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MONITORING SPATIAL VARIATION OF AMBIENT AIR POLLUTANTS IN ALIMOSHO LOCAL GOVERNMENT AREA OF LAGOS STATE

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Abstracts
Monitoring ambient air pollutants covers all necessary steps and actions to mitigate the increasing negative impacts of air pollutants on health, the economy and the environment. Ambient air pollution is a significant cause of death and disease globally. This study specifically identifies the source and concentration of pollutants in the study area and the effect of climatic variables on the pollutants. Data obtained from the direct fieldwork carried out were further analysed using tables, figures, and SPSS software to determine the mean, error of mean and standard deviation. The findings of the study revealed that measured levels of NO_2, O_3, CO, $PM_{2.5}$ and PM_{10} in all sampling sites were relatively high and above regulatory limits; however, there was no significant difference except in SPM (at all the sampling points) and NO_2 (only in important traffic intersection). The sources in the four site classes studied (traffic-related, dumpsite emission, commercial and residential) are contributory but with varying contributions; however residential sources are very low. The results suggest that strict and appropriate vehicle emission management of industrial air pollution control and close burning management of wastes should be considered in the study area to reduce the risks associated with these pollutants. More so, relevant regulatory bodies must develop monitoring mechanisms, regulations and enforcement measures. National development and drive should focus more on renewable and alternate energy.

Keywords: Ambient, Air pollutant, Dumpsite emission, Monitoring, Spatial variation

Introduction

Air can simply be referred to as the invisible gaseous substance surrounding the earth, a mixture mainly of oxygen and nitrogen. Also, air can be defined as the mixture of invisible, odourless, tasteless gases (such as nitrogen and oxygen) surrounding the earth. In a much broader and more complex sense, it could be described as the homogeneous mixture of gaseous substances, such as nitrogen, oxygen, and smaller amounts of other substances; a gas mixture in the earth's atmosphere (Magaji and Hassan, 2015).

A pollutant is a substance or energy introduced into the environment that has undesired effects or adversely affects a resource's usefulness. It can also be described as the contaminants that get introduced into the natural environment beyond permitted limits and cause deleterious effects to the inhabitants in a visible way (Microbial Diversity in the Genomic Era, 2019). These pollutants could be solid particles, liquid droplets, or gases; and can also be natural or artificial (U.S.E.P.A., 2006; Narayanan, 2009).

Air pollutants are classified into two (2), which are primary and secondary. Processes usually produce primary pollutants, while secondary pollutants are not emitted directly; instead, they form in the air when primary pollutants react/interact. The typical air pollutants are particulate matter (PM_{10} and $PM_{2.5}$), carbon dioxide (CO_2), ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (Co), sulfur dioxide (SO_2), lead (Pb), and methane (CH_4), (Lutgens and Edward, 2000). Air pollutants arise from a wide variety of sources, although they are mainly a result of the combustion process (Friedrich and Reis, 2004). The most significant sources include power generation, motor vehicles and industry. The two nitrogen oxides, NO and NO_2 (together called NOx) from anthropogenic sources, are present as a consequence of various combustion processes from both stationary sources, i.e. power generation (21%) and mobile sources, i.e. transport 44% (Adoki, 2012).

Oxidation is a significant source of NO2, an intermediary between NO emission and O_3 formation. Ambient air pollution is a broader term used to describe air pollution in outdoor environments. Poor ambient air quality occurs when pollutants reach high enough concentrations to affect human health and the environment (PAHO 2018). It is important to note that the common sources of outdoor air pollution are emissions caused by combustion processes from motor vehicles, solid fuel burning, open burning of municipal waste and agricultural residues, and industrial sectors (Akanni, 2010; Komolafe *et al.*, 2014).

Monitoring ambient air pollutants covers all necessary steps and actions to mitigate the increasing negative impacts of air pollutants on health, the economy and the environment. Ambient air pollution is a significant cause of death and disease globally. The health effects range from increased hospital admissions and emergency room visitations to an increased risk of premature death. According to World Health Organization (WHO), an estimated 4.2 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children. About 88% of these deaths occur in low and middle-income countries (Pan African Health Organization – PAHO).

The study focused on the most populous and visibly polluted local government in Lagos State, Alimosho local government area. The specific objectives are as follows: To identify the major air pollutants in the study area, access and map the sources of air pollutants concentration in the area and identify the effects of climatic variables on the pollutants.

The Study Area

Alimosho is a Local Government Area in the Ikeja Division of Lagos State, Nigeria. It was carved out of Ikeja Local Government in the year 1991. Before the decentralisation via the creation of Local Council Development Areas (LCDA) in Lagos State, Alimosho Local Government was situated in Ikotun and subsequently relocated to Akowonjo after its creation. The Local Government has five (5) major markets spread across its environs, including Iyana-

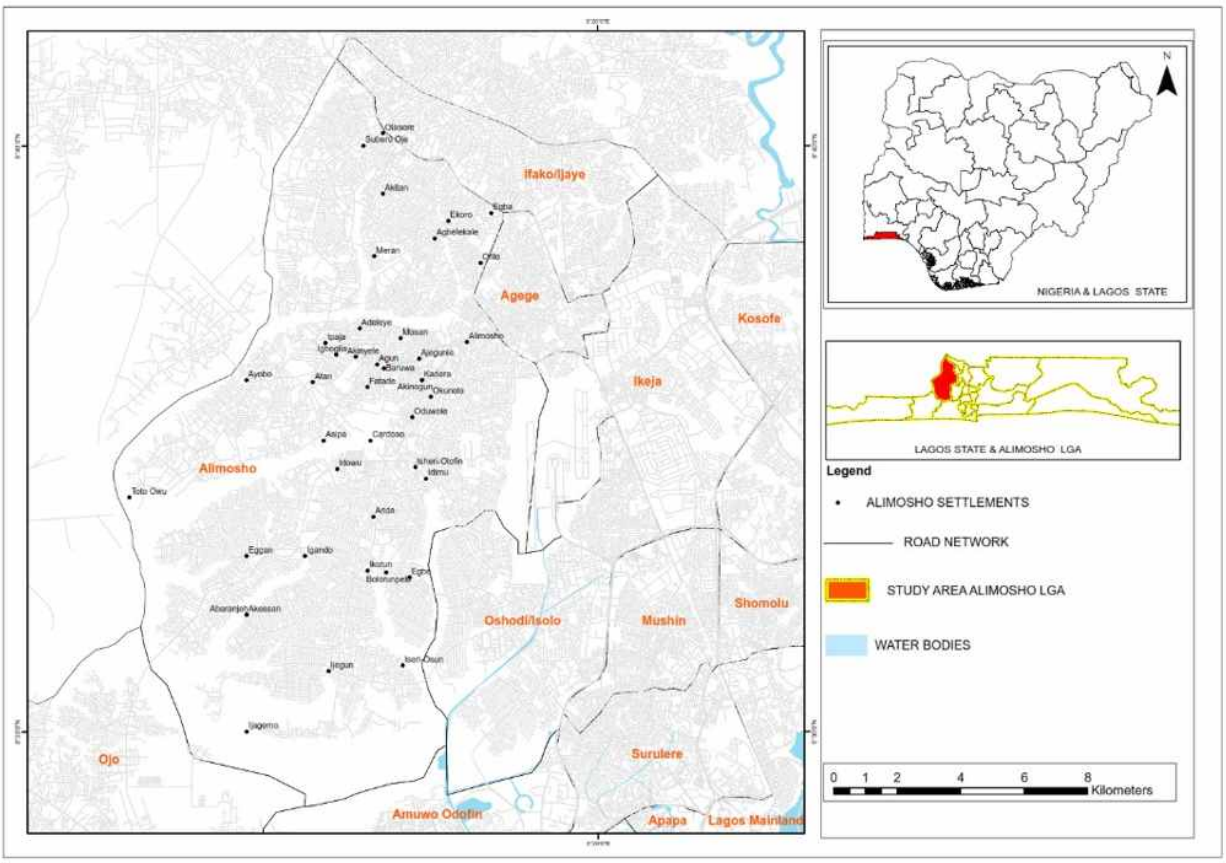

Figure 1. Alimosho Local Government Area

Ipaja market, Olubede Market, Baale Market, Orisunbare Market and Egbeda Market.

