

Assessment of Noise Pollution Levels in the Major Towns Across Benue South Senatorial District, Nigeria

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ABSTRACT Noise is undoubtedly a common occurrence in daily life and is considered to be one of the most effective alarm systems in the environment around us. This study was carried out in 5 Local government areas in Benue zone C where Busy Roads, Garages, Schools, Residential areas, Hospitals, Hotels, and Markets were considered for data collection of noise pollution level. The results obtained from the study depicted that the noise pollution level in Otuokpo ranges from 52.0 dB to 98.9 dB at maximum level and 16.7 dB to 38.6 dB at minimum level, in Ogbadibo it ranges from 40.0 dB to 88.9 dB (max) and 15.0 dB to 29.0 dB (min), in Okpokwu it ranges from 46.0 dB to 90.9 dB(max) and 14.0 dB to 35.6 dB (min), in Apa it ranges from 45.0 dB to 91.9 dB (max) and 16.0 dB to 30.6 dB (min) and in Oju it ranges from 35.7 dB to 87.9 dB (max) and 14.0 dB to 30.0 dB. The noise level results obtained depicted that they are at the permissible limit set by World Health Organization (WHO) and Federal Ministry of Environment (FMEnv) with the range of 30.0 dB to 85.0 dB and 40.0 dB to 90.0 dB respectively, except in some residential areas and garages. Since some areas shows higher noise pollution level compare to the permissible limit set by World Health Organization (WHO) and Federal Ministry of Environment (FMEnv) authorities should enforce regulations, implement noise control measures such as soundproofing and equipment maintenance, promote public awareness, encourage green buffers, and ensure health protection for individuals exposed to high noise levels.

KEYWORDS: Noise pollution, Concentration, FMEnv, Monitor, Noise, Regulatory Body, WHO

I. INTRODUCTION

A sense of annoyance, disruption, or irritation caused by noise is very common in urban centres. People can be adversely affected by noise in a variety of ways, and road noise has a significant detrimental impact on people's physical and mental health [1]. Children's bodies which are still developing, according to studies, need no noise because it's detrimental to them [2]. Noise is undoubtedly a common occurrence in daily life and is considered to be one of the most effective alarm systems in the environment around us. Though it has gradually grown to be a very significant pollutant and a threat to the quality of man's atmosphere, it is still persistently upsetting human serenity and tranquillity [3]. After air and water pollution, noise is regarded as the third most dangerous sort of pollution [4]. According to [5], noise is one of the physical environmental variables influencing human health in today's society, as well as a pollutant that is rapidly increasing due to the world's extremely high population, transportation, traffic, and advancements in commercial, industrial, and social activities.

Noise pollution has a health impact because it causes hearing impairment, interferes with speech communication, disrupts rest and sleep, and has psycho-physiological and mental health implications. Other effects include a decrease in children's comprehension, concentration, assimilation, and performance effects; effects on residential behaviour and annoyance, as well as interference with proposed activities [4]. Although many researches about the assessment of noise pollution level and air quality have been conducted by many researchers in Nigeria [6, 7, 8, 9, 10]. However, study on adequate monitoring of noise pollution level and noise pollution index. With regard to the aforementioned, this work Centered around assessing the air quality and noise pollution levels among others within selected areas of Benue Zone C which will help in formulating essential air and noise pollution data to guide informed decision-making on urbanization, industrialization, and contribute to sustainable development efforts. The selected areas were chosen based on the level of activities and the population of the inhabitant of the towns.

II. MATERIALS AND METHODS

A. STUDY AREA

This research was carried out in the major towns in Benue Zone C (Benue South) putting into consideration the various federal constituencies located in the area. Hence, the study was carried out in Otukpo, Oju, Otukpa, Okpoga and Ugbokpo. The research was concentrated in the densely populated areas and highly busy areas (i.e Busy Road, Market, residential zone, Hotels, School, Hospital and Garage). Benue zone C is characterized by a tropical sub-humid climate with a wet and dry season. The seven-month wet season begins in April and finishes in October. The total yearly rainfall varies between 1,200 mm and 1,500 mm, especially in the months of March and April, daily high temperatures are the norm. These high temperatures, combined with the high relative humidity, provide unfavourable or disabling weather conditions along the river valleys. The zone is primarily populated by Idoma and Igede-speaking people and has an estimated area of 7,500 sq. km. and 1,307,647 inhabitants [11].

