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Assessment of Traffic Noise Pollution in Residential Neighbourhood of Lagos, Nigeria

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ABSTRACT

Noise pollution is unwanted, unpleasant and dangerous to health and well being of people and communities. Road traffic is a major source of environmental noise exposure in cities across the world. This study assesses traffic noise pollution in residential neighbourhood of Alimosho local government Lagos, Nigeria. The study measured traffic noise and conducted volumetric analysis of traffic flow and survey on effect of traffic noise on residents' health. The result of volumetric analysis indicates that there were more commercial vehicles plying the roads than private cars which trigger high traffic noise in the residential neighbourhood. Furthermore, the traffic noise levels show that the mean traffic noise is 71.70dBA which is above the recommended standard 55dBA for outdoor during daytime in a residential neighbourhood. The study also reveals that traffic noise peaks in the afternoon and as distance increases from the traffic noise source, the intensity of noise levels reduces. Finally, the study found that traffic noise causes headache, annoyance, speech interference and lack of concentration in that order to the residents living in the study area. The study concludes that the level of traffic noise in the study area is high and dangerous to the health of the residents. This calls for policy actions that will reduce traffic noise in residential neighbourhoods.

Key Words: Traffic noise, Residential neighbourhood, Noise pollution, Noise level

1. INTRODUCTION

One of the major menaces facing contemporary society today is noise pollution (Obafemi and Ofondu, 2015). Noise is a major public health problem in most cities of the world. Noise is a wrong sound in the wrong place at the wrong time (Thompson 1994). Noise is the sound that exceeds the acceptable level and creates an annoyance (Balashanmugam et al, 2013). Noise pollution is an unwanted and dangerous sound which makes the environment impure. It produces unpleasant and undesired physiological and psychological effect on people. The annoyance from noise varies depending on the sensitivity and mental state of an individual (Mokhtari et al, 2007). Hence, noise is intolerable because of discomfort, fatigue, disturbances and pain it causes (Singh and Davar, 2004).

The major sources of noise in cities are road traffic, rail traffic, aircraft, construction, equipment, machinery, industries, lawn mowers, generators and the neighbourhood (Schomer, 2001 & Berglund and Lindvall, 1995). Road traffic has been the major source of noise in cities producing the loudest sound. The growth in population and high rate of urbanization being experienced in most urban centres has resulted in the rise of motorization. The increase in vehicular traffic volume has contributed to rise in road traffic noise pollution making it the main source of noise in cities. Dai et al (2005) reiterate that motor vehicle being a symbol of modern civilization brings convenience of travel and economic productivity in cities but also creates unpleasant traffic noise in the living environment. Balashanmugam et al (2013)

identify inadequate city planning that allow homes, schools, offices, hospitals and commercial centres built close to main roads without the buffer zone or adequate sound proofing as cause of traffic noise in cities. Traffic noise emanates from engines, exhaust system, horns, road surface, aerodynamics friction, number of automobile, commercial and industrial activities within the residential areas of cities.

World Health Organization (1995) reiterates that transport noise is one of the main sources of environmental noise exposure in the urban centres. Similarly, Berglund and Lindvall (1995) note that traffic noise accounts for about two-third of the total noise pollution in urban areas. In the United States, over 40 per cent of the population are exposed to transport noise levels exceeding 55dBA and even higher in European countries and Japan (World Health Organization, 1995). European Environmental Agency (2017) reports that noise pollution is a major environmental health problem in the continent which transport sector account for substantially. It was further reiterated that road traffic noise is a dominant source making around 100 million people to be exposed to road traffic noise above 55dBA in 33 member countries and 32 million to very high level above 65dBA.

Noise pollution poses serious threat to the quality of life in cities. Exposure to noise can have serious and damaging impact on people and communities. Kiernan (1997) observes that exposure to relatively low level of noise have impact on our physiological and psychological systems causing hypertension, sleep disruption and hinder cognitive development in children. Direct exposure to noise over a period of time by those living close to highway, railway and or airport can lead to health challenges like hypertension, hearing loss, tinnitus, annoyance and anxiety disorder, stress, negative emotions, feeling of surprise, frustration, anger, fear, mental health and behavioural problems, permanent loss of memory, poor school and career performance, cognitive delays in learning and interference with speech communication (World Health Organization, 2004; Shendell, Barnett and Boese, 2004 & Fields, 1993). Therefore, Noise is a physical exposure agent and environmental and occupational hazard presenting risks to human health and well being (Ana et al, 2009).

