>2</sub>, with PM<sub>2.5</sub> (94.5%), SO<sub>2</sub> 4.3% and NO<sub>2</sub> recording 1.2%. Based on the results, it is recommended that existing environmental laws and regulations by enforced for compliance in the area by an authorized bodies and gas flared should be revolutionized.

**Keywords:** Ambient air Quality, settlements, gas flaring, health.

### 1.0 Introduction

Urban agglomerations are places of increased emissions of anthropogenic pollutants into the atmosphere. Concentrations of air pollutants are not only governed by various physical, chemical, or biological processes within the atmosphere, but also by anthropogenic actions. The dependency of air quality on economic development is also reflected in a typical temporal sequence of air pollutant levels (Fenger 1999). Air quality issues sometimes represent challenging environmental problems currently faced by societies as more and more studies suggest impacts of atmospheric pollution on human health and environment as a whole (Desauziers, 2004). Poor air quality most notably

occurs in urban areas where some (or all) of the following factors exist (Kindzierski and Scotten, 2004): numerous sources emitting air pollutants (e.g. automobile, industrial and commercial activities), meteorology (e.g. poor mixing conditions in the atmosphere), irregular topographic features, and large populations. It is reported that over 70-80% of air pollution in mega cities in developing nations is attributed to vehicular emissions caused by a large number of older vehicles coupled with poor vehicle maintenance, inadequate road infrastructure and low fuel quality (Guliaet al, 2015).

Evidences from various governmental organizations and international bodies have proven that air pollution is a major risk to the environment, quality of life, and health of the population (Colbeck and Nasir, 2010; WHO, 2000a, 2004a, b, 2007).

Economic development, urbanization, energy consumption, transportation/motorization and rapid population growth are major driving forces of air pollution (Colbeck and Lazaridis, 2010). In Nigeria, growing cities, increasing traffic, rapid economic development and higher levels of energy consumption lead to the pollution of air. The predominant industrial activities that are going on in areas, especially the upstream and downstream sectors, as well as others anthropogenically related activities including biomass combustion, refuse burning, gas flaring and traffic emissions release a barrage of substance like volatile organic compounds, oxides of nitrogen, oxides of sulphur, particulate matter and methane at levels that most times exceed both national and international limits (Ana, 2015). Based on these, there is need to monitor the ambient air quality of residential, commercial and industrial areas of Bayelsa where incessant gas flaring and other anthropogenic activities are the order of the day for environmental sustainability.

### 2.0 Materials and Methods

**2.1 Study Area:** Yenogoa which is the capital of Bayelsa State, is situated in the Southern part of Nigeria. It covers 21,100 sq. kilometers and it is geographically located within latitude 04° 15' N, 05° 22' N and 60° 45' E. According to 2006 population census (NPC, 2006). Yenogoa has a population of over two million (2,000, 000). The main monthly temperature is between 26°C

to 28<sup>0</sup>C. Annual rainfalls are heavy, between 3,000mm to 3,500mm. The relative humidity in the area ranged between 80% to 85%. The study area is predominantly oil exploration and exploitation with incessant gas flaring (Nwachukwu and Ugwuanyi, 2010; Osuji and Avwiri, 2005; Ugwuanyi and Obi, 2002; Oyekunle, 1999).

**2.2 Air Sampling Techniques:** The study was conducted at nine randomly selected stations in residential, commercial and industrial areas, and sampling was done for 6 months. Study locations were further subdivided into three points each based on the activities prevalence in the area:

**2.2.1 Commercial Settlement (CS):** Point 1(Pt1)- Amarata (AM), Point 2(Pt2)- Swali (SW) and Point 3(Pt3) Onopa (ON) were selected to get representative air quality samples. These areas are highly populated, businesses in the area are very intense and because of that, the amount of vehicular movement in these areas is quite high.

**2.2.2 Industrial Settlement (IS):** Point 1(Pt1)- Oloibiri (OL), Point 2(Pt2) Imiringa (IM), Point 3(Pt3) - Gbarain (GB) were selected to get representative air quality samples. These areas are highly industrialized areas where gas is incessantly flared.

