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Seasonal Monitoring of Criteria Air Pollutants and Noise Levels across Six Selected Housing Estates in Ogun State, Nigeria

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ABSTRACT

Levels of criteria air pollutants (CAP) between Dry and Wet seasons vary, this could be indicated when assessed and compared with the thresholds. Their seasonal variations were assessed in six chosen housing estates for possible air pollution on the inhabitants, whose intention is to live in an area that is conducive. Six CAP and noise levels were assessed across the selected housing estates in Ogun State to evaluate their levels for two dry and wet seasons. The CAP (CO_2, CO, NO_2, H_2S and SO_2, volatile organic compound (VOC)) and noise levels were quantified using calibrated handheld equipment; hung 1.5 m above ground. Sampling was done 8hrs/ day, once a week for three months in each dry (starting from June) and wet (starting from November) season. Obtained data were subjected to descriptive and inferential statistics at $p < 0.05$ level of statistical significance. There were indications that levels of CO_2 and CO in the dry seasons were 3-folds the wet seasons while NO_2 in 10-folds, levels of both H_2S and SO_2 were below the detection limits in the wet seasons but exceeded the limits in dry seasons. Levels of VOC and Noise were not different in the two seasons. Order of percentage influence of the CAP was $CO_2 > SO_2 > SPM > CO > VOC$ across the sampling seasons: $CO_2 > CO > VOC > NO_2 > SPM$ in the wet season but $SO_2 > SPM > VOC > CO_2 > CO$ in the dry season from Linear regression equation. Season was observed to dictate CAP unlike noise levels.

Keywords: Criteria air pollutants, Handheld equipment, Linear regression equation, Abeokuta

Introduction

Criteria Air pollutants (CAP) could either be gaseous which include oxides of sulphur, nitrogen and carbon, hydrogen sulphide, hydrocarbons, ozone and other oxidants; or particulate pollutants that include dust, mist, fumes, smoke, smog and aerosols. Major CAP sources include fugitive dust emissions, fossil-fuel combustion, anthropogenic biomass burning and industrial and vehicular emissions (Jacobson, 2012). Monitoring of CAP is comparison of the level of air pollutants with recommended thresholds and or past researches to abate them to a tolerable level and evaluate the influence of air pollution regulatory policy (Vedamadavan and Sarithabanuraman, 2012). Key pollutants with prominent air quality effects include NO_X, SO_2, CO, CO_2, VOCs, H_2S and non- and respiratory particulate matters (SPM) (USEPA, 2012a). They may react with some

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reactive molecules to form secondary inorganic and organic aerosol (USEPA, 2012b). The SPM fractions primarily produced via stepwise chemical reactions are not limited to nitrogen oxides (NO_X), sulfur dioxide (SO_2), ammonia (NH_3) and volatile organic compounds (VOCs).

Level of CAP depends on their emission and precursors, specific characteristics, changes in meteorological conditions and regional seasonal variations (EEA, 2010). Zafar *et al.* (2010) explicitly stated that CAP mean concentrations are usually higher during the wet season than in the dry season because the gases that had been dispersed into the atmosphere would remain suspended and concentrated during the dry season until being washed down onto the earth surface through rainfall distribution, thereby reducing the concentration of the atmospheric pollutants. List of the air pollutants regulated by the Clean Air Act Amendments of 1970 (and its following modifications) was the reasons some gases are labeled harmful to both human health and the environment (UNECE, 2013). Oxides of sulphur (SO_2) and nitrogen (NO_X) are precursors to acid rain. Implications of increase in industries, population and migration include rise in both CAP and noise levels (Erisman *et al.,* 2011). Adverse impact possible between suspended particles and high cases of asthma symptoms in children (Yu and Lumley, 2000) and increase inhaled NOx (Koenig *et al.,* 2003; 2005) had been reported. Occurrences of gaseous and suspended particulates as air pollutant threaten human health with a great clinical risk (WHO, 2002). Acute exposures to NO_2 gas could elicit airway responsiveness and lung function injury while chronic exposure reduces immunity and triggers respiratory infections (Han and Naeher, 2006). Minute quantity of CO is highly toxic and known to decrease human efficiency (Ojo and Awokola, 2012). Oxides of nitrogen (i.e. NO and NO_2) are among the air pollutions mostly emitted into the atmosphere with deleterious on both man and the environment (Brechler and Fuka, 2014). The latter gas (NO_2) is highly toxic, corrosive and irritating to the eyes and respiratory tract (Osuntogun and Koku, 2007).

