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Assessment of Air Quality in Major Motor Parks in Ilorin Metropolis, Kwara State, Nigeria

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ABSTRACT

Air pollution monitoring is particularly at low level in Africa. The study assessed the ambient air quality (VOC, H_2S, CO, $PM_{2.5}$, PM_{10}, O_2, LEL, and HCHO) at five major motor parks in Ilorin Metropolis, Kwara State, Nigeria. Samples were taken from three points in each motor parks in the morning, afternoon and evening between 6.00am and 6.00pm for a period of four weeks. The coordinates of sampling points were taken with a Garmin Dakota 20 device. Hand held mobile multi-gas monitor with model AS8900 was used to assess the concentrations of Hydrogen Sulphide (H_2S,), Carbon Monoxide (CO), Oxygen (O2), Combustible (LEL) while BLATN with model BR – Smart Series air quality monitor was used to assess the concentration of Particulate Matter (PM) $PM_{2.5}$ and PM_{10}, Formaldehyde (HCHO) and Volatile Organic Compounds (VOC).Wind speed, Temperature and Relative Humidity were assessed using a handheld digital anemometer TL-300. Data were analysed using tables, maps, correlation matrix and Analysis of variance (ANOVA). The Result revealed exceedance of Combustible LEL levels across the motor parks to permissible limits of Federal Ministry of Environment (FMEV) but lower than WHO limit. The VOC concentration in New-Shao garage exceeded the recommended limit for both FMEV and WHO, the concentrations of other parameters across the motor parks were lower and within the set limits of FMEV and WHO. In terms of Air Quality Index (AQI) rating, the air quality for CO across the motor parks was good and safe. The AQI for $PM_{2.5}$ across the motor parks were unhealthy for sensitive groups while $PM_{2.5}$ at Sawmill garage Motor Park most likely to have unhealthy health effects. The AQI for PM_{10} is good for Offa garage Motor Park while it was moderate for the remaining motor parks. The air quality of the study area is polluted due to particulate pollution. The quality of air around the motor parks needs to be regularly monitored to ensure compliance to recommended regulations.

Key words- Ambient air quality, Pollution monitoring, Particulate Matter, Motor parks, Air pollution

I. INTRODUCTION

Rapid Urbanization and transportation has increased vehicular usage in Nigeria recently and this in turn has resulted in citing of motor parks that are put into operation. Motor parks are usually associated with transportation that involves the use of commercial vehicles by offering a place for commuters to come and board vehicles to their place of destination. A Motor park is an essential part of transport system and it is an area designated by relevant authority to provide ease of intra and inter-state transportation for long and short journey passengers. Motor parks play a crucial role in the management of traffic and congestion in cities. However, the activities of a motor park could pollute the air especially from exhaust pipes of vehicles coupled with the use of fossil fuel through incomplete combustion by the engine causing air pollution in the forms of smokes, dusts and so on. One of the major challenging environmental problems that has affected both the developed and developing countries of the world today is air pollution which has recently been linked to increased morbidity and mortality rates.