Material and Methods

There are two sources of data used in this study. These are primary and secondary data sources. The sampling points were selected to cover the points areas. Random and purposeful sampling techniques were used to sample points in the study area. The sampling points considered were as follows:

- Vehicular Intersection – The traffic intersection at Egbeda bus stop was a case study.
- Dumpsite a case study was the major dumpsite at Oko filling, on Lasu-Igando road.
- Residential Land Use – a case study here was the Diamond Federal Housing Estate situated on the Lasu-Igando road.
- Commercial Land Use – the Igando multipurpose market was used as a case study for commercial land use.

Table 1: Sampling Points Location

Sample points	Latitude	Longitude
Traffic Intersection	6.5981233	3.2907503
Dumpsite Area	6.5660301	3.2523533
Residential Area	6.577474	3.263521
Commercial Area	6.552802	3.240325

The data was used to analyse simple descriptive statistics such as mean (statistic and standard error of mean), standard deviation, and range. According to USEPA (2000), the Air Quality Index (AQI) describes ambient air quality. It is a rating scale for outdoor air. The lower the AQI value, the better the air quality. AQI rating A stands for Very good (0-15), B for Good (16-31), C for Moderate (32-49), D for Poor (50-99) and E for Very Poor (100 and over).

Nigeria Ambient Air Quality Standards

The Federal Government of Nigeria established the Federal Environmental Protection Agency (F.E.P.A.) in 1988 to protect, restore and preserve the ecosystems of Nigeria. FEPA established environmental guidelines and standards for reducing

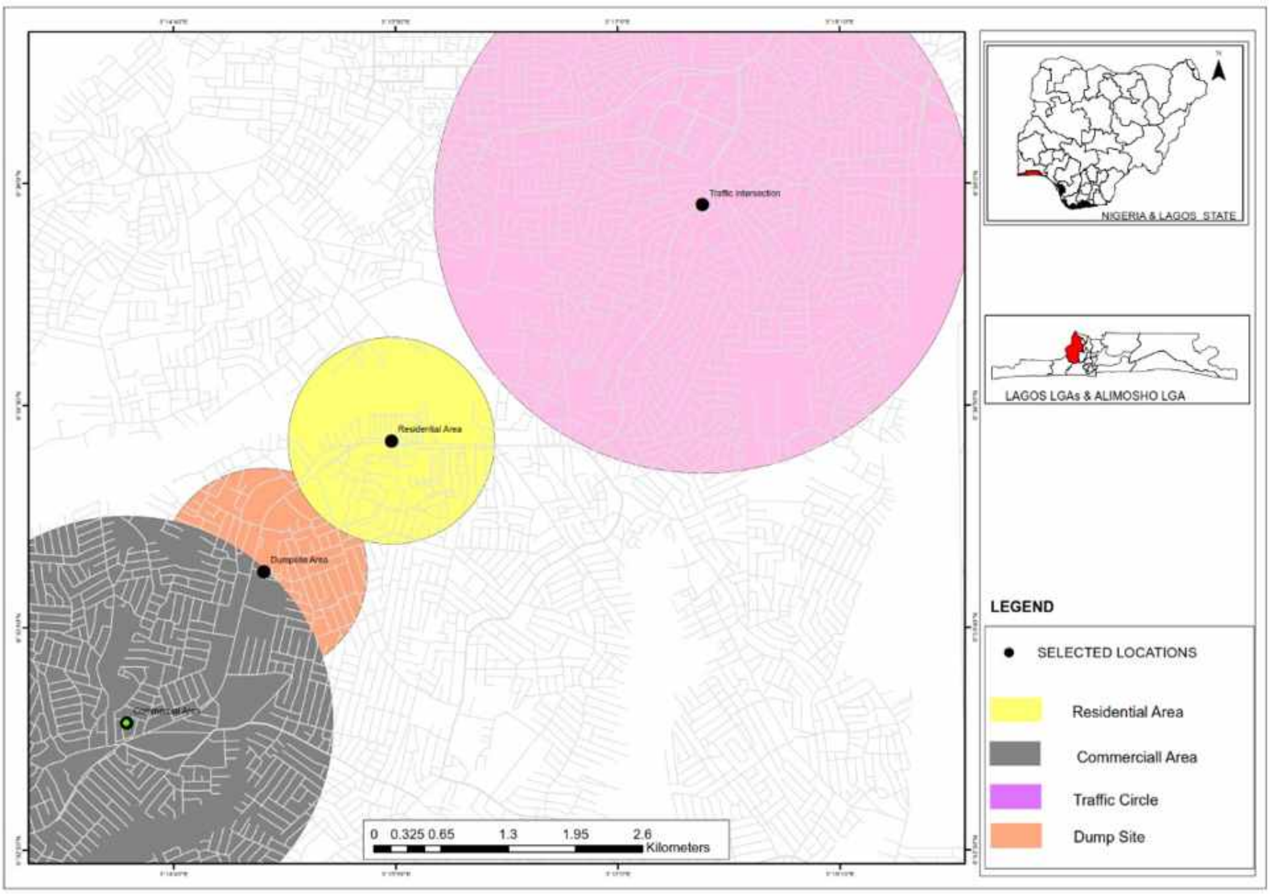

Fig 2.Sampling points showing air pollutant sources

Table 2: Nigeria Ambient Air Quality Standards

Pollutant	Averaging Time	Standard Limit
Particulates	1-hour average	250 μg/m^3
Sulphur dioxide	1-hour average	0.01 ppm (26 μg/m^3)
Non-methane Hydrocarbon	3-hour average	160 μg/m^3
Carbon monoxide	8-hour average	Ten ppm – 20 ppm (11.4 μg/m^3 – 22.8 μg/m^3)
Nitrogen dioxide	1-hour average	0.04 ppm – 0.06 ppm (75.0 μg/m^3 – 113 μg/m^3)
Photochemical oxidant	1-hour average	0.06 ppm

and controlling all forms of pollution. This involved establishing the National Ambient Air Quality Standards (N.A.A.Q.S.) for conventional pollutants to protect public health and the environment (F.E.P.A., 1999). The table below illustrates the ambient air quality standards in Nigeria.

The units of measure for this standard are part per million (P.P.M.) per volume and micrograms per cubic meter of air (μg/m^3). Recently, most of the states within Nigeria have developed ambient air quality standards under the state environmental protection agency (USEPA) to regulate and control the concentration of pollutants in their environment. Studies on the concentration of pollutants in the atmosphere show that some pollutants in some regions of Nigeria exceed the acceptable limits set by the state's environmental protection agency and the defunct federal environmental protection agency (Oguntunde et al., 2014).