**2.2.3 Residential Settlement (RS):** Point 1(Pt1) Kpansia (KP), Point 2(Pt2), Biogbolo (BI) Point 3(Pt3), with indiscriminate dumping and burning of refuse which pollutes the acid as observed. Monitoring of air quality and climatic variables (Table 1) were done in the ambient air during dry season (January-March). Triplicate sample collection was carried out in each study station during the study seasons and the average values for each parameter was determined. The weather characteristics (temperature, relative humidity). The air sampling (8 hourly basis) was carried out between the months of Jan-March in all the selected stations during day time using equipment in Table 1:

**Table 1: Methods used in determining the Gaseous Emissions and Meteorological Variables**

Parameters	Air Monitors	Range	Alarm
CO ( $\mu\text{gm}^{-3}$ )	CO monitor Gasman model 1925H	0-50ppm	50ppm
NO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	NO <sub>2</sub> Gas monitor Gasman model 1983N	0-10ppm	3.0ppm
SO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	SO <sub>2</sub> Gas monitor Gasman model 19648H	0-10ppm	2.0ppm
PM <sub>10</sub> ( $\mu\text{gm}^{-3}$ )	Haz-Dust TM particulate monitor	0.1-200	+1.0
Temp (Oc)	Thermometer	10 – 50°C	-
R. Humidity (%)	Multi -purpose Hydro. model	(20-100%)	-

The collected air quality data were then compared to the Ambient Air Quality Standard (prescribed limit) set by the Environmental Protection

Agency (EPA) in 1995 (Table 2) to determine health effects on the people as follows:

**Table 2 Air Quality Index (A.Q.I): Health implication**

Air Quality index (AQI) Values When the AQI is in this range	Levels of Health Concern Air quality conditions are:	Colours As symbolized by this color
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very unhealthy	Purple
301 to 500	Hazardous	Maroon

**Environmental Protection Agency (EPA), 1991**

Apart from above index, measured air quality data were then compared to the Ambient Air Quality Standard (prescribed limit) set by the Department of

Environment (DOE) in 1995 (Table 3) to determine the level of pollution in residential, commercial and industrial environments:

**Table 3. Recommended Pollutant Threshold Level (Prescribed Limit) for the different Zones set by the Department of Environment**

Threshold Level/Study location	Concentration in microgram per cubic meter ( $\mu\text{gm}^{-3}$ )		
	SPM	SO <sub>2</sub>	NO <sub>2</sub>
Residential	500	120	120
Commercial	400	100	100
Industrial	200	80	80

Source: Department of Environment (DOE)1995

**2.3 Data Analysis:** Air qualities measured were presented in tables, graphs, percent, mean and percentage. Also description of the result in words was used for the presentation. Standard deviation, Co-efficient of variation and mean were also used to test if there was any significant variation in the perception of environmental impacts among residents in the different zones in the study area.

### 3.0 Results and Discussion

Table 4-7 represent the results of ambient air pollutants, climatic variables the Mean (x),

Standard Deviation (S.D) and Coefficient of Variance (C.V) in the selected residential, Commercial and industrial zones in the study areas. Table 4 represents the characterization of three selected monitoring sites for ambient air quality with Point 1- Kpansia, Point 2- Yenizue-ejene and Point 3- Biogbolo in the Residential Area; Table 5 showing Commercial Area with the study locations viz: Point 1- Amarata, Point 2- Swali and Point 3- Onopa, and Table 6 showing industrial area with study locations viz: Point 1- Oloibiri (OP), Point 2- Imiringa, Point 3 - Gbarain and Table 7.

**Table 4: Air Pollutants in Residential Area and Mean (x), Standard Deviation (S.D) and Coefficient of Variance in selected Residential Areas.**

Parameters	*Pt 1	*Pt 2	*Pt 3	X	S.D	C.V
CO ( $\mu\text{gm}^{-3}$ )	15600	15600	15500	15567	47.1	0.00303
CO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	1080000	1150000	1190000	1140000	45460	0.0399
NO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	70.1	52.4	69.6	64	8.23	0.129
SO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	255	254	304	271	23.3	0.0860
PM <sub>2.5</sub> ( $\mu\text{gm}^{-3}$ )	15360	17180	16110	11383	4891	0.4297
Temp (oC)	35.8	36.8	30.8	36.9	21.1	0.00688
R. Humidity (%)	63.8	63.5	55.4	60.9	3.89	0.0639

Source: Fieldwork, 2015.

