IMPLICATIONS OF FOSSIL FUEL GENERATING SET ON RESIDENTS' WELLBEING IN LAGOS, NIGERIA

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ABSTRACT

Air pollution has been identified has one of the factors responsible for increase in the incidence of diseases and ill health in several developing countries. With incessant power outage due to poor capacity to generate electricity in Nigeria, majority of people has resulted into using alternative power sources including solar, battery powered inverter and fossil fuel generating set. This study investigated factors responsible for, frequency of and health implications of fossil fuel electricity generating set usage in Ikorodu, Lagos. Using multistage sampling technique, 186 households were randomly from 932 residential buildings in selected localities. Aggregate weighted mean index analysis was to analyse Residents' Agreement Index (RAgI) and Generating set Impact Perception Index (GEPI). Findings revealed that irregular power supply, efficiency of generating set and low voltage of public supply were the major factors responsible the use of fossil fuel generating set RAgI values of 3.33, 3.14 and 3.09 respectively. On the whole, environmental effects of generating set were the most perceived impacts while the least perceived were the health implications with a mean GEPI of 3.93 and 3.29 respectively. Considering the multiplicity of effects on residents, fossil fuel electricity generating set is one of the major sources of electricity is not sustainable. Therefore, considerable efforts should be made by government to improve on the conventional means of power generation and supply.

Keywords: *Fossil fuel; Electricity generating set; Noxious gaseous pollutants; Ikorodu Lagos*

1. INTRODUCTION

The quality of living in any settlement depends to a large extent on the availability and adequacy of physical and social facilities. However, such facilities including sanitary sewerage, water supply, roads and electricity (power supply) are rather inadequate or in an ill-state in most developing countries (Dao, 2008; Fay and Toman, 2010). In Nigeria, of particular importance among these facilities is electricity which is undeniably indispensable in the modern society. Although uninterrupted supply of electricity has been a priority of successive government, it remains a mirage because the country has for a long time been known for its defective power supply (Sambo *et al.*, 2010; Sanusi, 2010; Obineche, 2015; Alphonsus, 2016). The rising rate of urbanisation and industrialisation has also exacerbated the situation making the demand for electricity outweigh its exiguous supply. It has been estimated that less than ten per cent of the national electricity demand could be met through the national power grid in the county (Mbamali *et al.*, 2012).

The nature of power supply in the country coupled with its indispensability has necessitated the quest for alternative sources of electric power in Nigeria (Somefun, 2015). One of these sources is fossil fuel generating set for domestic and industrial power supply. Most households in Nigerian cities operate small capacity fossil fuel electric power generating set to augment the shortfall of electricity supply (Energy Commission of Nigeria, 2009; Stanley *et al.*, 2010; Olaleye and Akinbode, 2012). Industrial and business establishments, on the other hand,

opted for fossil fuel generating set that have the capacity to meet their daily operations (Onochie, 2015). Fossil fuel generating set although are viable alternative source of energy, they are also a veritable source of a multiplicity of environmental problems. The combustion of fossil fuel in generating set has been associated with environmental pollution which in turn has adverse effects on the physical and mental health of individual (Offiong, 2003; Dimari *et al*., 2007).

In the literature, the emission of noxious gaseous pollutants like carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), and particulate matters also accompanies generating set operations (Intergovernmental Panel on Climate Change, 1996). The pernicious environmental implications of these pollutants are not negligible. Indoor air pollution from fossil fuel combustion was observed to have claimed more than 1.6 million lives and left over 38.5 million disabled worldwide in the year 2000 (Smith *et al.*, 2003). In Nigeria, an annual death toll of 79,000 persons resulting from indoor air pollution due to burning biomass was reported by World Health Organisation [WHO] (2007). Exposure to nitrogen oxides has been linked to decrements in lung function, increased airway reactivity and increased susceptibility to infection while carbon monoxide has been shown to cause nausea, vomiting, impaired vision (Lee *et al.*, 1996). Moreover, long term exposure to particulate matters, a complex mixture of particles that can be solid, liquid or both has also been linked with increased acute respiratory morbidity inform of pneumonia, asthma (Soubbotina, 2000; Hertel *et al.*, 2001; WHO, 2008).

Another well-known and documented effect of fossil fuel generating set is the noise produced which is a continuous nuisance not only to the user but the ambient residents (citations). The operations of generating set have been shown in empirical studies to raise ambient indoor and outdoor noise levels above the WHO limits of 30dB and 70dB respectively (Stanley, 2011). Continuous exposure of residents to such unwanted and unpleasant sound has been known to induce annoyance, aggression, sleeping problems, hearing loss, lack of concentration and stress (Awosusi and Akindutire, 2014). The noise effects among other health effects of fossil fuel generating set on residents' liveability are not readily discernible because they are often made manifest with exposures to long term averages rather than short term peak levels of pollution.