Results and Discussion

This analysis answers this study's first objective, which is to identify the major air pollutants in the study area. The sampled parameters, which are: Carbon monoxide (CO), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Particulate matter ($PM_{2.5}$ and PM_{10}) and Ozone (O_3), are shown in Table 3. This set of readings was obtained in two sessions. The first session, the morning session, was carried out over two hours between 8:00 am and10:00 am, while the second session, which was the evening session, was carried out between:00 pm and 6:00 pm across all days of the research. These time frames were chosen to achieve a balanced result, as both times are known for heavy movement and traffic to and fro works and businesses across the study area.

Carbon Monoxide (CO)

As shown in Table3., during the first week of the research, the concentrations of carbon monoxide (CO) that were obtained in the morning in the study area ranged between 1 ppm and 14 ppm, with the highest concentration measured at the vehicular intersection (Egbeda bus stop) and the least in the residential area (Diamond estate). The concentrations of CO that were obtained on the mornings of the second week ranged between 1 ppm and 32 ppm, with the highest concentrations measured at the vehicular intersection (Egbeda bus stop) and the least in the residential area (Diamond estate). During the third week, the level of CO measured in the morning ranged from 1 to 26 ppm. The morning levels of CO obtained during the fourth week ranged from 1 ppm to 30 ppm.

For the evening session during the first week of the research, as shown in Table 3., concentrations of CO ranged between 1 ppm and 16 ppm, with the highest concentrations measured at a vehicular intersection (Egbeda bus stop). During the second week, CO levels ranged from 1 ppm to 30 ppm; CO levels measured in the third week ranged between 1 ppm and 28 ppm. Lastly, the CO values measured during the fourth week ranged from 1 to 29 ppm.

Nitrogen dioxide (NO_2)

During the study, the concentration of NO_2 was only recorded at vehicular and traffic intersections (Egbeda bus stop). This is because traffic congestion is significant in the case study city. This may be characterised by uncontrolled automobile growth, poor road infrastructure and private car-induced traffic system because the burning of fossil fuel is known to be the major contributor to the existence of NO_2. The values obtained during week one, as shown in Table 3. varied from 0 ppm to 1 ppm, while the

Table: 3. Levels of Ambient Air Pollutants (ppm) in the study area -- Morning &Evening Sessions.

Week	Day	Sampling points	CO	SO_2	NO_2	$PM_{2.5}$	PM_{10}	O_3
1	1	Vehicular Intersection	11.0	0.0	0.0	9.0	24.0	50.0
		Dumpsite Area	12.0	0.0	0.0	8.0	17.0	45.0
		Commercial Area	5.0	0.0	0.0	17.0	29.0	51.0
		Residential Area	2.0	0.0	0.0	8.0	18.0	46.0
	2	Vehicular Intersection	9.0	0.0	1.0	7.0	27.0	53.0
		Dumpsite Area	5.0	0.0	0.0	6.0	19.0	42.0
		Commercial Area	4.0	0.0	0.0	14.0	28.0	49.0
		Residential Area	3.0	0.0	0.0	8.0	16.0	40.0
	3	Vehicular Intersection	14.0	0.0	0.0	10.0	26.0	48.0
		Dumpsite Area	11.0	0.0	0.0	7.0	20.0	53.0
		Commercial Area	3.0	0.0	0.0	16.0	25.0	45.0
		Residential Area	1.0	0.0	0.0	6.0	15.0	49.0
		Mean	6.67±1.29	.000	.083±.0833	9.67±1.11	22.0±1.45	47.58±1.18
		Std. Deviation	4.46	.0000	.2887	3.8455	5.03	4.10
2	1	Vehicular Intersection	32.0	0.0	2.0	8.0	25.5	50.5
		Dumpsite Area	15.0	0.0	0.0	9.0	23.0	50.0
		Commercial Area	6.0	0.0	0.0	19.0	27.0	43.0
		Residential Area	2.0	0.0	0.0	9.0	17.0	42.0
	2	Vehicular Intersection	28.0	0.0	1.0	10.0	24.0	48.0
		Dumpsite Area	13.0	0.0	0.0	8.0	19.0	50.0
		Commercial Area	5.0	0.0	0.0	17.0	25.0	44.0
		Residential Area	1.0	0.0	0.0	5.0	14.0	40.0
	3	Vehicular Intersection	30.0	0.0	1.0	11.0	22.0	49.0
		Dumpsite Area	14.0	0.0	0.0	7.0	20.0	46.0
		Commercial Area	7.0	0.0	0.0	14.0	26.0	42.0
		Residential Area	2.0	0.0	0.0	6.0	16.0	36.0
		Mean	12.92±3.27	.000	.333±.1880	10.25±1.25	21.54±1.24	45.04±1.33
		Std. Deviation	11.34	.0000	.6513	4.33	4.29	4.62
Table								
3	1	Vehicular Intersection	21.0	0.0	3.0	8.0	21.0	45.0
		Dumpsite Area	16.0	0.0	0.0	7.0	20.0	44.0
		Commercial Area	6.0	0.0	0.0	12.0	23.0	41.0
		Residential Area	1.0	0.0	0.0	5.0	13.0	35.0
	2	Vehicular Intersection	23.0	0.0	1.0	10.0	18.0	44.0
		Dumpsite Area	20.0	0.0	0.0	9.0	17.0	42.0
		Commercial Area	8.0	0.0	0.0	15.0	21.0	38.0
		Residential Area	3.0	0.0	0.0	6.0	11.0	32.0
	3	Vehicular Intersection	26.0	0.0	0.0	11.0	19.0	49.0
		Dumpsite Area	24.0	0.0	0.0	8.0	16.0	44.0
		Commercial Area	6.0	0.0	0.0	12.0	25.0	42.0
		Residential Area	2.0	0.0	0.0	3.0	12.0	30.0
		Mean	13.0±2.75	.000	.333±.26	8.833±.98	18.0±1.27	40.5±1.64
		Std. Deviation	9.54	.0000	.8876	3.38	4.39	5.67
4	1	Vehicular Intersection	27.0	0.0	1.0	8.0	20.0	49.0
		Dumpsite Area	16.0	0.0	0.0	7.0	17.0	44.0
		Commercial Area	9.0	0.0	0.0	15.0	26.0	50.0
		Residential Area	1.0	0.0	0.0	6.0	19.0	45.0

2	Vehicular Intersection	24.0	0.0	1.0	7.0	21.0	44.0
	Dumpsite Area	13.0	0.0	0.0	7.0	15.0	40.0
	Commercial Area	6.0	0.0	0.0	11.0	26.0	47.0
	Residential Area	1.0	0.0	0.0	4.0	16.0	42.0
3	Vehicular Intersection	30.0	0.0	0.0	9.0	25.0	48.0
	Dumpsite Area	19.0	0.0	0.0	6.0	20.0	50.0
	Commercial Area	10.0	0.0	0.0	13.0	27.0	45.0
	Residential Area	2.0	0.0	0.0	4.0	14.0	39.0
	Mean	13.17±2.93	.000	.167±.1124	8.08±.981	20.5±1.32	45.25±1.07
	Std. Deviation	10.15	.0000	.3892	3.397	4.58	3.696

Source: Author's Fieldwork, 2021

value of NO_2 obtained in week two ranged between 0 and 2 ppm. The values of NO_2 obtained during the third week ranged from 0 ppm to 3 ppm, while the values obtained during the fourth week ranged from 0 ppm to 1 ppm.

For the evening session during the first week of the research, as shown in Table 3. concentrations of NO_2 ranged the same as in the morning session. During the second week, NO_2 levels ranged from 0 to 1 ppm; NO2 levels measured in the third week ranged between 0 and 2 ppm. Lastly, the NO_2 values measured during the fourth week ranged from 0 to 1 ppm.