**Table 5: Air Pollutants and the Mean (x), Standard Deviation (S.D) and Coefficient of Variance (C.V) in the Commercial Area.**

Air Quality	*Pt 1	*Pt 2	* Pt 3	(X)	S.D	C.V
CO ( $\mu\text{gm}^{-3}$ )	20200	16800	17800	18267	1427	0.0781
CO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	11600	11400	12400	11800	432	0.0366
NO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	111	147	237	165	53	0.321
SO <sub>2</sub> ( $\mu\text{gm}^{-3}$ )	205	718	483	469	210	0.448
PM <sub>2.5</sub> ( $\mu\text{gm}^{-3}$ )	19670	19770	23170	20890	1627	0.0780
Temp (°C)	30.8	30.3	31.9	31	1.39	0.00456
R. Humidity (%)	81.3	74.8	64.3	73.5	7	0.0952

Source: Fieldwork, 2015.

### 3.1 Comparison of Recommended Pollutant Threshold Level for the different Zones with the selected Study locations.

Comparison of PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>2</sub> the three Settlements to the DOE (1995) Threshold Limits are shown below:

**3.1.1 Residential Settlement (RS):** From Table 7, among the three study locations in the residential zone, particulate matter recorded the mean value of 11382 $\mu\text{gm}^{-3}$  above the PM 500( $\mu\text{gm}^{-3}$ ), prescribed limit of DOE (1995), sulphur dioxide recorded the mean value of 271  $\mu\text{gm}^{-3}$ , above the 120  $\mu\text{gm}^{-3}$

<sup>3</sup>prescribed limit of DOE (1995), with nitrogen dioxide recording the mean value of 64  $\mu\text{gm}^{-3}$ , below the 120  $\mu\text{gm}^{-3}$ , prescribed limit of DOE (1995). The results in the residential zone shows that particulate matter is the dominant factor: >PM<sub>2.5</sub>>SO<sub>2</sub>>NO<sub>2</sub>. High concentrations of pm and SO<sub>2</sub> were suspected to be caused by indiscriminate open air burning of waste, vehicular traffic etc. The result conformed with the findings of Avnish and Pawar (2010) who observed the same results in residential area in India.

Joshi *et al.*, 2006; Chauhan and Joshi, 2010 found that the concentration of gaseous pollutants viz: NO<sub>x</sub> was under the permissible limits as per CPCB in the residential area which the present study is in line.

- 3.1.2 **Commercial Settlement (CS):** The result in Table 6 indicates that particulate matter recorded the mean value of 20890  $\mu\text{g m}^{-3}$ , above the PM 500  $\mu\text{g m}^{-3}$ , prescribed limit of DOE (1995), sulphur dioxide recorded the mean value of 469  $\mu\text{g m}^{-3}$ , above the 120  $\mu\text{g m}^{-3}$  prescribed limit of DOE (1995), with nitrogen dioxide recording the mean value of 165  $\mu\text{g m}^{-3}$ , above the 120  $\mu\text{g m}^{-3}$ , prescribed limit of DOE (1995). The result in the commercial zone shows that particulate matter override other pollutants viz:  $\text{PM}_{2.5} > \text{SO}_2 > \text{NO}_2$ .

The high concentration of pm is suspected to be from manmade sources such as automobile exhaust and other anthropogenic activities. The result is in consonance with the observation that the diesel engine produces high level of very small particles (Gupta, 1999). Sandhu *et al.*, (2004) reported that the high concentration of RSPM in all commercial sites due to plying of diesel vehicles. Motor vehicles also generate a range of particulate matter through the dust produced from brakes, clutch plates, tires and indirectly through the re-suspension of particulates on road surfaces through vehicles—generate turbulence (Watkins, 1991). Jain *et al.*, (2004), Rajasekhar *et al.*, (1999) reported that the higher concentration of SPM exceeds the permissible limits, this may be attributed to automobile pollution in commercial environment.

