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Hazards Assessment Analyses of Fossil-fuel Generators: Holistic-study of Human Experiences and Perceptions in South-Southern Nigeria

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ABSTRACT:

Users of fossil-fuel generators for electricity-supply to households/buildings/premises/apartments in Port-Harcourt, Uyo & Calabar metropolitan-cities [and environs] of Nigeria, with their Neighbours were repeatedly engaged for three (3) consecutive years, to determine their subjective-perceptions and experiences of the associated environmental, health, psycho-social, financial, security and safety hazards/issues etc. Field surveys/investigations were conducted on the study-area, which was segmented into three-hundred (300) settlement-clusters; then, tailor-suited questionnaires were administered to generator-users and their neighbours [as 'respondents']. After analyzing the data, research-findings revealed that: There is an overwhelming dependence on, and a prevalent/predominant use [80.1% of all

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68,400 households/buildings/premises/apartments surveyed in 3 years] of fossil-fuel generators in these cities and environs. Some generator-users are fully-aware and 'strongly-agree' that, there are related: Environmental-hazards [air-pollution (50.9%) and noise-pollution (48.8%) etc.]; Health-hazards [sleep-disturbance (84.6%), hearing-loss (67.1%), ophthalmic-problems (45.0%) & difficulty in mental-concentration (88.8%) etc.]; Psycho-social issues [quarrels/verbal confrontations (89.4.0%), reports to local-authority(ies)/mediation (6.4%), revenge-attempts (2.6%), forced-relocations (1.3%), arrests (0.2%) & litigation (0.1%) etc.]; Financial-implications [purchase-costs ranging from US$90.91 - ≥US$60,606.06 etc.]; Security concerns/challenges [the 5,500 reported cases of gunshot-violence i.e. 41.8% of all 13,158 generator-related crimes committed etc.]; and Safety-hazards [fire-incidences, fuel-ingestions and deaths accounting for 5.6%, 60.5% and 2.2% resp. of all 8,928 reported-cases of generator-use related accidents].

KEYWORDS: Fossil-fuel, Hazards, Generators, Electricity, Users, Neighbours.

1. Introduction

As Nigeria battles for the historic realization of her highly popularized Vision 2020:20, to ascend the world's stage for all-round global competitiveness; aside endemic corruption, national policy inconsistency, internal sabotage and the lack of synergistic political will; one of the greatest threats to the realization of this laudable dream is the seeming incapacity of its successive governments to provide adequate and uninterrupted electricity for country's current estimated 167 Million citizens, in fifty five (55) years of her existence as a sovereign national entity.

With the unbundling of the 'Power Holding Company of Nigeria' (PHCN) [being the nation's apex electricity body, and formerly known as 'National Electric Power Authority' (NEPA)] by the Federal Government of Nigeria (FGN) on 30th September 2013, paving the way for the establishment of eighteen(18) companies [comprising of ten (10) Generation Companies (GENCOs), five (5) Distribution Companies (DISCOs) and three

(3) Transmission Companies (TRANSCOs)], saddled with the responsibilities of respectively generating, distributing and transmitting electric power to the nation's teeming population; there still seems to be no end in sight to the Nigeria's erratic & epileptic power supply.

To underscore the continuously dwindling efficiency and effectiveness of 'PHCN' since its inception on 1st April 1972, it is noteworthy to cite that, "with an installed generating capacity of only 6,000MW [as against the 30,000MW estimated national peak demand], the PHCN could only provide a maximum of 3,000MW on the average, yet with transmission losses ranging from 30 – 50%" (Hall, 2006).

Without doubts, such a crisis situation of acute shortage in electricity supply has forced individuals, private businesses, corporate organizations, government agencies and academic institutions etc., to resort to Fossil-fuel electricity generators, as a means of privately providing electric power to meet their local consumption needs. This is in view of the comparatively low cost implications involved and the fact that fossil fuels [such as 'gasoline' and 'diesel'] are oftentimes readily available for purchase in all parts of the country.

The above ugly trend has led to a present situation in which an estimated sixty (60) Million plus Nigerians own and regularly run (use/operate) their own electricity generating sets. (ECN, 2009). A move that has earned Nigeria the infamous title of being "The World's largest importer of generators", and has largely contributed to her being "One of the largest importers of refined Petroleum products [such as 'PMS' and 'AGO'], in addition to the deplorable state of the nation's four (4) refineries. Little wonder, (The Vanguard Newspaper, 2009) published a statement credited to 'MAN' (Manufacturers Association of Nigeria) as follows: "In the previous year alone, the average residential

expenditure for fuelling electric-power generators in Nigeria climbed to an all-time high of $13.35 Billion (₦1.56 Trillion) per annum". Not to mention the whopping sum of $ 10.41 Billion (₦ 2.74 Trillion) spent by Nigeria's federal government on the Power sector, since the present democratic dispensation from 1999 to 2015. {Vanguard Newspaper; 9th September, 2015}. Such an alarming Energy crisis, We strongly believe greatly undermines the individual and collective leadership efforts aimed at achieving national Energy Security/Self-sufficiency and boosting Industrialization and ensuring rapid sustainable economic growth.

Now, for the purpose of proceeding in this study, we will define the following: "A hazard is any biological, chemical, mechanical, electrical, environmental or physical agent that is reasonably likely to cause harm or damage to humans, other organisms or the environment in the absence of its control". (www.en.wikipedia.org). "A Health Hazard is any chemical, organism, condition or circumstance for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur when (people) human-beings are exposed to it." (www.osha.gov.us, www.safety.nmsu.edu). "An Environmental Hazard is the state of events which has the potential to threaten the surrounding natural environment and adversely affect people's health, and includes pollution and natural disasters". (www.en.wikipedia.org). "Psychosocial Hazards are linked with the interrelationships between individual's thoughts and behaviours and their social environments". (Leka and Cox, 2008). "Fossil-fuel Generators also called Electricity Generators are devices that convert Mechanical energy to Electrical energy for use in an external circuit. The source of mechanical energy may vary widely from a hand crank to an internal Combustion Engine (ICE). (www.en.wikipedia.org). Oftentimes, these ICEs are basically fuelled by Petroleum-hydrocarbons such as 'Premium Motor Spirit (PMS)' commonly called 'Gasoline' and 'Automobile Gas oil (AGO)' commonly

called 'Diesel'------both which are products of fossilization; thus the name 'Fossil-fuel Generators' "

1.1 Hazardous Effects of [Fossil-Fuel] Electricity Generators

Aside the noise pollution, undesirable vibration impacts and heat generation that are usually associated with the normal operations of a running Electric power [Fossil-fuel] generator; countless research findings have clearly established and proven beyond all reasonable doubts that the combustion of fossil fuel in electricity generators have grave consequences on the natural environment, human health and several aspects of our psychological & socio-economic lives etc.

a) Environmental Hazards:

For environmental hazards consideration, beginning with the secondary (indirect) effects which basically are 'Climate Change (Global warming)' [with its numerous attendant negative impacts] and Secondary pollutants emissions [so-called because, they are deleterious products of the primary pollutants] and include acid rain, smog, Green House Gases (GHGs) and high ozone levels in the air we inhale. (US Sustainable Energy Strategy-Executive summary, 1995; www.en.wikipedia.org; IPPC, 2005). For instance in a country like the USA, accounting for less than five percent (< 5%) of the world's population, over ninety percent (> 90%) of all the world's GHG emissions, which come from the combustion of fossil fuels. (www.wikipedia.en.org).

Green House Gases (GHGs) like CO_2 (g) and Dinitrogen (I) Oxide [N_2O (g)] are emitted into the atmosphere from several sources/means including Fossil fuel combustion, which in conjunction with other GHGs like Water vapour [H_2O (g)], Methane [CH_4 (g)], Ozone [O_3 (g)], Hydrofluorocarbons [HFCs (g)], Perfluorocarbons [PFCs (g)] and SulphurHexafluoride [SF_6 (g)] are gradually resulting in disastrous climate change

consequences such as: adverse weather conditions, rising sea levels, drought, famine & shortages, unnatural death & extinction of some plants & animal species and unprecedented scales/magnitudes of flooding risks particularly in nations with large populations in the coastal regions (Steven Gilbert, 2011).

Also, the primary (direct) environmental effects are the principal air pollutions resulting from Fossil fuel combustion which are Carbon (II) Oxide [CO (g)], Sulphur Oxides [SO_X] such as Sulphur (IV) Oxide [SO_2 (g)] & Sulphur (VI) Oxide [SO_3 (g)], Nitrogen Oxides [NO_x], Unburnt Hydrocarbons and Particulate matters such Fine soot, Ash particles, Volatile Organic Compounds [VOCs] and Heavy metals. (US National Energy Strategy-Executive summary, 1991/1992; IPCC, 2005; www.en.wikipedia.org).

Now, for the purpose of this study, a pollutant is defined as a harmful substance which is not a natural constituent of the environment, or if occurring naturally, is present in abnormal high concentrations.

Having shown that one of the secondary (indirect) consequences of fossil-fuel combustion is 'Climate change' also known as 'Global warming', which amongst other things, consequently results in an increase in air temperature, which in turn has impacts on the distribution of 'Fauna' and 'Flora', thus affecting the space distribution of some vector-borne diseases. In addition, heat accumulation in urban centres, associated with the use of fossil-fuels, has adverse effects especially for old people (UNESCO-EOLSS, 2015).

b) Health Hazards:

Most of the health implications are the direct consequences of the environmental hazards, this is because, the highly toxic environmental pollutants from fossil-fuel combustion consequently lead us to the health hazards from these same fossil-fuel generators, this is

in view of the fact that, these pollutants they emit have claimed the lives of countless millions around the world and places enormous burdens on the health sectors of every nation. To validate this claim, the Scientific American in 2015 published what it tagged the 'Human Cost of Energy' in its publication entitled "The Healthcare Burden of Fossil Fuel" on Americans alone in the previous year, [as an excerpt from its September, 2011 issue]; as shown in the table below:

Table 1: U.S. Health-Burden Caused by particulate Pollution from Fossil-fuelled Power Plants (Generators)

S/No	Illnesses	Mean Number of Cases
1	Asthma (hospital admissions)	3,020
2	Pneumonia (hospital admissions)	4,040
3	Asthma (emergency room visits)	7,160
4	Cardiovascular ills (hospital admissions)	9,720
5	Chronic bronchitis	18,600
6	Premature deaths	30,100
7	Acute bronchitis	59,000
8	Asthma attacks	603,000
9	Lower respiratory ills	630,000
10	Upper respiratory ills	679,000
11	Lost workdays	5.13 million
12	Minor restricted-activity days	26.3 million

Diesel exhaust [like other fossil-fuels' exhausts such as that of 'Gasoline'] contributes to ambient sulfur oxides, nitrogen oxides, polycyclic aromatic hydrocarbons (PAHs), and trace metals are causative agents to mutagenicity, carcinogenic effects, as well as chronic respiratory morbidity and mortality ln living organisms. They are capable of changing the genetic message and can lead to cancer. In vitro studies on Sulphur (IV) oxide and its compounds explains its capability of altering DNA by deamination of cytosine (a

pyrimidine base). Chromosomal abnormalities has also be identified in pollen grains exposed to Sulphur (IV) oxide. The in vivo biochemical studies is still being unfolded, this is due to its optimal pH lower than physiological range (National Academy of Science, 1980). The major compound of nitrogen formed in fossil-fuel combustions are nitric oxide and nitrogen (IV) oxide. Although their mutagenicity still remains conjectural. However, atmospheric reaction with these oxides will produce certain mutagenic agent. Example is nitrous acid which is capable of causing deamination of guanine, adenine, cytosine, and cross-linking of the DNA. Another product from the atmosphere is nitrosamines, known for is carcinogenicity in laboratory animals (National Research Council, 1980).

With regard to Trace Metals, according to the book written by National Academic of Science 1980, Continuous combustion of fossil -fuel will increase the emission of anthropogenic arsenic, chromium and cadmium. There are no clear evidence on their mutagenic abilities (James and Jacqueline, 2013). The major toxicity of Polycyclic Aromatic Hydrocarbons (PAHs) and Oxygenated Polycyclic Aromatic Hydrocarbons (OPAHs) is the cause of cancer through mutagenesis. Many chemicals in diesel engine exhaust can damage DNA (the material that controls the growth and development of living cells). This damage could lead to the unregulated growth of cells and possibly result in cancer. The initial step in cancer development is thought to be the transformation of some chemicals, such as those found in diesel-engine exhaust, into substances that react with DNA. These combinations of chemicals and DNA, known as DNA adducts, may change the genetic message and lead to cancer. (James and Jacqueline, 2013; Choy, 2001). Below is a table showing the USEPA 2011 recommended human exposure limits to some PAHs [usually emitted into the atmosphere during fossil-fuel combustion].

