EVALUATION AND METHODOLOGICAL APPROACH TO AIR POLLUTION CONTAMINATION AND ITS ASSOCIATED RISK IN UYO METROPLOLIS, AKWA IBOM STATE, NIGERIA

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Abstract: The research evaluated the variations of the air pollution in Uyo metropolis and was recommended that policy should be made by government for traffic control and traffic personnel training. Environmental education programme also be organized for the public. Policies to ban used/old automobile engines and polluting power generating plants should be made by the relevant authority. Regular and frequent air quality and noise pollution monitoring should be carried out while relevant regulatory agencies should effectively enforce the environmental laws and policies.

Key Words: Air pollution, Traffic control, Environmental health, Pollutants.

1. INTRODUCTION:

Air pollution is primarily a product of man's own activities. Man's activities generate the pollutants that cause the natural and pure air polluted, and thus bring both man and his environment under threats of health and environmental degradation. Air pollutants may be from natural sources such as, forest fire and dust storm and volcanic eruption. The anthropogenic sources of air pollution include automobile combustion of fossils fuels, household cooking and burning of firewood and thermal power plants. There can also be primary air pollutants from atmospheric chemical reactions that result in secondary air pollutants such as smog. These air pollutants can be in the form of particulate matters or in the gaseous form. The negative impacts and health hazard of the air pollutants on environment and man have prompted several researches on this field of study.

It requires proper and regular monitoring of the assumed natural and pure air to investigate the presence of the pollutants constituents and their level in the air. These can be done via selection of sampling locations of the study area by standard methods as outlined by WHO and other national standards for sampling site selections. The best available technology or the best practical technology and techniques should be employed. The standard and recommended methodologies for field data gathering should be used. Data analyzing, data interpretation and presentation should be in the simpler form like air quality index of the study area for public understanding and consumption.

The review aims to look at different researches that were carried out by various scholars in air quality in different cities in Nigeria and other countries, putting into consideration the air quality parameters, sampling / equipment techniques and methodologies. Also to be considered are challenges in air quality monitoring, interpretation and presentation of air quality data.

2. LITERATURE REVIEW:

Air Quality Assessment at Traffic Control Points in Uyo Metropolis, Nigeria by Udotong, (2015), the study showed the contributions of toxic gases into the atmosphere from motor cycles, tricycles, motor cars and trucks. Ten sampling points were chosen and two control locations and portable digital air quality monitors (Gasman, UK) were used. The air pollutants that were monitored include carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ammonia, hydrogen sulphite (H_2S) and chlorine gas (Cl_2). Also monitored were Noise level and meteorological parameters. All the field data gathered were compared with the U. S. National Ambient

Air Quality Standards (US NAAQS), Nigerian Ambient Air Quality Standards and the instruments alarm/precision levels. The mean concentrations of CO (35ppm), SO_2 (0.3ppm), NO_2 (0.4ppm), NH_3 (5ppm), H_2S (0.7ppm), HCN (2ppm), and Cl_2 (0.9ppm) were observed highest in locations with heavy traffic as against the mean values of CO (11ppm), SO_2 (<0.1ppm), NO_2 (<0.1ppm), NH_3 (2ppm), H_2S (0.4pmm), HCN (<1ppm), and Cl_2 (0.2ppm) with lowest reading at locations where the operation of these traffic were reduced . The noise level (66.6-110.6 dB(A)), radiation (0.41mR/hr), and heat (542-544 Rad) were also recorded highest at heavy traffic monitoring locations. The air quality assessment revealed most of the air pollutants monitored were above the US NAAQS at some of the monitoring heavy traffic points but below the instruments alarm levels. It was observed that the data generated from this monitoring , revealed that the various transport operations contributed significantly to high levels of gaseous air pollutants at traffic control points in Uyo metropolis. The gaseous air pollutants emissions levels monitored were compared to statutory limits and the associated human health consequences were noted.

