

Investigative Study of Climate Change on Air Quality, Environment and Human Health in Southeast, Nigeria

¹Nicholas, Eno-obong. S.*, ²Ukoha, Pius. O.

Department of Pure and Industrial Chemistry, Faculty of Physical Sciences,
University of Nigeria, Nsukka, Enugu State, Nigeria.

Abstract: This research work was carried out in Southeast, Nigeria in the industrial and residential areas of Delta State with the aim to investigate the effect of climate change on the air quality of the survey areas, to ascertain its impact on the environment and to compare the overall results of the air quality assessment with the Air Quality Index (AQI) ratings, since there has been a growing global interest on climate change and its effect, especially on the environments/ humans. Climate change is caused by numerous factors, namely; increased CO₂, deforestation, ozone layer depletion, and greenhouse gas emission into the atmosphere by natural and man-made activities. The air quality status of the sampled areas was analysed using Gasman Air Monitoring Meter (Models 1200-19831) and Air Ae Steward Meter (Haz-DustTm; PM_{2.5} and PM₁₀, Model: HD1000). The results of the air quality assessment in both areas of Delta State analysed were in the ranges of 113.00-133.00 µg/m³ for PM_{2.5}, PM₁₀ (153.30-179.67 µg/m³), relative humidity (92.33-95.00 %), pressure (1011.00-1011.70 hpa), elevation (23.00-67.33 m), cloud (85.33-87.33 %) and wind speed (1.07-1.13 m/s). Other results in (ppm) were: SO₂ (0.63-0.73), NO₂ (0.40-0.76), CO (147.30-266.50), CO₂ (16,860.00-28,900.00). The Air Quality Index (AQI) ratings of the obtained results showed that, the area with low industrial activities (Okpanam Road, Asaba Local Government Area) was rated from poor (D) to very poor (E) while in the area with high industrial activities (Warri Refinery Depot, Ekpan Community, Uvwie Local Government Area), it was rated from very poor (E) to hazardous (F).

Keywords: Climate change, Air Quality, Environment, Air Quality Index (AQI), Human health

Introduction:

The effect of climate change on human beings and nature are increasingly apparent. Heat waves, unprecedented flooding and wildfires have cost billions in damages already on earth. Climate change is defined as any change in climate over time whether due to natural variability or as a result of anthropogenic activity [8]. Climate Scientists agrees to the fact that the earth is currently having challenges of increase/rapid warming which is caused by rising levels of greenhouse gases in the environment/atmosphere. Air quality refers to the condition of the air within our surrounding or environment and it can be affected in many ways by the pollution emitted from these sources [1]. Air pollution causes some gases in the atmosphere to exist at higher than normal conditions, and can be seriously harmful to human health. Examples of these include: nitrogen oxides, sulphur oxides, carbon monoxide, particulate matter, photochemical oxidants (for example; ozone) and lead, along with a variety of airborne heavy metals and volatile organic compounds which are as a result of industrialization and traffic emissions which pollute the atmosphere [3]. Several studies have been conducted/carried out to monitor the quality of air environment within the Niger Delta region and the results obtained from these researches has always shown high level of toxic substances in the air quality [13], [6-7], [10], [5]. Air quality assessment have been carried out by various researchers in Uyo Metropolis, Akwa Ibom State [2], [4] and in Owerri Municipal council, Imo State, Nigeria [14].

Study Area:

The study was carried out in Delta State, Nigeria in Okpanam Road, Asaba, local government area, its coordinates, 6°11'52.23"N 6°43'42.48"E (industrial/residential area) and also at Warri, Warri Refinery Depot Area, Ekpan Community, Uvwie local government area, its coordinates, 5°31'N 5°45'E (industrial and gas flaring area). Delta State is located in Southern Nigeria and it is one of the Niger Delta States in Nigeria and divided into twelve local government areas (LGA's) and also has a total land area of 17, 698 sq.km (6,833 sq mi). It is an oil producing state with one of the highest production output in the country and it is also one of the richest states in Nigeria and has an estimated population of about 4.2 million with Urhoba, Itsekiri, Ijaw (Izon), Isoko and Anioma (Igbo) as the main ethnic groups in population [9]. Delta State lies roughly between longitudes 5°00 and 6°45'N. Rainfall is usually heaviest in July and the average rainfall is about 266.5mm in the coastal areas and 190.5 mm in the extreme of north. Temperature increases from the south to the north. Delta state has its capital as Asaba, it is predominantly an administrative city while Warri is the commercial and oil base of the state.