The CAP had been traced to be a significant factor linked to elicit high clinical health risks in predisposed patients (Bada *et al.,* 2019), while the devastating health effect of SO_2 is not limited to aggravation of illness in susceptible weakened respiratory function patients such as asthmatics (Augustine, 2012). It is noteworthy that human across tiers of life are at risk from CAP while the severity of the hazard is dictated by age and underlying medical conditions (Campbell *et al*., 2007). Human well-being, ecosystem integrity and resilience, biodiversity and climate are threatened from serious and irreversible effects of ambient CAP and acoustic levels because the more polluted an area is the less convenient surroundings air quality become (Townsend *et al.,* 2003; Erisman and Larsen, 2013). Prevention of human health from continuous air pollution associated with anthropogenic activities peculiar to high population areas makes housing estates an option to live. Unlike the study of Oyebanji *et al.* (2016) which investigated seasonal variations of air pollutants across selected rural communities within a local government in Ogun, this study thus assessed seasonal variations of CAP and decibel levels in six housing estates across selected local government areas in Ogun State.

Materials and methods

Study Areas

Six out the existing housing estates were thus selected areas across Ogun State and assessed for criteria air pollutants in two seasons. The state is located in the derived savannah region and South-west, Nigeria (Latitudes 70º 5′ N to 70º 20′ N and Longitude 3° l7′ E to 30º 27′ E) with a geographical area of 1, 256 km. Both Lagos and Oyo States have a borderline with Ogun State. The region has a mean annual rainfall greater than 1000 mm with massive rugged geological formations (Akanni, 1992). Graph of Ogun State weather conditions is

shown in Figure 1. The region has two common seasons, the dry season ranging from October to February and the Wet season ranging from March to September, which are the weather conditions in Nigeria, a Tropical region in West Africa. The six selected areas across Ogun State are Ijebu-Ode, Sagamu, Laderin, Arigbajo, Obada-Oko and Ilaro.

Sampling collection

Criteria Air Pollutants (CAP) were comparatively monitored between Dry and Wet periods for two seasons. The CAP were measured *in-situ* using handheld equipment: DustTrak (TSI, Air Met Scientific, UK) for SPM; Land-duo (Industracom, North Sydney, Australia) for CO_2, CO and NO_2; QRAE$^+$ meter (Fisher Scientific, Loughborough, UK) for H_2S, SO_2 and VOC and Noise Detector (SD-200, Air Met Scientific, UK) for noise.

The CAP handheld equipment being sensor dependent were calibrated before the next period of monitoring. They were hung 1.5 m above ground level at the sampling site while quantifying/ evaluating the CAP (Anake *et al.,* 2016). Sampling was done 8 hrs/ day, once a week for three months in each Dry (November –March.) and Wet (April – October.) season. Sampling was done 12 times in each season.

Statistical analyses

Obtained data were subjected to descriptive (mean and standard deviation, histogram) and inferential (Linear regression equation, ANOVA and postHoc) statistics and $p < 0.05$ level of statistical significance.