Particulate Matter ($PM_{2.5}$ and PM_{10})

During the morning session of the first week, as shown in Table 3., the commercial area (Igando market) had the highest concentration of $PM_{2.5}$ of 17 $\mu g/m^3$. The most negligible value was obtained at the dumpsite (Oko filling) and residential area (diamond estate) of 6 $\mu g/m^{3,}$ respectively. In the second week, $PM_{2.5}$ ranged between 5 $\mu g/m^3$ and 19$\mu g/m^{3,}$ while the values of $PM_{2.5}$ recorded during the third week ranged between 3 $\mu g/m^3$ and 15 $\mu g/m^3$. Lastly, the level of $PM_{2.5}$ obtained in the fourth week ranged from 4 $\mu g/m^3$ to 15 $\mu g/m^3$.

For the evening session, as shown in Table 3., the highest level of $PM_{2.5}$ was obtained in the commercial area (Igando market) at 17 $\mu g/m^3$. The least was obtained at the residential area (Diamond estate) of 4 $\mu g/m^3$. In the second week, the $PM_{2.5}$ values ranged between 5 $\mu g/m^3$ and 18 $\mu g/m^{3,}$ while the values of this pollutant obtained in the third week ranged from 4 $\mu g/m^3$ to 14 $\mu g/m^3$. During the fourth week, the level of $PM_{2.5}$ measured ranged between 4 $\mu g/m^3$ and 13 $\mu g/m^3$.

The morning values of PM_{10} in the study area, as illustrated in Table 3. ranged between 15 $\mu g/m^3$ to 29 $\mu g/m^3$, with the highest concentration recorded at the commercial area (Igando market) while the least value was obtained at the residential area (Diamond estate). The values for the second week ranged from 14 $\mu g/m^3$ to 27 $\mu g/m^3$, while the third week ranged from 11 $\mu g/m^3$ to 25 $\mu g/m^3$ and the fourth-week values obtained ranged the same as the second week.

For the evening session, as shown in Table 3. the highest level of PM_{10} was obtained in the vehicular intersection (Egbeda bus stop) at 28 $\mu g/m^{3,}$ while the least was obtained at the dumpsite (oko filling) and residential areas (diamond estate) respectively of 16 $\mu g/m^3$. In the second week, the PM_{10} values ranged between 12 $\mu g/m^3$ and 29 $\mu g/m^{3,}$ while the values of this pollutant obtained in the third week ranged from 11 $\mu g/m^3$ to 26 $\mu g/m^3$. During the fourth week, the level of PM_{10} measured ranged between 12 $\mu g/m^3$ and 28 $\mu g/m^3$.

Ozone (O_3)

For Ozone (O_3) level across the morning session of the first week, the vehicular intersection (Egbeda bus stop) and dumpsite area (Oko filling) had the highest values (53 ppm), while the least (40 ppm) was obtained in the residential area (Diamond estate) as shown in 3. . The second week ranged between 36 ppm to 50.5 ppm with the highest concentration in the vehicular intersection (Egbeda bus stop). The third week ranged from 49 ppm to 30 ppm, while the fourth-week values of O_3 obtained ranged from 39 ppm to 50 ppm, with the highest concentrations occurring in the dumpsite (Oko filling) and commercial areas (Igando market), respectively.

For the evening session, as shown in Table 3., the highest level of O_3 was obtained in the vehicular intersection (Egbeda bus stop) at 51 ppm, while the least was obtained at the residential area (Diamond estate) at 38 ppm. In the second week, the O_3 values ranged between 37 ppm and 51 ppm, while the values of this pollutant obtained in the third week ranged from 31 ppm to 48 ppm. During the fourth week, the level of O_3 measured ranged between 38 ppm in the residential area (Diamond estate) and 50 ppm in the dumpsite area (Oko filling).

The findings of the study showed that measured levels of NO_2, O_3, CO, $PM_{2.5}$ and PM_{10} in all sampling areas were relatively high and above regulatory limits; however, there was no significant difference except in SPM (at all the sampling points), and NO_2 (only in major traffic intersection.

Sources of ambient air pollutants

This analysis answers the second objective of this study which is to access and map the sources of air pollutants in the study area, and this is graphically illustrated in Figure 3.6

The maps were generated using ESRI's ArcGIS 10.6.1. The data was obtained from the recordings of six air pollutants at four (4) land-use types in the Alimosho Local Government Area of Lagos State.

Carbon- monoxide (CO)

The levels of CO obtained from the study area, as shown in Figure3, were only from the traffic intersection (Egbeda bus stop), having a mean value of 0.92. Carbon monoxide is produced when fuel burns at a higher temperature. The most common sources here are fumes from vehicle exhaust.

Particulate Matter $_{2.5}$ ($PM_{2.5}$)

The levels of $PM_{2.5,}$ as shown in Figure4, were high around commercial land use (Igando multipurpose market) with a mean value of 14.58 and relatively high in the vehicular intersection (Egbeda bus stop) with a mean value of 9.0. low in the dumpsite area (Oko filling) with a mean value of 7.42, and very low in the residential area (Diamond estate) with a mean value of 5.83. This can be attributed to the concentration and density of vehicular movement into the market.