Materials and Methods:

The air quality assessment was determined using Gasman Air Monitoring Meter (Models 1200-19831) and Air Ae Steward Meter (Haz-DustTm; PM_{2.5} and PM₁₀, Model: HD1000). The air quality assessment was carried out on an hourly basis for 3 h per sampling stations in triplicate, the periods of taking measurement of data from selected sites were as follows for four working days (morning; peak hours, afternoon; off peak period and Evening; peak hours) in Okpanam Road, Asaba local government area and Warri Refinery Depot Area, Ekpan Community, Uvwie local government area of Delta State. After calibrating the instrument according to the manufacturer's specification and guidelines, at each designated position, the instrument for the air pollutant assessment was held at arm's length in an open space. The knob was adjusted to TEST/GAS position and allowed to stand for some minutes and reading were taken when the display on LCD was stable.

Results and Discussion:**Table 1:** Air Quality Measurement, Noise Level and Field Meteorology Record in Delta State (Industrial/Residential) Areas

S/N	Parameters	Concentrations		Air Quality Index (AQI) Ratings
		Fields		
		Okpanam Road, Asaba L.G.A (Keke loading Bay, Residential area)	Warri Refinery Depot Area, Ekpan Community, Uvwie L.G.A (Industrial area)	
1.	NO ₂ (ppm)	0.40±0.10	0.76±0.15	Very Poor (E) in both areas
2.	SO ₂ (ppm)	0.73±0.15	0.63±0.25	
3.	CO (ppm)	147.30±31.56	266.50±7.10	
4.	CO ₂ (ppm)	16,860.00±1760.34	28,900.00±3207.80	Hazardous (F) in both areas
5.	PM _{2.5} (µg/m ³)	133.00±36.07	113.00±7.00	Poor (D) in both areas
6.	PM ₁₀ (µg/m ³)	179.67±48.01	153.30±9.07	Very Poor (E) in both areas
7.	Temp. (°C)	26.89±1.17	29.33±2.52	Moderate (C) in both areas
8.	RH (%)	92.33± 7.02	95.00± 5.57	
9.	WS (m/s)	1.07±0.72	1.13±0.97	
10.	Elevation (m)	67.33±10.41	23.00±7.00	
11.	Pressure (hpa)	1011.00±1.00	1011.70±0.58	
12.	Cloud (%)	87.33±15.04	85.33±10.50	

PM - Particulate Matter, RH - Relative Humidity, WS - Wind Speed

The obtained results of the air quality assessment in Delta State showed that NO₂, SO₂ and CO₂ values in this study were of higher concentrations in Okpanam Road, Asaba Local Government Area (Keke loading Bay, T-junction area) and Warri Refinery Depot, Ekpan Community, Uvwie Local Government Area which were above the recommended set standards of 0.04-0.06 ppm for NO₂, SO₂ (0.04-0.06 ppm) and CO₂ (500 ppm) by [12], [15]. Comparing the obtained results with the Air Quality Index (AQI) ratings, it was observed that NO₂ and SO₂ were rated very poor (E) while CO₂ was rated hazardous (F) in both areas as shown in Table 1 above which was as a result of greenhouse effect which contribute a great deal to global warming. These values obtained in this work were in supports with the earlier findings by [6-7] who reported high particulate pollution in Warri Metropolis in Delta State, Nigeria.

The values obtained for PM₁₀ were of higher concentrations in both areas, which were observed to be above the permissible limits of 150.00 µg/m³ for ambient air quality set by [11-12]. The results of PM_{2.5} were also of higher values in both areas and was above the set standards of 75.00 µg/m³ by [15] as shown in Table 1 above. The PM₁₀ and PM_{2.5} results when compared with the set standard of air quality index (AQI) ratings [11-12], it was indicated that PM₁₀ was rated very poor (E) while PM_{2.5} was rated poor (D) in the industrial/residential areas.

CO results were above the permissible limit of ambient air quality set standards of (10) ppm by [12] which was due to flared gases, emissions from motor vehicles associated with high traffic density and congestion. Comparing the results with the AQI ratings, it was seen that, CO values were rated very poor (E) in both areas of Delta State. The obtained results for temperature were above the ambient temperature level of 25 °C by [11-13] and it was rated moderate (C) in the industrial and residential areas by the AQI ratings.

The results recorded at the different monitoring points for all the atmospheric pollutants analysed in this research survey areas were found to be of higher values than the recommended set standards [11-12]. The results obtained were in accord with the previous findings carried out by [6-7], [2] and [4-5] which states that, the heavy traffic, industrial activities, congestion, flared gases from

the Warri Refinery Depot, densely population, road intersection, generator power plants, rotten wastes, agricultural practices and urban run-offs could be attributed to the sources of the atmospheric pollution in Delta State which could be harmful to human health and the environment.

Conclusion

It was concluded that the prevailing industrial activities of an area can actually have effect on the air quality which causes climate change and its resultants on human health could be dangerous.