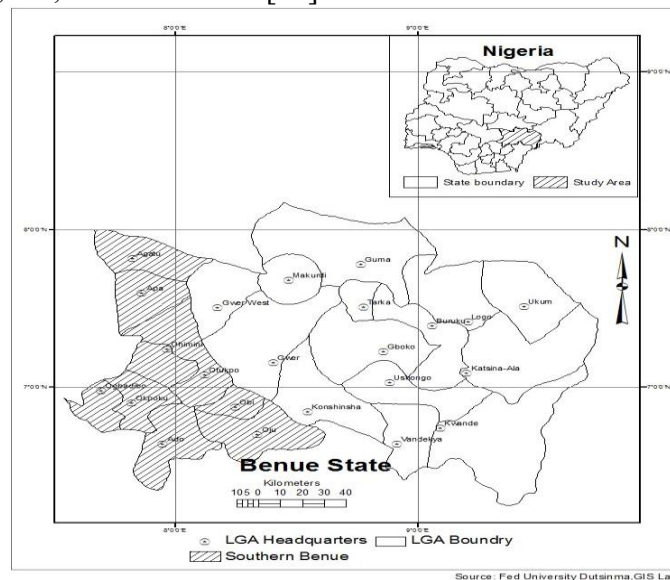


Figure 1: Benue South Location Map

B. DATA COLLECTION FOR NOISE POLLUTION

The sound level at each location was measured using a digital sound level meter (Model: GM 1351), which was held in the hand and its microphone pointed at the potential noise sources approximately 1 to 2 meters away from reflective objects. This data was collected morning (8 a.m. - 10 a.m.), afternoon

(12 noon – 2 p.m.) and evening (5 p.m. - 7 p.m.) for a minimum of five (5) days in each sampled location and the mean was evaluated.

The noise measuring instrument that was used has the following specification:

- Measuring Range: 30dBA~130dBA
- Accuracy: ± 1.5 dB
- Digit & Resolution: 4 digit & 0.1Db
- Frequency Response: 31.5Hz~8KHz
- Sampling Rate: 2times/s
- Automatic Backlight Display
- 9V Battery Operation



Figure 2: A Digital Sound Level Meter (Model: GM 1351)

III. RESULTS AND DISCUSSION

Table 2 shows the mean noise pollution level obtained from Okpoga in Okpokwu local government area from different locations; Busy Road (Ugbokolo-Okpoga express way), Garage (Ugwu-Okpoga Round About), School (World Hope International Secondary), Residential area (Ugwu-Okpoga), Hospital (St. Mary's Hospital), Hotel (James Okpoga Millenium Venture), Market (Okpoga central Market). From the result obtained the mean pollution level in all the locations is above the permissible limit set by W.H.O and FMEnv as compared with the values in table 7 above except in the residential zone where the mean noise pollution level was at the limit with a value of 50.3 in the morning as against 55 and 60.

Table 1: Identification of Sampling Stations with Geographical Locations of the Study Areas

LOCATION	OTUKPA		OKPOGA		OJU		UGBOKPO		OTUKPO	
	LONG.	LAT.	LONG.	LAT.	LONG.	LAT.	LONG.	LAT.	LONG.	LAT.
BUSY ROAD	7.669098	7.139554	7.756067	7.155867	8.347560	7.155867	8.567560	8.555467	8.556456	8.150576
GARAGE	7.583173	6.995697	7.757317	7.195797	7.757317	7.195797	8.085317	7.859579	7.825357	6.574325
SCHOOL	7.585932	7.000938	7.759727	7.100956	7.759727	7.100956	7.006459	7.780095	7.105450	7.800095
RESIDENTIAL ZONE	7.583173	6.995682	7.783173	7.995678	7.783173	6.995672	7.654831	6.755670	8.654053	7.857087
HOSPITAL	7.583201	6.997265	7.783201	7.997260	7.783201	7.997260	7.678320	6.698261	8.785320	7.654261
HOTEL	7.582827	6.996646	7.782827	6.896646	7.782827	6.896646	7.676827	6.679879	8.876827	7.879979
MARKET	7.582827	7.000936	7.787904	7.860936	7.787904	7.860936	7.678790	7.770936	7.876787	7.876709

TABLE 2: Mean Noise Level in Various Locations in Okpokwu Local Government Area

LOCATIONS	BUSY ROAD			GARAGE			SCHOOL			RESIDENTIAL AREA			HOSPITAL			HOTEL			MARKET		
	M	N	E	M	N	E	M	A	E	M	N	E	M	N	E	M	N	E	M	N	E
NOISE LEVEL (dBA)	88.9	70.4	80.7	88.0	77.8	65.2	76.6	66.6	56.6	50.3	76.1	60.7	59.6	66.9	46.0	68.9	73.2	60.6	79.6	90.9	80.6
MAX	33.0	25.3	28.6	32.6	27.4	22.0	24.7	22.6	18.0	16.0	24.5	20.0	19.3	23.8	14.0	25.0	24.1	17.0	26.0	35.6	30.0
MIN																					
TEMPERATURE (°C)	24.2	30.0	27.4	25.0	30.5	26.0	22.3	22.3	22.3	22.4	29.7	25.9	23.0	30.7	25.0	24.9	30.1	28.0	24.3	29.4	25.2
RELATIVE HUMIDITY (%)	78.5	66.0	70.5	78.6	61.5	66.6	76.4	76.4	76.4	82.6	72.3	75.4	78.5	64.4	69.6	88.3	62.2	77.5	78.4	67.2	67.0

Key:M: Morning, N: Afternoon, E: Evening

Table 3 shows the mean noise pollution level obtained from Ugbokpo in Apa local government area from different locations; Busy Road (Ugbokpo-Adoka express way), Garage (Benue links park), School (Elshadai Secondary School), Residential area (Ugbokpo town), Hospital (General Hospital), Hotel (Apa Luxury Suite), Market (Ugbokpo main Market). From the result gotten, the mean pollution level in all the sampled locations in Ugbokpo were above the permissible limit set by W.H.O and FMEnv except in the garage and residential zone which was at the limit as compared with the values in table 7.