The pervasiveness of these maladies have triggered a resurgent interest to addressing environmental pollution. Despite the growing global concerns to reduce environmental pollution in our urban environment (California Air Resources Board, 2001; Environmental Protection Agency [EPA], 2003; WHO, 2007; EPA, 2011) the residents' demand for and the use of generating set is on the increase, especially in highly urbanised regions like Lagos in Nigeria. The reason for such high demand for generating sets by residents is to enjoy the social and economic benefits that electricity provides while neglecting associated negative effects on human wellbeing and the environment.

The need to make critical enquiries into the underlying health effect of fossil fuel generating set is compelling. Although, the erratic power supply appears to be obvious reason for the widespread usage of generating set as alternative power supply, could there be other subtle reasons for its pervasive usage? Analysing residents' perception on this may provide a right direction towards addressing the menace associated with fossil fuel generating set usage in Nigeria.

2. THE STUDY AREA

Ikorodu, the study area is a sub-city in Lagos, Nigeria. It is located in the North-Eastern part of Lagos abutting the Lagos Lagoon. It shares boundary with Ogun State in the North while in the East. It has common boundary with Agbowa-Ikosi, a town in Epe Division of Lagos State. Ikorodu Local Government Area is located approximately between latitude $60^{o}37'$ – $60^{o}45'$ North and longitude $30^{o}3'$ – $30^{o}5'$ East with a land area of about 394 square Kilometres (Soladoye and

Yinusa, 2012). The area enjoys a tropical climate with distinct dry and wet seasons. The dry season is short and occurs between November and March while the wet season starts from April to November. Rainfall is less than 2500mm every year and temperature is not less than 30^{o}C on the average throughout the year (Odumosu and Balogun, 1999).

The main occupation of Ikorodu people are trading (commerce) and farming. However, the relative closeness of Ikorodu to sprawling Lagos conurbation have made it a fast growing suburb near Lagos metropolis. There is influx of people into Ikorodu from its surrounding towns and villages as well as Lagos metropolis. The population of Ikorodu were 184, 674 and 527, 917 in 1999 and 2006 censuses respectively; with an estimated population of 619,516 in 2011 and 727,000 in 2016 (National Population Commission, 2006; National Bureau of Statistics, 2012; Brinkhoff, 2017).

3. MATERIALS AND METHODS

The study adopted the social survey research method with the study population being the residents of Ikorodu. In order to ensure representativeness in questionnaire administration, probability sampling was adopted through a multistage technique. This necessitated making an inventory of the existing 19 political wards in Ikorodu. These political wards are Aga/Ijimu, Agbala, Agura/Iponmi, Baiyeku/Oreta, Erikorodu, Ibeshe, Igbogbo I, Igbogbo II, Ijede I, Ijede II, Imota I, Imota II, Ipakodo, Isele I, Isele II, Isele III, Isiu, Odogunyan and Olorunda/Igbaga. From this sampling frame, 25 per cent (25%) of the political wards were selected using simple random sampling technique. This led to the selection of five (5) political wards comprising Ipakodo, Odogunyan, Imota I, Isele I and Olorunda/Igbaga, as shown in Table 1. The number of identifiable streets in each ward were selected (Table 1).

Using simple random sampling technique, twenty per cent (20%) of the total number of buildings within the selected streets were selected (see Table 1). Lastly, the systematic sampling technique was used to sample buildings along the already identified streets. The first building in each of these streets was selected using simple random sampling technique and then the selection of every subsequent 5th building, alternating between both sides along the road after each selection. In each sampled building, an adult of at least eighteen years was selected for questionnaire administration and on the whole 186 copies of the questionnaires were administered within the study area (see Table 1). The questionnaire elicited information on frequency and duration, factors responsible, perceived impacts on health and wellbeing, maintenance structure for generating set and mitigating strategies in responding of generating set implications.

Table 1: Sampling Units and Sample Size for Ikorodu

Neighbourhood	Number of Streets	Number of Buildings	Sampled Buildings (20%)
Ipakodo	43	232	47
Majidun	15	170	34
Owutu	12	97	20
Ajaguro	49	385	77
Ishawo	5	38	8
Total	**124**	**932**	**186**

Source: Authors' Fieldwork, 2017

The data collected from the survey were analysed using descriptive statistics. Data obtained with variables for the likes of frequency and duration of g use were analysed with frequency and percentages. Cross tabulation was used in assessing the relationship that exist between the socioeconomic variables comprising educational level, occupation and income. The results of relationships were confirmed using inferential statistics such as the Chi-Square while presented as contingency tables. The Chi-square statistics (χ^2) was confirmed at the level of significance of 0.05 ($\alpha = 0.05$) considering the probability value (p-value) is less or equal to the level of significance ($p \leq 0.05$).