Hassan *et al.,* (2012) evaluated Pollutants in Ambient Air of Abuja. BW Technology Gas Alert Microcrip was used to analysed samples from heavy populated areas and less densely populated location of Abuja Municipal Area Council, Kuje and Dobi Village The field data revealed different concentrations of Hydrogen Sulphite (H_2S), carbon monoxide (CO), and low explosive limit gases. It was noted that the influx increased in population growth may be attributed to the relatively high concentrations of the air pollutants detected in Abuja municipal area council. There was no low explosive limit gas was detected in Kuje area council but with only emission of low explosive limit gases in Dobi, Gwagwalada area council which can be attributed to decomposed refuse in the market and rice milling waste within the environment, in Dobi village. Increased production of gaseous waste and increased number of industries.

Ewona *et al.,* (2013) carried out a study on air quality and environmental health in Calabar, Cross River State, Nigeria. The paper focuses on air pollution and its adverse health outcomes in Calabar. The Data for Temperature (0^oC), Relative Humidity (%), wind speed (m/s), pressure (psi), Cloud Cover (oktas), Heat Radiation (kw/m3), wind Direction, NO_2 (ppm), NO (ppm), O_2, SO_2 (ppm), H_2S (ppm), CO_2, VOC(ppm), NH_3 (ppm), SPM (ppm) and Noise (dBA) were collected from Environmental Impact Assessment (EIA) by Cross River State Ministry of Environment in conjunction with Niger Delta Development Commission which covers a period of two years (October 2010 to September 2012). The data obtained were daily values from which future assumptions were made. Based on these data, a simple Descriptive analysis was employed. The results recorded a non-significant value of CO, CO_2, NO_2, NH_3, CH_4 and VOCs. The statement however, provides advice to health providers on how to integrate issues regarding air quality and environmental health into patient education and environmental health advocacy. There are also recommendations to the government, industries and the general public on the promotion of effective air pollution policies to ensure continued protection of lives.

Air Quality Index (AQI) was used to show the ambient air quality of Jaipur city, India by (Kumar *et al.,* 2011). Twelve sampling sites were chosen in residential, industrial and commercial areas of the city. The data on air pollutants which was collected from the monitoring was carried out to evaluate Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphurdioxide (SO_2) and oxides of nitrogen (NOx). The sampling was done for a period of 24 hours in winter season of the year, 2009-2010. Air Quality Index which was calculated revealed the concentration of suspended particulate matter above the permissible standards stipulated by Central Pollution Control Board (CPCB) in highly commercial or industrial zones excluding residential area of Tilak Nagar. Also the Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2) levels in residential, industrial and commercial areas remain below stipulated limits of CPCB. Five locations revealed AQI values ranged from 76 to100, representing areas with relatively high air pollution. One sampling location detected AQI values above 100, representing severe air pollution area.

The literature review as earlier outlined revealed that various researchers have monitored and reported air and noise pollution in Uyo. The data reported by some were relatively high and above both national and international acceptable limits/standards with associated health risk. However, the various studies have shown methods for monitoring air quality and mitigation measures. Several previous studies did not really broaden the scope of the

researches in terms of numbers of air pollutants to monitor and the sampling points to cover all the increasing traffic / congestion in the city. Uyo is a developing city, hence the daily influx of people into Uyo leads to increase in population growth, commercial activities, vehicular movement and industrial activities, and thus the need for this study.

3. METHODOLOGY:

Methods of Data Collection/Instrumentation

Sampling Equipment

The sampling equipments used were portable digital hand held air quality and noise meters to monitor air pollutants and noise pollution. The portable meters used in the study amidst others is as follows;

The Aerocet 531S is a small, handheld, battery operated, and completely portable meter with detection limit of 1.0µg/m^3that measures$PM_{10,}$ $PM_{7,}$ PM_4, $PM_{2.5,}$ PM_1andTSP. The portable meter provides both particle counts and mass PM measurements as stored datalogged values, real-time networked data, or printed result. Here, a known volume of ambient air is drawn through a glass fibre filter (20 x 25cm) of known weight under a fixed roof by means of a heavy duty turbine blower at a constant flow rate ranging from 1.1 – 1.7m^3/min. Re-weighing of the filter after sampling under controlled condition gives a direct measurement of particulate mass. Particulate matter having diameters (stoke's equivalent diameter) between 0.1 and 100µm are removed from the air stream by filtration on the glass fibre filter(Stoker *et al.,*1975). The concentration of the particulate is determined by dividing the mass of the SPM by the volume of air sampled (WHO, 1976).

