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Climatic Implications of Atmospheric Pollution in Lagos State of Nigeria

By

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Abstract

Air quality is paramount to healthy living on the planet health. Emission of some green house gases (GHGs) such as carbon monoxide (CO), carbon dioxide (CO₂) and sulphur dioxide (SO₂) constitute air pollution in the study area. The effects of this on the weather variables of minimum temperature, maximum temperature and rainfall of Lagos State were examined in this study. Correlation and regression analyses were employed to study the strength of relationships. The results showed a strong positive relationship of 0.85 and 0.79 between CO and minimum temperature and between CO and maximum temperature. A stronger positive relationship of 0.93 and 0.88 is established between CO₂ and minimum temperature and between maximum temperature respectively. The positive relationship between SO₂ and the above weather variables is mild while rainfall exhibited a very weak positive relationship between all the three gaseous pollution in the study area. The atmospheric concentrations of the three gases are on the increase. Between year 2008 and 2011 CO increased from 0.9ppm to 2.5ppm, CO₂ witnessed an upsurge of 457.7ppm from 400.3ppm while SO₂ rose from 3.5ppm to 4.5ppm. Year 2011 witnessed the highest emission of CO, CO₂ and SO₂ in Lagos State within the time frame of 2008 and 2011. Suggestions were made on how to lower the level of these gases emitted into the atmosphere and on how to attain and sustain a climate-friendly energy supply in the area.

Introduction

Urbanization always leads to development which is usually accompanied by environmental degradations of various forms. One of them is emission of pollutants through motor vehicle and industrial activities. The prediction that Nigeria will experience unprecedented increase in environmental degradation resulted from air pollution caused by man has been observed by Onokala and Ali (2009).

Pollution that nature could not handle comes from man-made sources. For instance, atmospheric concentration of the Green House Gases (GHGs) is increasing at an alarming rate.

Odjugo (2009) noted that concentration of GHGS were as low as 70ppbv (part per billion by volume) before the prehistoric era and this was successfully managed by nature. However by 2005, this value has increased to 1750ppbv which represented 150% increase. A further rise of 3700ppbv was projected by year 2100.

Air quality is paramount to healthy living on planet earth for its implications on both the chemistry of the atmosphere and the energy balance equation of the earth. In the developing countries of Africa such as Nigeria, rain water is a valuable resource. It constitutes an important source of water for domestic and agricultural activities (Agriculture in Nigeria is rain-fed). Sulphur dioxide (SO_2) and Nitric Oxide (NO_2) emitted into the earth atmosphere by man's operations are major precursor of acid rain. Studies have shown that such rain has high potential to acidify soil, lakes, streams, farm crops and to accelerate corrosion of monuments, roofing sheets etc.

The atmosphere is transparent to the short wave radiation of the electromagnetic spectrum but translucent to the earth infrared long wave radiation. The transparency of the atmosphere to the incoming solar radiation and its opacity to the outgoing terrestrial radiation is termed 'green house effect'. Thus the resultant effects of the excessive emission of GHGs particularly Carbon dioxide is unprecedented global warming with its attendant havocs such as drought, floods, etc

Bello and Isiguzo (1999) observed a persistent positive temperature anomaly at three locations in rainforest of Nigeria. In the same vein, Olanrewaju (2009) noted similar rise in temperature for a city in the Guinea savannah ecological zone of Nigeria. Again based on BNRCC 2011 an increase of between 2.0°C - 2.2°C maximum temperature has been projected for Nigeria. This increase in temperature might not be unconnected with GHGs emission among other factors. Thus, this present study examined the effect of the emission of some GHGs of Carbon monoxide, carbon dioxide and sulphur dioxide on the weather variables of Lagos megacity in Nigeria. This is with the intention of improving the air quality of the city which inhabits high per cent age of Nigerians.

The Study Area

The study area is Lagos State located on latitude $6^{\circ} 27'$ North of the equator and on longitude $3^{\circ} 24'$ East of the Greenwich Meridian (see figure 1).