Table 2: USEPA recommended human exposure limits to some PAHs

S/No	PAHs	Exposure limits (ng/m^3)
	Dibenz{a,h}anthracene	≤ 580
	Benzo{a}pyrene	≤ 640
	Benzo{b}flouranthene	≤ 6400
	Benzo{k}flouranthene	≤6400
	Indenol{1,2,3-c,d}pyrene	≤ 6400
	Benz{a}anthracene	≤6400
	Naphthalene	≤30,000
	Chrysene	≤64,000

In addition, health conditions and symptoms such as Headache, Nausea and Unconsciousness have been linked to less than ten (< 10) hours human exposure to 100 – 300ppm of [CO (g)], which is a typical primary (direct) air pollutant emitted during fossil-fuel combustion. While, 1-4 hours human exposure can result in Unconsciousness and outright death. (US National Energy Strategy-Executive summary, 1991/1992). Also, apart from the fact that NO_x depletes the Ozone layer, Bronchiolitis, a dangerous disease has been traced to a human exposure of 150 – 200ppm of it [NO_x], within 3 – 5 weeks of this exposure. (Dimari et al, 2007)

The main diverse effects on human health of atmospheric pollution resulting from fossil-fuel combustion [whether or not from electricity generators] are: Ophthalmic problems, Skin injuries, Gastro-intestinal, Cardio-vascular and Respiratory diseases and some types of Cancer. Also, certain effects on the nervous system have been associated with high levels of 'CO (g)' in the air. (UNESCO-EOLSS, 2014)

Furthermore, using an IMR-1400 Combustion gas Analyzer and a digital Sound level meter, (Stanley, 2011) observed that the indoor and outdoor sound levels emitted by

fossil-fuel generators running (operated) in Kaduna-------a big city in North-western Nigeria, oftentimes exceeded the WHO acceptable limits of 70dB(A) for normal discussions and 30dB(A) for sleeping and resting. These excess decibels [in the form of localized noise pollution] have been shown to account for extreme emotional outbursts & behavioural attitudes, high blood pressure and abnormal development of the feotus. (Stanley, 2011).

c) Other Hazards/Issues:

Besides the environmental and health hazards associated with the combustion of fossil-fuels in electricity generators, scholarly research literatures have progressively revealed that there are other issues of concern that call for urgent attention. These include Psycho-social hazard/issues [like frosty (strained) and severed relationships between generator users and their neighbours]; financial pressures/implications/expenses [like the considerable sums of monies expended to purchase, install, continuously run, regularly service and periodically repair the generators]; in addition to the several financial implications, safety hazards, security concerns and psychological effects/considerations that are traceable to its operations and routine maintenance, which will be briefly highlighted now and extensively treated later in this work.

A psychosocial hazard is any hazard that affects the mental well-being or mental health of a person and may have physical effects by overwhelming the individual coping mechanisms and impacting the person's ability to live in a healthy and safe manner. Although these issues have been around for many years, Psycho-social hazards are only now being recognized as potential workplace hazards. The hazards generally are not from physical things that you can see (like a saw blade) or smell (like paint). Rather, many of these hazards come about as a result of interactions with others. In some cases, the hazard is brought into the home from the environment. There are often no obvious

outward signs of the effects of exposure and the methods to control these hazards are somewhat different than methods used to control other traditionally known hazards. (www.work.alberta.ca).

A Security breach is an act from outside an/a organization / household / building / premises / apartment that bypasses or contravenes security policies, practices, or procedures. A similar internal act is called security violation. On the other hand, a crime is any harmful act or omission against the public which the State wishes to prevent and which, upon conviction, is punishable by fine, imprisonment, and/or death. No conduct constitutes a crime unless it is declared criminal in the laws of the country. Some crimes (such as theft or criminal damage) may also be civil wrongs (torts) for which the victim(s) may claim damages in compensation. (www.businessdictionary.com).

1.2 Statement of the Problem (Justification)

The seeming lack and vivid scarcity or outright unavailability of a single authoritative and highly comprehensive research publication on the multiplicity of the attendant Environmental, Health, Psychosocial, Financial, Security & Safety hazards and other Issues associated with the use (operation) of fossil-fuel generators in Nigeria; and particularly covering a Large study-area, [like a cluster (combination) of several states or at least even a cluster (combination) of several metropolitan cities & their respective environs]; from the strategic viewpoints of practically examining, comprehensively documenting, and then critically & holistically analyzing the generators users' and their neighbours' perceived opinions (perceptions) and recorded historical experiences etc.; has been the primary motivation for this elaborate research work.

1.3 Aim of the Study

To critically & holistically analyze the documented perceived opinions (perceptions) and factual experiences of generators' users and their Neighbours on the Environmental, Health, Psychosocial, Financial, Security & Safety hazards and other Issues associated with the independent use (operation) of fossil-fuel generators for electricity supply to households/apartments/buildings/premises in Nigeria's metropolitan cities of Port-Harcourt, Uyo & Calabar and their respective environs.

1.4 Objectives of the Study

In order to achieve the above aim, the understated objectives will be pursued:

- To provide a highly comprehensive list of the multiple hazardous exposures and numerous negative issues/concerns associated with the use (operation) of fossil-fuel generators, and to suggest ways to mitigate them.
- To conduct field studies in order to systematically examine and exhaustively document the subjective awareness-levels of generators' users and their Neighbours concerning the Environmental, Health, Psychosocial, Financial, Security & Safety hazards and other Issues etc., associated with the use of fossil-fuel generators for electricity supply
- To carefully determine their individual risk assessment-ratings (indices) of the generator-use related unsafe acts and environmentally-unfriendly practices.
- To provide a robust database [of the occurrence-frequencies (rates)] of all generator-use related accidents and crimes/security-breaches reported to have occurred within the three (3) year study-period.
- To outline the root causes of the crippling power (energy) crises in Nigeria, and to proffer far-reaching solutions to gradually checkmate the dire situation.

1.5 The Study-Area

The Study-area is a part of the Niger-delta region of Nigeria, consisting of the metropolitan capital cities [Port-Harcourt, Uyo & Calabar and Environs] of some three (3) states [Rivers, Akwa-Ibom & Cross-river] in the South-Southern geo-political zone of the country. Being predominantly a natural combination of several oil-rich plateaus, lowlands, islands and water-bodies etc., it occupies a total land [mass] area of 39,262 Km^2 and accommodates a combined estimated population of 11,993,755 people, according to the year 2006 census figures. Now, for the purpose of specificity of details, we shall now proceed in this study, by briefly discussing each of these three big cities and listing some of the surrounding major towns in their immediate neighbourhoods, that make-up their respective environs; below as follows:

a) *'Port-Harcourt' Metropolis and Environs*

Established in 1912, Port-Harcourt is the capital city of Rivers state [and the un-official capital of the Niger-delta region & South-south geo-political zone of Nigeria]; whose current metropolitan status spans beyond eight (8) local governments of the state. It is located on latitude 04° 47' 21" N and longitude 06° 59' 54" E and has a population of 1,947,000 people, according to year 2012 census figures, [ranking as the fifth (5th) most urbanized city in Nigeria, lagging behind Lagos, Kano, Ibadan, and Abuja respectively; and occupying an area of 360km^2, popularly nicknamed "Nigeria's Garden City", it is known as the "[Petroleum] Resource Capital City of Nigeria", being the chief oil refining city in the country [presently processing around 210,000 barrels of crude oil daily]; and accommodating high profile offices of IOCs such as the Royal Dutch Shell (SPDC), Chevron-Texaco, Total-Fina-ELF, Mobil and Agip etc; aside the several multinational companies, a host of manufacturing Industries, national agencies and international bodies/organizations domiciled in the city. Furthermore, it boasts of an international airport, an aerodrome, an ultra-modern stadium, a sports village and at least two universities etc. Assuming the status of a fast growing major national industrial hub, accommodating a considerably high volume of socio-economic activities and being a

beehive of commercial activities, Port Harcourt is a dreamland for most job-seekers and young school-leavers from various states of Nigeria; thus, it has a reasonably high population density. However, like most big cities in Nigeria, it is not spared from the nation's debilitating power crisis, since it is also plagued by the blighting scourge of an erratic and epileptic electricity supply; unarguably forcing majority of its approximately two million (~2,000,000) residents to basically resort to fossil-fuel generators as their main (primary) alternative to meet their ever rising energy demand and energy supply-deficit in a non-stationary 21st century world. Some of the economically-viable towns/local government areas [with considerable human populations] that are strategically located within its surrounding neighbourhood, and are considered of interest to us in this study are Oyigbo, Onne, Ahoada, Eleme, Omagwa, Okrika, Etche, Tai, Ikwerre, Bori-Ogoni, Elele, Degema, Aluu, Opobo, Ndoni, Gokana, Andoni, Emohua and Bonny-Island.

b) '*Uyo' Metropolis and Environs*

Emerging as the capital city of Akwa-Ibom state, following the state's creation [after being carved out from the old Cross-river state] on 23rd September, 1987; it sits on a land area of 115Km^2, with a longitude of 07° 54′ 34″N and a latitude of 05° 02′ 20″E, while having a population of 436,606 people, according to year 2006 census figures. It is a key player to Nigeria's oil & gas exports, sitting atop a vast amount of the nation's petroleum resource deposits. With the aggressive developmental strides of its successive governments, it has gradually emerged as a metropolitan city boasting of an Olympic-size stadium, an international airport, two (2) universities, high profile offices of some international Oil Companies and numerous sites of attraction for tourists. Some of the economically viable neighbouring towns with sizeable human population [in its environs] that are of interest to us in this study include: Eket, Oron, Ikot-Ekpene, Itu, Etinan, Abak, Ibiono-Ibom and Ikot-Abasi.

c) *'Calabar' Metropolis and Environs*

Being the headquarters of Nigeria's eastern Naval command, it is presently the capital city of Cross-river state; [but was formerly the seat of government of the then Niger coast protectorate, Southern protectorate and oil-River protectorate ----------earning it the famous title of "Nigeria's first ever capital city"]. Dating prior to the 16th century, it has been reputed as a recognized international seaport for the trade of palm oil and slaves etc., during the Atlantic slave trade era. Its geographical coordinates are Latitude 04° 34' 27"N and Longitude 06° 58' 32" E and has a population of 461,796 people according to year 2006 census figures; and occupies an area of 406Km^2. It is a littoral city with vast untapped maritime-economic potentials. Widely acclaimed as "Nigeria's cleanest city", in addition to its rising tourism potentials, it is usually awash with tourists from various parts of the world all year round------making it the nation's tourism hub and a leading tourism destination on the African continent. Its economy also features an active oil and gas sector, but at the moment, many of its oil wells have been ceded to its neighbouring [daughter] state of 'Akwa-Ibom'. As a large metropolitan city, it boasts of a Free Trade Zone (FTZ), an international airport, a seaport, an ultra-modern stadium, several universities and a number of resort & amusement parks etc. Some of the economically viable neighbouring towns with sizeable human population [in its environs] that are of interest to us in this study include: Uyanya, big-Iwuru, Akpet-central, Apiapum, Antigha, Ugep, Nko, Akpakum, Etighide, Ogoja, Okurikan, Ikom, Odukpani-central ("Eight-miles"), Akpa-okoyong, Ikot-nakanda and Obudu.

Figure 1A: Map of Niger-delta region of Nigeria showing the study-area [comprising of three states (Rivers, Akwa-Ibom and Cross-River) and their metropolitan capital cities (Port Harcourt, Uyo and Calabar)]:

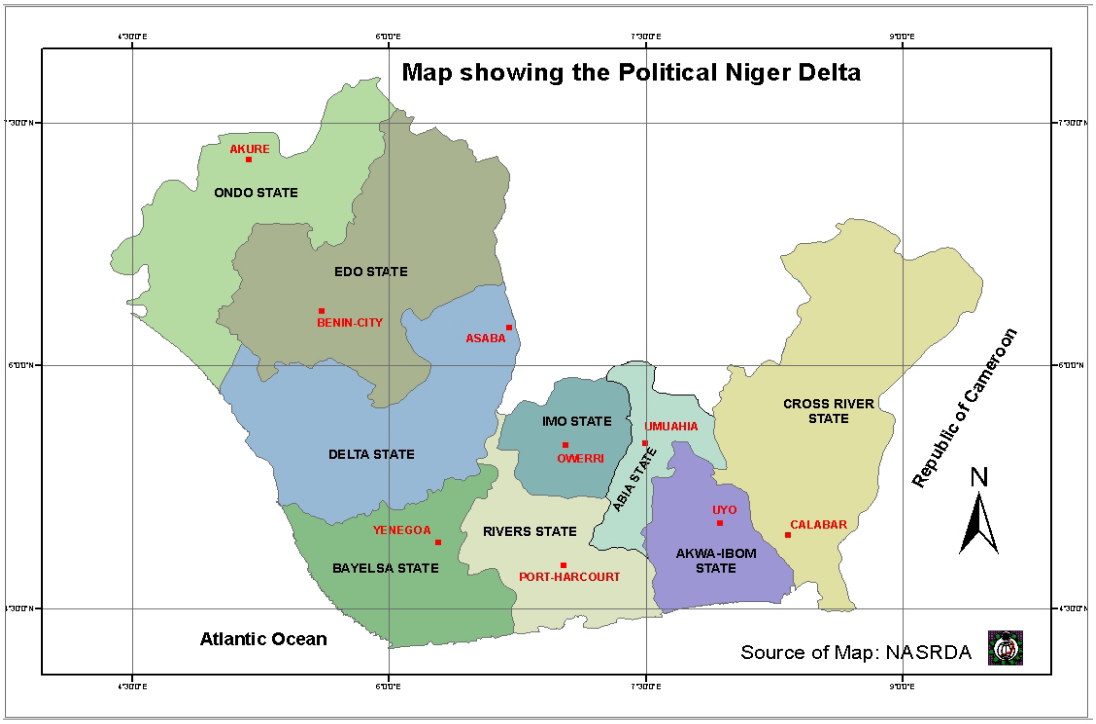
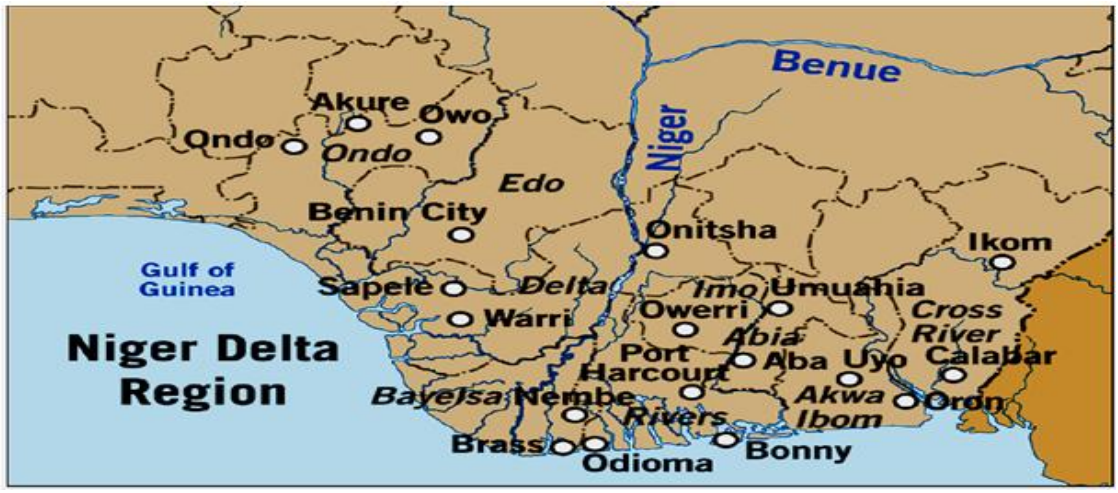