[4,22,14] Atmospheric pollution is a condition in which certain substances, which include gases (Sulphur dioxide, nitrogen oxides, carbon monoxides, hydrocarbons, etc.), particulate matters (smoke, dust, fumes, aerosols, etc.) are present in such concentrations that may produce undesirable effects on man and ecosystem. [16] Air pollution is the presence of one or more pollutants such as gas, dust, odour, fumes, mist, smoke or vapour in the atmosphere in such a way that may be injurious to plant, animals and human life. Air pollution describes the discharge of toxic or harmful substances into the atmosphere through anthropogenic activities or by natural means. Anthropogenic activities like burning of fossil fuels, transportation and industries release pollutants such as carbon monoxide, Sulphur dioxide, nitrogen oxides, particulate matter and hydrocarbons into the air. [6] It has been proved that air pollution cost over 2% of gross domestic product in developed nations and 5% in developing nations. [12,13] Air pollution, nevertheless, continues to cause a considerable threat to health globally. Air pollution was estimated to contribute to 1.2 to 2 million deaths yearly in China. [23,21] Researches have reported the associations between exposure to air pollutants and health effects such as respiratory and cardiovascular diseases. [5, 22, 8, 4] This air pollution could cause adverse health effects on those who reside or engage in activities within the motor parks. The smoke and other particulates in the air that are emitted from vehicles, generating set and other processes can be a serious source of public complaint when the motor parks are closely located in residential areas and when the emissions are unabated. Particulate matter (PM) PM_{10} and $PM_{2.5}$ are small enough to penetrate the lungs, a vital organ in respiratory system. Particularly, elderly people, susceptible groups with pre-existing lung or heart diseases, as well as children are vulnerable to be affected by the poor quality of air. An assessment by WHO on the burden of air pollution related disease revealed that yearly, more than two million premature deaths was attributed to the effects of outdoor and indoor air pollution arising from the burning of solid fuels. In 2012 alone, 7 million deaths in the world were attributable to the combined effects of ambient (3.7 million) and household (4.3 million) air pollution. [22,15] reported air pollution as one of the great killers in our age, as polluted air was responsible in 2015 for 6.4 million deaths worldwide; 2.8 million from household air pollution while about 4.2 million resulted from ambient air pollution. It is estimated that in the absence of aggressive control, ambient air pollution is projected by 2060 to cause between 6 million and 9 million deaths annually. [13] Cardiovascular mortality due to exposure to gaseous pollutants such as nitrogen dioxide (NO2) has been reported by [18] while Sulfur dioxide (SO2) health effect was reported by. [19] Air pollution monitoring is at low level in Africa, however, we do not know the actual health impact of air pollution in all places due to lack of monitoring of air pollution levels. The implication of this is that there will more emissions and pollutants in the atmosphere if not controlled. [10] As reported by, [21] air pollution has killed more people globally than malaria, HIV/AIDS, tuberculosis or breast cancer. The health impacts recorded could possibly be an underestimation especially for a developing country like Nigeria with increasing population of people on a daily basis. These barriers in data need to be tackled as it will enable us to have a broader view of the likely impacts of air pollution to the health of the public why finding ways of mitigating it. However, assessment of air quality in motor parks has not well been researched so this study assessed the air quality of Major Motor Parks in Ilorin Metropolis, Kwara State, Nigeria.

II. MATERIALS AND METHODS

Description of the study Area

The study area was Kwara State, Nigeria. Ilorin, the Kwara State capital is located between latitude 8º 36´ N and 8º 50´

N of the equator, and longitude 04º 33´E of the Greenwich Meridian. Ilorin is found in the North central part of the Federal Republic of Nigeria with a population of more than one million people according to 2006 population census. Ilorin has diverse ethnic groups of mainly Yoruba, Fulani, Gobir, Hausa and Nupe, that constituted it. Ilorin is located in the transitional zone between the deciduous woodland of the South and dry savannah of North Nigeria. [(2)] Ilorin has three Local Government Areas (LGAs) namely; Ilorin West LGA, Ilorin South LGA and Ilorin East LGA. It covers about 100 km2. The landscape ranges in elevation in the western part from 273 m to 333 m and in the eastern part from 273 m to 364 m. Ilorin has both dry and wet season with rainy season beginning from May through October while the dry season starts in November and ends in April. The temperature of Ilorin ranges between 33°C-35°C from November to January and between 34-37°C from February to April. Ilorin has a relative humidity of between 75%to 88% around May to October and about 35% to 80% during the dry season period of November to April. [(3)] Sobi hill is the dominant landform and it is the highest point in the city about 394 m above sea level [(2)]