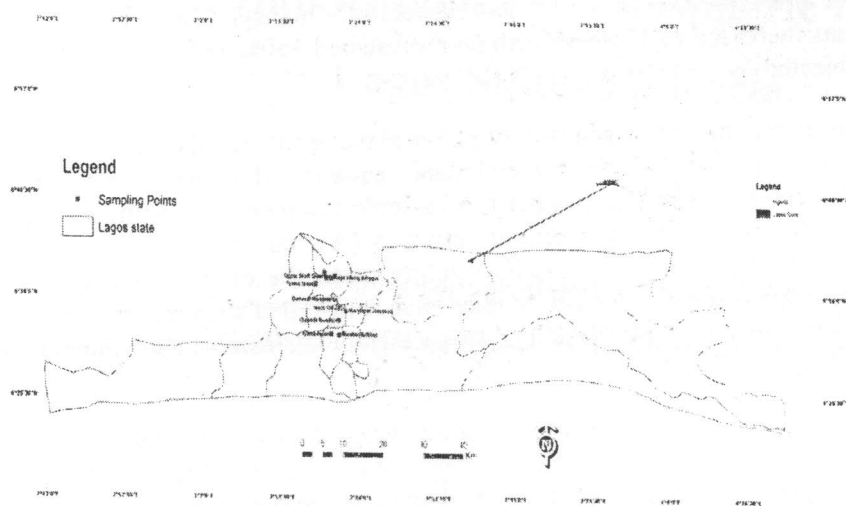


Fig1: Map of the Study Area

It has a land mass of 3,577km² out of which 787km² constitute lagoon, swamps, marshes and creeks. Lagos State has tropical hot and wet climate with an average temperature of 27°C and annual average rainfall of 1532mm. Its average relative humidity is put at 85% (Aina 1994 as cited in Adeoye 2010).

Lagos State has a population of about 18million people. It has attained the 6th largest city of the world and has been projected to become the 3rd urban conurbation on the planet earth by year 2015. By the reason of this population it joined the megacity recently (Adeoye 2010). LURG (2009) put the growth rate of Lagos at 5.7% which indicates that it is growing 2000 inhabitants per day. Population explosion is taking place in Lagos because 60% of the nation's industrial and commercial establishments are located here. These activities increase the number of vehicles that ply the roads of the mega city. Afolabi (2008) put the number of vehicles plying the roads of Lagos megacity at 800,000. This would have increased tremendously in conjunction with the present rapid increase in population taking place in the study area. Ayode (1999) observed the increase in the rate of urbanization worldwide and canvassed for the need to know the atmospheric environment of where the greater proportion of people live and the need to ensure a pleasant and healthy environment for urban dwellers.

Method of Study

Both climatic and pollution data were sourced through secondary information. Climatic data of rainfall, maximum and minimum temperature were obtained from the archives of the Nigerian

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Clima

Table 1

Climatic Variable
Minimum Temperature
Maximum Temperature (°C)
Mean Temperature
Rainfall (mm)

Source: T

Meteorological Agency (NIMET) Oshodi, Lagos while pollution data which comprise emission records of carbon monoxide (CO) carbon dioxide (CO₂) and sulphur dioxide (SO₂) were collected from the Ministry of Environment, Lagos. The sampling points used include Ogba, Iyana Ipaja, Ikeja (along Air Port Road), Ikeja GRA, Oregun, Oshodi, General Hospital, Maryland and Mushin. These constitute the industrial and heavy traffic areas. Carbon monoxide was collected using carbon monoxide sensor. Carbon dioxide was collected using carbon dioxide sensor while sulphur dioxide was collected using sulphur dioxide meter. All were collected in parts per million (PPM) at a height of 3.4 metres above the surface. The collection of data covers four years which spanned between 2008- 2011.

The collection of climate data was on monthly basis while pollution data were compiled annually. Hence climatic data were also partitioned on annual basis for easy comparison. Both correlations and regression analyses were used to study the strength in relationship between the two variables.