In further analysis, descriptive statistics based on the aggregated weighted mean index was used in analysing data collected with variables that were measured using the 5-point Likert scale. This evolved two indices which were named the Residents' Agreement Index (RAgI) and Generating set Effect Perception Index (GEPI). The Residents' Agreement Index was determined using the ratings "Strongly Agree", "Agree", "Indifferent", "Disagree" and "Strongly Disagree" with assigned weights of 5, 4, 3, 2 and 1 respectively. The Generating set Effect Perception Index was determined under the ratings "Very High", "High", "Medium", "Low" and "Very Low" with assigned weights of 5, 4, 3, 2 and 1 respectively.

The Weighted Value (*WV*) for each item in on any of the two scales will be obtained as the product of the number of responses for each rating to a variable and the respective weight of the value. This is expressed as:

$$WV = F_i W_i \qquad \ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Where

WV	=	Weighted Value,
F_i	=	Frequency of responses for variable *i*,
W_i	=	Weight attached to responses on variable *i*,
i	=	Designated value of the Likert point response

The total of the Weighted Value (*TWV*) for each variable will be obtained by summing the product of the number of responses of each rating for a variable and the respective weight of the value; expressed as

$$TWV = \sum_{i=0}^{S} F_i W_i \qquad \ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

TWV for each variable was divided by the number of respondents to compute the appropriate index. For each index, the Deviation about the Mean (DM) and the Variance (σ) (see Equation iii), Standard Deviation (SD) (see Equation iv) and Coefficient of Variation (see Equation v) were all in the effort to measure how the distributions are dispersed from the mean in order to make correct observations about the reliability of the dataset.

$$\sigma^2 = \frac{\sum /x - \dot{x}/^2}{n} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

$$SD = \sqrt{\sigma^2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \text{(iv)}$$

$$CV = \frac{S.D \times 100}{\dot{x}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \text{(v)}$$

4. Results and Discussion

4.1 Socioeconomic Characteristics of Respondents

There is a linkage between socioeconomic characteristic of respondents and man quest for comfort. This assertion as explained by lifestyle theory and amplified by Roserberg (2003) is of paramount importance to the study. Most considered socioeconomic characteristics in this kind of discourse are gender, occupation, education and income. Research has shown that woman is likely to be exposed to harm than their male counterpart United Nation Habitat (2005). The male respondents which constituted 60.2% are more than female respondents with 39.8% (Table 2). This is because most men are involved in job that requires regular supply of electricity.

Table 2: Gender of Respondents

Gender	Respondents	Percentage
Male	112	60.2
Female	68	36.8
Total	**186**	**100.0**

Source: Authors' Fieldwork, 2017

The nature of occupation and education qualification sometimes determines the level of generating set usage. For instance, some artisans (welder, electrician, pepper grinder) depend solely on generating set during power-outage. This implies that individual in such profession are likely to have impact on the environment. Education qualification and occupation status of respondents as illustrated in Table 3 shows that respondents with primary 14.3%, secondary 28.60% and tertiary education 57.10% are traders. While respondents who obtained primary 17.60%, secondary 38.20% and tertiary education 44.10% are civil servants. However, respondents with secondary 42.30% and tertiary education 57.70% are artisans whereas; respondents with primary 10.70%, secondary 19.00% and tertiary education 70.2% are engaged in other occupation (private worker, farmer, land surveyor). Thus, this table shows that a higher percentage with tertiary education 60.80% engaged in other occupation different from the aforementioned. However, it can be deduced from the chi square test that there is a significant difference in the occupation status and the level of education of respondents in the study area at *p*-value less than 0.05.

Income size and level of education are factor that influence the usage of generating set in a given society. This is expected because only those with high financial status are able to acquire a generating set regardless of their education qualification. Out rightly, education level is not indispensable as it connotes individual perception and disposition on the potential impact of generator usage. The relationship between income earned and education qualification is illustrated in Table 3. It shows that respondents with primary12.50%, secondary 31.20% and tertiary education 56.20% earn less than ₦10,000 while respondents with primary 20.4%, secondary 22.4% and tertiary education 57.1% earn ₦10,000 - ₦20,000. In like manner, respondents who completed primary 20.5%, secondary 43.2% and tertiary education 36.4% earn between ₦21,000- ₦30,000. However, only respondents with secondary 22.1% and tertiary education 77.9% earn above #30,000.