TABLE 4: Mean Noise Level in various Locations in Otukpo (Otukpo Local Government Area)

LOCATIONS	BUSY ROAD			GARAGE			SCHOOL			RESIDENTIAL AREA			HOSPITAL			HOTEL			MARKET			
VARIABLES	M	N	E	M	N	E	M	A	E	M	N	E	M	N	E	M	N	E	M	N	E	
NOISE LEVEL (dBA)																						
MAX	92.9	82.5	88.6	90.0	81.2	77.2	81.7	71.6	66.6	70.4	83.1	72.7	68.6	70.9	52.0	68.9	75.5	67.6	87.6	98.9	85.8	
MIN	38.6	28.3	28.8	28.6	27.8	23.0	25.7	23.6	18.5	19.6	27.5	24.0	20.4	25.7	16.7	24.0	26.6	19.8	29.0	35.8	32.0	
TEMPERATURE (°C)	24.6	30.0	27.4	25.6	30.8	27.0	23.3	26.7	22.5	23.4	29.9	25.8	23.0	30.5	24.0	24.7	30.7	25.0	23.3	30.4	25.5	
RELATIVE HUMIDITY (%)	79.5	67.0	73.5	77.6	66.5	69.6	78.8	65.4	76.7	80.7	73.5	78.4	68.5	64.8	69.8	88.8	62.5	79.5	75.4	69.5	68.1	

Key: M: Morning, N: Afternoon, E: Evening

Table 4 describe and show the mean noise pollution level obtained from Otukpo in Otukpo local government area from different locations; Busy Road (Akpa Street Road), Garage (New Market garage), School (Federal University of Health Sciences), Residential area (OTIA), Hospital (Federal University of Health Sciences, Teaching Hospital), Hotel (Leach Hotel), Market (Otukpo main Market). From the result obtained, the mean pollution level in all the sampled locations in Otukpo were above the permissible limit set by W.H.O and FMEnv as compared with the values in table 7.

TABLE 5: Mean Noise level in various locations in Otukpa (OGBADIBO Local Government Area).

LOCATIONS	BUSY ROAD			GARAGE			SCHOOL			RESIDENTIAL AREA			HOSPITAL			HOTEL			MARKET			
VARIABLES	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	
NOISE LEVEL (dBA)																						
MAX	82.5	79.8	85.7	62.5	77.8	55.2	63.1	70.6	45.3	59.3	70.1	66.7	56.6	58.9	40.0	65.9	71.2	65.6	76.6	88.9	78.6	
MIN	27.0	26.5	28.7	23.6	25.2	18.2	21.7	24.0	16.0	19.6	23.8	25.9	17.6	19.8	15.0	22.9	24.0	25.0	27.9	31.0	29.0	
TEMPERATURE (°C)	23.2	29.8	25.4	25.5	30.5	24.0	25.6	29.8	26.4	23.4	30.7	26.9	23.0	30.7	25.0	24.9	30.1	23.0	22.3	28.4	26.2	
RELATIVE HUMIDITY (%)	79.5	68.0	72.5	77.6	60.5	65.6	80.3	66.2	77.8	78.6	66.3	75.4	79.5	63.4	68.6	80.3	59.2	77.1	76.4	66.2	67.0	

Key: M: Morning, N: Afternoon, E: Evening

Table 5 show the mean noise pollution level obtained from Otukpa in Ogbadibo local government area from different locations; Busy Road (Otukpa-Orokam road), Garage (Santa Cruz Park, Obu), School (Community Secondary School), Residential area (Olachagbaha), Hospital (General Hospital), Hotel (Royal Guest House), Market (Ukwo-Ogbo). From the result obtained, the mean pollution level in all the sampled locations in Otukpo were above the permissible limit set by W.H.O and FMEnv as compared with the values in table 7, except in the garage.

TABLE 6: Mean Noise Level in Various Locations in Oju (OJU Local Government Area).

LOCATIONS	BUSY ROAD			GARAGE			SCHOOL			RESIDENTIAL AREA			HOSPITAL			HOTEL			MARKET			
VARIABLES	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	
NOISE LEVEL (dBA)																						
MAX	77.3	68.2	55.3	72.5	66.3	56.3	67.4	72.6	35.7	60.4	70.1	57.7	50.6	60.9	48.0	50.9	66.2	45.6	77.6	87.9	76.6	
MIN	28.8	25.0	19.0	26.8	24.9	19.0	25.0	26.0	14.0	20.4	25.9	19.9	16.0	20.8	15.0	16.7	25.0	15.5	28.0	30.0	27.8	
TEMPRATURE (°C)	22.2	29.0	25.4	24.0	30.5	22.0	23.6	28.8	23.4	21.4	30.7	22.9	23.0	31.7	25.0	24.9	30.1	26.0	23.3	28.4	25.4	
RELATIVE HUMIDITY (%)	80.5	68.0	66.5	78.6	61.5	71.6	83.3	68.2	84.8	82.6	72.3	80.4	78.5	64.4	68.6	88.3	62.2	77.5	79.4	68.2	69.0	

Key: M: Morning, N: Afternoon, E: Evening

Table 6 show the mean noise pollution level obtained from Oju in Oju local government area from different locations; Busy Road (Oju-Obi Road), Garage (Ihioo Garage), School (College of Education Oju), Residential area (OHIO), Hospital (General Hospital), Hotel (Phoenix Lodge), Market (Oju Town Main Market). From the result obtained, the mean pollution level in all the sampled locations in Oju were above the permissible limit set by W.H.O and FMEnv as compared with the values in table 7, except in the garage that is at the set limit.