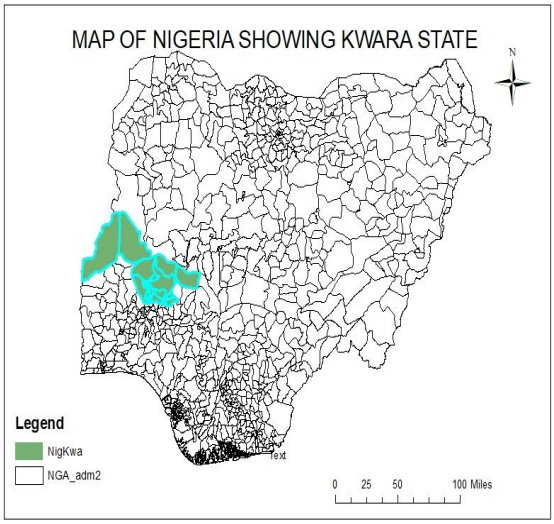

Figure 1: Map of Nigeria

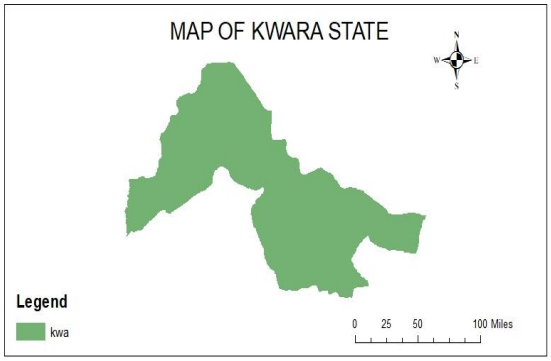

Figure 2: Map of Kwara State

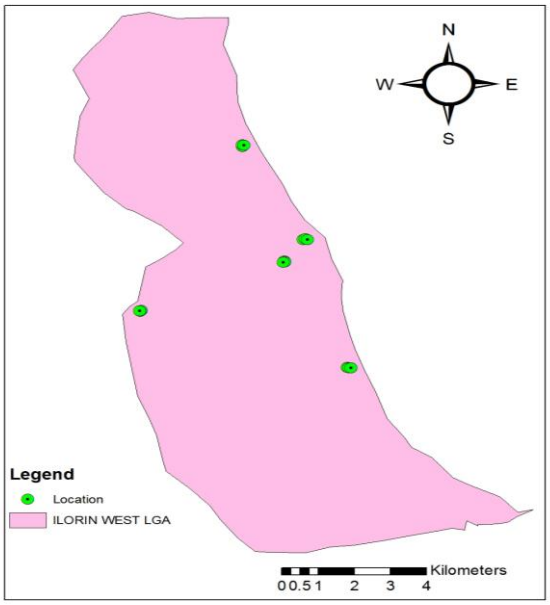

Figure 3: Map of Ilorin West LGA Showing the Motor park locations

Method of Data Collection

Sample collections were limited to air quality in five selected Major motor parks: Offa garage motor park, Soludero motor park, Maraba motor park, New- Shao garage motor park and Sawmill garage motor park. In situ (on-the-site) measurements of pollutant concentrations, and meteorological parameters were conducted at selected sampling points Air quality assessment were randomly taken at different distances in three sampling point locations within the vicinity of each selected motor parks. The assessment of air quality parameters took place during weekdays alternately (Monday, Wednesday and Friday) at daytime between 6.00am and 6.00pm.Measurementwas taken three times

daily; morning (6-8am),afternoon (12-2pm) and evening (4-6pm). Night samples were not collected. The average values for repeated readings at each sampling point were computed. Data collection started from 24thSeptember, 2019 through 20th of October 2019 within the five selected Major motor parks in Ilorin Metropolis for a period of four [(4)] weeks.

Tools for Data Collections

Digital Hand Multi-gas Monitor

A Hand held mobile Smart Sensor multi-gas monitor with model number AS8900 and BLATN with model BR – Smart 126 portable hand held air quality monitor device were used to assess the presence and concentration of the following gases: Smart sensor multi-gas monitor AS8900 measured the levels of Oxygen (O_2), Hydrogen Sulphide (H_2S), Combustible (LEL),Carbon monoxide (CO) while BLATN BR-Smart 126 device was used to assess Particulate Matter ($PM_{2.5}$) and (PM_{10}), Volatile Organic Compound (VOC) and Formaldehyde (HCHO) concentration levels.

Meteorological parameters

Meteorological parameters such as temperature, wind speed, relative humidity and were measured using a portable calibrated digital handheld Anemometer TL-300.

Global Positioning System (GPS)

The handheld digital Global Positioning System (GPS) Garmin Dakota 20 device was used to extract the coordinates and points of each location air quality readings were taken within the study area. The data obtained was used to produce a digital map through the use of ArcGIS 10.5 software.

Data Management

Statistical Analysis

Data obtained from the assessment were subjected to statistical analysis. Data computation was carried out using the Statistical Package for Social Sciences (SPSS version 23).Mean and standard deviation; tables were computed for each of the parameter. The test of significance of difference between the parameters assessed in the study location was computed. Analysis of variance (ANOVA) was used to establish the variations among the parameters at 0.05 significance level $p<0.05$. Correlation matrix was used to establish relationship among the parameters at 0.01 significance level with $p<0.01$.Each of the parameter was compared with National (FMEV) and International standards (WHO).