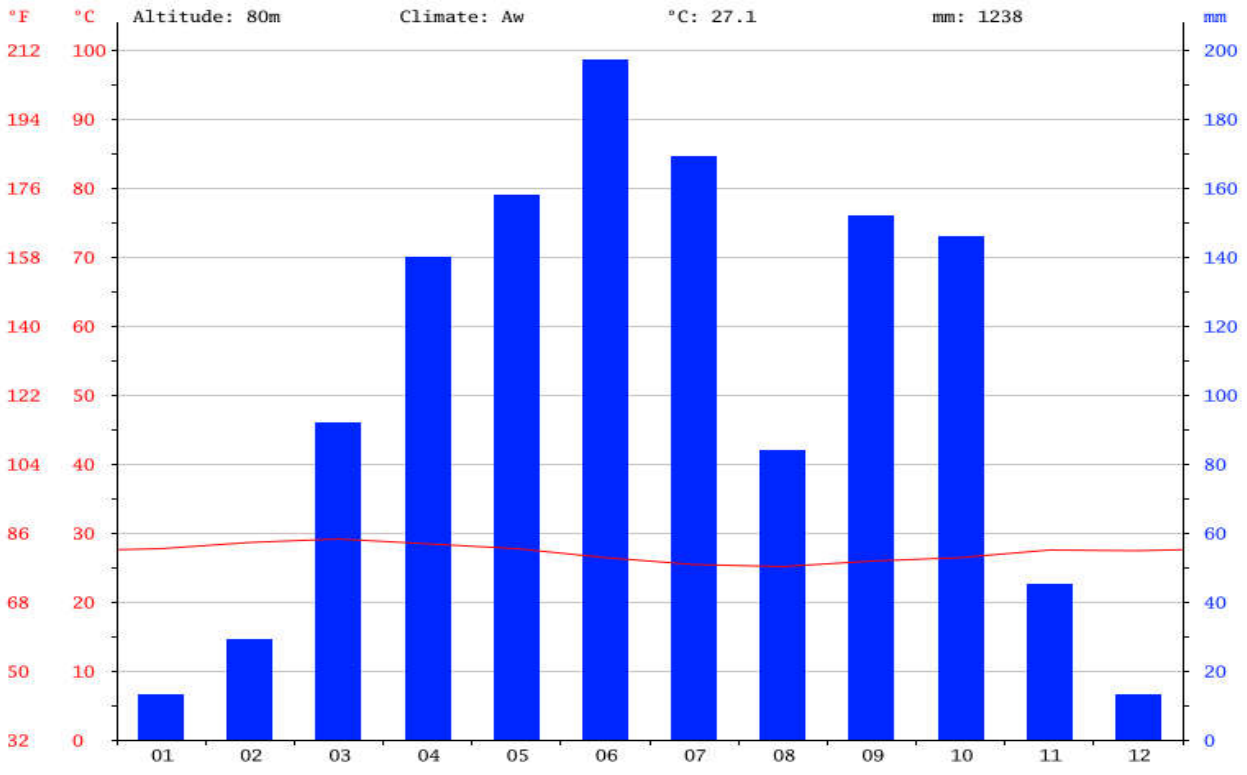

Figure 1: Typical weather condition of Ogun state. Source: Climate-of-Ogun (2019).

Results and Discussion

Tables 1 and 2 depict seasonal quantified values of the CAP and decibel across the six assessed housing estates in Ogun State, while comparative linear regression equation of individual parameter is as shown in Table 3. Table 4 shows percentage influence of the CAP across the sampling season and in each sampling season. The levels of CO_2 were ranged significantly ($p < 0.05$) from 6.81 ± 0.48 (Laderin) to 10.41 ± 2.01 µg/ m3 (Shagamu) during the dry seasons while from 2.08 ± 0.06 (Obada-Oko) to 3.15 ± 0.63 µg/ m3 (Arigbajo) in the Wet seasons. More levels of CO_2 were observed to be contributed from the sampling locations in dry season (-0.0279) as linear regression equation indicated than in the wet season, but 51.54 % of CO_2 levels in the wet season might influence more environmental impacts. The seasonal variations of CO_2 despite being significantly ($p < 0.05$) different were observed to be lower than the limit: 10 µg/ m3 (DNR, 2011; EPA, 2016). High percentage levels of CO_2 with likely higher negative effects on the environment could be due to its low dispersion into the air from weather influence with high relative humidity, low temperature and solar radiation which could have enhanced greater dispersion.