TABLE 7: Noise Pollution Permissible Limit in dBA by Regulatory Bodies for Different Locations

LOCATIONS	W.H.O LIMIT		FMEnv	
	Morning	Evening	Morning	Evening
BUSY ROAD	53	45	70	60
GARAGE	85	45	90	80
SCHOOL	55	40	50	40
RESIDENTIAL ZONE	55	45	60	40
HOSPITAL	40	30	60	50
HOTEL	55	45	60	50
MARKET	70	50	70	60

A. Otukpo Local Government Area

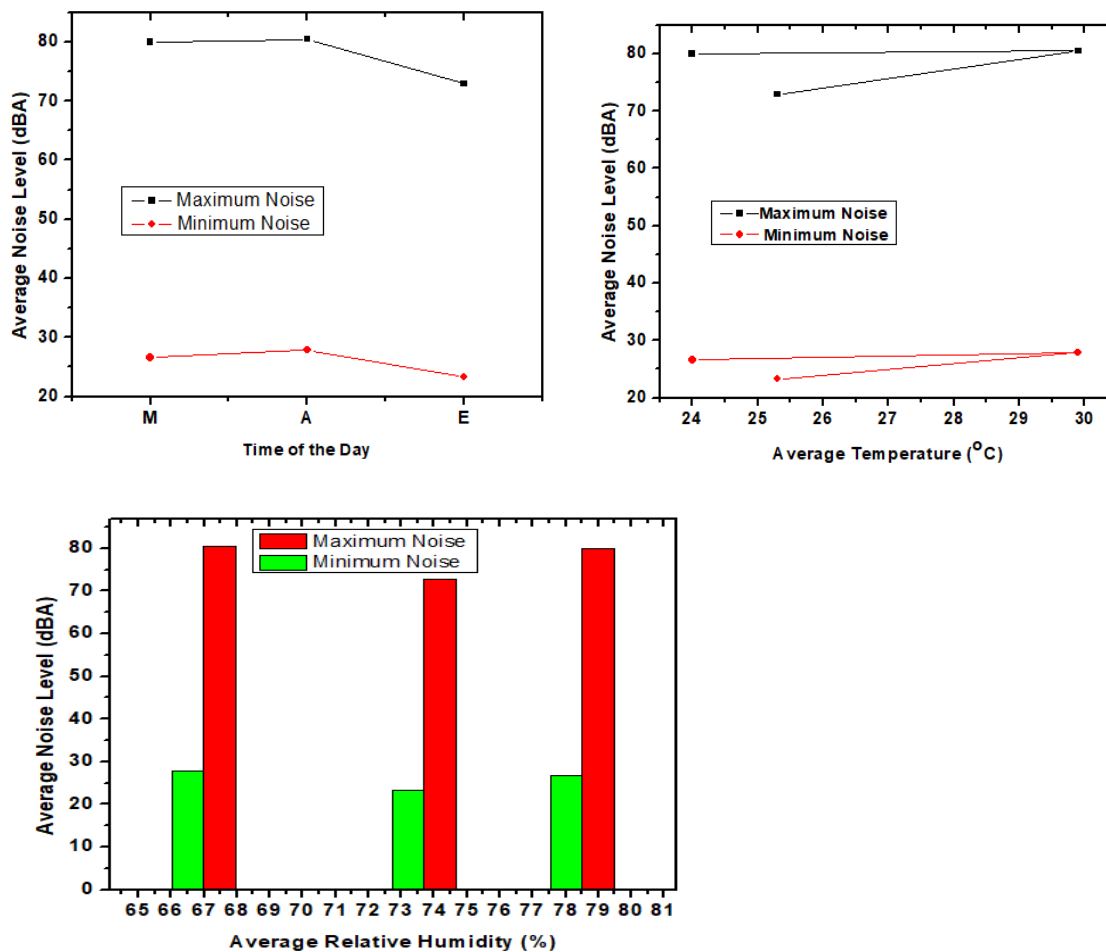


Figure 3: Graphs showing the correlation and relationship of the data of the parameters in Otukpo.

In Otukpo town of Otukpo local Government area, the maximum noise level was recorded in the afternoon. This is due to the high level of the noise pollutants during the day when compared to the evening. The velocity of sound also increases with temperature which is in line with the work of [8]. When the temperature levels were 23, 26 and 26.2°C, the noise levels were respectively 72, 80 and 80.5 dBA indicating that the noise levels increase with temperature as established by the work of [8]. When Relative humidity increases the noise levels decreases and vice-versa. At the minimum values of 65, 73 and 78 %, the noise levels were respectively 28, 22 and 24 dBA. The maximum relative humidity levels

of 67.5, 74 and 79 %, recorded a considerable increase in the noise level of 80, 75 and 80 dBA respectively. This clearly indicates that the noise level tends to decrease in environments where the relative humidity is relatively high.