- 3.1.3 **Industrial Settlement (IS):** The result in Table 6 indicates that particulate matter recorded the mean value of 21510  $\mu\text{g m}^{-3}$ , above the PM<sub>2.5</sub> 500  $\mu\text{g m}^{-3}$ , prescribed limit of DOE (1995), sulphur dioxide recorded the mean value of 1702  $\mu\text{g m}^{-3}$ , above the 120  $\mu\text{g m}^{-3}$  prescribed limit of DOE (1995), with nitrogen dioxide recording the mean value of 423  $\mu\text{g m}^{-3}$ , above the 120  $\mu\text{g m}^{-3}$ , prescribed limit of DOE (1995)  $\text{PM}_{2.5} > \text{SO}_2 > \text{NO}_2$ . These were suspected to be caused by the oil and non-oil related industries including refinery, petrochemical, liquefied natural gas, chemical fertilizer, aluminum smelter, paper, cement, flour, wood, battery and textile industries etc which emit various kinds of air pollutants. The pollution from these industries adds to the burden of gaseous and particulate pollutants in the air.

In this study information regarding air pollution from three of these industries namely the chemical fertilizer plant, petroleum refinery plant and the petrochemical complex would be reported (Ana, 2015). Then air pollution is termed as „the price of Industrialization” (Gias *et al.*, 2006).

The overall result shows that PM<sub>2.5</sub> is the dominant factor in the study area with residential having 21.16%, commercial recorded 38.84% and the industrial zone with the highest percentage of 40%, in residential SO<sub>2</sub> recorded 11.09%, NO<sub>2</sub> recorded 9.68% accordingly, in commercial SO<sub>2</sub> recorded 19.20%, NO<sub>2</sub> 24.96% and in industrial zone SO<sub>2</sub>, NO<sub>2</sub> recorded 69.69%, 65.35% being the highest in the study area above the DOE (1995) air quality standards (Fig.1). This result is in line with the findings of Oluwole *et al.* (1996) in a typical air quality assessment of the Niger Delta showed that the levels of volatile oxides of carbon, nitrogen and sulphur and total particulates exceed existing Federal Environmental Protection Agency's (FEPA, 1991) standards leading to moderate to hazardous health effects (Table 2), Table 4-5.

High concentration of particulate matter in the atmosphere is responsible for stress on the heart, bronchial constriction, impairment of lung elasticity and gaseous exchange efficiency, silicosis (a form of pneumoconiosis caused by inhalation of dust particles), respiratory tract disease, systematic toxicity (Pelucchi *et al.* 2009), and altered immune defense (WHO, 2004; Obi and Ugwuanyi, 2002; Kappos *et al.* 2004). Gulia *et al.*, 2014). Sulphur dioxide irritates the skin and mucous membranes of the eyes, nose, throat, and lungs. High concentrations of SO<sub>2</sub> can cause inflammation and irritation of the respiratory system, particularly during heavy physical activity. The resulting symptoms may include pain when taking a deep breath, coughing, throat irritation, and breathing difficulties. High concentrations of SO<sub>2</sub> can affect lung function, worsen asthma attacks, and aggravate existing heart disease in sensitive groups. This gas can also react with other chemicals in the air and convert to a small particle that can lodge in the lungs and cause similar health effects. Nitrogen dioxide causes the reddish-brown haze in city air, which contributes to heart and lung problems and may be carcinogenic (Gulia *et al.*, 2014). Comparison of PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>2</sub> the