Through photosynthesis, CO_2 content is reduced in the atmosphere and its accompanied effect and consequences on climatic changes. The carbon sequestered in plants result in balance between fixed carbon by photosynthesis and released carbon in the atmosphere by respiration. A microclimate that buffers the temperature differentials between hot (dry season) and cool (wet season) period is created by green surroundings to abate warmer temperature and pollutants dispersion (Gheorghe and Ion, 2011). The surface ocean and atmosphere exchange, vegetation and the atmosphere, marine biota and the surface ocean as well as the surface ocean, the intermediate and deep oceans contribute to levels of CO_2 annually. Total human industrial CO_2 production: primarily from use of coal, oil, and natural gas and the production of cement is currently on the increase (Houghton, 2007).

Concentrations of CO were between 1.28 ± 0.09 (Laderin) and 1.95 ± 0.38 µg/ m3 (Shagamu) in the dry seasons while 0.39 ± 0.03 (Ijebu-Ode) and 0.59 ± 0.12 µg/ m3 (Arigbajo) in the Wet seasons. Levels of CO were observed to be more contributed from the sampling locations in dry season (-0.0046) than in the wet season, though 24.38 % of CO in the wet season was shown to result in possibly higher negative impacts. In the hotter period (such as dry season), increased atmospheric turbulence resulting from solar activity raises the height of the mixed layer, resulting in generally lower CO concentrations compared with those of the cool period (EPA, 2000) such as wet season in this study. When CO is released to the atmosphere, it reacts with photochemically produced hydroxyl radicals and oxidizes to CO_2 (EPA, 2000; 2010). Lethal exposures to CO produce coma, convulsions and cardiorespiratory arrest (Wolf *et al.,* 2008).

The direct emission of CO from living plants increases as a function of solar irradiance (Sanderson, 2002). In general, warm and moist conditions found in most soils influence uptake, whereas hot and dry conditions as found in deserts and some savannas influence CO emission (EPA, 2000; 2008). If the natural sources of CO precursors are high, the natural sources of CO in the atmosphere would then be greater than anthropogenic contributions (Miller *et al.,* 2008). It was observed that not only coal gas from domestic consumption contributes CO as a significant constituent but modern technology processes such as iron smelting, still emitting also (Robert and Edward, 2009). In the presence of oxygen, CO burns to produce CO_2 (Thompson, 2009). In 2005, human activity was observed to add 84 % of all CO emissions while biogenic emissions accounts for 16 % (EPA, 2012). Level

of CO increases in the atmosphere during fuels incomplete combustion and contributes to the greenhouse effect, smog and acidification.

It attaches hemoglobin in blood, prevents oxygen transport through the body and results in oxygen depletion of the heart, brains and blood vessels to eventually result to death. It is produced in animal metabolism in low quantities and considered to have normal biological functions (Hampson and Zmaeff, 2001). The CO is one of the anti-inflammatory, vasodilators and promoters of neo-vascular growth (Li *et al.,* 2009). The CO had 200 times binding affinity for hemoglobin greater than O_2 (Chakraborty *et al.,* 2004). The developing fetus may be a sensitive target of CO, through hypoxic and/or non-hypoxic mechanisms (Lopez *et al.,* 2008). Acute CO poisoning is largely the result of tissue hypoxia. Signs of CO toxicity include weakness, tachycardia, and tachypnea rhabdomyolysis; and (3) palpitations, cardiac dysrhythmias (Kao and Nañagas, 2006), persistent neurologic squeal (Choi, 2002), and pathologic changes in the brain (Lo *et al.,* 2007).

Quantified value of H_2S was determined to range significantly ($p < 0.05$) from 0.02 ± 0.01 (Laderin, Obada-Oko and Ilaro) to 0.04 ± 0.02 µg/ m3 (Shagamu) in the dry seasons while BDL (below detection limit) in all the sampling locations in the wet seasons. It was however shown that 0.4 % of detected H_2S in the dry season might contribute to possible sampling areas' ecological effects. The H_2S being a colorless, very poisonous and flammable gas with foul odour of rotten eggs could come from anaerobically bacterial degradation of organic matter (such as swamps, sewers, gases volcanic, natural gas, and some well waters). The H_2S is one of the air pollutants (CO, H_2S, Br_2, I_2 and Hg – vapors) which are not only highly injurious to animals and human beings but also capable of influencing adverse effects on plants (Gheorghe and Ion, 2011).