The Series 500 monitor Aeroqual is a portable meter with the high sensitive replaceable sensors of different gaseous air pollutants.The portable meter measured Volatile Organic Compounds (VOCs), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Hydrogen Sulphite (H_2S), Carbon Monoxide (CO), Ammonia (NH_3) and Methane (CH_4) by the principle of light absorption and emission. The infrared waves length of the parameters are not the same (different).Nitrogen dioxide (NO_2) has0.001ppm detection limit, Methane (CH_4) detection limit is 1.0ppm while other air pollutants stated above have 0.01ppm detection limit.

Sampling procedures

Fourteen (14) sampling locations were selected in the study area using World Health Organisation standard for site selection studies for 'population density, topography, industrial clusters, heavy traffic' and one sample location for control point.

The GPS map Model 76Cx Garmin Global Positioning Systems was used to determine geo-references of the sampling locations in accordance with the above stated criteria

Table 1 : Number of Tricycles and Vehicles at Traffic Points at the Time of Monitoring for 10 Minutes Interval

S/N	Sampling Points	Morning hours (peak period)		Afternoon hours (off peak period)		Evening hours (peak period)	
		Tricycles	Vehicles	Tricycles	Vehicles	Tricycles	Vehicles
1.	SP1	51	40	30	20	68	55
2.	SP2	34	38	21	23	40	46
3.	SP3	50	71	45	53	80	67
4.	SP4	60	62	28	40	50	54
5.	SP5	62	43	30	26	68	48
6.	SP6	30	40	20	30	41	58
7.	SP7	40	65	19	31	48	75
8.	SP8	35	36	20	16	40	58

9.	SP9	40	30	20	20	31	47
10	SP10	50	110	41	70	60	90
11	SP11	50	60	39	35	55	70
12	SP12	40	61	30	28	56	65
13	SP13	42	30	27	14	50	46
14	SP14	48	25	34	16	41	26
15	CTR	15	20	9	10	10	12

4. RESULTS AND DISCUSSION:

Noise

Noise values monitored during the study were relatively high in all the sampling locations as expected due to mechanical, vehicular movement, generator power plants, dense population and other noise associated activities. Itam Market by Goodluck Jonathan Flyover recorded the highest noise level (Fig. 4.4). Heavy traffic with long waited vehicles and market activities could be the reason for the highest value of noise at this location. Various researches including Udotong, (2015) and Ewona *et al.,* (2013) also reported the same high values of noiseduring peak period. Hence, the findings are in agreement the noise levelrecordedis as a result of heavy traffic with high densely clustered people with commercial activities around the study location. This was observed during the peak periods (morning and evening) when many people were going and coming back from offices and other businesses.

This air quality assessment study has uncovered the trend of the rapid air pollutions in relationship to the rapid population explosion of the Uyo City due to rural-urban migration and resulting increasein anthropogenic activities, which require frequent and regular air quality and noise pollution monitoring.

Gaseous Pollutants

Variation of the Volatile Organic Compounds (VOCs) mean data were between 308.2-514.5ppm. This was higher than the mean value of 192.37ppm recorded at the control. The individual data for VOCs ranged from 147.8ppm - 841.0ppm. The individual site data was relatively higher than the control point. However, all the readings were below the FMENV permissible limit of 6000ppm. The highest mean concentration of VOCs was recorded at the Nwaniba Roundabout by Oron Road

There was a noticeable variation in nitrogen dioxide (NO_2) mean concentration across the study locations, it varied between 0.13-0.56ppm. However, the individual concentrations at the study locations varied from < 0.001 – 0.7ppm across the monitoring sites. The highest ambient concentration of nitrogen dioxide was noticed at the Itam Market by Goodluck Jonathan Flyover.

Mean concentration of sulphur dioxide (SO_2) varied between <0.01 - 0.3ppm. This was higher than the mean value of 0.03ppm recorded at the control point. The individual data for SO_2 ranged from <0.01ppm - 0.4ppm. The individual site data was relatively higher than the control. However, the concentrations of SO_2 in four (4) sampling locations were below the detectable limit of the equipment used. The highest mean concentration of SO_2 was recorded at the AkpanAndem Market by Udoumana..