Figure 1B: Map of Niger-delta region of Nigeria showing the study-area [comprising of three (3) states (Rivers, Akwa-Ibom and Cross-River) with their capital cities (Port Harcourt, Uyo and Calabar) and some major towns]:



1.6 Preliminary Surveys

Three (3) yearly Preliminary random surveys of households / apartments / buildings / premises in the three (3) cities [Port-Harcourt, Uyo, Calabar & environs] that make-up the Study-area, were conducted, in order to ascertain their annual generator-possession-and-usage-status; as a necessary pre-condition, prior to the actual commencement of the research project, considering the project's peculiarities and scope. Consequently, the investigation team consecutively surveyed 120,000; 108,000 and 90,000 households/apartments/buildings/premises, out of which only 102,108; 91,044 and 72,090 were actively using fossil-fuel generators during years '2013', '2014' and '2015'; respectively. This informed the investigation-team's decision to produce and administer 72,000 questionnaires at the end of the third year. Now, the other details of these 'Preliminary [random] surveys' are summarily reported below as follows:

Table 3: Preliminary random surveys of the study-area for possession & usage status of fossil-fuel Generators

S/No	Classification (Type) of generator-User	Description of generator-User characteristic(s)	Year 2013 Field-Visit prior to the study		Year 2014 Field-Visit prior to the study		Year 2015 Field-Visit prior to the study	
			Specific No.	% of Total No of [households/ apartments/ buildings/ premises] Surveyed	Specific No.	% of Total No of [households/ apartments/ buildings/ premises] Surveyed	Specific No.	% of Total No of [households/ apartments/ buildings/ premises] Surveyed
1.	Active User	• Presently using a generator	102,108	85.4	91,044	84.3	72,090	80.1

2.	Inactive Users	• Initially (formerly) using (running or operating) a fossil-fuel generator, but recently stopped temporarily, for one or more reasons. • Are working hard to continue the use of generators soonest, under the appropriate conditions.	1,320	1.1	2,808	2.6	1,980	2.2
3.	Passive Users	• Not actually using a generator • But [may be a neighbor who is] directly benefiting from a User; in certain way(s), such as charging of GSM-phones and rechargeable lamps & torches etc.	8,640	7.2	7,344	6.8	9,270	10.3
4.	Intending Users	• Planning (intending) to start using (operating) a generator in the near future, as soon as	2,760	2.3	2,160	2.0	1,980	2.2

		finances are in place.						
5.	Non-Users	• Not presently using a generator. • Not directly benefiting from a User; in any way, such as charging of GSM-phones and rechargeable lamps & torches etc. • Not and never planning (intending) to use a generator, at any time in the foreseeable future. • Not and never planning (intending) to directly benefit from a User, at any time in the foreseeable future.	4,800	4.0	4,644	4.3	4,680	5.2
TOTAL NUMBER of all households/apartments/buildings/premises surveyed prior to the study			**120,000**	**100.0**	**108,000**	**100.0**	**90,000**	**100.0**

Consequently, at the end of three consecutive years [2013 – 2015] of repeated field-visits, it was inferred that:

Potential Users = (Active Users) + (Inactive Users) + (Passive Users) + (Intending Users) - - - - - - - - - - - - - - - Axiom 1

Potential Users = 72,090 + 1,980 + 9,270 + 1,980 = **85,320**

Potential Users =85,320 [=**94.8%** of all 90,000 households/apartments/buildings/premises surveyed prior to study]

Figure 2: Classification (Type) of Generator-User

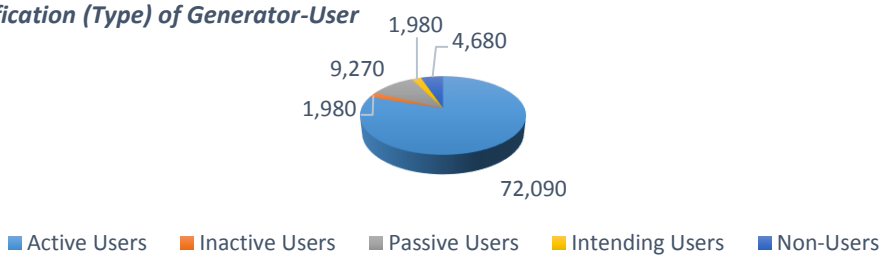


Table 4: Yearly updates on progressive Activity-history for Questionnaires administered during the three (3)-Year study period.

S/No	Activity	Sub-Activity	Year 2013	Year 2014	Year 2015
1.	Administering of Questionnaires	(i) Number of User-respondent Questionnaires administered (ii) Number of Neighbour-respondent Questionnaires administered (iii) Total number of all Questionnaires administered	51,250 51,250 **102,500**	45,000 45,000 **90,000**	36000 36000 **72,000**
2.	Determination of Number of missing Questionnaires	(iv) Number of User-respondent Questionnaires not returned (v) Number of Neighbour-respondent Questionnaires not returned (vi) Total number of all Questionnaires not & never returned or collected	4,708 6,016 **10,724**	3,414 5,052 **8,466**	990 582 **1,572**

3.	Determination of Number of filled & returned Questionnaires	(vii) Number of User-respondent Questionnaires filled & returned by Users (viii) Number of Neighbour-respondent Questionnaires filled & returned by Neighbours (ix) Total number of all Questionnaires filled & returned	46,542 45,234 **91,776**	41,586 39,948 **81,534**	35,010 35,418 **70,428**
4.	Discarding of some returned Questionnaires	(x) Number of Neighbour-respondent Questionnaires discarded By the investigation team At the end of each year (xi) Number of Neighbour-respondent Questionnaires discarded By the investigation team At the end of each year (xii) Total number of all Questionnaires intentionally discarded for the purpose of numerical-equality of both Users and Neighbours; and a host of other reasons.	0 0 **0**	0 0 **0**	810 1,218 **2,028**
5.	Final decisions on which the of filled & returned Questionnaires are to be analyzed	(xiii) Number of [the same identity] Users, consecutively visited & examined thrice, [From year 2013 to 2015]; having three (3) different Questionnaires retrieved (Collected) during each of these three (3) separate years, and eventually collated & analyzed (studied) by the Investigation team, at the end of the third year [2015] (xiv) Number of [the same identity] Neighbours, consecutively visited & examined thrice, [From year 2013 to 2015]; having three (3) different Questionnaires retrieved (Collected) during each of these three (3) separate years, and eventually collated & analyzed (studied) by the Investigation team, at the end of the third year [2015] (xv) Total number of all [the same identity] respondents consecutively Visited & Examined thrice, [from year 2013 to 2015]; having three (3) different Questionnaires Retrieved (collected) during each of these three (3) separate years, and eventually Collated & analyzed (studied) by the Investigation team, at the end of the third year [2015].	0 0 **0**	0 0 **0**	34,200 34,200 **68,400**

2. Materials and Method

- **Segmentation of the Study-area:**
- **Preliminary Random Survey:**
- **Purposive Sampling:**
- **Field studies/investigations:**
- **Statistical-analysis of field data:**

2.1 SEGMENTATION OF THE STUDY-AREA:

At the beginning of this investigation on 1st January 2013, the three (3) metropolitan cities that constitute the study-area were segmented as follows:

(a) Port-Harcourt City [and its environs i.e. economically viable surrounding towns/local government areas such as: Oyigbo, Onne, Ahoada, Eleme, Omagwa, Okrika, Etche, Tai, Ikwerre, Bori-Ogoni, Elele, Aluu, Opobo, Ndoni, Gokana, Andoni, Emohua and Bonny-Island etc.] in Rivers state; were carefully segmented (fragmented) into a first (1st) set of One Hundred (100) settlement-clusters.

(b) Uyo City [and its environs i.e. economically viable surrounding towns such as: Eket, Oron, Ikot-Ekpene, Itu, Etinan, Abak, Ibiono-Ibom and Ikot-Abasi etc.] in Akwa-Ibom state; were carefully segmented (fragmented) into a second (2nd) set of One Hundred (100) settlement-clusters.

(c) Calabar City [and its environs i.e. economically viable surrounding towns such as: Uyanya, big-Iwuru, Akpet-central, Apiapum, Antigha, Ugep, Nko, Akpakum, Etighide, Ogoja, Okurikan, Ikom, Odukpani-central ("Eight-miles"), Akpa-okoyong, Ikot-nakanda and Obudu etc.] in

Cross-river state; were carefully segmented (fragmented) into a third (3rd) set of One Hundred (100) settlement-clusters.

Thus, giving rise to a total of Three Hundred (300) settlement-clusters in all, so as to ensure an effective, detailed & grass-root study; and to generate a robust database of useful information needed for the critical-holistic analysis.

2.2 PRELIMINARY RANDOM SURVEY:

As was earlier stated, there were three (3) consecutive Preliminary Random Surveys conducted on some 120,000; 108,000 and 90,000 households/apartments/buildings/premises respectively; which [as at the time of this study] were located in the Three Hundred (300) settlement-clusters, obtained from the segmentation of the study-area; to ascertain their respective generator-possession-and-usage-status, during year 2013, year 2014 and year 2015 respectively; [which is explicitly stated in 'Sub-section 1.6' above].

2.3 PURPOSIVE SAMPLING:

At the end of the third year 2015, from each of these Three Hundred (300) settlement-clusters [mentioned in step '2.1' above], one hundred and twenty (120) households/apartments/buildings/premises per settlement-cluster, were initially chosen [i.e. selected & considered] as temporary case-samples; after which, on an afterthought, only a sum total of one hundred and fourteen (114) households/apartments/buildings/premises per settlement-cluster, were finally chosen [i.e. selected & considered] as ideal case-samples.

NOTE:

The major considerations (factors) for selection of a household/apartment/building/premises as an ideal 'case-sample', included among other things geographical spread, comparative degree of accessibility,

availability of a "conjugate User-Neighbour Pair", relative frequency of usage (operation) of generator and willingness to co-operate with the investigation team.

2.4 FIELD STUDIES/INVESTIGATIONS:

Field studies/investigations were conducted, by means of administering identical copies of a tailor-suited questionnaire to the city's residents that compose (make-up) the target study-group; within a study period of thirty-six (36) months, from 1st January 2013 – 31st December 2015.

NOTES:

(a) It was during each of these three (3) annual Field studies/investigations, that the investigation team embarked on fact-finding visits to each of the prospective/ideal case-samples [i.e. study-households/apartments/buildings/premises]; during which, two (2) questionnaires were purposively administered for each of these study-households/apartments/buildings/premises; i.e. one to the generator-user [as the 'first respondent'] and another to the generator-user's proximate neighbour [as the 'second respondent']. At the end of the third year 2015, this finally amounted to 288 relevant questionnaires per settlement-cluster [i.e. 114 generator-Users & 114 Neighbours], and 68,400 in all.

(b) It is noteworthy to recall [from 'Table 4' above] that, in the third year 2015, out of the total of seventy-two thousand (72,000) questionnaires produced and administered to only those same-identity respondents, who were engaged in the last two (2) previous years [i.e. both 'year 2013' and 'year 2014' respectively]; as many as 70,428 were duly completed and promptly returned/retrieved from respondents; from which, only 68,400 were subsequently analyzed; representing an effective net response profile of 95.0%.

(c) For each of the three (3) yearly surveys conducted, in instances, where the respondents [i.e. Users or Neighbours] eventually did not or could not complete the filling of the questionnaires, the investigation team members first determined if this was as a result of personal unwillingness or the level of literacy (education) [on the part of the respondent]; after which they [the investigation team members] either found another

willing respondent or directly interrogated the unlearned but willing respondents, and consequently helped them to fill the questionnaires.

(d) Also, follow-up teams of research-experts and trainee-researchers carefully re-traced the study-routes to mop-up whatever work was left undone, before it was deemed fit to conclude the survey-process at the end of each of these three (3) years.

(e) Among other things, this purpose-adapted identical questionnaires carefully considered (addressed) the following critical issues/subjects below:

I.Respondents' and Generators' Particulars (Details):

- Respondents' Personal Profile
- Generator Ownership Status, Fuel-type and Basic Considerations
- Generator Technical Specifications and Usage Information

II.Health Hazards/Conditions:

- External Health Hazards linked to Generator Usage
- Internal/Biological Health Issues linked to Generator Usage
- Sick Building Syndrome (SBS) Signs and Symptoms triggered and/or aggravated by Generator Use

III.Environmental Hazards/Issues:

- Consequences of Running (Operating) A Generator on the Environment
- Direct Effects/Impacts of Generator-use on Building surfaces and structures

IV.Psychosocial Issues/Considerations:

- Neighbours' Opinions, Complaint and Actions towards Users' Attitudes and Responses
- Users' Opinions, Attitudes and Responses towards Neighbours' Complaints and Actions

V.Financial Issues:

- Cost Implications of Possessing and Running (Operating) a Generator at Off-Peak (Normal) Periods
- Estimated Cost-Increments of Replacing and Running (Operating) an old Generators, incurred by only User-Respondents at Special Seasons

- Estimated Cost-Discounts on Replacing and Installing New Generator, Enjoyed by only User-Respondents for Special Reasons

VI. Security [& Psychological] Concerns:

- Users' and Neighbours' Perceived Opinions on possibility/likelihood of Security threats/breaches arising from Generator-use (operation)
- Reported Cases of Security breaches/lapses and Crimes arising from Generator-use (operation), that were Perpetuated during the thirty-six (36) months of this Study

VII. Safety Concerns:

- Users' Perceptions of Risk Assessments of Unsafe Acts and Environmentally-unfriendly Practices related to Generator Use
- Reported Cases of Generator-use related Accidents that occurred during the thirty-six (36) months of this Study

VIII. Psychological Opinion-poll:

- Users' General Perceptions on the seemingly indispensable role that 'Generators' currently play in the lives
- Users' and Neighbours' Suggestions for the Mitigation of Generator-Use related Hazards in Nigeria
- Users' and Neighbours' Suggestions to Salvage the Power Sector in Nigeria.