Acknowledgement

Authors would like to thank the staff of the Department of Pure and Industrial Chemistry, Faculty of Physical Sciences, University of Nigeria, Nsukka, Enugu State, Nigeria, who gave us all the needed supports during the course of this research work.

Conflict of Interest

Authors did not show any conflict of interest

Recommendations

1. Emissions impact on human health, ecosystems, food security and the entire climate within the region was increasing at a very dangerous proportion and the government should urgently establish and equipped air pollution monitoring centres and network the agencies especially in the oil industrialization areas.
2. This research work has created awareness on the safety level of the environment since there is a growing concern in the rising level of air pollution, mainly from industrial and vehicular emissions, oil and gas flaring from companies, domestic use of wood and its compliance with the ambient set standards [11,12 and 15].
3. Proper environmental monitoring/measures should be adopted in Warri Refinery Depot, Ekpan Community, Uvwie local government area in Delta State in order to control the atmospheric pollution and anthropogenic emissions in the area.

References

- [1]. Air Pollution (2011). *Impacts of air pollution and acid rain on wildlife*. Air Pollution. <http://www.air-quality.org.uk/17.php>. Accessed on 21 January, 2015.
- [2]. Antai, R. E., Osuji, L. C. and Beka, F. T. (2016). The Impact of Air and Noise Pollution; A Case Study of Uyo Metropolis, Akwa Ibom State, Nigeria. *International Journal of Science Inventions Today (IJSIT)*, 5(5), 402-414.
- [3]. Augustine, C. (2012). Impact of air pollution on the environment in Port Harcourt, Nigeria. *Journal Environmental Science. Water Resources*, 1(3), 46-51.
- [4]. Ebong, G. A. and Mkpene, V. N. (2016). Air Quality Monitoring in Uyo metropolis, Akwa Ibom State, Niger Delta Region of Nigeria. *International Journal of Scientific Research in Environmental Sciences*, 4(2), 0055-0062.
- [5]. Ebong, G. A. (2015). Monitoring of Atmospheric Trace Metal pollution in an Oil Producing Area of Akwa Ibom State, Nigeria Using Funaria Hygrometrica Moss *International Journal of Scientific Research in Environmental Sciences*, 11(1), 91-101.
- [6]. Efe, S. I. (2006). Particulate Pollution and its Health Implications in Warri Metropolis, Delta State Nigeria. *Environmental Analysis*, 11, 1339-1351.
- [7]. Efe, S.I. (2003). Effects of Gas Flaring on Temperature and Adjacent Vegetation in the Niger Delta Environment. *International Journal of Environment*, 11(1), 91-101.
- [8]. IPCC TAR WG1(2001). The report Climate Change 2001: The Scientific Basis. In Houghton, J.T., Ding, Y., Griggs, D. J., Noguer, M.; van der Linden, P. J., Dai, X.; Maskell, K. and Johnson, C. A. (eds) Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: University Press, ISBN 0-521-80767-0
- [9]. National Population Commission (NPC)(2006). Nigeria National Census: Population Distribution by Sex, State, LGAs and Senatorial District:2006 Census Priority Tables (Vol.3), <http://www.population.gov.ng/index.php/publication/140-popn-distrib-by-sex,-state-jgas-and-senatorial-distr-2006>.
- [10]. Tawari, C. C and Abowei, J. F. N. (2012). Air Pollution in the Niger Delta of Nigeria. *International Journal of Fish Aquatic Science*, 1, 94-114.
- [11]. U.S. Environmental Protection Agency (1994). National Air Quality and Emissions Trends Report United States Environmental Protection Agency, Washington, DC, USA, Pp. 2- 6.
- [12]. U.S. Environmental Protection Agency, USEPA. (2003). Guideline for Reporting Daily Air Quality. Air Quality Index (AQI), EPA454/k-03-002, Office of Air Quality Planning and Standards: Research Triangle Park, NC.
- [13]. Ukpong, E.C. (2012). Environmental impact of aggregate mining by Crush rock industries in Akamkpa local government area of Cross River State. *Nigerian Journal of Technology*, 31(2), 128-138.
- [14]. Umunnakwe, J. E and Aharanwa, B. C. (2018). Preliminary Studies on mean Levels of Vehicular Emissions at sections of Owerri, Road, Nigeria. *International Journal of Trend in Scientific Research and Development (IJTSRD)*, 2(5), 456-464.
- [15.] World Health Organization, (2000). *Addressing the Links Between Indoor Air Pollution, Household Energy and Human Health*. Based on the WHO-USAID Global Consultation on the Health Impact of Indoor Air Pollution and Household Energy in Developing Countries (Meeting Report).