Hydrogen sulphide (H_2S) was less than the detectable limit<0.01ppm of the instrument used at all the sampling sites. This is an indication of the low level of the gas in the study location.

Carbon monoxide (CO) mean concentration in the study location varied between0.3-0.76ppm. Sampling points 7 (Akpan Andem Market by Udoumana) recorded the highest mean concentrations of CO. The individual concentration across the sampling points ranged from 0.2 - 0.9ppm. These values were more than 0.66ppm mean concentration of CO recorded within the control point.

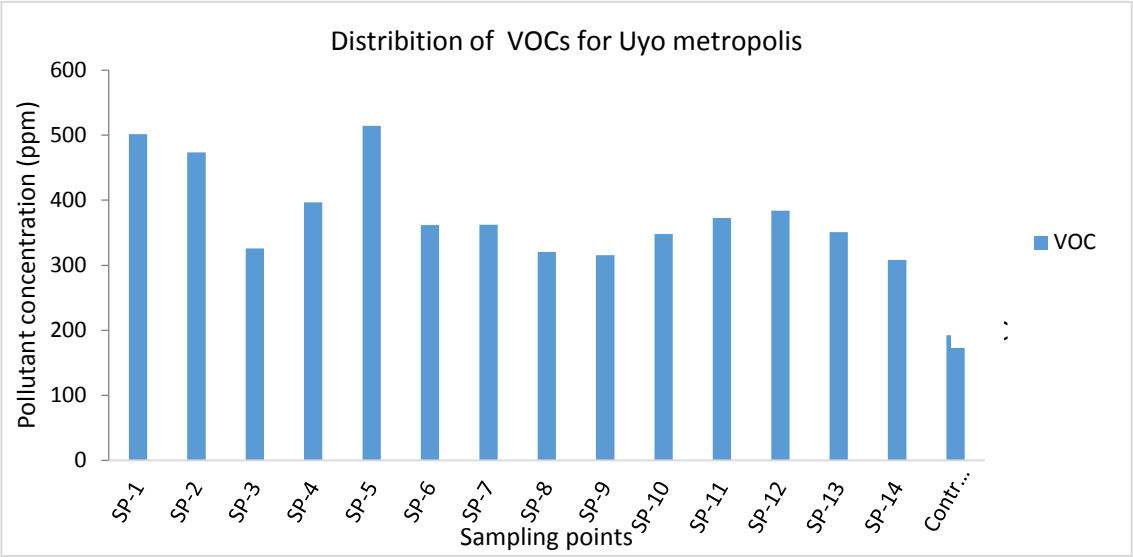

Figure 1. : Morning, Afternoon and Evening Mean Values of VOCs of the Study Area

The mean concentration of ammonia (NH_3)ranged from <0.01-2.7ppm. Sampling point 11 (Itam Market by Goodluck Jonathan Flyover) recorded the highest mean value of NH_3. The individual concentrations of ammonia in the study location varied from <0.01 to 3.1ppm. The mean concentration of the control was 0.66ppm(Fig. 4.3).

Methane (CH_4) concentration in the study area varied from individually from <1.0 –18.0ppm. The highest individual value was recorded within sampling point 1 (Four Lane Roundabout by Nwaniba Road). The mean concentration of methane varied from <1.0 –7.0ppm. The highest mean value was again recorded in sampling point 1 (Four Lane Roundabout by Nwaniba Road). The value recorded was higher than the control point which had <1.0ppm concentration of methane

RECOMMENDATIONS:

The following recommendations are made based on the findings of this research:

1. Policy should be made by government for traffic control.
2. Traffic personnel training programme should be frequent.
3. Traffic awareness campaign should be carried out.
4. Environmental awareness programme should be organized for the public.
5. Policies to ban used/old automobile engines and power generating plants should be made by the relevant authority.
6. Regular and frequent air quality and noise pollution monitoring should be carried out.
7. Relevant regulatory agencies should effectively enforce the environmental laws and policies.

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