IV. RESULTS AND DISCUSSION

Results

Air Quality concentration across the motor parks

The average mean concentration of air quality parameters: O_2, LEL, H_2S, CO, $PM_{2.5}$, PM_{10}, HCHO and VOC assessed in the selected motor parks are presented in Table 1 as compared with the national and international maximum permissible standards.

Table 1.Comparison of Average Mean Concentration of O_2, LEL, H_2S, CO, $PM_{2.5}$, PM_{10}, HCHO and VOC levels in all the selected motor parks with recommended standard

Parameters	Offa Garage	Soludero	Maraba	New-Shao garage	Saw-mill garage	FMEV Standards	WHO Standards
Air Temp. (°C)	31.17	31.31	31.72	32.06	32.33	29.5-36.9	-
O_2 (%)	20.86	20.89	20.89	20.87	20.87	20.90	>23.50
LEL (%)	9.07	8.95	8.87	9.07	9.05	5	15.5
H_2S (ppm)	0.02	0.05	0	0.03	0	100	150
CO (ppm)	0.62	0.35	0.69	0.18	0.60	50	50
$PM_{2.5}$ (µg/m^3)	40.60	44.36	50.38	51.71	60.70	115	25
PM_{10} (µg/m^3)	51.77	55.73	60.52	61.69	72.19	150	50
HCHO (mg/m^3)	0.02	0.01	0.01	0.01	0.01	0.012	30
VOC (mg/m^3)	0.25	0.26	0.25	0.60	0.24	0.500	0.500

Meteorological parameters

Table 2. Average mean values for Wind speed, Relative humidity and Air temperature in the motor parks

Motor parks	Wind Speed (m/s)	Relative Humidity (%)	Air Temperature (°C)
Offa Garage	0.052	57	31.36
Soludero	0.061	55	31.30
Maraba	0.056	51	31.72
New-Shao Garage	0.084	51	32.05
Saw-mill Garage	0.055	51	32.33

Table 3.ANOVA showing variation in average concentration of air quality parameters across the motor parks

Parameters		Sum of Squares	df	Mean Square	F	Sig.
O_2 (%)	Between Groups	.006	9	.001	1.107	.481
	Within Groups	.003	5	.001		
	Total	.009	14			
LEL (%)	Between Groups	1.519	9	.169	4.780	.050
	Within Groups	.177	5	.035		
	Total	1.696	14			
CO (ppm)	Between Groups	1.196	9	.133	1.406	.370
	Within Groups	.473	5	.095		
	Total	1.669	14			
$PM_{2.5}$ (µg/m^3)	Between Groups	1198.072	9	133.119	8.372	.015
	Within Groups	79.498	5	15.900		
	Total	1277.570	14			
PM_{10} (µg/m^3)	Between Groups	1221.323	9	135.703	14.046	.005
	Within Groups	48.307	5	9.661		
	Total	1269.630	14			
Air Temp.(°C)	Between Groups	402.341	9	44.705	712.633	.000
	Within Groups	.314	5	.063		
	Total	402.654	14			
VOC (mg/m^3)	Between Groups	.476	9	.053	2.272	.190
	Within Groups	.116	5	.023		
	Total	.593	14			
HCHO (µg/m^3)	Between Groups	17.726	9	1.970	.481	.840
	Within Groups	20.487	5	4.097		
	Total	38.212	14			
H_2S (ppm)	Between Groups	.010	9	.001	.852	.608
	Within Groups	.007	5	.001		
	Total	.017	14			

Significant at 0.05 alpha level , $p<0.05$

Table 4. Correlation matrix for air quality parameters in the selected motor parks

	Variables	1	2	3	4	5	6	7	8	9	10
1	Relative Humidity (%)	1									
2	Temp.(°C)	-0.987**	1								
3	O_2 (%)	-0.331	0.295	1							
4	LEL (%)	-0.828**	0.865**	0.005	1						
5	H_2S (ppm)	0.389	-0.394	-0.004	-0.464	1					
6	CO (ppm)	0.270	-0.268	0.167	-0.416	-0.149	1				
7	$PM_{2.5}$ (µg/m^3)	0.247	-0.279	0.058	-0.400	0.067	0.094	1			
8	PM_{10} (µg/m^3)	0.287	-0.305	-0.009	-0.386	0.037	0.086	0.988**	1		
9	HCHO (mg/m^3)	0.441	-0.417	-0.722**	-0.102	-0.151	0.102	-0.411	-0.322	1	
10	VOC (µg/m^3)	0.321	-0.331	-2.225	-0.308	0.426	-0.376	0.369	0.352	-0.062	1