By considering this relationship, majority of the respondents with tertiary education degree 66.8% earn above ₦30,000. This explains why they are economically buoyant to a procure generator. More so, in our contemporary world of today, it is no gain say to remark that the level of education most often determines the level of income. The dichotomy in education attainment and income is well supported in literature and coupled with the fact that there is a high tendency for those who have higher education qualification than those with lower education qualification. However, the chi square test shows that there is a significant difference in the

relationship between income and education status of respondents in the study area at *p*-value of 0.000 which is less than 0.05.

Table 3: Relationship between Educational Qualification, Occupation and Income

Socioeconomic	Education			Total f (%)
	Primary f (%)	Secondary f (%)	Tertiary f (%)	
**Occupation				
Trader	6 (14.3)	12 (28.6)	24 (57.1)	42 (100.0)
Civil Servant	6 (17.6)	13 (38.2)	15 (44.1)	34 (100.0)
Artisan	0 (0.0)	11 (42.3)	15 (57.7)	26 (100.0)
Others	9 (10.7)	16 (19.0)	59 (70.2)	84 (100.0)
Total	21 (11.3)	52 (28.0)	113 (60.8)	186 (100.0)
**Income				
<-₦10,000	2 (12.5)	5 (31.2)	9 (56.20)	16 (100.0)
₦10,001- -₦20,000	10 (20.4)	11 (22.4)	28 (57.10)	49 (100.0)
₦21,001- -₦30,000	9 (20.5)	19 (43.2)	16 (36.40)	44 (100.0)
> -₦30,000	0 (0.0)	17 (22.1)	60 (77.90)	77 (100.0)
Total	**21 (11.3)**	**52 (28.0)**	**113 (60.8)**	**186 (100.0)**

$^{*}\chi^{2}_{(6)} = 13.043, \alpha = 0.05, p = 0.043;$ $^{**}\chi^{2}_{(6)} = 28.992, \alpha = 0.05, p = 0.000$

4.2 Reasons for Using Generating Set by Residents

From the survey, selected respondents have at least one portable generating set in their household. Five underlying reasons for the use of generating set were investigated, as shown in Table 4. These factors consisted of outrageous billings, irregular power supply, expediency of generating set, poor extension of power line to area and low voltage of public supply. Three factors were considered noteworthy because they have values higher than the mean RAgI of 3.05 (Table 3). They comprised irregular power supply, expediency of generating set and low voltage of public supply with high Resident's Agreement Index (RAgI) of 3.33, 3.14 and 3.09 respectively.

It thus stands to reason that although irregular power supply has the highest value and is a very substantial factor, the closeness of the other two factors suggested that it is not the overriding reason for the use of generating set. In order words, even if power supply becomes regular some people are likely to continue using generating set because of their perceived expediency as article of ostentation. This is found to be a social issue which has earned the low capacity generating set used by households the name '*I Better Pass my Neighbour*'. Moreover, the situation where power supply is consistent but without the fitting voltage still would not stop people from using generating set. Poor extension to the area has a smaller value (2.93) while outrageous billing being the least with index value of 2.75 is the lowest factor contributing to the usage of generating set. Both are considered less prevailing factors because they have index values lesser than the mean RAgI.

Table 4: Reason for Usage of Generating Set by Residents

Factor	SA	A	I	D	SD	TWV	nR	RAgI	(x-x)	$(x-x)^2$
	5	4	3	2	1					
Irregular power supply	290	176	39	86	28	619	186	3.33	0.28	0.0784
Outrageous billing	135	172	39	124	41	511	186	2.75	0.3	0.0900
Expediency of generating set	235	164	87	58	40	584	186	3.14	0.09	0.0081
Poor extension of power line to area	205	156	78	52	54	545	186	2.93	0.12	0.0144
Low voltage of public supply	130	240	84	92	28	574	186	3.09	0.04	0.0016
Mean								***3.05***	***0.17***	***0.039***

Source: Authors' Fieldwork, 2017

4.3 Effects of Fossil Fuel Electricity Generating Set Usage on Residents

The adverse effects of generating set on residents can be divided into three main categories; the environmental, economic and health effects. Each of these categories was measured with specific variables or items on a 5-point Likert scale to determine their mean Generating set Impact Perception Index (GEPI) using the mean. From the three categories, the most perceived among the respondents is the environmental effect of generating set with a mean GIPI of 3.93, the next is the economic effect with 3.53 while the least perceived are the health effects with a mean GIPI of 3.29, as shown in Table 5).