Results and Discussion

Climatic variation

The climatic pattern during the period of study is reflected in table 1 below:

Table 1: The Climatic Pattern of Lagos State between 2008 and 2011

Climatic Variables	2008	2009	2010	2011	Mean
Minimum Temperature (°c)	24.3	22.4	22.6	30.3	24.9
Maximum Temperature (°c)	31.9	30.5	30.4	34.7	31.9
Mean Temperature	28.0	26.4	26.5	32.5	28.4
Rainfall (mm)	151.3	116.0	115.2	144.4	131.7

Source: The Author, 2013

Minimum temperature ranged between 22.4°C recorded in year 2009 and 30.3°C of year 2011. However, the least maximum temperature of 30.4°C was observed during the year 2010 but year 2011 still retained the highest maximum temperature of 34.7°C. Generally, the temperature is high and year 2011 was the warmest (see figure 2 below).

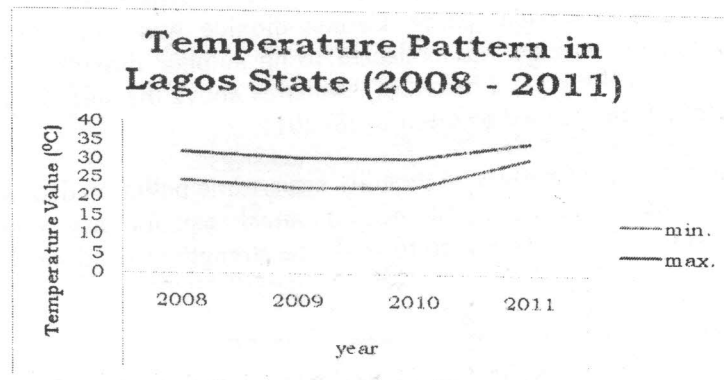


Fig 2: A Line Graph showing both Maximum and Minimum Temperature of Lagos (2008-2011)

Source: Author's Fieldwork, 2013

Rainfall fluctuates in Lagos State. Incidentally, year 2010 that recorded the least maximum temperature also observed the least mean annual rainfall amount of 115.2mm while the highest mean annual rainfall of 151.3mm occurred in year 2008 (see figure 3). It appears high air temperature induces high rainfall amount in the study area. The atmosphere of Lagos is characterised by high relative humidity. Increase in air temperature will generate lot of convectional activities that result in rainfall.

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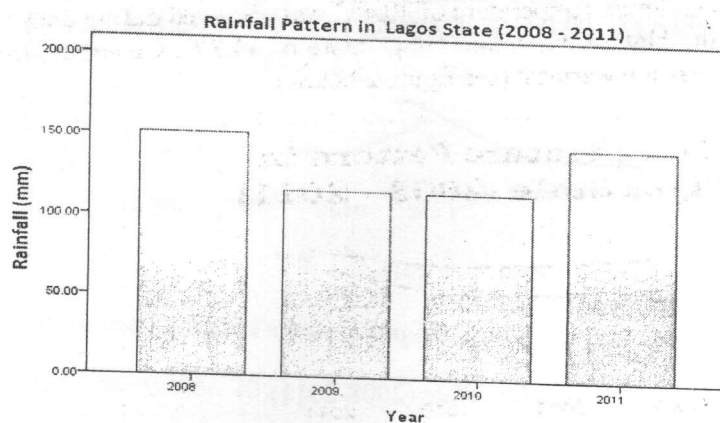


Fig 3: Rainfall Pattern in Lagos (2008-2011) Source: Author's Fieldwork 2013

Variation in Air Pollutants

Variation in selected air pollutants of CO, CO₂ and SO₂ is shown in table 2 below. The atmospheric concentrations of the three pollutants varied over the study period.

Table 2: Variations in Pollution Emission (2008- 2011).