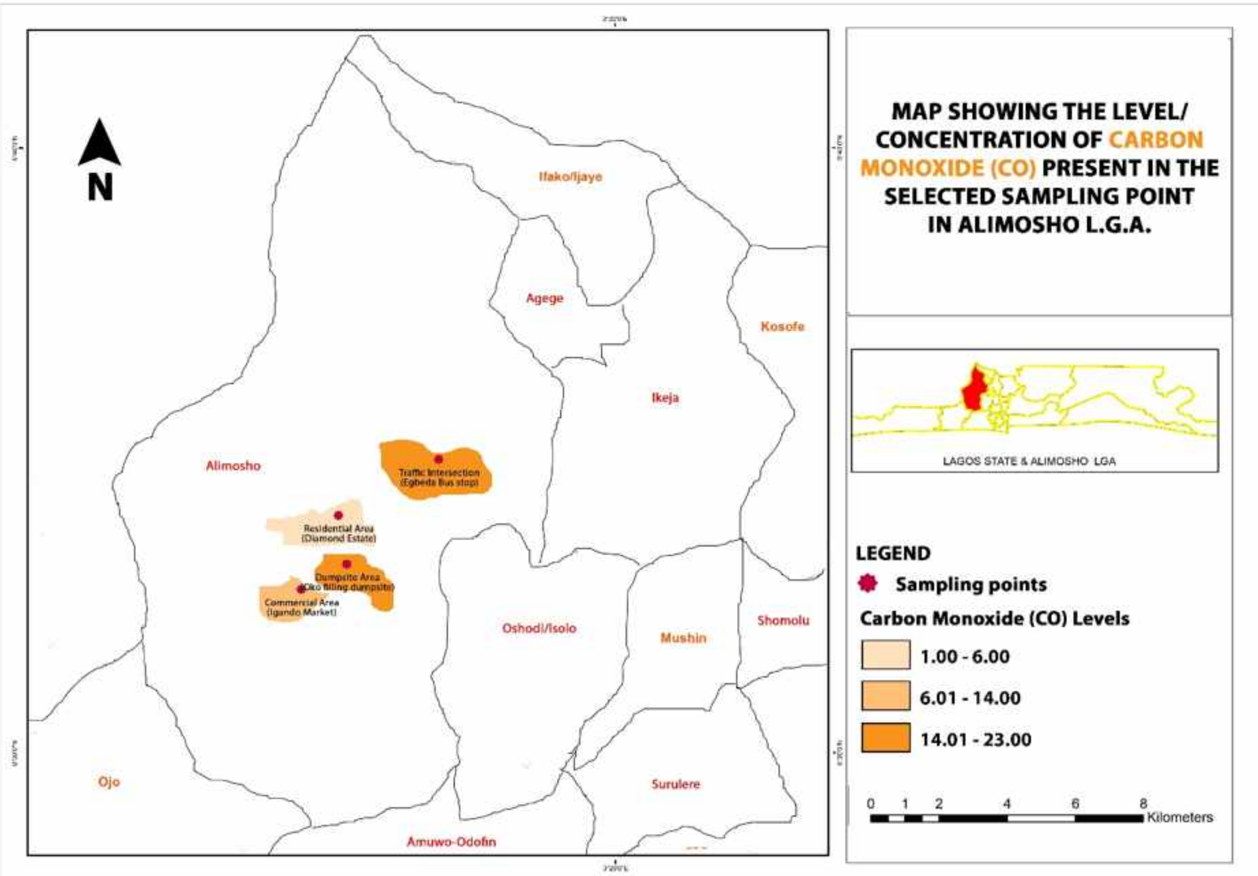

Figure.3 Concentration of Carbon monoxide (CO) sources in the study area

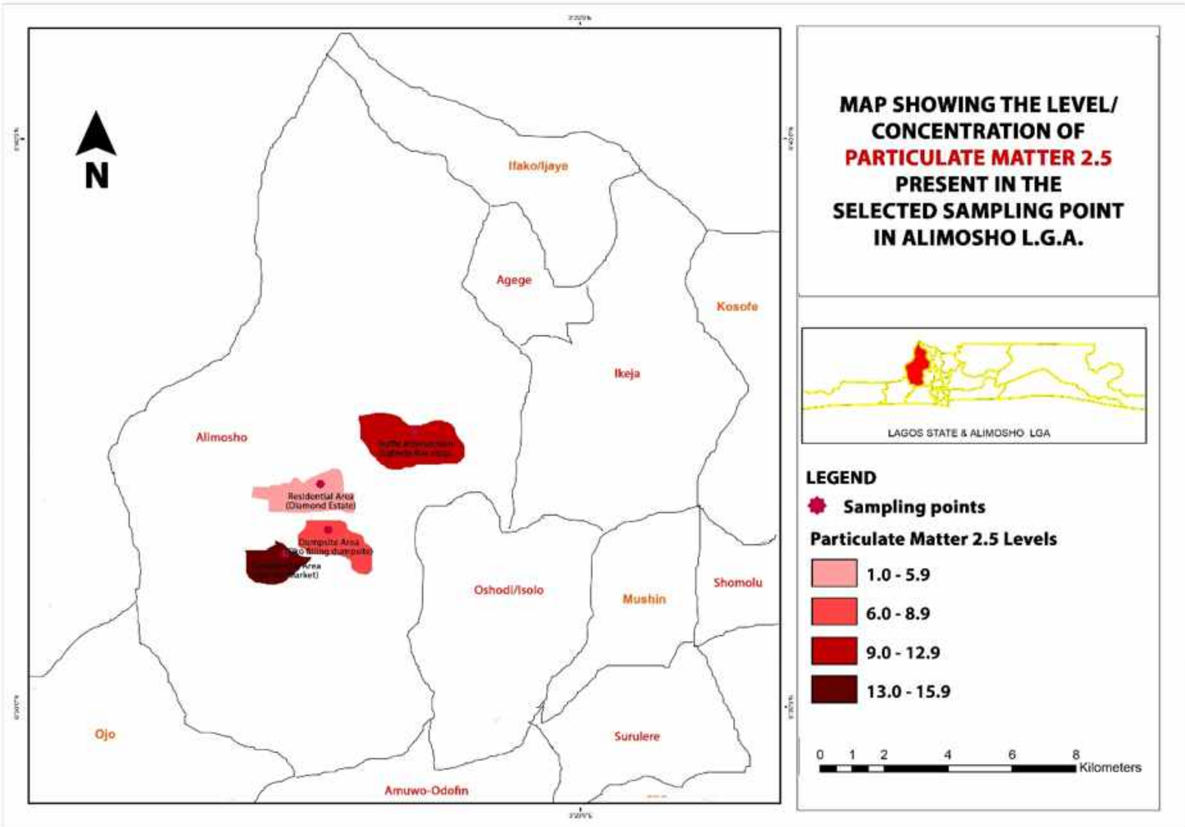

Figure.4: Concentration of Particulate Matter ($PM_{2.5}$) sources in the study area

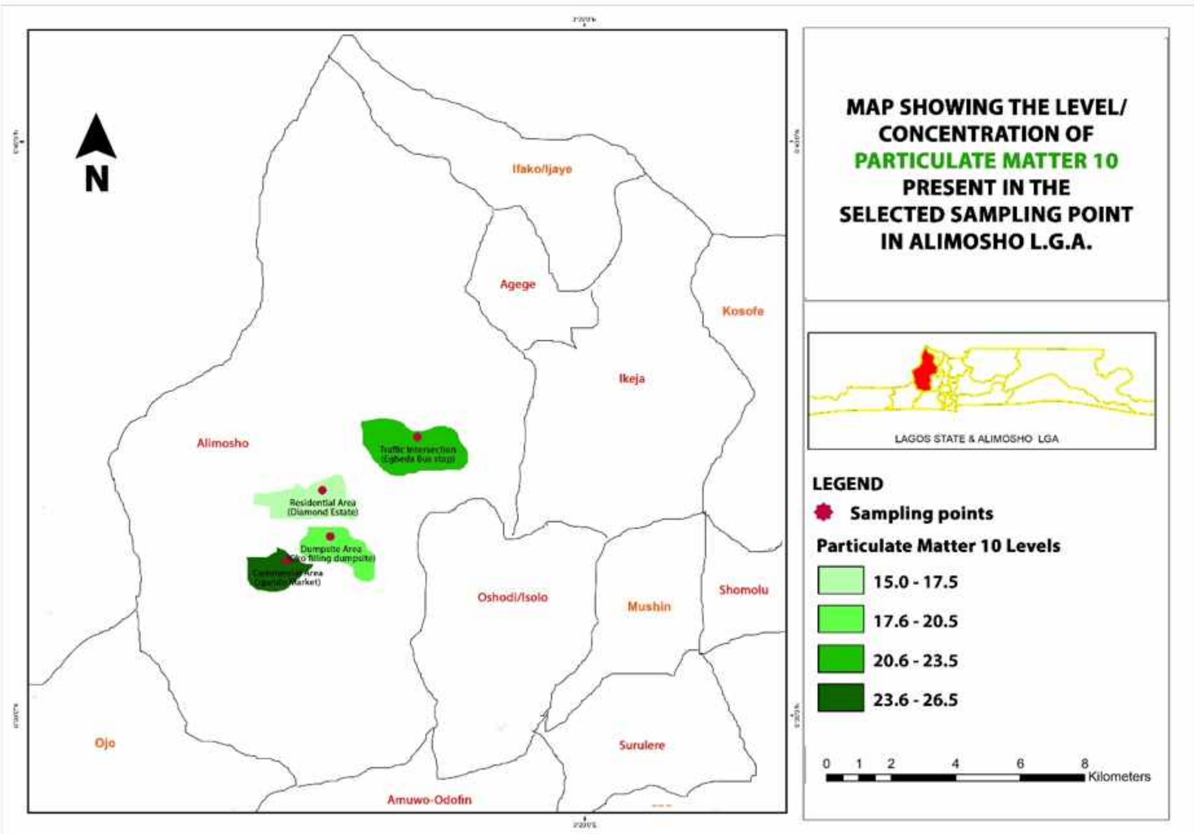

Figure 5 Concentration of Particulate Matter $_{10}$ (PM_{10}) sources of the study area

Particulate Matter PM_{10} (PM_{10})

Figure 5 shows a high concentration of PM_{10} around the commercial area (Igando market) with a mean value of 25.67 and a relatively high level at the traffic intersection (Egbeda bus stop) of the study area with a mean value of 22.67. The concentration was relatively low at the dumpsite area (Oko filling) with a mean value of 18.5 and very low at the residential area (Diamond estate) of the study area with a mean value of 15.08. It is mainly caused by incomplete burning of carbon, for example, motor vehicle exhaust and is higher in areas with heavy traffic congestion.