B. Oju Local Government Area

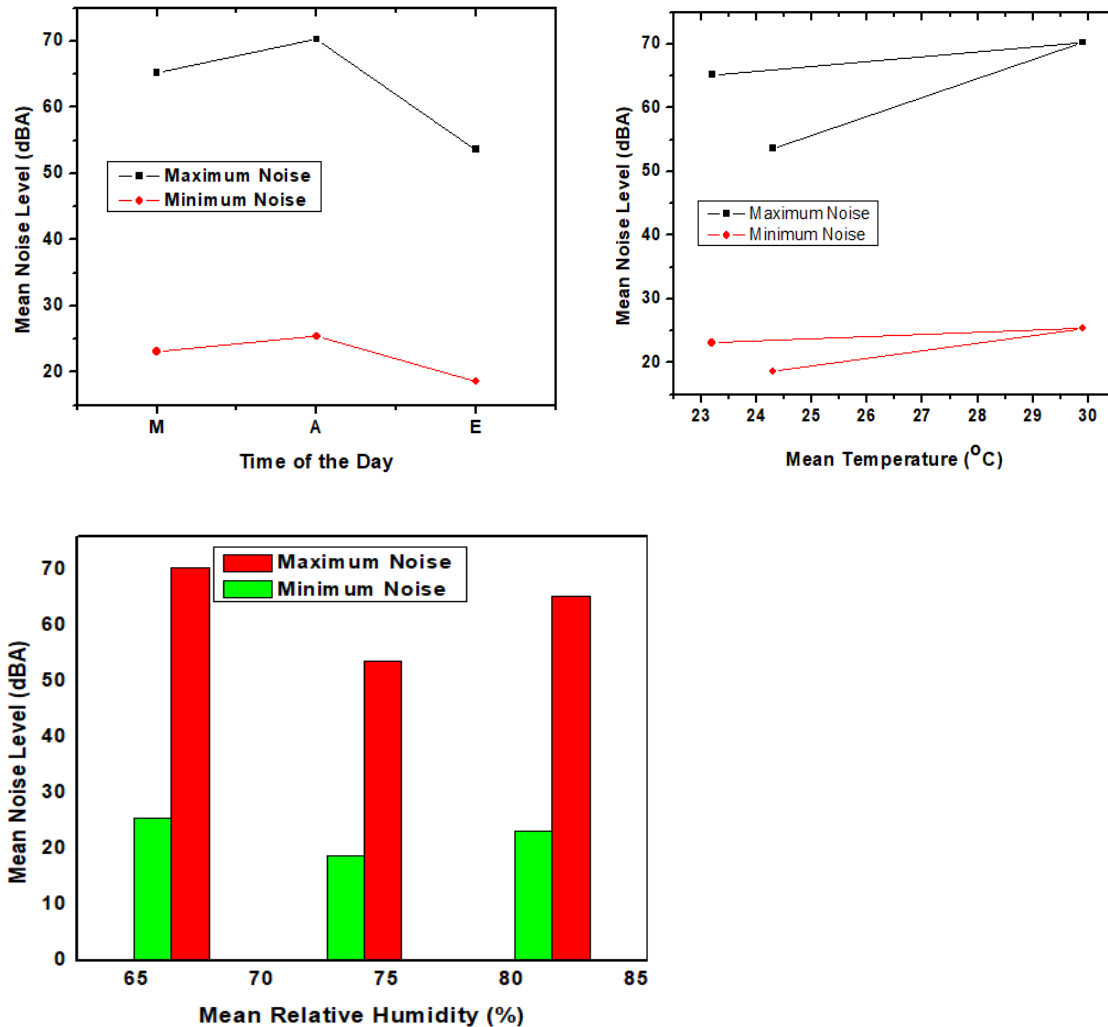


Figure 4: Graphs showing the Correlation and Relationship of the Data of the Parameters in Oju

In Oju town of Oju local Government area, the maximum noise level was recorded in the morning and afternoon. This is due to the high level of the noise pollutants during the day when compared to the evening. The velocity of sound also increases with temperature which is in line with the work of [10]. When the temperature levels were 23, 24.4 and 30°C, the noise levels were respectively 23, 19 and 25 dBA at the minimum level and 65, 54 and 70 dBA at the maximum level, indicating that the noise levels increase with temperature as established by the work of [10]. When relative humidity also increases the noise levels decreases. At the minimum values of 65, 74 and 81 %, the noise levels were respectively 25, 19 and 20 dBA. The maximum relative humidity levels of 67.5, 75 and 82.5 %, recorded a considerable increase in the noise level of respectively 70, 52 and 65 dBA. This clearly indicates that the noise level tends to decrease in environments where the relative humidity is relatively high. This agrees with work of [6, 12] which assessed the air quality and noise level and concluded that the noise level increases with decrease in relative humidity and increase in temperature.