Table 5: Perceived Effects of Generating Set on Residents

Effect Indicators	VH	H	M	L	VL	TWV	GEPI	(x-x)	$(x-x)^2$
	5	4	3	2	1				
***Environmental**									
Vibration on land	340	260	141	12	-	753	4.05	0.12	0.014
Defacement of building wall with exhaust and soot	345	156	153	50	2	706	3.79	-0.14	0.020
Engine oil spill affecting plants and living organisms	260	80	144	54	39	577	3.10	-0.84	0.689
Smoke from exhaust pipe	390	184	141	24	3	742	3.99	0.06	0.004
Noise from engine	400	256	99	12	3	770	4.74	0.81	0.656
Mean Score							***3.93***		***0.28***
Health									
Hearing loss/disability	105	84	198	128	14	529	2.84	-0.40	0.160
Aggravation of heart problems	105	96	189	128	14	532	2.86	-0.39	0.152
Annoyance	370	268	63	44	-	745	4.01	0.76	0.578
Disturbance of sleep	455	200	75	36	-	766	4.12	0.87	0.757
Lack of concentration	450	256	33	36	3	778	4.18	0.93	0.865
Aggravation of Asthmatic problems	140	128	144	126	15	553	2.97	-0.28	0.078
Throat irritation	120	80	159	130	24	513	2.76	-0.49	0.240
Tinnitus	135	60	111	142	36	484	2.60	-0.65	0.422
Headache	420	172	87	50	5	734	3.95	0.70	0.490
Nausea	160	128	120	112	26	546	2.94	-0.31	0.096
Electrocution	170	124	93	128	33	548	2.95	-0.30	0.090
Mean Score							***3.29***		***0.39***

Economic									
Cost of fuel	550	264	132	-	-	946	5.09	1.56	2.434
Cost of maintaining generating set	215	108	147	128	3	601	3.23	-0.30	0.090
Damages to electrical appliances	150	132	150	80	33	545	2.93	-0.60	0.360
Cost of constructing generator house	115	116	168	114	21	534	2.87	-0.66	0.436
Mean Score							***3.53***		***0.82***

Source: Authors' Fieldwork, 2017

The most dominant environmental impact of generating set usage was noise pollution which has the highest index of 4.74. Incessant vibration and air pollution from smoke were also identified as major threats with 4.05 and 3.99 respectively. Others effects like defacing of building wall and littering of floor with engine oil recorded perception values below the mean GEPI (3.93).

In terms of health implications, **g**enerating set is one of the veritable sources of air pollution. Combustion processes of fossil fuel use by generating set is associated with adverse effects on health (Mbamali et al., 2012). Apart from the heat, vibration and noise accompanying generating set operations, Carbon dioxide (CO_2), Nitrogen oxides (NOx), Sulphur [IV] oxide (SO_2), Carbon [II] oxide (CO), and particulate matter are also released (IPCC, 1996) and these are air pollutants that increase susceptibility of residents to stress, nausea and respiratory anomalies. Of the eleven maladies used in analysing the health effects of generating set in the study area, lack of concentration, disturbance of sleep and annoyance are the highest with GEPI values of 4.18, 4.12 and 4.01. They were thus the most perceived health effects. Other effects with GEPI values below the mean value were hearing loss, tinnitus, aggravation of asthmatic and heart problems, electrocution, nausea and throat irritation. The economic effects of generating set usage include the cost of fuel, cost of maintaining, damages to electrical appliances and cost of barriers to reduce noise. However, the most dominant among these is the cost of fuelling the generating set (5.09).

These findings indicate that the environmental and economic effects are the most perceived adverse implications of fossil fuel generating set usage while health impacts have the least mean GIPI (3.29). However, this is not an indication that the health effects are minimal as major health effects of fossil fuel generating set are not readily perceptible because they are often made manifest with exposures to long term averages rather than short term peak levels of pollutant. The low mean GEPI of health impacts only suggests that residents are not aware of the detrimental impacts of fossil fuel generating set on their health.

The coefficient of variation of the index for environmental effects which is low (13.38%) likewise revealed that the responses were clustered around the mean and probably relatively the same across the study area. the coefficient of variation for economic effects however has a higher value (25.8%) which shows that the responses are slightly polarized and may vary with residents. Hence the environmental effect given its high GEPI and low coefficient of variation are the dominant adverse effects felt in the study area.

4.4 Duration of Usage of Generating Set by Residents

Duration of generating set usage is one of the factors to determine the magnitude of its effects. The analysis of findings as illustrated in Figure 1 revealed that the highest proportion of respondents use generating set for less than 4 hours on Mondays, and between 5-8 hours on Tuesdays, Wednesdays, Thursdays, Fridays and Saturdays. On Sundays however most respondents use generating set for the duration of 9-12 hours. This may be attributed to the fact that most families and individuals are always indoors on Sundays. Moreover, Fridays, Saturdays and Sundays have the highest proportion of residents using generating set for more than 13 hours with an aggregate of 23.1%, 19.9% and 24.7% respectively. Although the use of

generating set varies across the days of the week, it generally increases over the week and reaches a peak on weekends.