The results of SO_2 varied with no significant ($p > 0.05$) difference from 0.03 ± 0.02 (Obada-Oko and Ilaro) to 0.07 ± 0.06 µg/ m3 (Shagamu) in the dry seasons while BDL in the wet seasons in all the sampling sites. Almost 44.01 % of detected SO_2 in the dry season was likely to threaten environmental sphere of the assessed housing estates. The results of SO_2 were above the set limit: 0.1 µg/ m3 (DNR, 2011; EPA, 2016) with possible acidic rain depending on where it is deposited due to trans-boundary movement of gaseous pollutants. High concentration of SO_2, a stinging gas, had been traced to combustion of coal and other fuels in industrial and domestic use (Gheorghe and Ion, 2011). Its emission in the environment could influence respiratory problems with human and acidification of water bodies. Its major adverse effects are the formation of acid rain and aerosols, which can be droplets in the rain, snow or aerosol particles. Aerosols and ozone are the major health hazards of photochemical smog (THP, 2016).

Table 1: Statistical Correlation of the Criteria Air Pollutants during the Dry Seasons

Location	CO_2 µg/ m^3	CO µg/ m^3	H_2S µg/ m^3	SO_2 µg/ m^3	NO_2 µg/ m^3	VOC µg/ m^3	SPM µg/ m^3	Noise dB
Shagamu	10.41± 2.01^{c}	1.95± 0.38^{c}	0.04± 0.02^{b}	0.07± 0.06^{b}	0.43± 0.11^{b}	9.05± 0.31^{e}	60.05± 1.77^{c}	67.37± 2.70^{c}
Ijebu-Ode	8.51± 2.47^{ab}	1.60± 0.46^{ab}	0.03± 0.01^{ab}	0.06± 0.04^{b}	0.25± 0.20^{a}	2.99± 0.08^{a}	58.62± 2.18^{b}	52.34± 1.02^{a}
Laderin	6.81± 0.48^{a}	1.28± 0.09^{a}	0.02± 0.01^{ab}	0.04± 0.01^{a}	0.54± 0.32^{bc}	3.33± 0.22^{c}	56.87± 0.43^{a}	54.78± 2.30^{b}
Arigbajo	10.05± 2.26^{ab}	1.89± 0.42^{ab}	0.03± 0.01^{ab}	0.04± 0.02^{a}	0.90± 0.57^{d}	8.97± 0.05^{d}	60.41± 1.99^{c}	67.32± 1.97^{c}
Obada-Oko	8.62± 0.41^{b}	1.62± 0.08^{b}	0.02± 0.01^{a}	0.03± 0.02^{a}	0.25± 0.19^{a}	3.00± 0.07^{b}	58.51± 0.36^{b}	52.33± 1.31^{a}
Ilaro	6.87± 0.21^{ab}	1.29± 0.04^{ab}	0.02± 0.01^{a}	0.03± 0.02^{a}	0.49± 0.16^{b}	3.27± 0.10^{a}	56.81± 0.18^{a}	54.83± 2.25^{b}
LIMITS	10	40	0.1	0.1	0.05	----	150-250	65

Means S.D, same superscripts down the column were not significantly ($p < 0.05$) different.
Limits Source: DNR, 2011; EPA, 2016.

Table 2: Statistical Correlation of the Criteria Air Pollutants during the Wet Seasons