C. Okpokwu Local Government Area

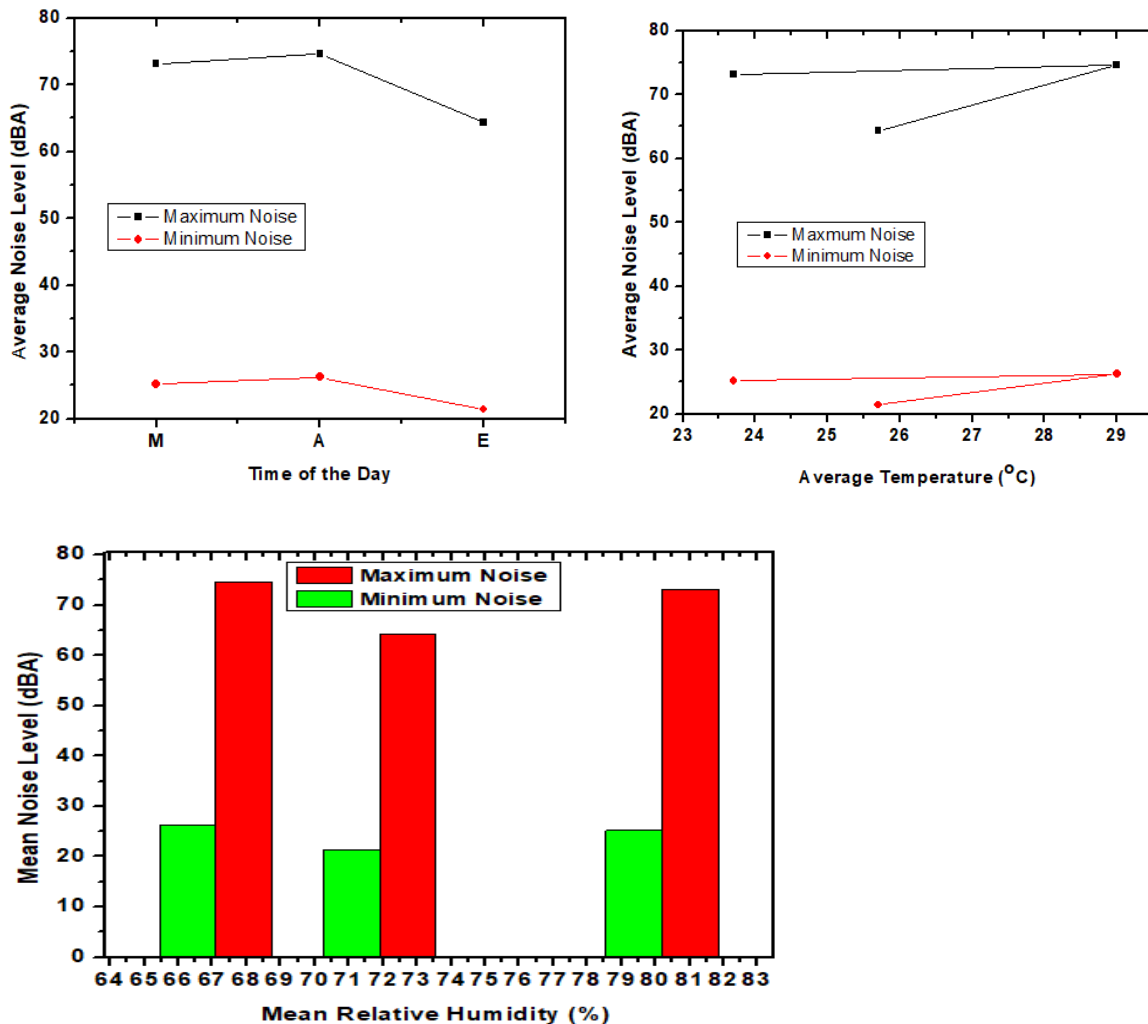


Figure 5: Graphs showing the correlation and relationship of the data of the parameters in Okpokwu

In Okpoga town of Okpokwu local Government area, the maximum noise level was recorded in the morning and afternoon. This is due to the high level of the noise pollutants during the day when compared to the evening. The velocity of sound also increases with temperature which is in line with the work of [13]. When the temperature levels were 23.6, 25.6 and 29 °C, the noise levels were respectively 25, 21 and 26 dBA at the minimum level and 73. 64 and 74 dBA at the maximum level, indicating that the noise levels increase with temperature as established by the work of [13]. The noise levels decrease with increase in relative humidity and vice versa, unlike the temperature. At the minimum values of 66, 71 and 79.5 %, the noise levels were respectively 22, 20 and 25 dBA. The maximum relative humidity levels of 68, 73 and 81 %, recorded a considerable increase in the noise level of respectively 75, 65 and 75 dBA. This clearly indicates that the noise level tends to increase in

environments where the relative humidity is relatively low. This disagrees with work of [8], which assessed the air quality and noise level and concluded that the noise level increases with the relative humidity and temperature.