Ozone (O_3)

Figure 6. indicates a high concentration of O_3 around the traffic intersection (Egbeda bus stop) with a mean value of 48.13 and dumpsite area (Oko- filling) of the study area, with a mean value of 45.83, while moderate concentrations were found in the commercial area (Igando multipurpose market) with a mean value of 44.75 and low levels were found in the residential areas (Diamond estate) with a mean value of 39.67. The rates of ozone in this study were very high due to the interaction of air pollutants from automobile emissions (major) and manufacturing operations (minor) with sunlight.

Climatic variable effects

This analysis answers the third objective of this study which is to identify the effects of climatic variables on these pollutants. and the results are discussed in Table 4.0, illustrated in Figures 7 to 10. The climatic variables measured in this study were the Ambient air temperature and the Relative humidity.

Ambient Air Temperature (^oC)

The sampled ambient air temperature (**^{o}C**) in the study area is shown in Table 4.0. The ambient air temperature at a major vehicular intersection (Egbeda bus stop) for the entire period of study ranged between 32^{o}C and 33^{o}C. The mean for ambient air temperature values recorded at this land use is 32.667

Figure 7 compares the mean value of ambient air temperature with that of CO, NO_2, $PM_{2.5}$, PM_{10}, and $O_{3,}$ which are, respectively, 22.92, 0.92, 9.0, 22.67 and 48.13. The temperature received in this land use had highly affected the level of O_3, moderately affecting

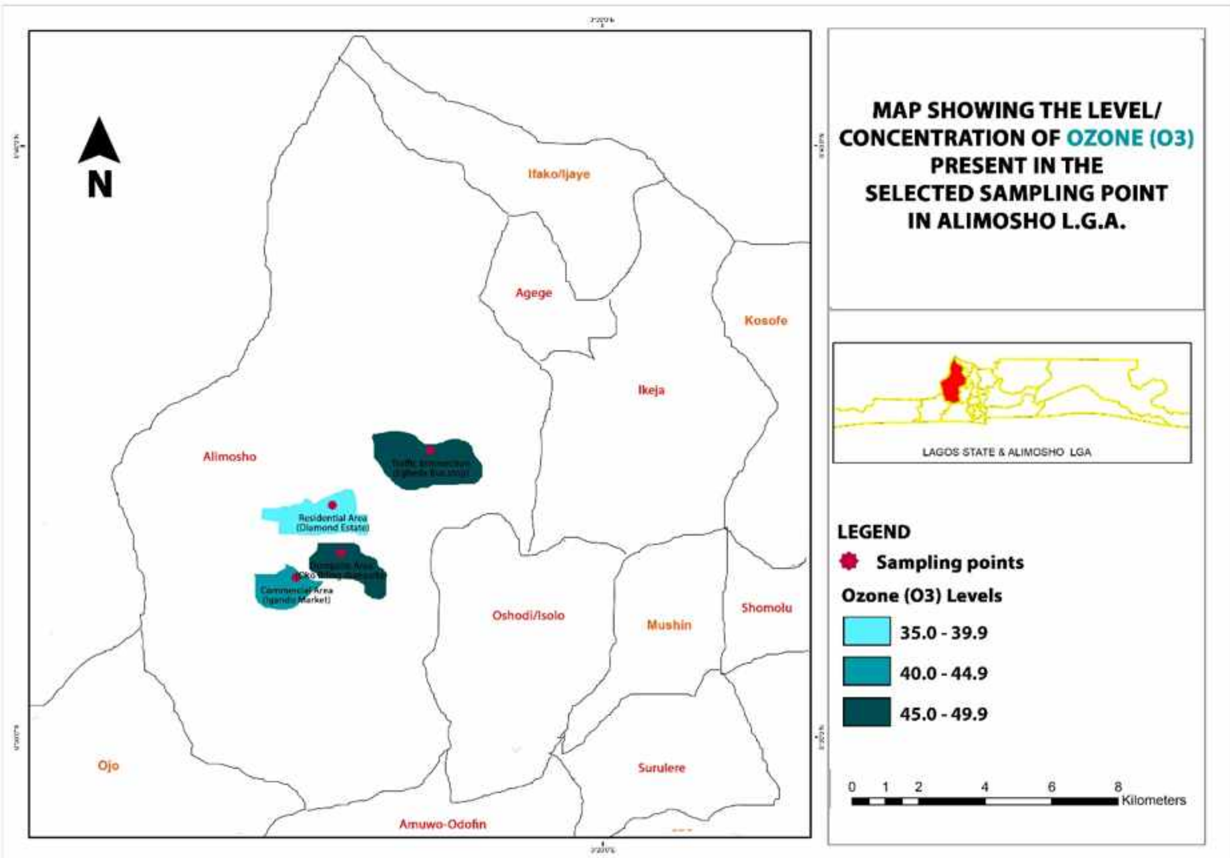

Figure 6. Concentration of Ozone (O3) Sources of the study area

CO and $PM_{10,}$ while a very low effect is seen in $PM_{2.5}$ and No_2.

The ambient temperature received at the dumpsite area (Oko filling) for the study period ranged between 31.5°C and 34°C. The mean ambient air temperature value recorded at this land use is 32.625. Figure 8 shows the mean value of ambient air temperature with the mean values of CO, NO_2, $PM_{2.5}$, PM_{10}, and O_3 with 14.83, 0.0, 7.42, 18.58 and 45.83, respectively. The temperature received in this land use highly affected the level of O_3, moderately affecting CO and $PM_{10,}$ while a very low effect is seen in $PM_{2.5}$, and no impact on NO_2, respectively.

Across all the sampled days in the commercial area (Igando market), the temperature received ranged between 31°C and 33.5°C. The mean ambient air temperature value recorded at this land use is 32.542. Figure 9. shows the mean value of ambient air temperature with the mean values of CO, NO_2, $PM_{2.5,}$ PM_{10}, and O_3 with 6.25, 0.0, 14.58, 25.67, and 44.75, respectively. The temperature received in this land use had highly affected the level of O_3, moderately affects $PM_{2.5}$ and $PM_{10,}$ while a very low effect is seen in CO, and no impact on No_2.