Studies on noise pollution in Nigeria focus more on school environment and commercial centres (Yesufu, et al, 2013; Ana et al, 2009 and Obafemi and Oondu, 2015). This reveals gap in knowledge about effect of traffic noise on residential environment especially with the increasing encroachment of commercial activities into residential neighbourhoods in the country. The available studies by Ibekwe et al (2016) and Oloruntoba et al (2012) focus on Abuja and Ibadan respectively. There is no study conducted in Lagos the most populated State in the country. This study therefore assesses traffic noise pollution in the residential neighbourhood of Alimosho local government Lagos, Nigeria.

2. LITERATURE REVIEW

The empirical literature on traffic noise pollution within the residential areas is well documented. Dai et al (2005) evaluate road traffic noise impacts to the residential areas in Regina, Saskatchewan, Canada. The findings of the study reveal that most of the residential areas have ambient noise that is higher than World Health Organization and Environmental Noise Control by Federal – Provincial Advisory Committee on Environmental and Occupation Health (CEOH) recommendation 55dBA day time and 50dBA night time which is caused by heavier traffic flow. However, residential areas without public traffic have good living environment from ambient noise. The environmental impacts of traffic noise on the communities indicate that disturbance on speech intelligence has the most negative effect followed by annoyance and sleep disturbance. Finally, the study established a

relationship between traffic noise and noise levels. The higher the traffic volume, the higher the noise levels. This is influenced by road construction and road surface conditions.

Al-Mutairi (2012) assesses the traffic noise pollution impact on residential and commercial development in Ahmadi, Kuwait. The traffic flow analysis is heaviest during the afternoon peak hours on all roads throughout the survey period. The noise levels are above the maximum permitted outdoor standard of 75dBA on most of the roadway locations which are specifically higher in the afternoon than morning. The noise level causes annoyance, fatigue and disturbance to the people. The correlation analysis established a positive and significant relationship between noise levels and different vehicle sizes and total traffic volume. The continuous use of automobile led to noisy urban environment and deterioration of quality of urban life in Kuwait. Oloruntoba et al (2012) assess the sources and noise levels and their health effects on people in the residential density neighbourhoods in Ibadan, Nigeria. The result reveals a mean noise level of 53.10dBA for low density, 68.45dBA for medium density and 68.36dBA for high density residential neighbourhoods. The noise levels for medium and high density neighbourhoods are higher than the 55dBA recommended maximum standard by World Health Organization adopted in this study. This established noise pollution in the residential neighbourhoods in Ibadan. The sources of noise indicate that vehicular noise, generator sets and music are the major sources of noise in the city in that order which peak at 7pm to 11pm in the three residential neighbourhoods. The health implications reveal that headache account for 30.2 per cent, lack of concentration 23.7 per cent and irritability 12.2 per cent were the major health effects on the residents in the study area.

Balashanmugam et al (2013) measure traffic noise in commercial, industrial, residential, educational and health centres within high population density and heavy traffic in Cuddalore town, India. The result of the study reveals that the average noise levels in residential areas is between 67.66dBA to 73.28dBA in Sangolikuppam, Allapakkam, Semmanda and Adinarayanapuram are higher than the recommended day time 55dBA and night time 45dBA Noise Pollution (Regulation Control) Rules 2000 for Indian cities. The exposure to these levels of noise over a long period of time can cause hearing loss, distraction, sleep disorder and lower productivity.

The reviewed literature established that traffic noise pollution is being experienced in the residential areas in most cities of the world. This is caused partly due to influx of commercial activities in residential areas and increase in automobile use in urban centres. This situation is also true of Nigeria, hence the need for this study.