three Settlements to the DOE (1995) Threshold Limits. These are shown below: The overall result shows that PM<sub>2.5</sub> is the dominant factor in the study area with residential having 21.16%, commercial recorded 38.84% and the industrial zone with the highest percentage of 40%, in residential SO<sub>2</sub> recorded 11.09%, NO<sub>2</sub> recorded 9.68% accordingly, in commercial SO<sub>2</sub> recorded 19.20% , NO<sub>2</sub> 24.96% and in industrial zone SO<sub>2</sub>, NO<sub>2</sub> recorded 69.69%,65.35% being the highest in the study area above the DOE (1995) air quality standards (. This results are in line with the findings of Oluwole *et al.*(1996) in a typical air quality assessment of the Niger Delta showed that the levels of volatile oxides of carbon, nitrogen and sulphur and total particulates exceed existing Federal Environmental Protection Agency's (FEPA,1991) standards leading to moderate to hazardous health effects (Table 2). High concentration of particulate matter in the atmosphere is responsible for Stress on the heart, bronchial constriction, impairment of lung elasticity and gaseous

exchange efficient, silicosis (a form of pneumoconiosis caused by inhalation of dust particles), respiratory tract disease systematic toxicity (Pelucchi *et al.* 2009)., and altered immune defense (WHO, 2004a; Obi and Ugwuanyi, 2002, Kappos *et al.* 2004). Guliaet *al.*, 2014). sulfur dioxide irritates the skin and mucous membranes of the eyes, nose, throat, and lungs. High concentrations of SO<sub>2</sub> can cause inflammation and irritation of the respiratory system, particularly during heavy physical activity. The resulting symptoms may include pain when taking a deep breath, coughing, throat irritation, and breathing difficulties. High concentrations of SO<sub>2</sub> can affect lung function, worsen asthma attacks, and aggravate existing heart disease in sensitive groups. This gas can also react with other chemicals in the air and convert to a small particle that can lodge in the lungs and cause similar health effects.Nitrogen dioxide causes the reddish-brown haze in city air, which contributes to heart and lung problems and may be carcinogenic Guliaet *al.*, 2014

**Table 6: Air Pollutants and the Mean (x), Standard Deviation (S.D) and Coefficient of Variance (C.V) in the Industrial Zone**

Parameters	*Pt 1	*Pt 2	*Pt 3	X	S.D	C.V
CO (µgm <sup>-3</sup> )	16600	16700	16700	16667	35.6	0.00214
CO <sub>2</sub> (µgm <sup>-3</sup> )	1110000	1080000	1150000	1113333	28674	0.0258
NO <sub>2</sub> (µgm <sup>-3</sup> )	419	566	311	432	105	0.243
SO <sub>2</sub> (µgm <sup>-3</sup> )	482	2565	2060	1702	887	0.5212
PM <sub>2.5</sub> (µgm <sup>-3</sup> )	24110	17910	22510	21510	2628	0.122
Temp (K)	307.5	307.1	306.6	307	0.374	0.00122
R. Humidity (%)	60.3	60.4	66.5	62.4	3.90	0.0625

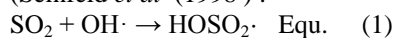
**Table 7: Comparison of Recommended Pollutant Threshold Level for the different Zones with the selected Study locations**

Threshold Level/Study location	Concentration in microgram per cubic meter (µgm <sup>-3</sup> )		
	PM2.5	SO <sub>2</sub>	NO <sub>2</sub>
<b>Residential (Standard)</b>	<b>500</b>	<b>120</b>	<b>120</b>
Study Location (Residential)	X: 11382 (21.16%)	X:271 (11.09%)	X:64 (9.68%)
<b>Commercial (Standard)</b>	<b>400</b>	<b>100</b>	<b>100</b>
Study Location(Commercial)	X: 20890(38.84%)	X:469(19.20%)	X:165 (24.96%)
<b>Industrial (Standard)</b>	<b>200</b>	<b>80</b>	<b>80</b>
Study Location (Industrial)	X:21510 (40%)	X:1702 (69.69%)	X:432 (65.35%)
<b>Mean/percentage</b>	<b>53782 (94.5%)</b>	<b>2442 (4.3%)</b>	<b>661(1.2%)</b>