Location	CO_2 µg/ m^3	CO µg/ m^3	H_2S µg/ m^3	SO_2 µg/ m^3	NO_2 µg/ m^3	VOC µg/ m^3	SPM µg/ m^3	Noise dB
Shagamu	3.10± 0.56^{c}	0.58± 0.10^{c}	< 0.01	< 0.01	0.05± 0.02^{b}	6.40± 0.20^{e}	33.15± 0.60^{b}	67.25± 2.59^{c}
Ijebu-Ode	2.09± 0.14^{a}	0.39± 0.03^{a}	< 0.01	< 0.01	0.04± 0.02^{a}	2.34± 0.15^{c}	32.08± 0.14^{a}	54.89± 2.21^{a}
Laderin	2.62± 0.69^{ab}	0.49± 0.13^{ab}	< 0.01	< 0.01	0.04± 0.02^{a}	2.14± 0.05^{a}	32.61± 0.73^{ab}	52.33± 0.98^{a}
Arigbajo	3.15± 0.63^{c}	0.59± 0.12^{c}	< 0.01	< 0.01	0.05± 0.02^{b}	6.43± 0.03^{d}	33.10± 0.67^{b}	67.46± 1.89^{c}
Obada-Oko	2.08± 0.06^{a}	0.40± 0.01^{ab}	< 0.01	< 0.01	0.04± 0.01^{a}	2.34± 0.06^{a}	32.09± 0.06^{a}	54.73± 2.15^{b}
Ilaro	2.61± 0.11^{b}	0.49± 0.02^{b}	< 0.01	< 0.01	0.04± 0.01^{a}	2.13± 0.04^{b}	32.62± 0.12^{ab}	52.34± 1.25^{a}
LIMITS	10	40	0.1	0.1	0.05	----	150-250	65

Means S.D, same superscripts down the column were not significantly ($p < 0.05$) different.
Limits Source: DNR, 2011; EPA, 2016.

Table 3: Linear Regression of the Assessed Parameters in the Dry and Wet Seasons

Parameter	Dry season	Wet season
CO_2 (µg/ m^3)	Y = -0.0279X + 2.7755 (R^2 = 0.0502, 5.02 %)	Y = -0.5813X + 11.4 (R^2 = 0.5154, 51.54 %)
CO (µg/ m^3)	Y = -0.0046X + 0.5174 (R^2 = 0.0404, 4.04 %)	Y = -0.0376X + 1.8304 (R^2 = 0.2438, 24.38 %)
H_2S (µg/ m^3)	Y = 0.0002X + 0.0288 (R^2 = 0.0045, 0.4 %)	It was not determined
SO_2 (µg/ m^3)	Y = -0.0023X + 0.062 (R^2 = 0.4401, 44.01 %)	It was not determined
NO_2 (µg/ m^3)	Y = -0.0104X + 0.2969 (R^2 = 0.0198, 1.98 %)	Y = -0.0016X + 0.0315 (R^2 = 0.0798, 7.98 %)
VOC (µg/ m^3)	Y = -0.3319x + 7.0928 (R^2 = 0.1679, 16.79 %)	Y = -0.2437x + 5.0923 (R^2 = 0.1784, 17.84 %)
SPM (µg/ m^3)	Y = 4.7834X + 38.126 (R^2 = 0.3569, 35.69 %)	Y = -0.0304X + 32.791 (R^2 = 0.0598, 5.98 %)
Noise (dB)	Y = -0.0818X + 59.711 (R^2 = 0.0025, 0.25 %)	Y = -0.8557X + 63.301 (R^2 = 0.1976, 19.76 %)

Nitrogen oxides (NO_2) quantifications had ($p < 0.05$) its lowest value (0.25 ± 0.20) at Ijebu-Ode but highest (0.90 ± 0.57 µg/ m3) at Arigbajo during the dry seasons while respectively 0.04 ± 0.02 and 0.05 ± 0.20 µg/ m3 ($p < 0.05$) at Ijebu-Ode/ Laderin and Shagamu/ Arigbajo in the wet seasons. Levels of NO_2 were observed to be more contributed from the sampling locations in wet season (-0.0016) with 7.98 % possibly instigating ecological systems' adverse effects. Levels of NO_2 were exceedingly above the set limit: 0.05 (DNR, 2011; EPA, 2016) in the dry season but within in the wet season. More possible effects in the wet seasons could be due to abundant availability of nitrogen in the atmosphere coupled to the high precipitation (rainfall pattern distribution) in the wet season. The NO_2 is the dominant source of the oxygen atoms required for ozone (O_3) formation in the troposphere and thus a major contributor to the greenhouse gas O_3, with a warming effect. NOx emissions contribute to air pollution (tropospheric ozone and particulate matter) and climate change, and have globally increased in tandem with fossil fuel use (Erisman *et al.,* 2015).