D. Ogbadibo Local Government Area

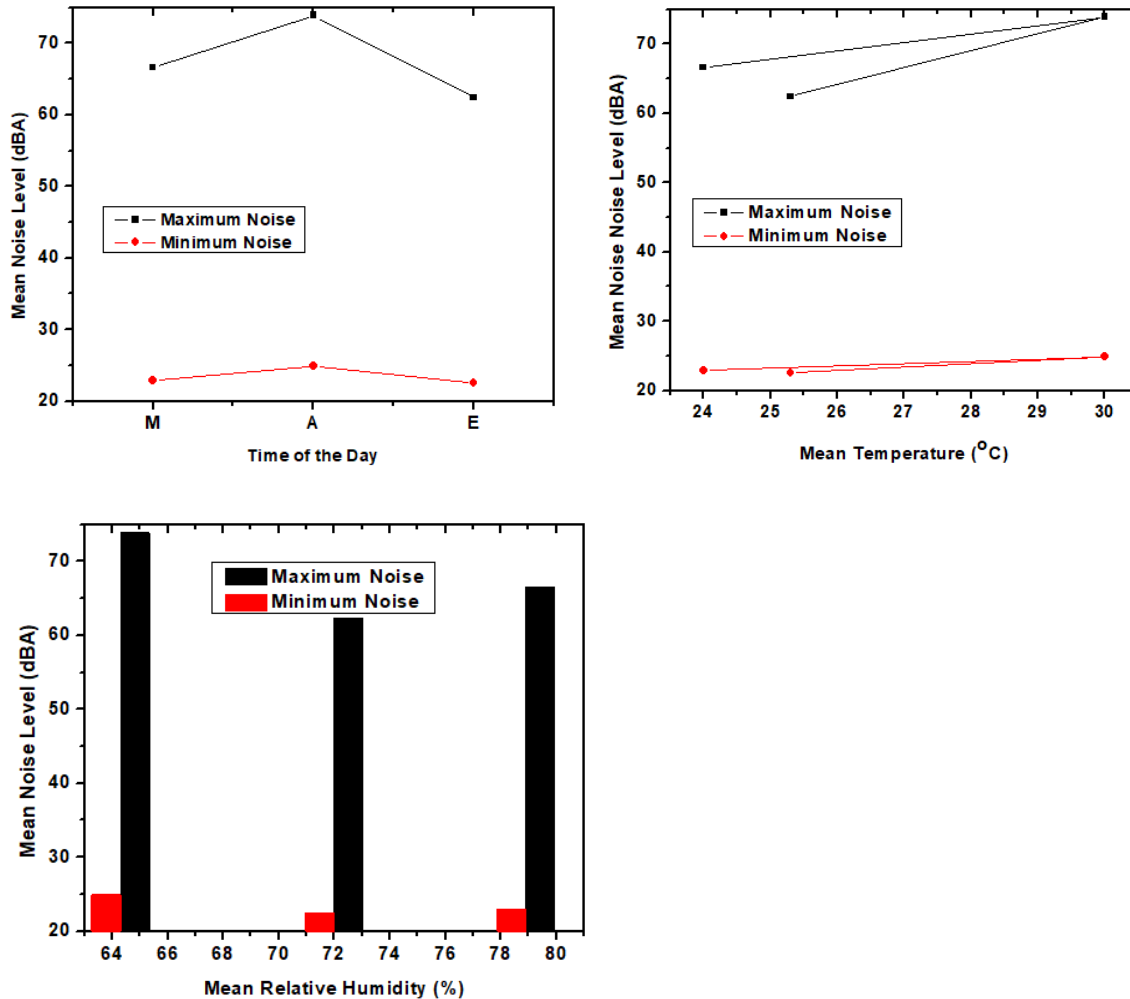


Figure 6: Graphs showing the correlation and relationship of the data of the parameters in Ogbadibo

In Otukpa town of Ogbadibo local Government area, the maximum noise level was recorded in the morning and afternoon. This is due to the high level of the noise pollutants during the day when compared to the evening. The velocity of sound also increases with temperature which is in line with the work of [1]. When the temperature levels were 24, 25.4 and 30 °C, the noise levels were respectively 23, 22 and 24 dBA at the minimum level and 66, 62 and 74 dBA at the maximum level, indicating that the noise levels increase with temperature as established by the work of [1]. The relative humidity also increases with the noise levels like the temperature. At the minimum values of 64, 71.5 and 78.5 %, the noise levels were respectively 25, 22 and 23 dBA this may be due to the scarcity of vegetations. The maximum relative humidity levels of 65, 72.5 and 79.5 %, recorded a considerable increase in the noise level of respectively 74, 62 and 75 dBA. This clearly indicates that the noise level tends to increase in environments where the relative humidity is relatively high. This agrees with work of [3] which assessed

the air quality and noise level and concluded that the noise level increases with the relative humidity and temperature.