(f) For each of the individual same-identity respondent [i.e. generator-User or Neighbour] repeatedly engaged in the 3 years:

I. <u>For every Question requiring only a "Numerical-Answer":</u>

- If the respondent choose a particular numerical-Answer thrice for all three (3) years consecutively, then that same Answer was finally adopted & used for analysis at the end of the third year 2015.
- If the respondent choose a particular numerical-Answer twice and then a different answer once, separately within these three (3) years, [irrespective of order]; then that very Answer that appeared twice was finally adopted & used for analysis at the end of the third year 2015.

- If the respondent choose a three (3) different numerical-Answers for each of the three (3) years; then the Final "Answer-Value" adopted & used for analysis at the end of the third year 2015, was the simple average of the three (3) years' characteristic 'answer-value'; calculated using the formula below:

$$\textbf{Final "Answer Value"} = \frac{(\textbf{Year 2013 Answer Value}) + (\textbf{Year 2014 Answer Value}) + (\textbf{Year 2015 Answer Value})}{\mathbf{3}}$$

II. **<u>For every Question requiring only a "Theoretical-Answer":</u>**

- If the respondent choose a particular theoretical-Answer thrice for all three (3) years consecutively, then that same Answer was finally adopted & used for analysis at the end of the third year 2015.
- If the respondent choose a particular theoretical-Answer twice and then a different answer once, separately within these three (3) years, [irrespective of order]; then the very Answer that appeared twice was finally adopted & used for analysis at the end of the third year 2015.
- If the respondent choose a three (3) different theoretical-Answers for each of the three (3) years; then integers were assigned to each of its available (provided) Theoretical Answer-Option from top-to-bottom, in an ascending order [starting from '1'], so as to obtain the "Year 2013 Answer-Option Integer (AOI)", "Year 2014 Answer-Option Integer (AOI)" and "Year 2015 Option Answer-Integer (AOI)" respectively.

After which, the Simple-Average of these three (3) years' Answer-Option Integers (AOIs) [whether the-same or different in numerical-value] was calculated to be the "Final Answer-Option Integer (AOI)" [to be used for analysis]; using the formula below:

$$\textbf{"Final AOI"} = \frac{(\textbf{Year 2013 AOI}) + (\textbf{Year 2014 AOI}) + (\textbf{Year 2015 AOI})}{\mathbf{3}}$$

COMBINED EXTRACTS FROM "YEAR 2013 QUESTIONNAIRES" OF THREE DIFFERENT RESPONDENTS AND FINAL ANALYSIS SHEET						
Question-No.	Question	Answer-Options	Tick your choice Answer-Option as appropriate			**Answer-Option Integer (AOI)**
			1st Respondent	2nd Respondent	3rd Respondent	
11A6.	As a neighbor, what was the most recent & major reaction and/or counter-action you took, due to your regular exposures to hazards from the generator of the person(s) in the next room/apartment/building/premises (compound)?	(i) Quarrel/verbal confrontation	√			**1**
		(ii) Reported to local authority(ies)/mediation				**2**
		(iii) Made an arrest, at least once		√		**3**
					√	**4**
		(iv) Litigation				**5**
		(v) Revenge attempt				**6**
		(vi) Relocation				

COMBINED EXTRACTS FROM "YEAR 2014 QUESTIONNAIRES" OF THREE DIFFERENT RESPONDENTS AND FINAL ANALYSIS SHEET						
Question-No.	Question	Answer-Options	Tick your choice Answer-Option as appropriate			**Answer-Option Integer (AOI)**
			1st Respondent	2nd Respondent	3rd Respondent	
11A6.	As a neighbor, what was the most recent & major reaction and/or counter-action you took, due to your regular exposures to hazards from the generator of the person(s) in the next room/apartment/building/premises (compound)?	(vii) Quarrel/verbal confrontation	√			**1**
		(viii) Reported to local authority(ies)/mediation				**2**
		(ix) Made an arrest, at least once		√		**3**
		(x) Litigation			√	**4**
		(xi) Revenge attempt				**5**
		(xii) Relocation				**6**

[Followed by an approximation (rounding-up) to the nearest whole number where necessary].This is illustrated with a question [from Table 16], as shown below:

COMBINED EXTRACTS FROM "YEAR 2015 QUESTIONNAIRES" OF THREE DIFFERENT RESPONDENTS AND FINAL ANALYSIS SHEET						
Question-No.	Question	Answer-Options	Tick your choice Answer-Option as appropriate			**Answer-Option Integer (AOI)**
			1st Respondent	2nd Respondent	3rd Respondent	
11A6.	As a neighbor, what was the most recent & major reaction and/or counter-action you took, due to your regular exposures to hazards from the generator of the person(s) in the next room/apartment/building/premises (compound)?	(i) Quarrel/verbal confrontation (ii) Reported to local authority(ies)/mediation (iii) Made an arrest, at least once (iv) Litigation (v) Revenge attempt (vi) Relocation	√	√	√	**1** **2** **3** **4** **5** **6**

Thus, the final answers [to "Question 11A6"] adopted & analyzed for:

- 1st Respondent = '1', i.e. "Quarrel/verbal confrontation"
- 2nd Respondent = '2', i.e. "Reported to local authority(ies)/mediation"
- 3rd Respondent = $'\text{Final AOI}' = \frac{(4) + (5) + (6)}{3} = \frac{15}{3}$

= '5', i.e. "Revenge attempt.

2.5 STATISTICAL-ANALYSIS OF FIELD DATA:

(a) Step 1:

(i) For questions in the questionnaire, requiring either a 'YES' or a 'NO' as the answers; the empirical data acquired were simply analyzed by computation of the percentages.

(ii) For questions requiring other personal opinions based on the options provided in the questionnaire, the empirical data acquired were also analyzed simply by computation of the percentages.

(iii) For questions in the questionnaire, requiring the subjective evaluations (assessments) of ` certain aspects of the generators' operational issues, based on the Likert Five-point Summation Method (Likert's scale) ranging from a minimum value of '1' to a maximum value of '5'; the empirical data acquired were carefully analyzed by calculation of the Arithmetic mean values.

(b) Step 2:

Below is the 'Weighted Mean Model' which has was employed to statistically obtain the weighted average empirical values for of '(iii)' in '**STEP 1**' above.

$\underline{\times} = \frac{\Sigma fx}{\Sigma f}$ - - - - - - - - - - - - - -equ.1

Let,

f = the frequency of the respondents' choice of each point on the Likert's scale.

x = the distinct choice of each respondent on the Likert's scale [=1, 2, 3, 4, and 5]

Where,

'1' corresponds to 'strongly agree'

'2' corresponds to 'Agree'

'3' corresponds to 'Undecided'

'4' corresponds to 'Disagree'

'5' corresponds to 'Strongly disagree'

$\underline{\times}$ = the overall Mean.

3. Results and Discussion

3.1 Results:

Below are twenty (20) tables [Tables '5'– '24'] and seven (7) figures [Figures '2A' – '2F', and '3'], in which are clearly presented the collated empirical data acquired from the questionnaires during field trip observations and investigations. Also, contained herein are the results obtained from the statistical analysis of these data.

Table 5: Respondents' Personal Profile

S/No	Variable Information	Individual status/choice/option	Observational/Occurrence Frequency	
			(No)	(%)
1.	Age [in years]	(i) ≤ 18	6,840	10.0
		(ii) 19 – 25	13,680	20.0
		(iii) 26 – 35	27,360	40.0
		(iv) 36 – 50	17,100	25.0
		(v) ≥ 50	3,420	5.0
		TOTAL	**68,400**	**100.0**
2.	Citizenship (Nationality)	(i) Nigerian	67,648	98.9
		(ii) Non-Nigerian (Foreigner)	752	1.1
		TOTAL	**68,400**	**100.0**
3.	Gender (Sex)	(i) Male	51,642	75.5
		(ii) Female	16,758	24.5
		TOTAL	**68,400**	**100.0**
4.	Marital Status	(i) Single	46,238	67.6
		(ii) Married	22,162	32.4
		TOTAL	**68,400**	**100.0**
5.	Vocation	(i) Self-employment	11,354	16.6
		(ii) Private sector	15,116	22.1
		(iii) Public/Civil Service	20,520	30.0
		(iv) Multinationals & Int'l Orgs.	7,114	10.4
		(v) Politics/Corporate governance	616	0.9
		(vi) Others	13,680	20.0
		TOTAL	**68,400**	**100.0**
6.	Highest level of Education attained	(i) Tertiary	60,739	88.8
		(ii) Secondary	6,498	9.5
		(iii) Basic (Primary)	1,094	1.6
		(iv) None	69	0.1
		TOTAL	**68,400**	**100.0**
7.	Number of Years of residence in the city	(i) < 1	12,312	18.0
		(ii) 1 – 2	20,520	30.0
		(iii) 3 – 4	15,048	22.0
		(iv) 5 -10	13,680	20.0
		(v) >10	6,840	10.0
		TOTAL	**68,400**	**100.0**
8.	Respondent's Status	(i) Generator User	34,200	50.0
		(ii) Generator User's Neighbour	34,200	50.0
		TOTAL	**68,400**	**100.0**

Table 6: Generator Ownership Status, Fuel-type and Basic Considerations

S/No	Variable Information	Individual status/choice/option	Observational/Occurrence Frequency	
			(No)	(%)
1.	Owns and runs generator(s)	(i) Yes	34,200	50.0
		(ii) No	34,200	50.0
		TOTAL	**68,400**	**100.0**
2.	Number of generators presently owned and run (operated) intermittently	(i) 1	20,208	59.1
		(ii) 2	13,272	38.8
		(iii) ≥ 3	720	2.1
		TOTAL	**34,200**	**100.0**
3.	Ownership date of first generator till date [in 'Year(s)']	(i) 0 – 5	7,798	22.8
		(ii) 6 – 10	14,911	43.6
		(iii) 11 – 15	4,891	14.3
		(iv) 16 – 20	3,762	11.0
		(v) >20	2,838	8.3
		TOTAL	**34,200**	**100.0**
4.	Basic Fuel-type	(i) PMS (Gasoline)	27,394	80.1
		(ii) AGO (Diesel)	6,635	19.4
		(iii) Others	171	0.5
		TOTAL	**34,200**	**100.0**
5.	Main reason(s)/purpose(s) for running (operating) generator	(i) For residential comfort	12,893	37.7
		(ii) For business operations	8,721	25.5
		(iii) For both of the above reasons	12,517	36.6
		(iv) For other reason(s)	69	0.2
		TOTAL	**34,200**	**100.0**
6.	Technology/Manufacturing Origin	(i) Chinese	17,647	51.6
		(ii) Japanese	13,748	40.2
		(iii) European	1,539	4.5
		(iv) American	1,163	3.4
		(v) Others	103	0.3
		TOTAL	**34,200**	**100.0**
7.	Switching-type	(i) Auto-ignition (Electronic Panel-board)	2,770	8.1
			7,250	21.2
		(ii) Semi Auto-ignition (Remote-controlled)	24,180	70.7
			34,200	**100.0**
		(iii) Manual start-and-off		
		TOTAL		
8.	Move-ability	(i) Stationary (Static)	7,661	22.4
		(ii) Non-stationary (Dynamic/Moveable)	26,539	77.6
			34,200	**100.0**
		TOTAL		
9.	What season/period of the year do you run your generator more?	(i) Peak dry season (Jan – April)	20,725	60.6
		(ii) Rainy season (May – Sept)	10,328	30.2
		(iii) Harmattan/dry-dusty season (Oct–Dec)	3,147	9.2
			34,200	**100.0**
		TOTAL		

Table 7: Generator Technical Specifications and Usage Information

S/No	Variable Information (Characteristics)	Total Number of generators considered	Mean
1.	Number of years of operation	34,200	2.98
2.	Rated Output Capacity (KVA)	34,200	3.20
3.	Daily duration of operation (Hours)	34,200	6.24
4.	Daily fuel consumption (Litres)	34,200	6.15
5.	Horizontal distance from generator to building (m)	34,200	5.57
6.	Rated Frequency (Hertz)	34,200	50
6.	Power factor	34,200	1.0
7.	Phase	34,200	1
8.	Noise emission levels [Acoustic rating] [dB(A)]	34,200	93.0

Table 8: Health Hazards/Conditions 1: [External Health Hazards linked to Generator Usage]

S/No	External Health Hazard	Number of Respondents Engaged	Observational/Occurrence Frequency	
			(No)	(%)
1.	Sleep disturbance	34,200	28,933	84.6
2.	Sleeplessness	34,200	4,070	11.9
3.	Hearing Loss	34,200	22,948	67.1
4.	Gradual deafness	34,200	12,483	36.5
5.	Choking Feeling	34,200	17,203	50.3
6.	Reduced Visibility	34,200	7,592	22.2

Table 9: Health Hazards/Conditions 2: [Internal/Biological Health Issues linked to Generator Usage]