3. MATERIALS AND METHODS

The study was carried out in Lagos located in the Southwestern part of Nigeria. Lagos has a land area of 3,577 sq. km and an estimated population of 17.5 million people. Lagos is the most densely populated city in the country with an average population density of 2,400 persons per square kilometre and annual population growth rate more than 5 per cent (Odeleye, 2011). Lagos is the hub of economic activities in the country playing host to over 2,000 manufacturing firms, 200 financial institutions, numerous commercial centres, educational institutions, seaports and airports. Lagos has twenty local government areas. Alimosho local government selected for this study has a land area of 183 sq. km and the largest population of 1.3 million people. It has seven wards namely: Akowonjo, Santos layout, Abati, Orisumbare, Alabata and Iyana-ipaja. The local government has been by and large residential area with limited commercial activities, however there has been conversion of residential buildings to commercial purposes in recent times. This

act is capable of attracting high level of traffic noise pollution due to increase commercial activities.

The information required for this study is traffic noise measurement, volumetric analysis of traffic flow and survey of health implication of traffic noise on the residents. The study measures environmental noise level emanating from traffic source in the residential neighbourhood of Alimosho local government, Lagos. This study adopted single location as sampling point for the measurement of traffic noise survey. The location is Ijegun-Ikotun traffic corridor and traffic noise levels measurement was taken at 10m, 20m and 30m from the roadside. The sampling was conducted on selected weekdays and weekend that is, Monday, Wednesday and Saturday in May 2018 during daytime due to low traffic at night and labour cost. The traffic noise was measured using sound level meter (SLM). The sound meter was positioned at 10cm and 30cm from the field assistant's ear to obtain the actual noise filtering into the ear. The sound level meter is calibrated on each day before use for accurate and reliable data collection. The sound level meter was set at slow response mode and measurements were done in A-weighting scale (dBA). The traffic noise measurement was performed on an hourly basis for 9 hours each day for three days. This corresponds to morning (6-9am), afternoon (12-3pm) and evening (4-7pm) peak periods. The measurement for each sampling was taken at 10 minutes intervals for each hour. The noise levels obtained were summed up and the average was taken to be the mean noise residents were exposed to at their residence. The traffic noise quality description for daytime in Table 1 is the recommended standard. The values obtained in this study are compared with the World Health Organization recommended standard to ascertain the extent of noise pollution in the study area.

Table 1: Noise quality description for daytime

Leq (dBA)	Noise quality description
55-60	Risky
60-65	Moderately
65-70	Highly risky
70-75	Dangerous
75-80	Highly dangerous
Greater than 80	Extremely dangerous

Furthermore, there was manual counting of vehicles plying the traffic corridor in the residential neighbourhood due to non-availability of data on daily traffic flow in this location. The number and types of vehicle were counted and reported on hourly basis for weekdays and weekend during the morning, afternoon and evening peak periods by the field assistants. The classification of vehicles was done by type in passenger car unit (pcu) taken after Hobbs (1979) adapted from Fadare and Wojuade (2007).

Table 2: Passenger car unit (pcu)

Type of vehicles	Units
Motorcycle	0.75
Car and Taxi	1.00
Mini bus	2.00
Bus and truck	3.00

Finally, a survey of health implications of traffic noise on residents was conducted. A structured questionnaire was designed to measure the impact of traffic noise on residents' health in the study area. The respondents were requested to indicate ailments that they experienced due to exposure to traffic noise pollution. A total of 135 questionnaire was administered on the residents using simple random sampling techniques out of which 120 that were properly filled were used for analysis in this study. The data collected were analysed using descriptive statistics such as percentages, tabulation and cross tabulation. The result of the survey is discussed moving forward.