Pollutant (ppm)	2008	2009	2010	2011	Mean
CO	0.9	1.3	1.4	2.5	1.5
CO ₂	400.3	411.9	402.8	457.7	418.2
SO ₂	3.5	4.2	3.8	4.5	4

Source: The Author, 2013

Generally, CO increased from 0.9ppm of 2008 to 2.5ppm during year 2011 (see fig 4).

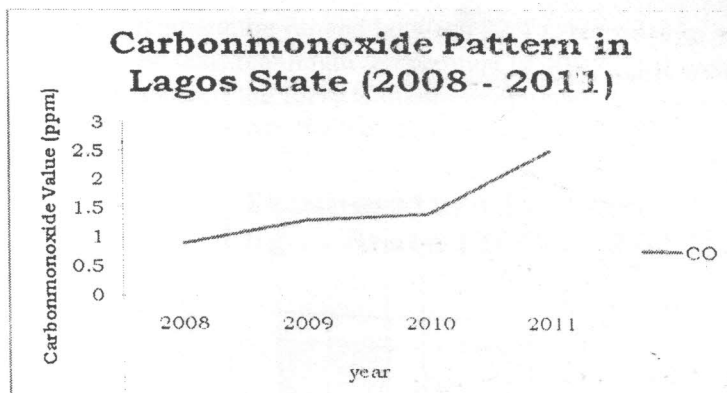


Fig 4: Carbon dioxide Pattern in Lagos State (2008-2011).

Source: The Author, 2013

The curve is not smooth because of a slight decline observed during year 2010. However the rise in atmospheric CO during the study period is very glaring.

Similarly, CO₂ and SO₂ level rose to 457.7ppm and 4.55ppm during the year 2011 from 400.3ppm and 3.5ppm of year 2008 respectively (see figures 5 and 6 below).

The pattern of rise in CO₂ over the period of study is similar with that of CO where the smoothness of the curve is depressed during year 2010. This can be resulted from factors that control the level of emission of these gases and the dynamism level of the atmosphere during this year (see fig 5 below).

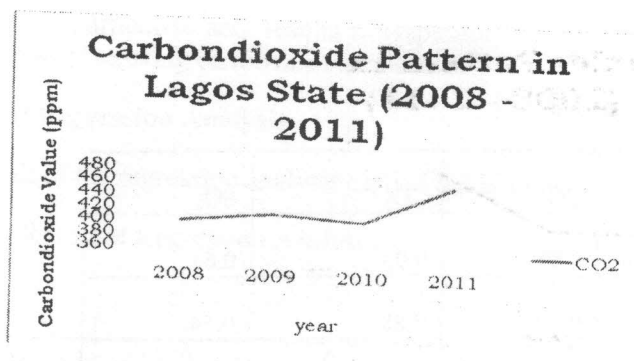


Fig 5: Carbon dioxide Pattern in Lagos (2008-2011)

Source: The Author, 2013

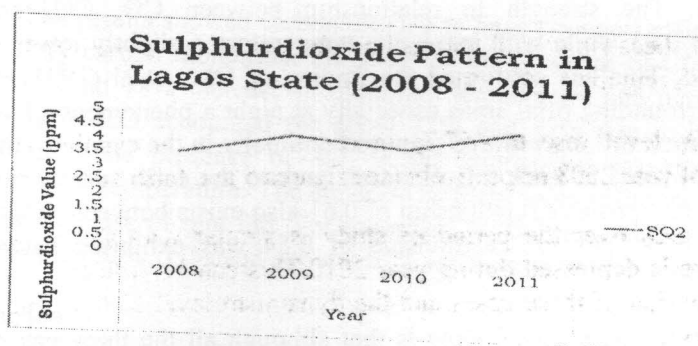


Fig 6: Sulphur dioxide pattern in Lagos State (2008-2011).

Source: The Author, 2013

The only difference between the pattern of SO_2 emission distribution over the study period and others is that the decline from 2009 through 2010 is more pronounced here compared with the decline observed in the distribution of the previous gases. The above findings showed year 2011 as year with the highest emission of CO, CO_2 and SO_2 in Lagos State.