On the whole, the highest proportion of residents (35.4%) use generating set for an average of 5-8 hours in a week while the least proportion (12.9%) use it for more than 12 hours, as shown in Figure 2. This analysis depicts a severe reliance on generating set in the study area to power the home and business activities. Since the ambient air pollution rate is a function of the amount and duration of exposure to pollutants and majority used electricity generating set for more than 5-7 hours weekly, it stands to reason that the situation in the study area is a veritable recipe for air pollution with deleterious effects on human health, wellbeing and city liveability.

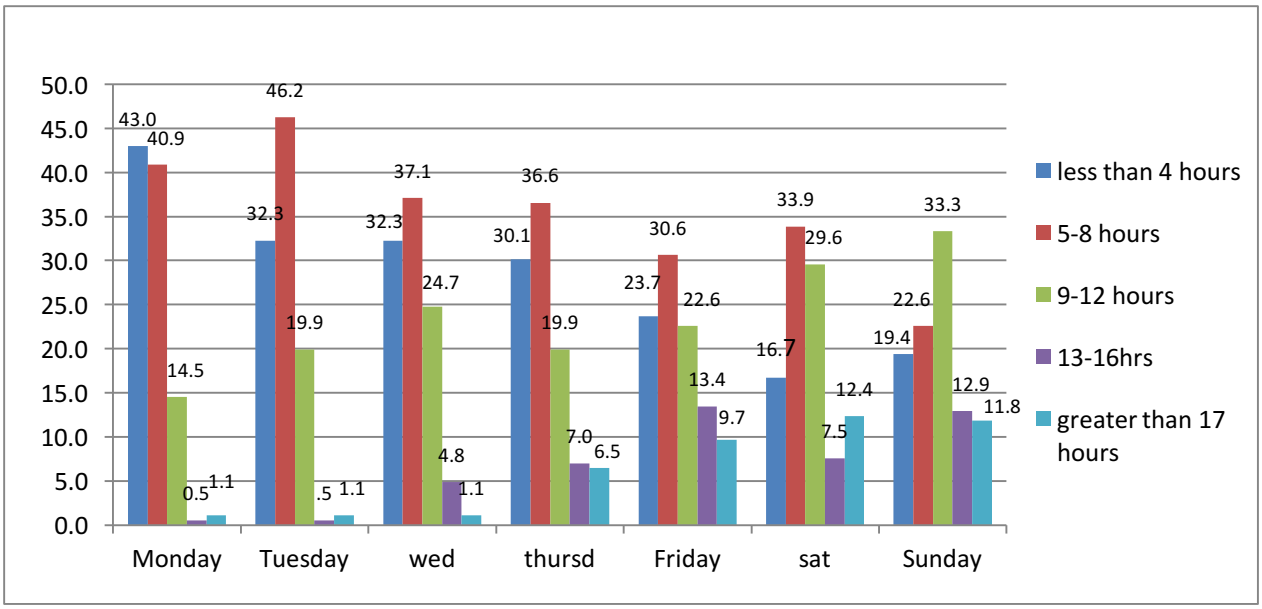

Figure 1: Weekly Analysis of Duration of Generating Set Usage
Source: Authors' Fieldwork, 2017