Table: 4. Ambient air temperature (°C) received in the study area

WEEK	DAY	Vehicular Intersection (Egbeda B/Stop)	Dumpsite Area (Oko-filling)	Commercial Area (Igando Multipurpose Market)	Residential Area (Diamond Federal Housing Estate)
1	1	33.0	33.0	32.0	33.0
	2	32.0	33.0	33.0	33.0
	3	32.0	33.0	33.0	32.0
2	1	33.0	31.5	33.5	32.0
	2	33.0	32.0	33.0	32.0
	3	33.0	32.0	33.0	30.0
3	1	33.0	33.0	33.0	32.0
	2	32.0	32.0	31.0	32.0
	3	33.0	33.0	32.0	33.0
4	1	32.0	33.0	31.5	32.0
	2	33.0	32.0	32.5	32.0
	3	33.0	34.0	33.0	33.0
	Mean	32.667±0.1421	32.625±0.2053	32.542±0.2172	32.167±0.2410
	Std. Deviation	.4924	.7111	.7525	.8348

Source: Author's Fieldwork, 2021

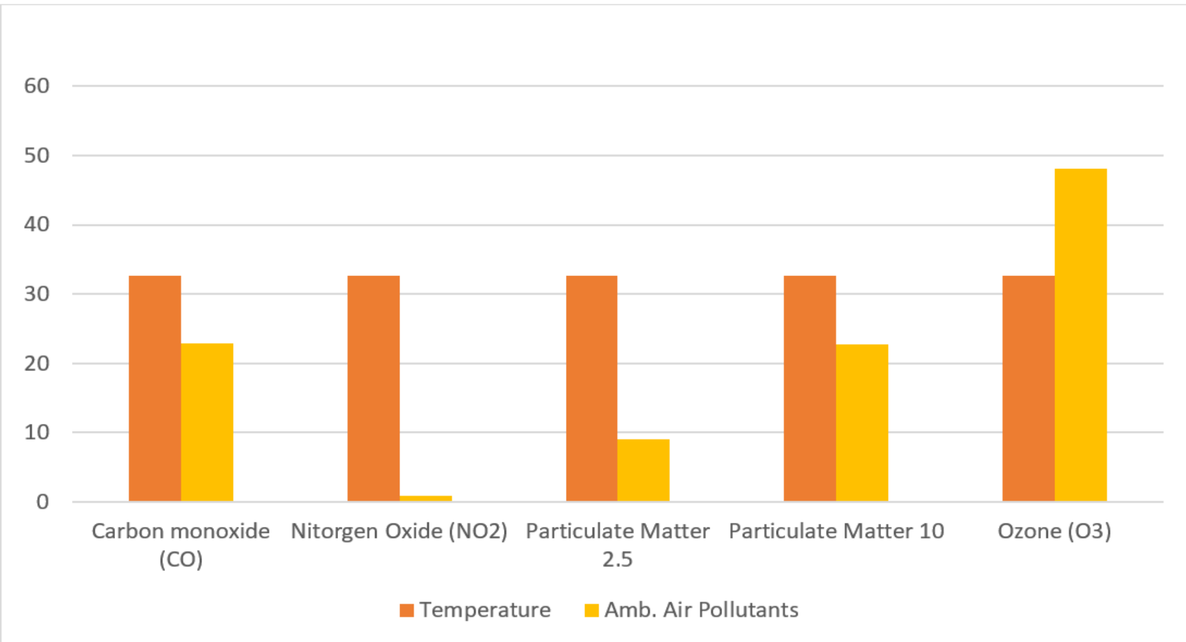

Figure7: Levels of Temperature and Air Pollutants at Vehicular Intersections in the study area

Relative Humidity (%)

The Relative humidity (%) of the study area is shown in Table 5. The relative humidity obtained across all days in the dumpsite areas (Oko filling), the relative humidity ranged between 47% and 61%. The mean for relative humidity values recorded at this land use is 53.42.

The Figure 10.shows the mean value of relative humidity with the mean values of CO, NO_2, $PM_{2.5}$, PM_{10}, and O_3 with 14.83, 0.0, 7.42, 18.58 and 45.83, respectively. The humidity received in this land use had highly affected the level of O_3, moderately affecting CO and $PM_{10,}$ while a low effect is seen in $PM_{2.5}$ and no impact in $NO_{2.}$

Across the days in the commercial area ((Igando market), the relative humidity also ranged between 47% and 61%. The mean for relative humidity values recorded at this land use is 52.67.

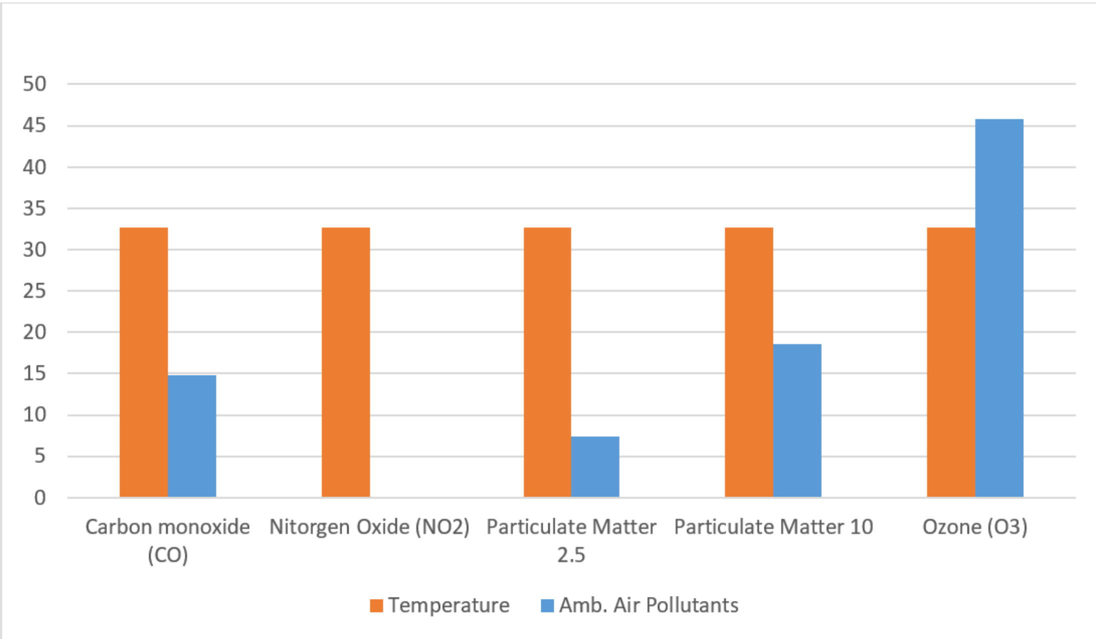

Figure.8: Levels of Temperature and Air Pollutants at Dumpsite Zone in the study area