** Significant at 1% ($p<0.01$)

Table 5. Air Quality Index (AQI) in each selected motor parks

Motor parks	$PM_{2.5}$ Conc. (µg/m^3)	$PM_{2.5}$ AQI	Health Impact	PM_{10} Conc. (µg/m^3)	PM_{10} AQI	Health Impact	CO Conc. (ppm)	CO AQI	Health Impact
Offa Garage	40.60	114	Unhealthy for sensitive group	51.77	47	Good	0.62	7	Good
Soludero	44.36	123	Unhealthy for sensitive group	55.73	51	Moderate	0.35	3	Good
Maraba	50.38	137	Unhealthy for sensitive group	60.53	53	Moderate	0.69	7	Good
New-Shao Garage	51.71	141	Unhealthy for sensitive group	61.69	54	Moderate	0.18	1	Good
Saw-mill Garage	60.70	154	Unhealthy	72.20	59	Moderate	0.60	7	Good

AQI was calculated using a user friendly AQI Calculator interface from USEPA. [1]

Air Quality Index (AQI) rating by United State Environmental Protection Agency (USEPA)

Good (0 -50)

Moderate (51 -100)

Unhealthy for sensitive group (101 –150)

Unhealthy (150 –200)

Very Unhealthy (201-300)

Hazardous (301-500)

DISCUSSIONS

Comparison of Average Mean Concentration of O_2, LEL, H_2S, CO, $PM_{2.5}$, PM_{10}, HCHO and VOC levels in all the selected motor parks with recommended standard

Table 1 shows the comparison of average concentration and levels of air parameters with National and International recommended standards, it shows that the level of Combustible LEL was higher than that of FMEV standard (5%) in all the motor parks but lower than that of WHO (15.5%). This is in agreement with the report of [17] that indicates exceedance of the level of Combustible LEL limit for FMEV but lower than that of WHO permissible limit. Particulate matter $PM_{2.5}$ ($\mu g/m^3$) and PM_{10} ($\mu g/m^3$) were all above the permissible limits of WHO but lower than that of FMEV. This supports the earlier study done by [17] who reported high Particulate matter levels in a study on air quality assessment in the same Metropolis which is above the WHO limits. The concentration of Carbon monoxide (CO) is below the FMEV and WHO permissible limits of 50ppm.However, the concentration of CO is below the reported value of between (0.801-4ppm) by. [9] Other parameters are within the recommended limits of FMEV and WHO except VOC in New-Shao garage (0.6%) which exceeds the limit for both FMEV and WHO (0.500 mg/m^3).The value of VOC is lower than the reported value of 1.20 ppm as indicated in a study by. [17] The exceedance in the level of VOC could be attributed to vehicular emission, wood burning and also due to the presence of petrol station near the motor park whose activities releases VOC into the surrounding air.

Average mean values for Wind speed, Relative humidity and Air temperature in the motor parks

Result from Table 2 indicates a slight variation in the wind speed across the motor parks with New-Shao garage having the highest speed of 0.084m/s, followed by Soludero park (0.061m/s), Maraba (0.056m/s), Sawmill garage (0.055m/s) and Offa garage with the least(0.052m/s). There was no difference in the level of Relative humidity (51%) across three motor parks (Maraba, New-Shao garage, and Sawmill garage) why Offa garage and Soludero parks had a Relative Humidity of 57% and 55% respectively. The Motor park with the highest mean temperature is Sawmill garage (32.33 °C) followed by NewShao garage (32.05°C), Maraba (31.72°C), Offa garage (31.36°C) and Soludero (31.30°C).

ANOVA showing variation in average concentration of air quality parameters across the motor parks

Hypothesis testing for Oxygen (O_2)

H0: There is no significant difference in the average level of O_2 across the motor parks

Ha: There is significant difference in the average level of O_2 across the motor parks

Decision: Reject Ho if $p \leq 0.05$, since P-value (0.481) is greater than 0.05 alpha level of significance, Ho is therefore accepted and concluded that there is no significant difference in the average level of O_2 across the motor parks average concentration of O_2 across the motor parks is the same.