S/No	Internal Health Hazard	Number of Respondents Engaged	Observational/Occurrence Frequency	
			(No)	(%)
1.	Ophthalmic Problems	34,200	15,390	45.0
2.	Skin Injuries	34,200	24,898	72.8
3.	Gastro-intestinal Problems	34,200	3,796	11.1
4.	Some types of Cancer	34,200	5,917	17.3
5.	Greater risk of Exposure to some Air-borne diseases	34,200	11,594	33.9
6.	Fainting Sensation/outright fainting	34,200	9,986	29.2
7.	Deaths	34,200	19,289	56.4

Table 10: Health Hazards/Conditions 3: [Sick Building Syndrome (SBS) Signs and Symptoms triggered and/or aggravated by Generator Use]

S/No	SBS Signs and Symptoms	Number of Respondents Engaged	Observational/Occurrence Frequency	
			(No)	(%)
1.	Headache	34,200	23,906	69.9
2.	Dizziness	34,200	5,233	15.3
3.	Nausea [predominantly experienced by Pregnant women]	34,200	8,618	25.2
4.	Eye, Nose and/or Throat Irritation	34,200	8,618	25.2
5.	Difficulty in mental Concentration	34,200	30,370	88.8
6.	Reduced Sensitivity to Odours	34,200	11,320	33.1
7.	Cardio-vascular Palpitations	34,200	15,732	46.0
8.	Chest pain	34,200	4,104	12.0
9.	Nose bleeds	34,200	1,505	4.4
10.	Increased Incidence of Asthma attack	34,200	31,567	92.3
11.	Personality changes and mood-swings	34,200	10,841	31.7
12.	Fatigue	34,200	4,651	13.6

Table 11: Environmental Hazards/Issues 1: [Consequences of Running (Operating) a Generator on the Environment]

S/No	Suggestions	Variations of 'relative Weights' of Individual Suggestions of Respondents, represented on the Likert's scale by suggestive-Frequency (f)					Number of Respondents Engaged for this specific purpose (Σf)	Modal Weight of suggested idea-ranking	Mean Value	% of Modal Weight of opinion
		1	2	3	4	5				
1.	Air Pollution	8,928	17,406	3,522	3,042	1,302	34,200	2	2.13	50.9
2.	Noise Pollution	16,692	12,414	2,052	1,500	1,542	34,200	1	1.79	48.8
3.	Harmful to Living things	6,330	15,594	10,740	1,128	408	34,200	2	2.23	45.6
4.	Induced structural defects in buildings	6,804	10,158	15,084	2,052	102	34,200	3	2.37	44.1
5.	Unwanted Heat generation	10,260	13,236	5,538	1,470	3,696	34,200	2	2.27	38.7
6.	Undue interference with biodiversity (the Ecosystem)	2,670	2,802	22,812	786	5,130	34,200	3	3.08	66.7
7.	Contributes to Green House Gas (GHG) emissions	2,088 *[6.1%]*	4,746	14,742	9,372	3,252	34,200	3	3.20	43.1

Where: 1 = 'strongly agree', 2 = 'agree', 3 = 'undecided', 4 = 'disagree', 5 = 'strongly disagree'.

Table 12: Environmental Hazards/Issues 2: [Direct Effects/Impacts of Generator-use on Building surfaces and structures]

S/No	Health Hazard	Total Number of Respondents Engaged	Observational/Occurrence Frequency	
			(No)	(%)
1.	Noticeable [unwanted] Vibrations	34,200	31,464	92.0
2.	Faults/Cracks on Wall surfaces	34,200	15,253	44.6
3.	Staining of Floor with spent (used) Engine-oil	34,200	31,874	93.2
4.	Defacing/discoloration of Wall finishes/surfaces	34,200	33,721	98.6

Table 13: Psychosocial Issues/Considerations 1: [Neighbours' Opinions, Complaint and Actions towards Users' Attitudes and Responses]

S/No	Neighbours' Psycho-social Issues/Considerations	Individual Belief/Opinion	Observational/Occurrence Frequency	
			(No)	(%)
1.	Neighbours' perception of User's level of awareness concerning his/her undue exposure to various hazards	(i) User is aware (ii) User is unaware (iii) User is aware, but indifferent **TOTAL**	14,056 1,881 18,263 **34,200**	41.1 5.5 53.4 **100.0**
2.	Complaints from Neighbours	(i) Received by User (ii) Rejected by User (iii) Received by User, but never responded to. **TOTAL**	3,488 12,859 17,853 **34,200**	10.2 37.6 52.2 **100.0**

3.	Suggestions from Neighbours	(i) Received by User	2,633	7.7
		(ii) Rejected by User	12,654	37.0
		(iii) Received by User, but never acted upon by Him/Her.	18,913	55.3
		TOTAL	**34,200**	**100.0**
4.	Neighbours' opinion of User's attitude and disposition to hazards	(i) Believes User is concerned	274	0.8
		(ii) Believes User is clearly indifferent.	25,753	75.3
		(iii) Believes User is accessible	581	1.7
		(iv) Believes User is not easily accessible	1,676	4.9
		(v) Believes User is simply inaccessible.	5,916	17.3
		TOTAL	**34,200**	**100.0**
5.	Neighbours' opinion of Generator User's action to eliminate or mitigate hazards	(i) Believes User attempted	1,026	3.0
		(ii) Believes User never attempted	33,174	97.0
		TOTAL	**34,200**	**100.0**
6.	The most recent & major reaction and counter-action by Neighbour due to his/her regular exposures to hazards from User's generator.	(i) Quarrels/verbal confrontation	30,575	89.4
		(ii) Reported to local authority(ies)/mediation	2,189	6.4
		(iii) Made an arrest, at least once	68	0.2
		(iv) Litigation	34	0.1
		(v) Revenge attempt	889	2.6
		(vi) Relocation	445	1.3
		TOTAL	**34,200**	**100.0**

Table 14: Psychosocial Issues/Considerations 2:

[Users' Opinions, Attitudes and Responses towards Neighbours' Complaints and Actions]

S/No	Users' Psycho-social Issues/Considerations	Total Number of Users with specific Opinion, Attitude and/or Response	Observational/Occurrence Frequency	
			(No)	(%)
1.	Believes Neighbours are simply jealous and intolerant	34,200	6,259	18.3
2.	Believes Neighbours have right to complain	34,200	1,505	4.4
3.	Feels unnecessarily challenged	34,200	6,840	20.0
4.	Does not believe anything much can be done	34,200	18,023	52.7
5.	Wished something could be done, but kept procrastinating	34,200	1,197	3.5
6.	Wished something could be done, and acted promptly.	34,200	376	1.1

Table 15: Financial Issues 1:

[Cost Implications of Possessing and Running (Operating) a Generator at Off-Peak (Normal) Periods] by User-respondents only.

S/No	Incurred Costs	Range of Values	Observational/Occurrence Frequency		Mean Cost
			(No)	(%)	
1.	Cost of Purchase of new Generator	(i) $90.91 - $121.21	4,993	14.6	$106.06
		(ii) $127.27 - $303.03	6,874	20.1	$215.15
		(iii) $309.09 -$484.85	11,081	32.4	$396.97
		(iv) $491.91 - $606.06	3,523	10.3	$548.99
		(v) $612.12 -$909.09	2,052	6.0	$760.61

		(vi) $915.15 - $1,818.18	1,539	4.5	$1,366.67
		(vii) 1,812.24 -$3,030.30	1,402	4.1	$2,421.27
		(viii)$3,036.36 - $6,060.61	1,300	3.8	$4,548.49
		(ix) $6,060.62 - $30,303.03	855	2.5	$18.181.83
		(x) $30,303.04 - $60,606.06	410	1.2	$45,454.55
		(xi) > $60,606.06	171	0.5	$60,606.06
		TOTAL No. and % of Users questioned	**34,200**	**100.0**	
2.	Cost of Haulage of Generator from Point-of-purchase to (household/apartment / building/premises)	(i) $0.00 - $6.06	8,995	26.3	$6.06
		(ii) $6.07 - $30.30	12,722	37.2	$18.19
		(iii) $30.31 -$60.60	6,498	19.0	$45.46
		(iv) $60.61 - $121.21	4,241	12.4	$90.91
		(v) > $121.21	1,744	5.1	$121.21
		TOTAL No. and % of Users questioned	**34,200**	**100.0**	
3.	Cost of Installation and/or Connection of Generator prior to its initial operation (use)	(i) $0.00 - $6.06	15,424	45.1	$6.06
		(ii) $6.07 - $30.30	8,037	23.5	$18.19
		(iii) $30.31 -$60.60	4,343	12.7	$45.46
		(iv) $60.61 - $121.21	3,420	10.0	$90.91
		(v) > $121.21	2,976	8.7	$121.21
		TOTAL No. and % of User questioned	**34,200**	**100.0**	
4.	Average daily Cost of Fuelling Generator	(i) $3.03 - $6.06	6,977	20.4	$4.55
		(ii) $6.07 - $18.18	16,040	46.9	$12.13
		(iii) $18.19 - $ 30.30	4,617	13.5	$24.25
		(iv) $30.31 - $36.36	3,454	10.1	$33.34
		(v) > $36.36	3,112	9.1	$36.36
		TOTAL No. and % of Users questioned	**34,200**	**100.0**	

Continuation of Table 15:

5.	Average bi-weekly Cost of lubricating Generator's engine	(i) $1.82 - $3.64	10,876	31.8	$2.73
		(ii) $3.65 - $6.06	12,038	35.2	$4.86
		(iii) $6.07 - $18.18	7,763	22.7	$24.25
		(iv) $18.19 - $36.36	2,360	6.9	$27.28
		(v) > $36.36	1,163	3.4	$36.36
		TOTAL No. and % of Users questioned	**34,200**	**100.0**	
6.	Average monthly Cost of Routine Maintenance (Servicing) and/or Repairs of Generator	(i) ≤ $6.06	9,918	29.0	$6.06
		(ii) $6.07 - $18.18	11,387	33.3	$12.13
		(iii) $18.19 - $30.30	4,309	12.6	$24.25
		(iv) $30.31 - $60.61	3,112	9.1	$45.46
		(v) $60.62 - $121.21	2,223	6.5	$90.92
		(vi) $121.22 - $303.03	1,436	4.2	$212.13
		(vii) $303.04 - $606.06	1,060	3.1	$454.55
		(viii)> $606.06	755	2.2	$606.06
		TOTAL No. and % of Users questioned	**34,200**	**100.0**	

Table 16: Financial Issues 2:

[Estimated Cost-Increments of Replacing and Running (Operating) an old Generator, incurred by only User-Respondents at Special Seasons]

S/No	Estimated Cost-Increments	Range of values	Observational/Occurrence Frequency		
			Number (No)	(%) of Total Users that Incurred Increments	(%) of Total Respondents Questioned

1.	Projected Cost-incremental-Percentage of Replacing [the Users' old, faulty and/or unserviceable] Generator with a new Generator [of the same technical specifications].	(i) +0 to 5% (ii) +5 to 10% (iii) +10 to 20% **TOTAL for Users that Incurred Increments** **TOTAL for Respondents Questioned**	816 10,608 12,576 **24,000** **34,200**	3.4 44.2 52.4 **100.0**	2.4 31.0 36.8 **70.2** **100.0**
2.	Estimated Cost-incremental-Percentage of running (operating) Generator longer and more often during the Peak dry and Harmattan Seasons.	(iv) +5 to 10% (v) +10 to 20% (vi) +20 to 50% (vii) + > 50% **TOTAL for Users that Incurred Increments** **TOTAL for Respondents Questioned**	2,688 6,552 10,296 4,464 **24,000** **34,200**	11.2 27.3 42.9 18.6 **100.0**	7.9 19.2 30.1 13.0 **70.2** **100.0**
3.	Estimated Cost-incremental-Percentage of running (operating) Generator during the Festive Seasons.	(i) +5 to 10% (ii) +10 to 20% (iii) +20 to 50% (iv) + > 50% **TOTAL for Users that Incurred Increments** **TOTAL for Respondents Questioned**	1,560 6,144 10,992 5,304 **24,000** **34,200**	6.5 25.6 45.8 22.1 **100.0**	4.6 18.0 32.1 15.5 **70.2** **100.0**
4.	Estimated Cost-incremental-Percentage of running (operating) Generator during Fuel Scarcity/Crises.	(i) +50 to 100% (ii) +100 to 200% (iii) +200 to 500% (iv) +500 to 1000% (v) + > 1000% **TOTAL for Users that Incurred Increments** **TOTAL for Respondents Questioned**	1,584 3,072 12,408 6,936 0 **24,000** **34,200**	6.6 12.8 51.7 28.9 0.0 **100.0**	4.6 9.0 36.3 20.3 0.0 **70.2** **100.0**

Table 17: Financial Issues 3: [Estimated Cost-Discounts on Replacing and Installing a new Generator, Enjoyed by only User- Respondents at Special Reasons]