Result of Correlation Analysis

The results of correlation analysis show positive relationships of varying magnitude between each pollutant and the climatic variables over the period of

Study (see table 3 below).

Table 3: Result of Correlation Analysis

Climatic variables	CO	CO ₂	SO ₂
Minimum Temperature (°C)	0.85	0.93	0.61
Maximum Temperature (°C)	0.79	0.88	0.54
Rainfall (mm)	0.15	0.40	0.01

Source: The Author, 2013

Both CO and CO₂ have greater affinity to raise air temperature. However, the result indicates that the atmospheric CO₂ and CO have higher tendency to raise minimum temperature than maximum temperature. The strength in relationship between CO, CO₂ and minimum temperature is 0.85 and 0.93 while with maximum temperature a slightly lower value of 0.79 and 0.88 were observed. This has confirmed the finding of Oke, et al (1991) that cities are usually warmer than surrounding rural areas especially at night a phenomenon known as urban heat island effect. Radiation of long infrared occurred optimally in the evening- night condition. These gases mostly CO₂ tends to track this radiation back to the earth surface thus raising the earth temperature. A strong positive relationship of 0.61 also exists between SO₂ and minimum temperature while a milder positive relationship of 0.54 was exhibited between SO₂ and maximum temperature.

The implication of the above finding is that although all the three gaseous pollutants under study are GHGs, it appears CO and CO₂ are stronger than SO₂ at raising the earth temperature. As their concentrations increase in the atmosphere, the earth environment becomes warmer.

The role of SO₂ as a pollutant may be more crucial in its ability to acidify atmospheric water with its attendant problems. Ubon, et al (2009) noted drops in ionic contents between atmospheric and rooftops due to sulphuric acid (H₂SO₄), hydrochloric acid (HCL) and nitric acid (HNO₃) in rain water that affect protective zinc oxide of roof sheets in urban areas that lies outside zone of gas flaring and rural and marine within region of gas flaring.

Leonard and Abdul-Gani (2011) emphasized the health implications of high concentration of SO₂ in the atmosphere as a precursor of breathing problem with asthmatic children and adults who are active outdoors. Short time exposure to air rich in SO₂ has been linked with wheezing, chest tightness and shortness of breath while long term exposure to such air especially when

such air has particulate soot results in respiratory illness, alterations in the lungs defences and aggravation of existing cardiovascular disease.

Result of Regression Analysis

The result of the regression analysis carried out is shown in table 4 below.

Table 4: Result of Regression Analysis

Variables	R ²		
	CO	CO ₂	SO ₂
Min. Temp (0C)	0.729	0.855	0.368
Max. Temp (0C)	0.616	0.782	0.289
Rainfall (mm)	0.22	0.111	0.018

Source: The Author, 2013.

The results showed carbon dioxide to have strongest affinity for raising air temperature followed by carbon monoxide. For instance the presence of CO₂ in the atmosphere explained about 86% and 78% increase in minimum temperature and maximum temperature. Similarly while that of CO accounted for about 73% and 62% rise in both minimum and maximum temperature. The presence of SO₂ in the atmosphere explained only about 33% and 29% increase in air temperature. The emission of these three pollutants into the atmosphere has little effect on increase of rain fall. For instance CO, CO₂ and SO₂ concentration in the atmosphere accounted for 22%, 11% and about 0.02% increase in rainfall amount.

Conclusion

The above findings revealed various threats of high level concentration of CO, CO₂, SO₂ pollutants to human health. While high levels of CO and CO₂ brings about unprecedented rise in temperature with its attendant environmental hazards such as sea level rise, flood, erosion, heat wave, drought etc emission of SO₂ degrades man and its environment through acid rain and various respiratory diseases.