Hypothesis Testing for LEL

H0: There is no significant difference in the average level of Combustible LEL across the motor parks

Ha: There is significant difference in the average level of Combustible LEL across the motor parks

Decision rule: Reject Ho if $p \leq 0.05$, since P-value (0.050) is not greater than 0.05 alpha level of significance, Ho is therefore rejected and concluded that there is

significant difference in the average level of Combustible LEL across the motor parks.

Hypothesis Testing for Carbon monoxide (CO)

H0: There is no significant difference in the average concentration of CO across the motor parks

Ha: There is significant difference in the average concentration of CO across the motor parks

Decision rule: Reject Ho if p≤0.05, since P-value (0.370) is greater than 0.05 alpha level of significance, Ho is therefore accepted and concluded that there is no significant difference in the average concentration of CO across the motor parks.

Hypothesis Testing for PM2.5

H0: There is no significant difference in the average concentration of $PM_{2.5}$ across the motor parks.

Ha: There is significant difference in the average concentration of $PM_{2.5}$ across the motor parks

Decision rule: Reject Ho if p≤0.05, since P-value (0.015) is less than 0.05 alpha level of significance, Ho is therefore rejected and concluded that there is significant differences in the average concentration of $PM_{2.5}$ across the motor parks.

Hypothesis Testing for PM10

H0: There is no significant difference in the average concentration of PM_{10}across the motor parks.

Ha: There is significant difference in the average concentration of PM_{10} across the motor parks.

Decision rule: Reject Ho if p≤0.05, since P-value (0.005) is less than 0.05 alpha level of significance, Ho is hence rejected and concluded that there is significant difference in the average concentration of PM_{10} across the motor parks.

Hypothesis testing for Air Temperature

H0: There is no significant difference in Temperature levels across the motor parks.

Ha: There is significant difference in Temperature levels across the motor parks.

Decision rule: Reject Ho if p≤0.05, since P-value (0.000) is less than 0.05 alpha level of significance, Ho is therefore rejected and concluded that there is significant difference in Temperature levels across the motor parks. .

Hypothesis testing for Volatile Organic Compounds (VOC)

H0: There is no significant difference in average concentration of VOC across the motor parks

Ha: There is significant difference in average concentration of VOC across the motor parks.

Decision rule: Reject Ho if p≤0.05, since P-value (0.190) is greater than 0.05 alpha level of significance, Ho is therefore accepted and concluded that there is no significant difference in average concentration of VOC across the motor parks.

Hypothesis testing for Formaldehyde (HCHO)

H0: There is no significant difference in average concentration of HCHO across the motor parks

Ha: There is significant difference in average concentration of HCHO across the motor parks

Decision rule: Reject Ho if p≤0.05, since P-value (0.840) is greater than 0.05 alpha level of significance, Ho is hence accepted and concluded that there is significant difference in average concentration of HCHO across the motor parks.

Correlation matrix for air quality parameters in the selected motor parks

As indicated in Table 4, there is a significant negative relationship between Air Temperature and Relative Humidity (r =-0.987**, P<0.01).This means that an increase in Air temperature causes a decrease in Relative Humidity or at a lower Air Temperature, the Relative Humidity increases. A negative significant correlation was found between Combustible LEL and Relative Humidity (r = -0.828**, P<0.01) this means as the level of Combustible LEL increases, Relative Humidity decreases and vice versa. However, a positive significant correlation was found between the level of Combustible LEL and Air Temperature (r = 0.865**, P<0.01) which means as Combustible LEL increases, there is

increase in Air temperature or a decrease in Air Temperature will cause the Combustible LEL to decrease. The result also reveals a significant positive relationship between Particulate Matter $PM_{2.5}$ and PM_{10}($r = 0.988^{**}$, $P<0.01$) meaning an increase in$PM_{2.5}$ results in an increase in PM_{10} or a reduction in $PM_{2.5}$ will reduce the concentration of PM_{10}.A significant negative relationship was found between Formaldehyde and Oxygen level ($r = -0.722^{**}$, $P<0.01$) which means as the level of Formaldehyde increases, the Oxygen level decreases.