S/No	Estimated Cost-Increments	Range of values	Observational/Occurrence Frequency		
			Number (No)	(%) of Total No of Users that enjoyed Discounts	(%) of Total No of Respondents Questioned
1.	Percentage Discount on re-purchasing cost of a new Generator, for long-standing Patronage as a faithful client/customer	(i) -5 to 10% (ii) -10 to 20% (iii) -20 to 50% (iv) - > 50% **TOTAL for Users that enjoyed discounts** **TOTAL for Respondents Questioned**	11,052 948 0 0 **12,000** **34,200**	92.1 7.9 0.0 0.0 **100.0**	32.3 2.8 0.0 0.0 **35.1** **100.0**
2.	Percentage Discount on Average Purchasing Cost of a new Generator, for being the first client/customer to patronize the seller, in the morning of that day.	(i) +5 to 10% (ii) -10 to 20% (iii) -20 to 50% (iv) - > 50% **TOTAL for Users that enjoyed discounts** **TOTAL for Respondents Questioned**	12,000 0 0 0 **12,000** **34,200**	100.0 0.0 0.0 0.0 **100.0**	35.1 0.0 0.0 0.0 **35.1** **100.0**
3.	Percentage Discount on Average Purchasing Cost of a new Generator, due to poor sales recorded by the seller in the previous months, weeks and days.	(i) -5 to 10% (ii) -10 to 20% (iii) -20 to 50% (iv) - > 50% **TOTAL for Users that enjoyed discounts** **TOTAL for Respondents Questioned**	10,476 1,524 0 0 **12,000** **34,200**	87.3 12.7 0.0 0.0 **100.0**	30.6 4.5 0.0 0.0 **35.1** **100.0**
4.	Percentage Discount on installation and/or connection cost of a new Generator, for long-standing Patronage as a faithful client/customer	(i) -5 to 10% (ii) -10 to 20% (iii) -20 to 50% (iv) - > 50% **TOTAL for Users that enjoyed discounts** **TOTAL for Respondents Questioned**	11,460 540 0 0 **12,000** **34,200**	95.5 4.5 0.0 0.0 **100.0**	33.5 1.6 0.0 0.0 **35.1** **100.0**

Table 18: Safety Concerns 1:

[Users' Perceptions of Risk Assessments of Unsafe Acts and Environmentally-unfriendly Practices related to Generator Use

S/No	Common Unsafe Acts and Environmentally-unfriendly Practices	Frequency of Risk-level Ratings (Indices)	Frequency of Risk-level Ratings (Indices) [f]	Percentage of Risk-level Ratings (Indices) [%]
1.	Smoking near a Fuelled [and running] Generator	(i) Safe (Not Risky) Act	18,126	53.0
		(ii) Permissible/Allowable Risk	7,182	21.0
		(iii) Serious Risk	5,404	15.8
		(iv) Fatal Risk	3,488	10.2
		TOTAL	**34,200**	**100.0**
2.	Igniting a naked flame or wild fire [such as 'bush fire'] within the neighbourhood of a fuelled Generator	(i) Safe (Not Risky) Act	1,026	3.0
		(ii) Permissible/Allowable Risk	1,881	5.5
		(iii) Serious Risk	8,174	23.9
		(iv) Fatal Risk	23,119	67.6
		TOTAL	**34,200**	**100.0**
3.	Receiving and/or making a GSM-Phone call while fuelling a running Generator	(i) Safe (Not Risky) Act	17,100	50.0
		(ii) Permissible/Allowable Risk	15,390	45.0
		(iii) Serious Risk	1,026	3.0
		(iv) Fatal Risk	684	2.0
		TOTAL	**34,200**	**100.0**
4.	Re-fuelling a generator while it is running	(i) Safe (Not Risky) Act	20,144	58.9
		(ii) Permissible/Allowable Risk	11,081	32.4
		(iii) Serious Risk	2,155	6.3
		(iv) Fatal Risk	820	2.4
		TOTAL	**34,200**	**100.0**
5.	Running a Generator in an enclosed space with persons inside the room	(i) Safe (Not Risky) Act	0	0.0
		(ii) Permissible/Allowable Risk	0	0.0
		(iii) Serious Risk	410	1.2
		(iv) Fatal Risk	33,790	98.8
		TOTAL	**34,200**	**100.0**
6.	Leakage of exhaust fumes from a running Generator into an enclosure	(i) Safe (Not Risky) Act	15,869	46.4
		(ii) Permissible/Allowable Risk	12,244	35.8
		(iii) Serious Risk	4,856	14.2
		(iv) Fatal Risk	1,231	3.6
		TOTAL	**34,200**	**100.0**

7.	Using the torchlight of a GSM Phone for illumination, while re-fuelling a running generator at night	(i) Safe (Not Risky) Act (ii) Permissible/Allowable Risk (iii) Serious Risk (iv) Fatal Risk **TOTAL**	28,557 4,822 752 69 **34,200**	83.5 14.1 2.2 0.2 **100.0**
8	Re-fuelling a running Generator from (using) a wide aperture (large opening) fuel-container without a funnel	(i) Safe (Not Risky) Act (ii) Permissible/Allowable Risk (iii) Serious Risk (iv) Fatal Risk **TOTAL**	24,179 7,866 1,471 684 **34,200**	70.7 23.0 4.3 2.0 **100.0**
9	Siphoning of fuel through mouth-sipping during maintenance/repairs of Generator by technician or user	(i) Safe (Not Risky) Act (ii) Permissible/Allowable Risk (iii) Serious Risk (iv) Fatal Risk **TOTAL**	29,138 4,036 342 684 **34,200**	85.2 11.8 1.0 2.0 **100.0**
10	Disposing Spent (Used) Oil on farmlands, green-areas, sewers or drains etc.	(i) Safe (Non-Risky) Act (ii) Permissible/Allowable Risk (iii) Serious Risk (iv) Fatal Risk **TOTAL**	33,687 513 0 0 **34,200**	98.5 1.5 0.0 0.0 **100.0**

Table 19: Safety Concerns 2: [Reported Cases of Generator-use related Accidents that occurred during the thirty-six (36) months of this Study].

S/No	Accident-type	Extent (degree) to which it occurred	Frequency of Occurrence	Percentage of Occurrence
1.	Fire Incidences	(i) Minor (ii) Major, but not controllable (iii) Escalated, explosive & uncontrollable **TOTAL No. of reported cases of fire incidences** **AVERAGE No. of fire incidences per Year**	360 126 18 **504** [= 5.6% of 8,928] **168**	71.4 25.0 3.6 **100.0**
2.	Skin-burns from Generator-exhaust	(i) Limited (ii) Serious **TOTAL No. of reported cases of Skin-burns** **AVERAGE No. of skin burns per Year**	747 333 **1,080** [= 12.0% of 8,928] **360**	69.2 30.8 **100.0**
3.	Fuel-ingestions	(i) Within safe limits (ii) Critically dangerous levels **TOTAL No. of reported cases of fuel-ingestions**	4,650 750 **5,400** [= 60.5% of 8928] **1,800**	86.1 13.9 **100.0**

		AVERAGE No. of Fuel-ingestions per Year		
4.	Dizziness and/or fainting	(i) Dizziness only (ii) Fainting only (iii) Dizziness and fainting **TOTAL No. of reported cases of reported cases of dizziness and/or fainting** **AVERAGE No. of Dizziness/Fainting per Year**	90 72 54 **216** [= 2.4% of 8,928] **72**	41.7 33.3 25.0 **100.0**
5.	Cuts and Injuries	(i) Minor (ii) Major (iii) Major, and requiring Surgery **TOTAL No. of reported cases of reported cases of Cuts and Injuries** **AVERAGE No. of Cuts and Injuries per Year**	720 162 54 **936** [= 10.5% of 8,928] **312**	76.9 17.3 5.8 **100.0**
6.	Electrocution due to improper connection and/or faulty connection etc.	(i) Within safe limits (ii) Critically dangerous levels **TOTAL No. of reported cases of electrocution** **AVERAGE No. of Electrocutions per Year**	558 36 **594** [= 6.7% of 8,928] **198**	97.0 3.0 **100.0**
7.	Fatalities (deaths)	(i) Resulting from Generator-fires (ii) Resulting from Generator burns (iii) Resulting from Generator fuel-ingestions (iv) Resulting from Generator-induced collapse (fainting) (v) Resulting from Generator-inflicted cuts and injuries (vi) Resulting from Generator Exhaust fumes choking and excessive 'CO(g)' Inhalation (vii) Resulting from Generator-related Electrocutions (viii) Resulting from GSM-triggered explosion of Generators **TOTAL No. of reported cases of Deaths (Fatalities)** **AVERAGE No. of Deaths (Fatalities) per Year**	9 0 45 27 0 81 21 15 **198** [= 2.2% of 8,928] **66**	4.5 0.0 22.7 13.6 0.0 40.9 10.6 7.7 **100.0**

NOTE: Total number of all reported cases of generator-use related accidents within the three(3) year study period = 8,928

Table 20: Security [& Psychological] Concerns 1: [Users' Perceived Opinions on possibility/likelihood of Security threats/breaches arising from Generator-use (operation)].

S/No	Possible Security-threat/breach	Variations of 'relative Weights' of Personal Convictions of Respondents, represented on the Likert's scale by Predictive-Frequency (f)					Total Number of Respondents Engaged for this specific purpose (Σf)	Modal Weight of Opinions	Mean Value	% of Modal Weight of Opinion
		1	2	3	4	5				
1.	Armed-robbers, Thieves, Burglars, Rapists & Kidnappers may operate unnoticed, under the cover darkness coupled with the noise (sounds) emitted by Generators running late at night or in the evenings. This security situation further degenerates with simultaneous rainfall.	26,472	7,728	0	0	N0	34,200	1	1.23	77.4
2.	When several loud noise-emitting Generators are running (operated) simultaneously within a small perimeter, Gunshot sounds may not be easily distinguishable. As maybe the case with crime-prone areas i.e. country-sides, suburbs and creeks with inadequate security apparatus.	2,154	2,460	4,206	11,418	13,962	34,200	5	3.95	40.8

3.	Armed-robbers, Thieves & Burglars oftentimes, may have an easy & unchallenged entry-access into homes, when someone comes out to switch-off the generator before midnight. This is usually characteristic of buildings without perimeter fencing.	34,200	0	0	0	0	34,200	1	1.00	100.0
4.	Running an expensive Generator with high technical specifications may attract burglars; since several users have had their homes burgled in their absence, with only their Generators carted away. Particularly in settlement-clusters with wide socio-economic divides (uneven income distributions).	2,151	2,460	4,242	11,460	13,887	34,200	5	3.95	40.6
5.	Running Generators may be stolen and carted away on wheel-barrows, motor-bikes, and taxi-cabs etc., with the power-cords (cables) suddenly snapped.	1,776	3,696	3,042	9,438	16,248	34,200	5	4.01	47.5
6.	A Generator may be stolen and hurriedly carted away; while it is temporarily left outside to cool down, after being switched-off, and before being moved inwards.	14,742	7,362	4,614	6,768	714	34,200	1	2.16	43.1

Where: 1 = 'strongly agree', 2 = 'agree', 3 = 'undecided', 4 = 'disagree', 5 = 'strongly disagree'.

Table 21: Security Concerns 2:

[Reported Cases of Security breaches/lapses and Crimes arising from Generator-use (operation), that were Perpetuated during the thirty-six (36) months of this Study].

S/No	Reported Cases of Security breaches/lapses and crimes related to Generator-use	Total number of all Reported cases of security breaches & crimes, from eye-witness accounts of respondents for the three (3) Years	Total Specific Observational/Occurrence Frequency for the three (3) years		Average Specific Observational/Occurrence Frequency per year	
			(No)	(%)	(No)	(%)
1.	Armed-robbery, Theft & Burglary easily carried out at night-times, under the cover of loud Noise (sounds) emitted by running (operational) generators.	13,158	1,145	8.7	382	8.7
2.	Rapes easily carried out at night-times, under the cover of loud Noise (sounds) emitted by running (operational) generators	13,158	316	2.4	105	2.4
3.	Kidnappings easily carried out at night-times, under the cover of loud Noise (sounds) emitted by running (operational) generators	13,158	711	5.4	237	5.4
4.	Gunshot-killings easily (Murders) carried out at night-times, under the cover of loud Noise (sounds) emitted by running (operational) generators.	13,158	197	1.5	66	1.5
5.	Gunshot-violence easily carried out at night-times,	13,158	5,500	41.8	1,833	41.8

	under the cover of loud Noise (sounds) emitted by several running (operational) generators.					
6.	Seeming attraction of burglars to a household apartment, which on investigation was traceable to a Generator of high technical specifications.	13,158	947	7.2	316	7.2
7.	Stealing of a Generator with/without its power cord (cable), while it was still running (in operation).	13,158	513	3.9	171	3.9
8.	Stealing of a Generator with/without its power cord (cable), while it was temporarily left outside to cool down, after being switched-off, and before being moved inwards.	13,158	3,829	29.1	1,276	29.1
Net Average specific Observational/Occurrence Frequency and Percentage per year					**4,836**	**100.0**

Table 22: Psychological Opinion-poll 1:

[Users' General Perceptions on the seemingly indispensable role that 'Generators' currently play in their lives]

S/No	Individual Perceptions	Variations of 'relative Weights' of Individual Suggestions of Respondents, represented on the Likert's scale by suggestive-Frequency (f)					Total Number of Respondents Engaged for this specific purpose (Σf)	Modal Weight of suggested idea-ranking	Mean Value	% of Modal Weight of Opinion
		1	2	3	4	5				
1.	When the Generator [which is used to power the fans and/or Air-conditioners] is switched-off, I will still perspire (sweat) and feel uncomfortable (very hot), regardless of how often I bathe.	28,488	4,170	1,542	0	0	34,200	1	1.21	83.3
2.	A 'Generator' is not a luxury, but rather an essential device in every Nigerian home, considering the present epileptic Power supply in the country; coupled with the daily need to power(energize or electrify) certain home appliances like Freezers/ Refrigerators Water Borehole	30,984	3,078	102	36	0	34,200	1	1.10	90.6

	pumps etc., on a daily basis.									
3.	I cannot do without a Generator, because am 'allergic' to darkness, and we rarely ever enjoy electricity from the national grid.	24,114	3,726	858	2,496	3,006	34,200	1	1.73	70.5
4.	It is compulsory to run a Generator in my house daily, because, our 'evenings' are incomplete without the Television and Hi-fi set entertainments.	18,366	5,064	1,434	3,828	5,508	34,200	1	2.21	53.7
5.	It is Prestigious to own and run a generator in my neighbourhood.	12,312	5,370	3,456	1,470	11,592	34,200	1	2.84	36.0
6.	If my generator is left running beyond 22:00hrs (10:00pm), then, I stand the great risk of having it stolen, even while still running (in operation).	6,978	6,702	4,722	7,146	8,652	34,200	5	3.11	25.3
7.	Generators have become an integral part of our family life, simply because We cannot get our children ready for school, and cope with	16,350	2,154	582	2,700	12,414	34,200	1	2.79	47.8

	our early morning chores [without adequate illumination] in the dark, since we often suffer a lot from Power outages (cuts).									
8.	The cost of continuously running and maintaining/servicing/repairing my generator is consuming a comparatively large chunk of my monthly Income (Pay).	17,166	7,044	2,118	3,624	4,248	34,200	1	2.14	50.2
9.	Generators play a critical role in our daily lives, furthermore, most Nigerians often depend on them, to Power(energize or electrify) high-load appliances such as Pressing Iron, Electric stove, Water heater and Washing machine etc.	21,408	8,514	0	2,496	1,782	34,200	1	1.68	62.6
10.	The Power crisis situation in the country may never get better; so Generators have come to stay with us in Nigeria.	24,006	5,160	3,144	1,302	588	34,200	1	1.52	70.2