The major sources of these pollutants in the study area are through motor vehicle emission and industrial operations. The adverse health implications of this has being highlighted in this study. Thus the government should step into actions that will reduce the level at which these gases are being emitted into the atmosphere. This can be achieved by securing a climate-friendly energy supplying. These could be in form of seeking for an alternative means outside of fossil fuel. Examples of these are wind and solar energy. Policy makers should adopt fuel octane rating standard. Fuel octane rating is a standard measure of a degree of fuel

efficiency. Fuels with a high octane rating are used in a high compression engine that generally has high performance.

References

- Adeloye, A.A (2010) "Lagos State Geoinformation Infrastructure Policy (Lais) as a Tool for Megacity Development: Opportunities and Challenges" a paper Presented at FIG Congress 2010, held in Sydney, Australia between 11th – 16th April 2010.
- Ayoade, J.O (1999) "*External Studies Programme GEO 411 Applied Climatology*" A bprint and Pak Ltd. Ibadan.
- Bello, N. J and Isiguzo, V.O. (1999) "Evaluation of Climate Change in some Forest Ecosystem in Nigeria. *Environment Annular* 1(3); 182 – 191
- BNRCC (Building Nigeria Response to Climate Change) 2011; Towards A National Adaptation Strategy and Plan of Action (NASPA); A Consultative Document for Stakeholder review and Consultation.
- Iguisi, E.O (2011) "Forward" Book of Proceedings of the International Conference of the Nigerian Meteorological Society on Climate Change Impacts: Risks and Opportunities, held in ABU zaria.
- IPCC (2007), The Fourth Assessment Report (AR4), Synthesis Report for Policy makers.
http://www.ipccrch/pdf/assessment-report/ar4-5yr/ar4_5yr_sprn.pdf
- Leonard, E and Abdul-Gani, O. (2011) A Change in the Transportation needs today a better Future for tomorrow; *Climate Change Review* (ditto 722-710.
- Lagos Urban Research Group (LURG) 2009: Lurg network. Wordpress.com/2009/06/22/Lagos-facts.
- Odjugo, P.A.O (2009), Global and Regional Analysis of the causes and Rate of Climate

Change; in Climate Change and the Nigerian Environment, Anyadike, R.N.C, Madu, I.A and Ajaero, C.K (eds), Department of Geography, University of Nigeria, Nsukka Conference

Proceedings 29th June – 2nd July, PP65 – 83.

Oladipo, E. (2011), The Challenge of Climate Change for Nigeria; An overview Paper Presented at the International Conference of the Nigerian Meteorological Society on Climate Change Impacts: Risks and Opportunities, held in Abuja, between 13th – 17th November 2011.

Oke, T.R, and Johnson, G.T. Steyn, D.G, Watson, I.D. (1991), Simulation Surface Urban Heat Island Under 'ideal' Condition at Night Part 2: Diagnosis of Causation. *Boundary Layer Meteorology* 56: 339-358.

Olanrewaju, R.M (2009), The Climate effect of Urbanization in a City of Developing Country: The Case Study of Ilorin Kwara State, Nigeria. *Ethiopian Journal of Environmental Studies and Management (EJESM)* 2(2): 67-72.

Onokala, P.C. and Ali, A.N. (2009), The Potential Role OF sustainable Urban Transportation in the Reduction of Green House Gases (GHGs) Emission. in Climate Change and the Nigerian Environment, Anyadike, R.N.C, Madu, I.A and Ajaero, C.K (eds), Department of Geography, University of Nigeria, Nsukka Conference Proceedings 29th June – 2nd July, PP65 – 83.

Ubuoh, E.A, Anyadike, R.N.C, Akande, S.O, Igbojionu, D.O, Akionbare S.M.O and Njoku, J.D (2009), Atmospheric Corrosion of Corrugated Iron Roofing Sheet in Selected Parts of Akwa Ibom, in Nigeria. in Climate Change and the Nigerian Environment, Anyadike, R.N.C. Madu, I.A and Ajaero, C.K (eds), Department of Geography, University of Nigeria, Nsukka Conference Proceedings 29th June – 2nd July, PP489-500.