Air Quality Index (AQI) in each selected motor parks

Table 5 Shows the Air Quality Index (AQI) in each selected motor parks in Ilorin Metropolis. Based on the United States Environmental Protection Agency (USEPA) AQI rating scale, the level of $PM_{2.5}$ in 4 motor parks (Offa Garage, Soludero, Maraba, and New Shao Garage) motor parks were unhealthy for sensitive group such as elderly, infants, children and people with immuno-compromised health conditions this might be due to activities that release pollutants into the air such as automobiles, generators and dusty nature of the motor parks while the $PM_{2.5}$ concentration at Sawmill garage was unhealthy which might be as a result of closeness of the motor park to the road and sawmilling industry that releases dusts and particulates. $PM_{2.5}$ has been linked to respiratory and cardiovascular diseases. In terms of PM_{10} levels, it was good at Offa Garage this might be as a result of mixing, dissolution, dispersion of air, and other chemical processes that takes place in the atmosphere. This means people in the area should always cover their nose with nose mask to avoid breathing in polluted air.PM_{10} concentration was moderate in the other 4 motor parks; Soludero, Maraba, New Shao garage and Saw-mill garage. The moderate level might be due to mixing and dispersion of pollutants in the air and also due to meteorological factors like wind speed and wind direction. PM_{10} is known to aggravate asthma and other respiratory and cardiovascular diseases at high levels. The levels of Carbon monoxide (CO) were good in all the motor parks; this could be as a result of dispersion of the air pollutant at a faster rate in the area coupled with meteorological influences such as wind direction and wind speed. This means the concentration of CO is safe and harmless in the motor parks.

V. CONCLUSION

The Result revealed high concentration of Particulate matter $PM_{2.5}$ and PM_{10} in all the motor parks as above the recommended limits of WHO but lower than the FMEV limit. The increase in the levels of particulate matter could be due to vehicular emission, burning of fire wood, windblown dust, saw-milling activities, the use of generators and other atmospheric processes such as mixing, dispersion and chemical processes in the atmosphere. The result indicates exceedance of levels of Combustible LEL across the motor parks above the FMEV standard but lower than WHO limit. However, with the exception of VOC in New-Shao garage (0.60 mg/m^3) which exceeded the recommended limit for both FMEV and WHO (0.500mg/m^3), the concentrations of other parameters such as CO, VOC, H_2S, HCHO, O_2, Relative humidity and Temperature were lower and within the permissible limit of Federal Ministry of Environment (FMEV) and WHO. Result of Analysis of Variance (ANOVA) showed a significant differences in the levels of Combustible LEL, $PM_{2.5}$, PM_{10} , Temperature and Formaldehyde (HCHO) across the motor parks while there were no significant differences in the levels of Oxygen (O_2), Carbon monoxide (CO) and Volatile Organic Compounds (VOC) across the motor parks. In terms of Air Quality Index (AQI) rating, the air quality for CO across all the motor parks was good. The AQI for $PM_{2.5}$ across all motor parks were unhealthy for sensitive groups while $PM_{2.5}$ at Sawmill garage motor park most

likely to have unhealthy health effects to the public. The AQI for PM_{10} is good for Offa garage motor park while it was moderate for the remaining motor parks. $PM_{2.5}$ and PM_{10} are known to aggravate respiratory and cardiovascular diseases. Hence, the need for regular assessment and monitoring of air quality in the motor parks should be done to ensure compliance with recommended regulations.

VI. RECOMMENDATION

In view of the finding of this study, it is highly recommended that:

- The Ministry of Environment and urban Housing should come up with policies that will help in urban planning of Motor parks through data keeping and monitoring.
- Regulatory agencies like NESREA, Ministry of Environment and other policy makers should update existing laws and regulations on air pollution and air quality standards in Nigeria.
- The need for further air quality monitoring and assessment should be done in the city in order to preserve the changes in the quality of the environment and the public at large.
- The use of personal protective equipment (PPEs) will go a long way in reducing the health risk associated with exposure to air pollutants among the vulnerable and sensitive groups in the study area.
- There is a need to promote and sensitize the vulnerable and sensitive groups on the dangers of air pollution.
- The need to fund research on improved clean technologies with little or no emission should be supported.

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Competing Interests

Authors have declared that no competing interests exist.

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