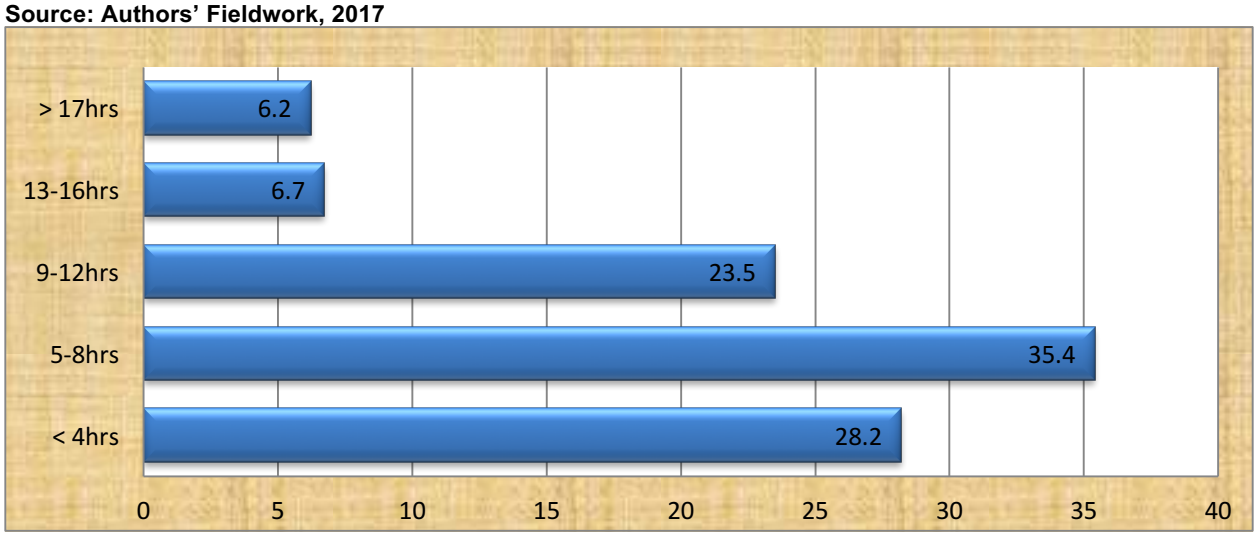

Figure 2: Weekly Average use of Generating Set
Source: Authors' Fieldwork, 2017

4.5 Response to Adverse Effects of Generating Set

As shown in Table 6, the most common methods for mitigating the effects of generating set in the study area were regular maintenance and isolation of generating set from building with the highest frequencies of 18.8% and 15.1% respectively. However, the more effective methods of reducing these adverse effects like using only sound proof generating set, air purifiers and planting of trees to improve air quality are least practised in the area. Besides, probing further into the two dominant methods highlighted the inadequacy of these methods. Observations from the area showed that only 10.2% of respondents maintained (serviced) generating set after four months of the usage, the highest proportion of respondents (48.9%) serviced their generating set after 4-8 months of usage while 17.2% serviced generating set after 9-12 months of usage. The poorer the maintenance culture, the higher the adverse health and environmental implications of generating set on residents. All these are pointers to the fact that a very small proportion of the respondents adopted the necessary mitigation measures to ameliorate the effects of generating set.

Table 6: Measures to Reduce Adverse Effects of Generating Set

Variables	Respondents	Percentage
Adopted Measure		
Regular Maintenance	35	18.8
Isolating generator from building	28	15.1
Adding anti-gelling addictives to fuel	27	14.5
Using only sound proof generator	18	9.7
Air purifier	19	10.2
Planting of trees to improve air quality	17	9.14
Using noise reduction screen	25	13.4
Missing	17	9.14
Total	**186**	**100.0**
Frequency of Maintenance		
0-4 months	19	10.2
4-8 months	91	48.9
9-12 months	32	17.2
After Every Use	44	23.6
Total	**186**	**100**

Source: Authors' Fieldwork, 2017

5. Conclusion

The study concludes that the pervasive use of fossil fuel electricity generator remains a problem that cannot be ignored considering the multiplicity of its effects on residents. While an enquiry has been made into the subtleties of the menace, the recommendations proffered hereunder based on the findings will provide sustainable strategies that if adopted will undoubtedly alleviate to the barest minimum the magnitude of the problem.

At first, more efforts should be made by the government in ensuring not only a stable but effectual power supply as it is a significant factor influencing the usage of fossil fuel generating set as alternative power supply. However, in the meantime efforts should be made at the very least, to ensure a stable power supply during the weekends when generating set usage reaches peak levels. This will reduce to a considerable degree, the frequency of generating set usage and its associated adverse effects. In addition, sensitisation programmes should be embarked upon to educate the populace on the health effects of noise pollution. The health implications of generating set are the least perceived among residents although cumulative effects on residents can be disastrous. It is thus imperative to spread through public media, religious groups, and educational institutions information about the health effects of using generating set as this will guide people in making better choices with regards to the use of generating set.

Stringent regulations should be made with regards to the provision/maintenance of building greenery and air space. This will help to reduce the concentration of pollutants from generating set in the ambient air and the associated adverse effects on health. Tightly packed buildings and poorly ventilated environments only aggravate the menace. Finally, that erratic power supply, as shown in the findings is not the sole factor for the use of generator so even if addressed, the use might persist. Consequently, necessary measures must be taken by the government to provide and encourage the use of cleaner, efficient and less hazardous power supply alternatives, one of which is solar energy. This could prompt the government to create appropriate policy incentives such as providing import tariff largesse for the viable power supply alternatives like solar home systems.

Another measure could be through charging affordable rates for the public power supply (a less hazardous and more efficient source of electricity) to encourage its use. Lastly, government could place import restrictions on certain types of generators especially poor quality ones made rather for the quickness of sale rather than for functionality or efficiency.

REFERENCES

Alphonsus, O. N. (2016). An examination of the challenges of power supply in Nigeria in post-privatization era, 2013-2016. *Asian Journal of Basic and Applied Sciences*, 3(1), 34-44.