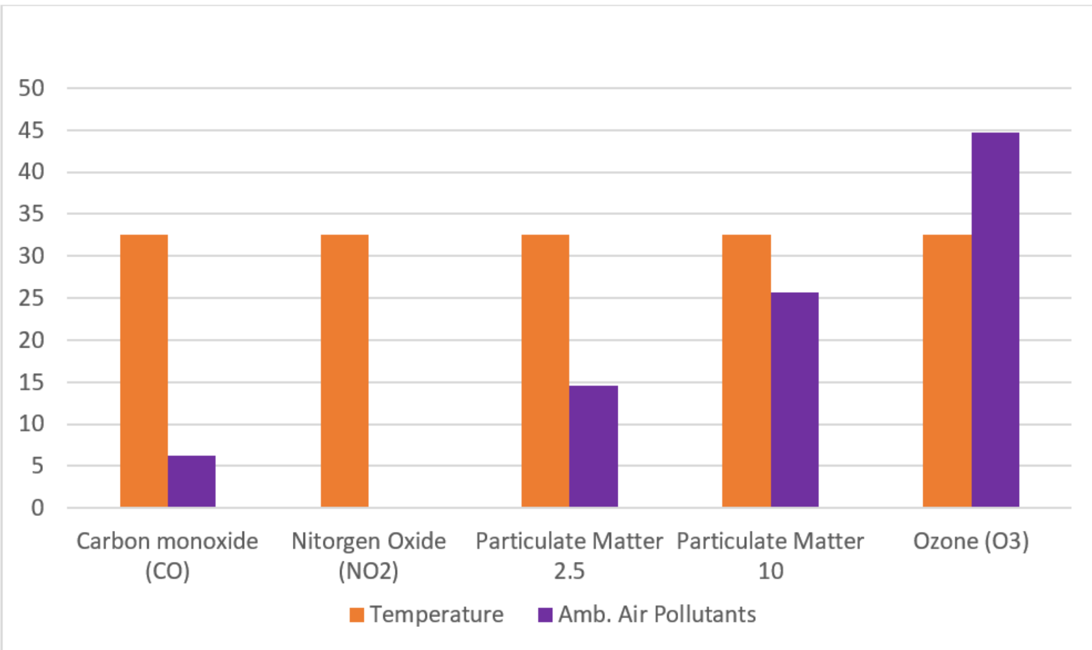

Figure 9: Levels of Temperature and Air Pollutants in the commercial zone in the study area

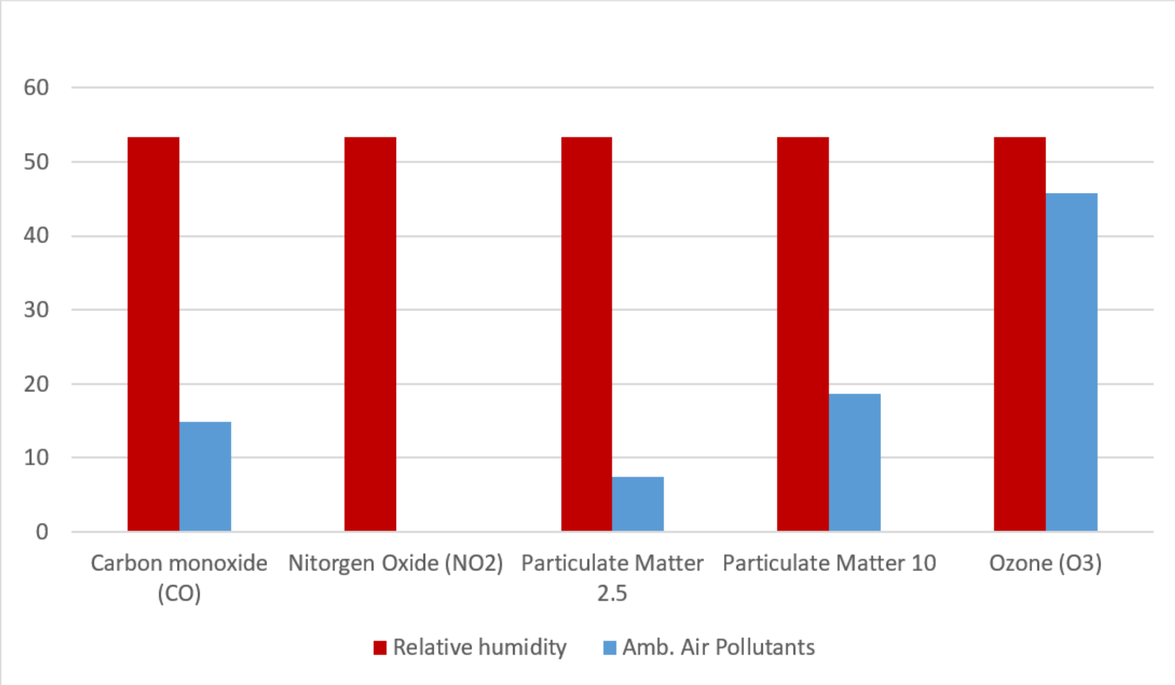

Figure 10: Levels of Relative humidity and Air Pollutants at dumpsite zone in the study area

Table 5: Mean relative humidity (%) of the study area

WEEK	DAY	**Vehicular Intersection** (Egbeda B/Stop)	**Dumpsite Area** (Oko-filling)	**Commercial Area** (Igando Multipurpose Market)	**Residential Area** (Diamond Federal Housing Estate)
1	1	56	52	60	57
	2	54	53	49	54
	3	51	54	48	50
2	1	55	53	57	52
	2	57	53	61	58
	3	55	52	47	53
3	1	49	54	50	51
	2	53	49	52	51
	3	50	54	48	55
4	1	58	61	51	57
	2	55	49	54	56
	3	51	47	55	50
	Mean	53.67±0.829	53.42±1.083	52.67±1.373	53.67±0.838
	Std. Deviation	2.871	3.753	4.755	2.902

Source: Author's Fieldwork, 2021

The rate of carbon monoxide (CO) was high in the vehicular intersection (Egbeda bus stop), ranging between 9ppm and 32ppm, followed by the dumpsite area (Oko filling dumpsite), which ranged between 5ppm and 24ppm; then low in the residential areas (Diamond Federal Housing Estate) ranging from 1ppm to 3ppm, during the morning sessions. The levels of NO_2 during the study could only be found and recorded in the vehicular intersection zone (Egbeda bus stop) with a range between 0ppm and 3ppm.

Low concentrations of $PM_{2.5}$ were found in the residential areas (Diamond Federal Housing Estate) with a range between 3ppm and 8ppm, while the high level was found in the commercial area (Igando Multipurpose Market) ranging between 10ppm and 19ppm. The concentrations of PM_{10} during the study were noticeably elevated in all areas/zones except for the residential area (Diamond Federal Housing Estate), which recorded low levels (11ppm to 20ppm). The ozone (O_3) levels were significantly high across the different land uses in the study area ranging from 30ppm to 53ppm. The ambient air temperature received during the study did not vary considerably in the vehicular intersection (Egbeda bus stop). The reverse was the case for the commercial areas (Igando market).

The temperature received in the vehicular intersection (Egbeda bus stop) had a high effect on the level of O_3, with moderate effects on CO and $PM_{10,}$ while a very low impact is seen in $PM_{2.5}$ and no effect on NO_2. The relative humidity was received at its peak and lowest both in the dumpsite (Oko filling) and commercial areas (Igando market) at 47% and 61%, respectively. Activities such as burning fossil fuels and open incineration were among the significant sources of these air pollutants. The ambient air in the vehicular intersection (Egbeda bus stop) can be described as poor due to high concentrations of these significant ambient air pollutants, especially CO and O_3.

Conclusion

In conclusion, various factors continue to enhance the occurrence of air pollution in our world today. This research has shown that human activities are majorly responsible for the spatial variation of these pollutants in the Alimosho Local Government Area of Lagos State and Nigeria. Air pollution is unsafe and unhealthy for a country, especially for its development. However, concerted efforts must be put in place to battle the menace of these air pollutants, which have contributed immensely to the bad state and unsafely of our air and environment. Air pollution is something that we cannot ignore now. It has caused significant damage to public health, with adverse effects concentrated in urban areas in both developed and developing countries; a broad range of adverse health effects affecting both the respiratory and the cardiovascular systems are observed in both short-term and long-term exposures (Brunekreef and Forsberg, 2005; WHO, 2009).

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