E. Apa Local Government Area

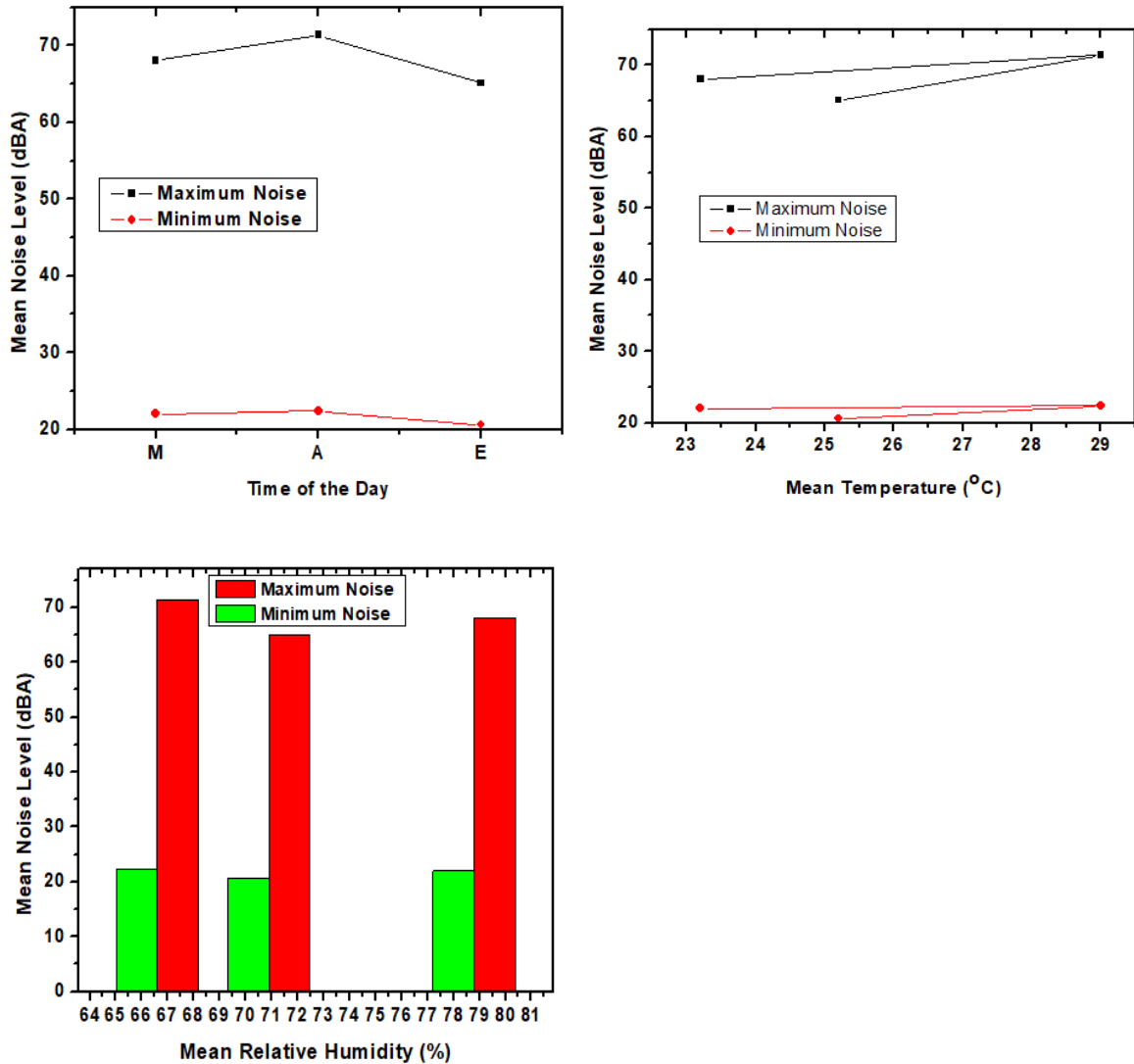


Figure 7: Graphs showing the correlation and relationship of the data of the parameters in Apa

In Ugbokpo town of Apa local Government area, the maximum noise level was recorded in the morning and afternoon. This is due to the high level of the noise pollutants during the day when compared to the evening. The velocity of sound also increases with temperature which is in line with the work of [1]. When the temperature levels were 23.2, 25.2 and 29 °C, the noise levels were respectively 20, 21 and 23 dBA at the minimum level and 67, 65 and 70 dBA at the maximum level, indicating that the noise levels increase with temperature as established by the work of [1]. The noise levels also increase with

increase in relative humidity like the temperature due to some environmental factors like absence of vegetations. At the minimum values of 66, 70 and 78 %, the noise levels were respectively 20, 21 and 23 dBA. The maximum relative humidity levels of 67.5, 71.5 and 79.5 %, recorded a considerable increase in the noise level of respectively 70, 65 and 68 dBA. This clearly indicates that the noise level tends to increase in environments with sparse vegetation where the relative humidity is relatively high. This agrees with work of [3, 14] which assessed the noise level and concluded that the noise level increases with the relative humidity and temperature.

IV. CONCLUSION

In this study, comprehensive assessment of environmental noise levels and air pollutions level has been carried out in Benue Zone C, where five (5) local government areas were considered as a case study. Seven (7) selected areas were surveyed in the five (5) local government areas (Busy Road, Garage, School, Residential area, Hospital, Hotel, Market). The result of this study shows that noise level is highest in the afternoon and lowest in the evening because of different activities in the sampled area. Although the obtained result of environmental noise level is at the permissible limit set by WHO and other regulatory body. Hence, there is need for Enforcement of existing national and international regulations of noise pollution standards, Industries should adopt cleaner technologies or face penalties for emissions above recommended levels, Restriction should be placed on siting of noise pollution-intensive facilities in residential or sensitive areas (schools, hospitals) and Installation of soundproof barriers and emission control systems in industries and along busy roads must be encouraged.

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Conflict of Interest

There was no conflict of interest in the cause of this research.

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