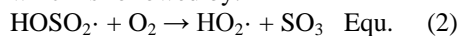
Temperature and relative humidity are driving force in chemical reactions while lower wind speed may promote buildup of chemicals in the atmosphere

since there will be less dispersive force to dilution effect. According to Seinfeld *et al* (1998) , Bailey *et al* (2005) observed that sulfur dioxide and nitric

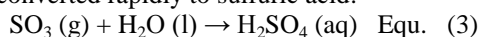
oxides will readily react to form new compounds in ambient air. They are converted into sulfuric acid and nitric acid (CAA,1998): In the gas phase sulfur dioxide is oxidized by reaction with the hydroxyl radical via an intermolecular reaction (Seinfeld *et al* (1998) :



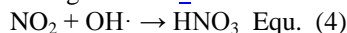
which is followed by:



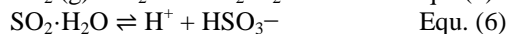
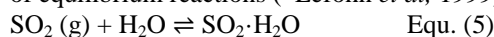
In the presence of water, sulfur trioxide (SO<sub>3</sub>) is converted rapidly to sulfuric acid:



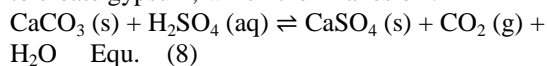
Nitrogen dioxide reacts with OH to form nitric acid:



When clouds are present, the loss rate of SO<sub>2</sub> is faster than can be explained by gas phase chemistry alone. This is due to reactions in the liquid water droplets. Sulfur dioxide dissolves in water and then, like carbon dioxide, hydrolyses in a series of equilibrium reactions ( Lefohn *et al*, 1999) :



Acid rain can damage buildings, historic monuments, and statues, especially those made of rocks, such as limestone and marble, that contain large amounts of calcium carbonate. Acids in the rain react with the calcium compounds in the stones to create gypsum, which then flakes off:



The effects of this are commonly seen on old gravestones, where acid rain can cause the inscriptions to become completely illegible. Acid rain also increases the corrosion rate of galvanized iron roofing sheet (Ubuoh, 2010). For instance Ana (2015) observed that, the presence of acidified rain water in the environment increases the corrosion rate of roofing sheets, monuments and other economic structures. In the Niger delta area there is glaring evidence of the impacts of corrosion on several building structures and arts work and these cases have been observed to deteriorate at rather alarming rates.

**3.2 Conclusion:** From the results of the atmospheric compositions in the study area, it is observed that air quality such as CO, CO<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>2.5</sub> varied based on anthropogenic activities. These variations are caused by the influence of atmospheric temperature and relative humidity respectively. The overall results show that apart from low NO<sub>2</sub> in residential area, particulate matter, sculpture dioxide and nitrogen dioxide were above the prescribe air quality threshold limits in the three zones chosen that affect man and his

environment. These air quality parameters are emitted to the atmosphere by incessant gas flaring and allied industries, vehicular emission and indiscriminate waste burning in the area. The result also show that PM<sub>2.5</sub> is the dominant factor in the atmosphere, sculpture dioxide ranking second and nitrogen dioxide being the third, with industrial area recording the highest percentage of the three special pollutants followed by commercial and the residential being the lowest percentage. The result further indicated SO<sub>2</sub> and NO<sub>2</sub> as acid precursors, reacting with water vapour and sulfurous acid (H<sub>2</sub>SO<sub>3</sub>) through oxidation to form H<sub>2</sub>SO<sub>4</sub> and nitric acid together leading to formation of acid rain in the atmosphere (Ubuoh *et al*,2010; Ubuoh, 2012b).Based on the results it is recommended that, in order to improve on the current air quality in the State, there is need to embark on the following:

- Industries, especially those present in the Niger Delta area of Nigeria should improve on their technology and find a way of minimizing air pollutants rather than emitting to the atmosphere.
- Government and NGO should stop playing politics with “ gas flaring”, that the existing environmental laws and regulations should be implemented and compliance enforced for environmental sustainability.
- There should be a focus on the reduction of pollution levels from vehicles, industry, to permissible levels as defined in national and international standards.
- Above all, gas flared should be revolutionized for better economy.

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