Continuation of Table 22:

11.	As a student, I cannot read with candles and hurricane-lanterns etc.; I struggle to read with rechargeable lamps [whose batteries would soon discharge (die-out), but I effortlessly and effectively read with Filament bulbs, fluorescent tubes and LED bulbs powered by electricity [even if it requires running (operating) a fossil-fuel generator].	8,994	5,952	1,980	6,738	10,536	34,200	5	3.11	30.8
12.	Some Nigerians don't own a Generator at the moment, but if only the costs of buying and fuelling it become cheaper, they would gladly get one; they really don't care about the so-called hazards and negative consequences claimed to be associated with	13,818	4,548	3,420	5,304	7,110	34,200	1	2.63	40.4

	its use (operation).									
13.	With no end in sight (view) to our nation's woes in the Power Sector, coupled with the over-dependence of the present-day 21st-Century Global Economy on 'Energy'; Generators currently constitute an indispensable part of the daily life of the average Nigerian; this is without prejudice to the current global thrust against the adverse effects of 'GHG' emissions and Climate Change	24,624	1,638	4,650	2,430	858	34,200	1	1.63	72.0

Where: 1 = 'strongly agree', 2 = 'agree', 3 = 'undecided', 4 = 'disagree', 5 = 'strongly disagree'.

Table 23: Psychological Opinion-Poll 2:

[Users' and Neighbours' Suggestions for the Mitigation of Generator-Use related Hazards in Nigeria].

S/No	Suggestions	Variations of 'relative Weights' of Individual Suggestions of Respondents, represented on the Likert's scale by suggestive-Frequency (f)					Number of Respondents Engaged for this specific purpose (Σf)	Modal Weight of suggested idea-ranking	Mean Value	% of Modal Weight of Opinion
		1	2	3	4	5				
1.	Connecting more settlement-clusters (communities) to the national grid	52,944	15,456	0	0	0	68,400	1	1.23	77.4
2.	Impose Regulations on Generator sales	4,308	4,920	8,412	22,872	27,888	68,400	5	3.95	40.8
3.	Ensure Improvement of Power supply from the national grid	68,400	0	0	0	0	68,400	1	1.00	100.0
4.	Imposing strict regulations on Generator-use	4,296	4,920	8,484	22,920	27,780	68,400	5	3.95	40.6
5.	Ensuring and enforcing appropriate restrictions on generator importation	3,552	7,392	6,084	18,876	32,496	68,400	5	4.01	47.5

6.	Investing more in less hazardous alternative sources of electric Power generation	29,484	15,324	9,228	13,536	828	68,400	1	2.14	43.1
7.	Creating the much needed awareness and embarking on Public enlightenment campaigns regarding the numerous hazardous and negative issues associated with the use of fossil-fuel generators.	16,752	3,660	26,664	6,876	14,448	68,400	3	2.98	39.0

Where: 1 = 'strongly agree', 2 = 'agree', 3 = 'undecided', 4 = 'disagree', 5 = 'strongly disagree'.

Table 24: Psychological Opinion-Poll 3:

[Users' and Neighbours' Suggestions to Salvage the Power Sector in Nigeria].

S/ No	Suggestions	Variations of 'relative Weights' of Individual Suggestions of Respondents, represented on the Likert's scale by suggestive-Frequency (f)					Number of Respondents Engaged for this specific purpose (Σf)	Modal Weight of suggested idea-ranking	Mean Value	% of Modal Weight of Opinion
		1	2	3	4	5				
1.	Boosting the Nation's installed and generating capacities.	65,736	2,664	0	0	0	68,400	1	1.04	96.1
2.	Adequate funding for research on 'Cleaner' and 'Green' sources of Energy.	6,024	2,388	2,388	14,640	42,960	68,400	5	4.26	62.8
3.	Hiring Expatriate technocrats & foreign experts from technologically-advanced countries to train Nigerian professionals & personnel in the Power Sector.	29,892	3,690	8,616	3,690	22,512	68,400	1	2.78	43.7
4.	Providing a more conducive investment climate for Private Sector Participation; and Strategically engaging the	35,700	17,304	1,428	4,104	9,864	68,400	1	2.05	52.2

	individual Private Investors and the organized Private Sector [from within & outside the country], by fully de-regulating the nation's Power Sector, [without undue political interference;] as is obtainable in most developed nations of the world.									
5.	Removing the 'Power Sector Budget & Administration ' from the 'exclusive List', and placing it in the 'concurrent list'	24,900	19,632	0	1,572	22,296	68,400	1	2.66	36.4
6.	Stepping-up the global campaign against Climate Change and GHGs emissions, on a national scale.	4,993	5,609	2,804	47,812	7,182	68,400	4	3.68	69.9
7	Investigating and checkmating home-based sabotages and endemic corruption plaguing the nation's ailing power sector.	56,436	9,024	1,236	816	888	64,800	1	1.26	82.5

8.	Boosting investments in critical Power Infrastructure such as in Distribution and Transmission Lines & Networks etc.	47,880	13,124	7,396	0	0	68,400	1	1.41	70.0
9.	Develop a realistic long-term sustainable vision for Nigeria's Energy Security & Self-sufficiency in the nearest future	45,072	13,680	4,860	3,000	1,788	68,400	1	1.58	65.9
10.	Draw-up a workable National Power-Sector Reform Policy & Blue-print, and then diligently stick to its full implementation within the contained timelines.	50,748	7,188	2,868	4,176	3,420	68,400	1	1.57	74.2

Where: 1 = 'strongly agree', 2 = 'agree', 3 = 'undecided', 4 = 'disagree', 5 = 'strongly disagree'.

Figure 2A: Safety Concerns 2,
[S/No: 1(Fire incidences) and 5(Cuts & injuries

Figure 2B: Safety Concerns 2,
[S/No 3: (Fuel-ingestions) and 6 (Electrocutions)]

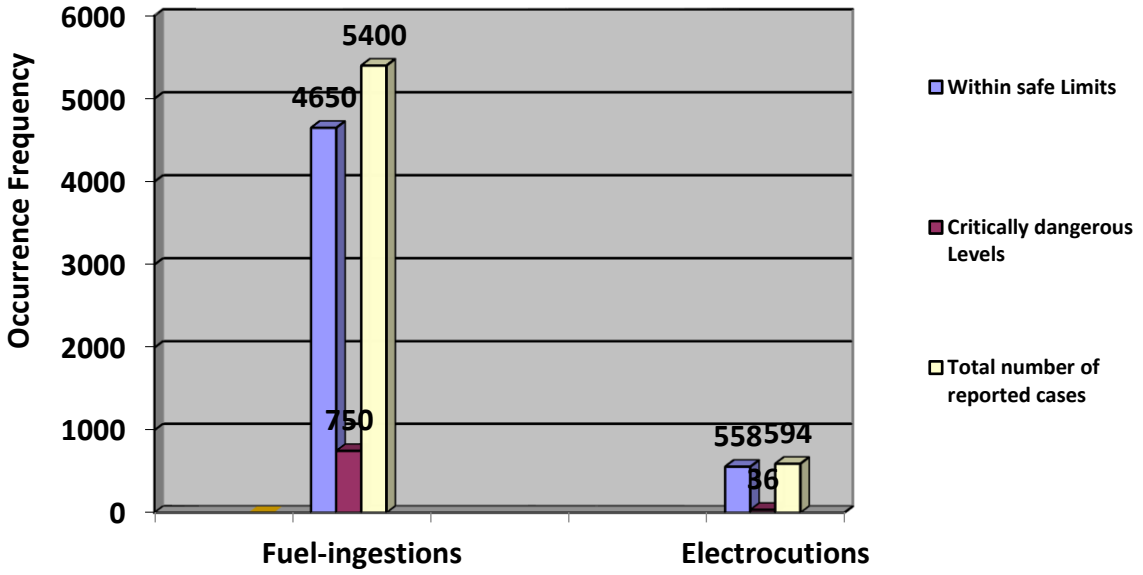


Figure 2C: Safety Concerns 2, [S/No 4: (Dizziness and/or fainting)]:

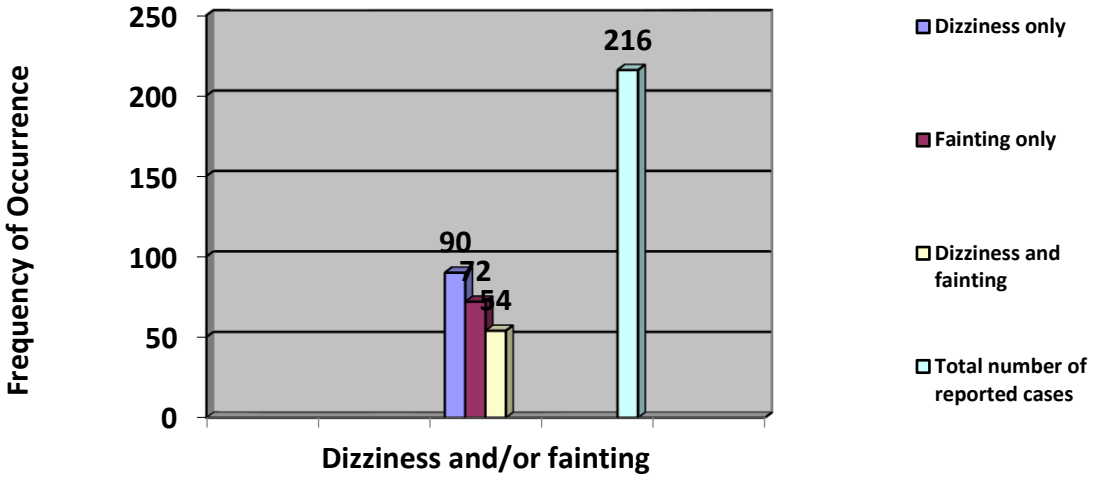


Figure 1D: Safety Concerns 2, [S/No 2: (Skin-burns)]

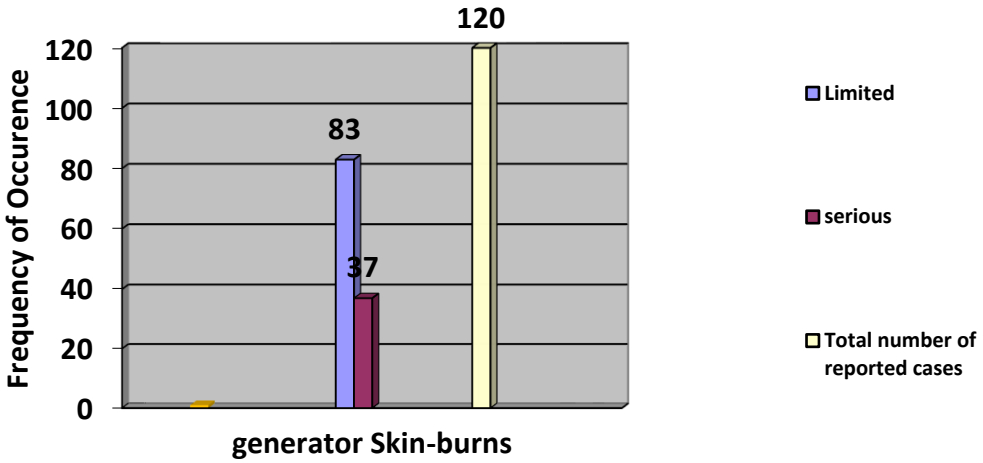


Figure 2E: Safety Concerns 2.
[S/No 7: (Average No of "Fatalities or Deaths")]