Awosusi, A. O. and Akindutire, I. O. (2014). Perceived health effects of environmental noise pollution on the inhabitants of Ado-Ekiti Metropolis, Ekiti State, Nigeria. *Journal of Biology, Agriculture and Healthcare,* 4(26), 106-113.

Dao, M. Q. (2008). The determinants of infrastructural development in developing countries. Journal for studies in economics and econometrics, 32(3), 43-54.

Dimari, G., Abdulrahman, F., Akan, J. and Ogugbuaja, V. (2007). Levels of nitrogendioxide of atmospheric air in Maiduguri, Borno State, Nigeria. *Medwell Research Journal of Applied Sciences,* 2(7), 846 – 849.

Energy Commission of Nigeria (2009, January 26). Sixty Nigerians now own power generators. *Vanguard Newspaper*, Available at www.energy.gov.ng

Fay, M., and Toman, M. (2010, June). *Infrastructure and Sustainable Development*. Paper presented at Korea-World Bank High Level Conference on Post-Crisis Growth and Development, Busan, Korea.

Hertel, O., De Leeuw, F., Raaschou-Nielsen, O., Solvang J., S., Gee, D., Herbarth, O., Pryor, S.; Palmgren, F., and Olsen, E. (2001). Human exposure to outdoor air pollution. *IUPAC Technical Report. Pure and Applied Chemistry,* 73(6), 933–958.

Intergovernmental Panel on Climate Change (1996). Greenhouse gas inventory. *Reference Manual*. Vol. 3.

Mbamali, I, Stanley, A., and Zubairu, I. (2012). Environmental, health and social hazards of fossil fuel electricity generators: A users' assessment in Kaduna, Nigeria. *American International Journal of Contemporary Research*, 2(9), 237-254.

National Bureau of Statistics (2012). *Annual abstract of statistics.* Federal Republic of Nigeria, Abuja, Nigeria.

Obineche, C. (2015, August 30). Real reasons electricity is not stable in Nigeria. *Sunday Sun*, pp 17 – 19.

Odumosu, T., and Balogun, Y. (1999). *Lagos State in Maps.* Ibadan: REX Charles Publications.

Offiong, A. (2003). Assessing the economic and environmental prospect of standby solar powered system in Nigeria. *Journal of Applied Sciences and Environmental Management,* 7(1), 37 – 42.

Olaleye, S.O., and Akinbode, S.O. (2012). Analysis of households' demand for alternative power supply in Lagos State, Nigeria. *Current Research Journal of Social Science*, 4(2), 121-127.

Onochie, O. A. (2015, October 21). 41 percent of Nigerian businesses generate own power. NESG. *Newswatch Times*, p. 46.

Sambo A., Garba, B., Zarma, I. H., and Gaji, M. M. (2010). Electricity generation and the present challenges in the Nigerian Power Sector. Energy Commission of Nigeria, Abuja-Nigeria. 1-17. https://www.researchgate.net/publication/228399732

Sanusi, S. L. (2010, August). *Funding of power projects: The role of the Central Bank of Nigeria (CBN)*. Paper presented at the Conference of the National Association of Energy Correspondents (NAEC) on Gas to Power: Prospects and Challenges, Eko Hotels and Suites, Victoria Island, Lagos.

Smith, K., Mehta, S., and Maeusezahl-Fenz, R. (2004). Indoor air pollution from household use of solid fuels: Comparative quantification of health risks. In M. Ezzati, A. Rogers, A. and C. Murray (Eds.), Global and regional burden of disease attributed to selected major risk factors (pp. 1435-1439). Geneva: WHO.

Soladoye, O., and Yinusa, N. (2012). Assessment of groundwater quality in shallow wells in Ikorodu Local Government Area of Lagos State, Nigeria. *Asian Journal of Natural and Applied Sciences,* 1(4), 5-15.

Somefun, O. A. (2015). The erratic electric power supply in Nigeria: Causes and remedy. *Technical Report*. Department of Electrical and Electronics Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Akure. doi: 10.13140/RG.2.1.4755.8008.

Soubbotina, T. (2000). *Beyond economic growth: Meeting the challenges of global development* (Second Edition). Washington, DC: The World Bank Group.

Stanley, A. M. (2010). *Air pollutants concentration and noise levels from electric power generators.* Paper presented at the Seminar Series of Faculty of Environmental Design, Ahmadu Bello University, Zaria.

Stanley, A. M. (2011). *Environmental sustainability of fossil fuel generators for electric power supply to buildings.* Paper presented at the Faculty of Environmental Design, Ahmadu Bello University, Zaria.

World Health Organization (2008). *Children's health and the environment.* WHO Training Package for the Health Sector. Geneva: WHO.