Excess nitrate from NO_2 deposition in drinking water sources has negative effects on human health. Infant methaemoglobinaemia and colon cancer have been related to high concentration of nitrate in drinking water (Van Grinsven *et al.,* 2010). Biomass sedimentation and microbial decomposition are enhanced, consuming the oxygen in the bottom water layers: hypoxic (low oxygen) with deleterious effects on fish, invertebrates and other aquatic organisms (Selman *et al.,* 2008). For this reason, WHO (2007) has set specific recommendations and many countries have adopted strict limits on permissible nitrate concentrations in drinking water. Effects of nitrogen on freshwater and marine ecosystems are related to N deposition, which can contribute to the acidification of surface waters (Curtis *et al.,* 2005). In coastal and marine ecosystems, eutrophication changes the algal species composition, reducing the species diversity and can lead to toxic algal blooms known as red tides (Anderson *et al.,* 2008). Algal blooms also affect corals by depleting oxygen in the water and by covering the corals (Bauman *et al.,* 2010). Solutions to reduce global nitrogen (or its oxides) impacts have called for the most effective mitigation options that keep emissions from entering the larger biogeochemical system. The most important general approaches to date are improving the efficiency of nitrogen use in agriculture (Erisman *et al.,* 2015), improving nitrogen use efficiency in the food chain (Grizzetti *et al.,* 2013), reducing fossil fuel combustion, and stimulating removal of nitrogen from the cascade which affect specific locations very differently (Erisman *et al.,* 2008).

The values of VOCs were lowest: 2.99 ± 0.08 at Ijebu-Ode and highest: 9.05 ± 0.31 µg/ m3 at Shagamu during the dry seasons while lowest: 2.13 ± 0.04 at Ilaro and highest: 6.40 ± 0.20 µg/ m3 at Arigbajo during Wet seasons. The VOC levels were significantly ($p < 0.05$) different throughout the sampling seasons with more influence from the sampling locations in wet season (-0.2437) when 17.84 % possibly activated harmful effects especially from inhalation in animal/man and

transpiration in plants. High adverse impacts from level of VOC in the wet season might result from possible thunderstorm accompanied precipitation in the wet season. The VOCs can be a range of different contaminants, such as carbohydrates, organic compounds and solvents, usually emit from petrol and gasoline reservoirs, industrial processes and fuel combustion, paint and cleanser use, or agricultural activities (Gheorghe and Ion, 2011). Emissions of a typical constituent (CH_4) of VOC can vary in response to the enhanced reactive nitrogen (Nr) deposition, depending on the carbon nitrogen and redox status of the soil, the vegetation composition, and the duration of exposure to Nr (Eriksson *et al.,* 2010). In wetlands where CH_4 is produced in abundance and Nr is limiting, adding Nr over the short-term can stimulate N-limited methane-oxidising bacteria and thus reduce CH_4 emission (Schimel, 2000). However, over the longer term, N can increase vascular plant biomass which increases CH_4 emission (Eriksson *et al.,* 2010). On balance, the long-term effects of Nr on vegetation species composition probably outweigh the short-term impacts on microbial community dynamics, resulting in a net increase in CH_4 emission from nutrient-poor wetlands, and a global warming effect (Bodelier and Steenbergh, 2014).

As the values of suspended particulate matter (SPM) were ranged ($p < 0.05$) from 56.81 ± 0.18 at Ilaro to 60.41 ± 1.99 µg/ m^3 at Arigbajo during the dry seasons, so it ranged ($p > 0.05$) from 32.08 ± 0.14 at Ijebu-Ode to 33.15 ± 0.60 µg/ m^3 at Shagamu in the wet season. Levels of SPM were observed to be more (-0.0304) contributed from the sampling locations in wet season as linear regression equation indicated than in the dry season when higher % (35.69) was likely to influence more adverse effects. The levels of SPM in the two seasons were lower than the limits: 150-250 µg/ m^3 (DNR, 2011; EPA, 2016). This could be due to its high dispersion into the air from fluctuated weather conditions with low relative humidity, high temperature and solar radiation which could have influenced higher dispersion than in the wet season. High level of SPM is prone to influence ecological impacts through inhalation in animal/ man and stomata penetration in plants. On plant, SPM cover the leaf blade to reduce light penetration and blocks stomata opening as a negative mechanical effect and in turn sharply impedes and declines photosynthetic process. Though plant significantly purifies troposphere of and reduces pollutants, leaf SPM retention is affected when deposition increases. SPM could influence acidification and form smog if released in the troposphere. On human, SPM may form a complex of organic compounds and minerals derivable from different such as industrial or transport combustion processes, with the smallest SPM being a carrier of toxic compounds down the respiratory tract and liable to be carcinogenic, though the upper respiratory tract limits the coarse SPM (Gheorghe and Ion, 2011).