4. RESULTS AND DISCUSSION

4.1 Traffic flow analysis

The mean traffic flow in passenger car unit (pcu) that plied the roads on hourly basis in the residential neighbourhood is presented in Table 3. The total mean traffic

volume on the road is 6192 passenger car unit per day for the period of survey. The mean traffic volume by vehicle type indicates that private car is in the range of 119 and 210. The mean traffic volume for tricycle range between 74 and 158, mini bus range between 80 and 165, truck between 161 and 285 and motorcycle range between 42 and 75. The finding reveals that the number of commercial vehicles plying the roads was more than private car. The commercial vehicles account for 77.1 per cent of the total vehicles while the remaining 22.9 per cent are private cars. The breakdown of the composition of vehicle type reveals that tricycle dominated, accounting for 33.3 per cent of the total traffic on the road. Tricycle is a form of motorcycle that has cover and capacity to convey 3-4 passengers per time. They are mostly used in residential neighbourhoods for short commute between bus stop and residences. This is followed by private car (22.9 per cent), motorcycle (18.2 per cent), mini bus (17.4 per cent) and truck (8.2 per cent) in that order. The high commercial vehicles recorded suggest the likelihood of high traffic noise in the residential neighbourhood. The temporal distribution of the traffic volume reveals that the peak volume periods were between the hours of 5-6pm and 6-7pm. The peak period is common to all types of vehicle private car, mini bus, motorcycle, tricycle and truck recorded the highest traffic volume at this time of the day. Traffic volume is highest in the evening because most workers return home from work at the same time even though they left for work at different times in the morning. The traffic increases gradually in the morning as from daybreak until students and workers are settled in their schools and workplaces. The lowest traffic volume was recorded in the afternoon when most of the workers are at their various workplaces.

Table 3: Mean traffic volume per day

Time	Private car	Tricycle	Mini bus	Truck	Motorcycle	Total
6am – 7am	119	74	80	161	42	476
7am – 8am	150	120	122	240	51	683
8am – 9am	168	128	122	270	63	751
12pm – 1pm	143	106	128	213	45	635
1pm – 2pm	136	118	116	198	66	634
2pm – 3pm	142	102	105	214	51	614
6pm – 7pm	188	146	159	274	75	842
7pm – 8pm	210	156	165	285	63	879
8pm – 9pm	168	128	129	208	51	678
Total	**(22.9) 1418**	**(17.4) 1078**	**(18.2) 1126**	**(33.3) 2063**	**(8.2) 507**	**6192**

4.2 Traffic noise level in the residential neighbourhood

A cursory observation of the residential neighbourhood reveals encroachment and unauthorized conversion of many residential building to commercial use. Subsequently, this attracts and increases both human and vehicular traffic, which generates excess noise in the residential neighbourhood on daily basis. The mean traffic noise levels in the residential neighbourhood surveyed are as shown in Table 4. The mean traffic noise levels recorded in the residential neighbourhood reveals that noise is loudest at 10m from the traffic noise source. The mean traffic noise level per day is 71.70dBA. The highest mean noise level 73.74dBA was recorded between 12noon-1pm while the lowest mean noise level 69.56dBA was recorded between 7pm-8pm in the night. Also, at 20m from the traffic noise source, the mean traffic noise level per day is 67.24dBA. The highest mean noise level 69.32dBA was recorded between 1pm-2pm and the lowest mean noise level 65.09dBA was recorded between 6am-7am in the morning. The findings indicate that there is little difference in traffic noise level between 10m and 20m from the traffic noise source. Furthermore, the result shows that the noise level is lowest at 30m from the

roadside noise source. The mean traffic noise per day is 54.45dBA. The highest mean noise level 55.72dBA was recorded between 1pm-2pm while the lowest mean noise level 53.66dBA was recorded between 6am-7am in the morning. The implication of these results is that as distance increases from the roadside into the residential neighbourhood the intensity of traffic noise reduces. The traffic noise level is mostly lower in the morning between 6am-7am because vehicular movement is relatively low at this time of the day. The temporal analysis of the traffic noise pollution in the neighbourhood reveals that the noise peaks in the afternoon between 1-2pm. This result corroborates the finding of Al-Mutairi (2012) who also observed that traffic noise level is highest in the afternoon in Kuwait. This time coincides with the period that elementary and high school students' return home from school. This is likely to increase traffic noise level due to their carelessness on the walkway and when crossing the road. This may prompt the drivers to use horn more frequently to alert the students.

Table 4: Mean traffic noise level per day

Time/Distance	10m	20m	30m	Mean/hr.
6am - 7am	70.57	65.09	53.66	63.11
7am – 8am	72.57	66.84	53.84	64.42
8am – 9am	71.37	66.82	54.68	64.29
12pm – 1pm	73.74	67.93	54.46	65.38
1pm – 2pm	72.83	69.32	55.72	65.96
2pm – 3pm	70.62	67.73	54.35	64.23
6pm – 7pm	71.13	66.91	53.69	63.91
7pm – 8pm	69.56	66.09	54.32	63.32
8pm – 9pm	72.89	68.39	55.29	65.52
Mean/distance	**71.70**	**67.24**	**54.45**	**64.46**

The mean measurement of traffic noise levels in the residential neighbourhood was compared with World Health Organization recommended standards. The recommended maximum noise level for outdoor location in residential neighbourhood is 55dBA. The mean traffic noise measurement at 10m from the traffic noise source is 71.70dBA. This result indicates that those residing in buildings within 10m from busy roadside are exposed to dangerous traffic noise levels (See Table 1). They are likely to be affected by exposure to traffic noise over a long period of time. Similarly, those that live 20m from the traffic noise source are exposed to highly risky level of noise. The hourly mean traffic noise levels for the three points (10m-30m) ranges between 63.11dBA and 65.96dBA implying that the noise level is generally at moderate level when this category is considered.

4.3 Effect of traffic noise on residents' health

The reported symptoms experienced by residents due to exposure to noise in the study area are presented in Table 5. The information reveals that headache accounting for 35 per cent is the most prevalent traffic noise ailment experienced by respondents in the study area. The result further shows that 30 per cent of the respondents claimed to be annoyed with traffic noise in the residential neighbourhood especially when heavy trucks are passing. The information also indicates that 22.5 per cent of the respondents suffer speech interference due to noise emanating from traffic sources in the residential neighbourhood. The respondents that account for the remaining 12.5 per cent reportedly experienced lack of concentration as a result of noise emanating from vehicular traffic movement within the residential neighbourhood while no respondents indicate to have hearing impairment caused by traffic noise pollution.

Table 5: Effect of traffic noise on residents' health

Ailment	Frequency	Per cent
Headache	42	35.0
Hearing impairment	-	-
Annoyance	36	30.0
Speech interference	27	22.5
Lack of concentration	15	12.5
Total	**120**	**100.0**

CONCLUSION

The study assesses the traffic noise pollution in residential neighbourhood of Alimosho local government in Lagos, Nigeria. The findings of the study reveal that there is encroachment of commercial activities into residential neighbourhood.

This has increased the influx of commercial vehicles into the residential neighbourhood. This situation has made traffic noise to be high especially in residential buildings located along the major roads. The traffic noise level is usually higher in the afternoon than any other time of the day. The traffic noise level is above the recommended standard for daytime and outdoor. It is at dangerous level on the noise quality description table. This result is in agreement with other major cities in United States, European Union, India and Japan. It was further found that the residents experienced headache, annoyance, speech interference and lack of concentration as a result of traffic noise in the residential neighbourhood. The study concludes that the traffic noise levels in the residential neighbourhoods of Alimosho local government is high and dangerous to the health of the residents.

The study therefore recommends that government should pay adequate attention to traffic noise management in residential neighbourhoods due to its adverse effects on people. They should legislate on noise pollution from vehicular traffic within residential neighbourhoods. The Lagos State Ministry of Environment and other related Agencies should effectively implement the laws by enforcing traffic noise standards on the motorists in the residential neighbourhoods. Furthermore, trucks and earth moving vehicles should be restricted from plying roads in the residential neighbourhood while aged vehicles and indiscriminate use of horn should be totally discouraged. Finally, city planning agency should create buffer zone by planting trees between residential neighbourhoods and major roads to act as barrier or insulation to sound propagation and reduce the intensity of traffic noise level before it reaches the residential buildings. This will improve the quality of life in residential neighbourhoods in the city.

The study could be improved by conducting further research in the areas within the local government and Lagos as a whole taking into cognizance more observation points. The noise level can also be measured at a farther point from the roadside especially in residential buildings. This will enhance our understanding of how traffic noise levels in residential neighbourhood affect the residents in Lagos and help city planners to initiate effective plan to address the situation.

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