Decibel levels of the areas were measured to range from 52.33 ± 1.31 (Obada-Oko) to 67.37 ± 2.70 dB (Shagamu) in the dry seasons but from 52.33 ± 0.98 (Laderin) to 67.25 ± 2.59 dB (Shagamu) in the wet seasons. The levels were observed to be significantly ($p < 0.05$) different across the sampling

locations. However, possible increased impacts could be attributed to the sampling locations in the dry season (-0.0818) whereas higher % (19.76) of the environmental adverse effects on the sphere of the assessed housing estates substantially occurred in the wet season. Noise levels were detected to exceed the set limit: 65 dB at Shagamu and Arigbajo (EPA, 2016) (Tables 1 and 2). Low heat stress from conducive environment associated naturally with the wet season might reduce the true possible noise-effects. Noise pollution is more intense in the work environment than in the general environment, although ambient noise increased an average of 1 dB per year during the 1980s. The average background noise in a typical home today is between 40 and 50 dB. Noise may be generally associated with industrial society, where heavy machinery, motor vehicles and aircraft have become everyday items (Gheorghe and Ion, 2011). Noise could psychological have more negative impacts in the dry season because of the harsh weather conditions which pose threats to man. It was indicated in Table 4 that the order of percentage influence of the CAP was CO_2 > SO_2 > SPM > CO > VOC across the sampling seasons: CO_2 > CO > VOC > NO_2 > SPM in the wet season but SO_2 > SPM > VOC > CO_2> CO in the dry season.

Table 4: Ranking of Percentage Influence of the Criteria Air Pollutants (CAP)

	Linear Regression Coefficient (R^2, %)	
	across the sampling seasons	
CAP	Wet Season	Dry Season
CO_2 (µg/ m^3)	51.54 1st	5.02 9th
CO (µg/ m^3)	24.38 4th	4.04 10th
H_2S (µg/ m^3)	--	0.45 12th
SO_2 (µg/ m^3)	--	44.01 2nd
NO_2 (µg/ m^3)	7.98 7th	1.98 11th
VOC (µg/ m^3)	17.84 5th	16.79 6th
SPM (µg/ m^3)	5.98 8th	35.69 3rd
	in each sampling season	
CO_2 (µg/ m^3)	51.54 1st	5.02 4th
CO (µg/ m^3)	24.38 2nd	4.04 5th
H_2S (µg/ m^3)	--	0.45 7th
SO_2 (µg/ m^3)	--	44.01 1st
NO_2 (µg/ m^3)	7.98 4th	1.98 6th
VOC (µg/ m^3)	17.84 3rd	16.79 3rd
SPM (µg/ m^3)	5.98 5th	35.69 2nd

Conclusion

There was increase in all the air quality pollutants in the dry seasons when compared with the wet seasons. This indicates that meteorological elements: temperature, relative humidity and length of solar radiations modulate dispersion of air quality pollutants in the troposphere. Temperature which is primarily higher in the dry seasons would influence greater dispersal of the pollutants unlike in the wet seasons. Relative humidity which is less in the dry seasons would dampen pollutants dispersion. Length of solar radiation is shorter in the wet seasons and reduces dispersion of air quality pollutants. Industrial activities within or around housing estates or residential environments should be discouraged.

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Conflicts of interest: None to declare.

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Queries

Q1 Confirm title, authors name and affiliations to be correct.

Q2 Confirm table numbering, there exist two table 2.

Q3 The reference is not consistent, check highlighted references and check for correction. Ensure they follow the format below.

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