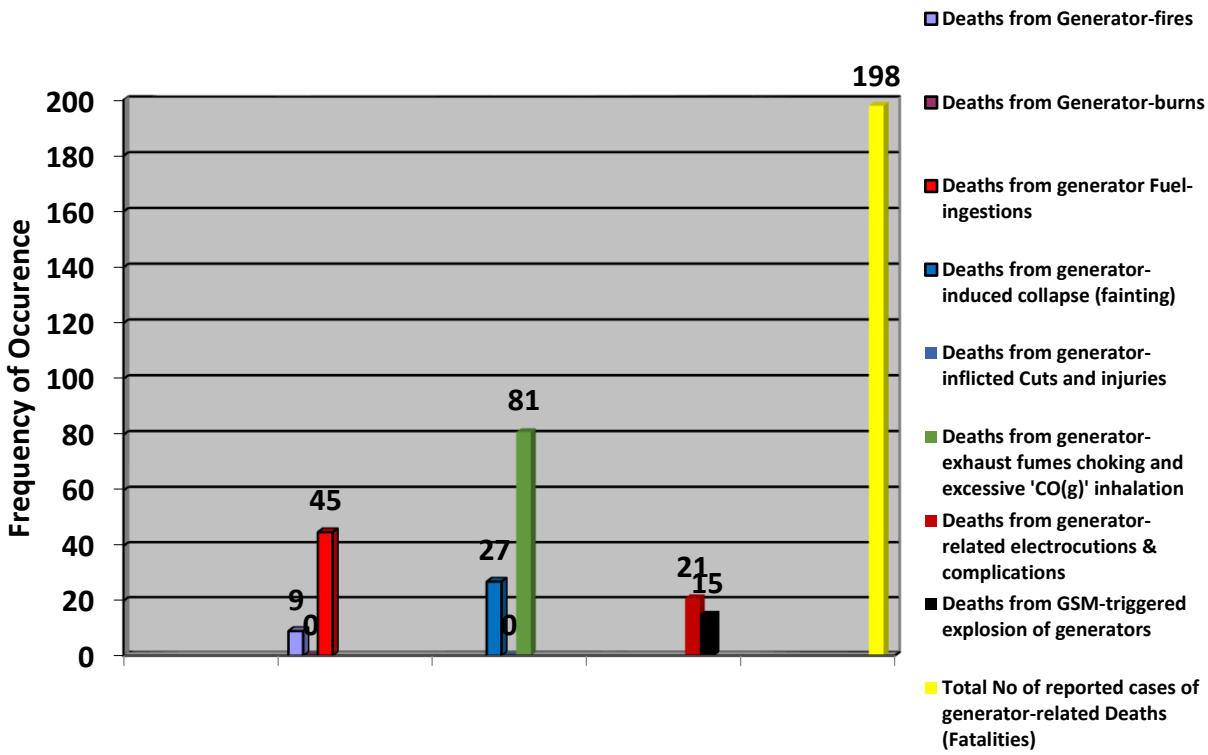


Figure 2F:
Total Nos. of specific Accident-types [related to Generator-use] per year

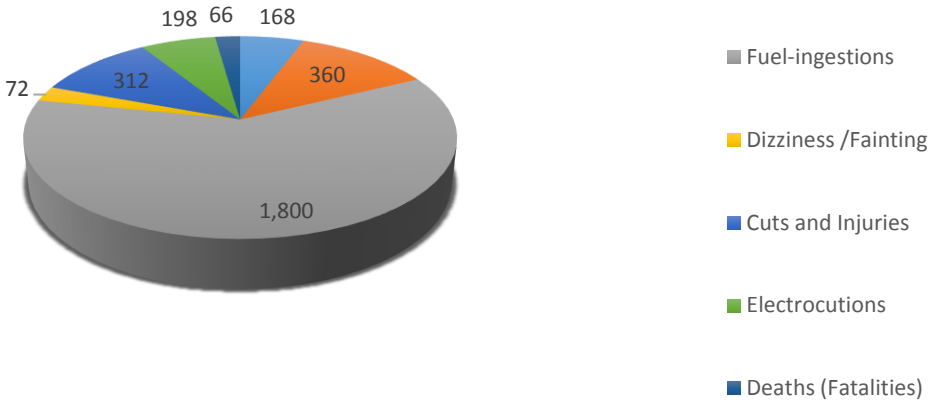
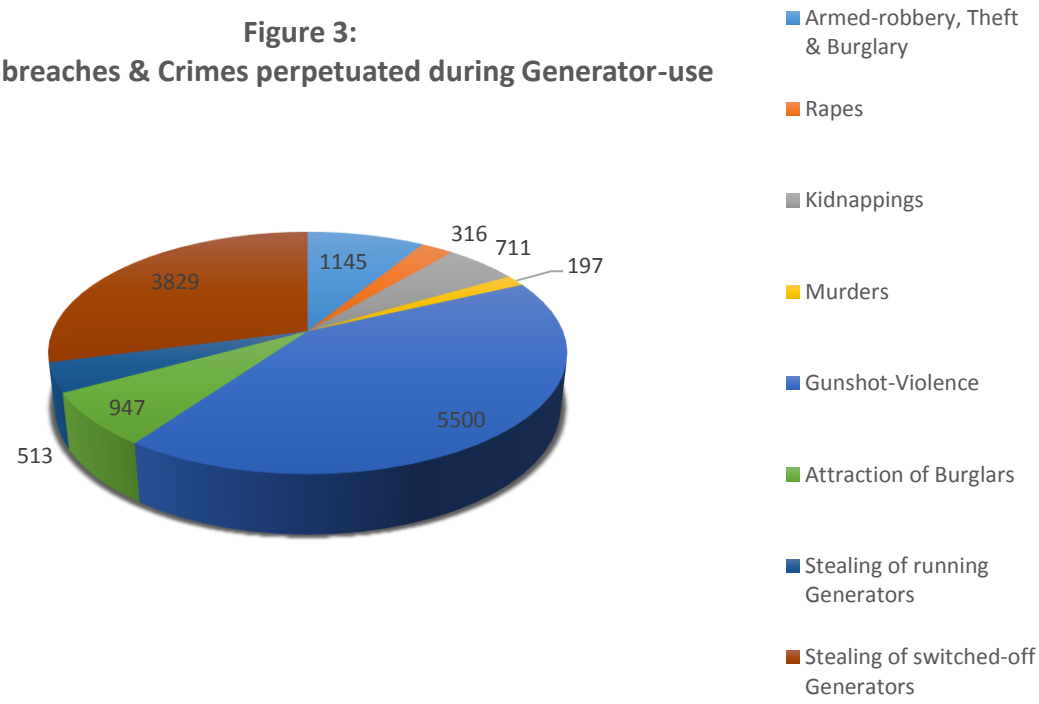


Figure 3:
Security breaches & Crimes perpetuated during Generator-use



3.2 Discussion of Results

3.2.1 Summarized general Assessment of 'Answering-patterns' and yearly change (flexibility/dynamics) of Mental-opinions [mindsets/paradigms/ideologies] by Respondents

A painstaking process of collating and carefully examining all 68,400 same-identity respondent questionnaires, [that were completely filled thrice from year 2013 to 2015]; which was carried out after the third (3rd) year, [in the early part of year 2016] revealed the following:

- 92.7% of all 68,400 respondents independently gave (provided) three (3) same answers for (to) 95.0% of all questions contained in the three successive years of 2013, 2014 and 2015; [irrespective of order].
- 6.2% of all 68,400 respondents independently gave (provided) two (2) same & one (1) different answers for (to) 95.0% of all questions contained in the three successive years of 2013, 2014 and 2015; [irrespective of order].
- 1.1% of all 68,400 respondents independently gave (provided) three (3) different answers for (to) 95.0% of all questions contained in the three successive years of 2013, 2014 and 2015; [irrespective of order].

Thus, from the above, the following may be inferred:

- That, well over two-third [92.7%] of all respondents are obviously very consistent in their mental-opinions, [mindsets & paradigms]; and are resiliently reluctant to change (modify) them, at any time in the foreseeable future.

- That, less than one-tenth [6.2%] of all respondents display (show/manifest) a questionable degree of consistency in their mental-opinions, [mindsets & paradigms]; since they may occasionally (rarely) deem if fit to change (modify) them under certain conditions, [which may be subjective, measurable systemic-change etc.].
- That, a minority [1.1%] of all respondents are obviously inconsistent in their mental-opinions, [mindsets & paradigms]; and may be actively willing to change (modify) them, as many times as possible.

3.2.2 Usage sampling and Respondents' profile

From Table 5, it is obvious that at the end of these three (3) consecutive years [2013-2015], the possession (ownership) and usage (operation) of fossil-fuel generators is now the order-of-the-day (societal norm) in Nigeria's metropolitan cities of Port Harcourt, Uyo & Calabar and their respective environs, having become an established societal norm. This is proven by the facts that majority [80.1%] of all surveyed households & premises in the study area are 'Active Users' and almost all [94.8%] of all surveyed households & premises in the study area are 'Potential Users' of fossil-fuel generators. [Also see Figure 1].

Also, majority of these generator-users and their neighbours in Port Harcourt, Uyo & Calabar and their respective environs are properly educated & mentally enlightened (88.8%), married (67.6%) male (75.5%) Nigerian citizens (98.9%) between the active labour-force ages of and 26-35 years and 36 – 50 years (25.0% and 40.0% resp.), working in the public service and private sector (30.0% and 22.1% resp.), who have been residing (living) in these cities & the surrounding towns for about 3 - 4 years 1 - 2 years (30.0% and 22.0% respectively); as can be seen in Table 5.

3.2.3 *Ownership status, Basic considerations, Technical specifications and Usage information*

Table 6 revealed that most generator-owners (users) acquired their first generator about 6 -10 years ago [likely before they relocated to the study-area] (43.6%) and presently own (possess) & operate (run) only one (59.1%), gasoline-powered (80.1%), Chinese-manufactured/technology (51.6%), manually-operated (70.7%) generator; which in most cases is non-stationary [i.e. moved in-and-out on a daily basis] (77.6%), more often/predominantly during the peak of dry season from January to April (60.6%) annually, mainly for the purposes of residential comfort or for both business operations & residential comfort (37.7 and 36.6% respectively).

As typical electro-mechanical machines, these fossil-fuel generators have a mean rated Output power (capacity) of 3.20 KVA, a mean noise emission level [i.e. acoustic rating] of 93dB [which exceeds the WHO maximum permissible limits of 90 dB(A) for daytime and 65 dB(A) for night-time], a mean alternating current [sinusoidal] waveform frequency of 50 Hz, and a Mean Power factor of '1'. Furthermore, they have been run (operated) for an average of 6.24 Hours daily for the past 2.98 years at a mean horizontal distance of 5.57m from the Users' households/apartments/buildings/premises [which is below the recommended safe distance of a minimum of 7.00m,] and consume averagely 6.15 Litres of fuel on a daily basis; as is clearly illustrated in Table 7.

3.2.4 *Health Hazards / Conditions*

From the respondents' perceptions in Table 8, the resulting external health hazards ranked in a descending order of subjective agreement to their likelihood of

occurrence are Sleep-disturbance (84.6%), Hearing-loss (67.1%), Choking-feeling (50.3%), Gradual deafness (36.5%), Reduced visibility 22.2%) and Sleeplessness (11.9%).

On the other hand, the internal health hazards associated with fossil-fuel generator-use (operation), when arranged in an ascending sequence of the respondents' perceived opinions, with respect to their occurrence-probability are Gastro-intestinal problems (11.1%), certain types of Cancer (17.3%), Fainting/fainting sensation (29.2%), Increased risk of exposure to some air-borne diseases (33.9%), Ophthalmic problems (45.0%), Death (56.4%) and Skin injuries----------being the most common to occur at 72.8% from Table 9.

Furthermore, Table 10 shows that Sick Building Syndrome Signs and Symptoms believed by respondents to be triggered and/or aggravated by running (operating/using) fossil-fuel generators are predominantly: Increased incidence of Asthma attack (92.3%), difficulty in mental Concentration (88.8%), Headache (69.9%), Cardio-vascular palpitations (46.0%), reduced Sensitivity to odours (33.1%) and Personality changes & mood-swings (31.7%). Others are Nausea [mostly suffered (experienced) by pregnant women] (25.2%), Eye, nose & throat irritation (25.2%), Dizziness (15.3%), Fatigue (13.6%), Chest pain (12.0%) and Nose bleeds (4.4%).

3.2.5 Environmental Hazards / Issues

The general notion of the individual perceptions of the typical 'Port Harcourt, Uyo & Calabar respondent' [and by implication 'Port Harcourt, Uyo & Calabar resident' etc.] with respect to the environment is that: Over half [50.9%] of them agree

[Modal weight = '2'] that 'Running (operating) a fossil-fuel generator pollutes the atmospheric air we breathe' (Mean value = '2.13'); nearly half [48.8%] strongly agree ['1'] that 'it results in Noise pollution' ('1.79'); about half [45.6%] agree ['2'] that 'It is generally harmful to living things' ('2.23'); and 44.1% are undecided/unsure ['3'] on whether or not 'it induces structural defects in buildings' ('2.37'). Over one-third [38.7%] agree ['2'] that 'It generates unwanted heat' ('2.27'); about two-third [66.7%] are undecided ['3'] on whether or not fossil-fuel generators unduly interfere with the natural biodiversity and consequently negatively impacts the ecosystem ('3.08'); while as low as 6.1% emphatically lament & complain [i.e. strongly agree] that fossil-fuel generators contribute to Green House Gas (GHG) emissions. [See Table 11].

Also, being common sights and regularly observable occurrences, almost all respondents opined that operating (running) generators adversely affect their immediate environment [i.e. building surfaces, structures & neighbourhoods] by way of generating noticeable unwanted vibrations [alongside the wanted electricity] (92.0%), Staining of floors with spent (used) engine-oil (93.2%) and defacing/discolouration of wall finishes/surfaces (98.6%); while nearly half of all respondents actually think & believe that it could also result in visible cracks/faults on wall surfaces (44.6%); as is evident from Table 12.

3.2.6 Psychosocial Issues / Considerations

When the research team considered the Neighbours' opinions, interactions & actions towards the Users' attitudes & responses, it was carefully observed that, of all the Neighbour-respondents engaged: 53.4% believe that that the generator-User (Owner) is fully aware of his/her [pitiable] plight, but yet is completely

indifferent (unconcerned) about his/her welfare (well-being); 52.2% have complained at least once to the generator-User, and have come to believe that, although the generator-User received [i.e. entertained & attentively listened] to the complaint(s), he/she never responded to it(them); and 55.3% have severally made seemingly (apparently) wise suggestions to the generator-User in order to ameliorate the situation, which although were welcomed(received) by the Users, yet he/she has never for once acted-on (implemented) any of them [and not even the simplest, cheapest & least-time consuming of the suggestions].

Still on the above issue, as high as 75.3% of all neighbours passionately think & believe that the generator-User is adamantly & callously indifferent (unbothered) & inhumane in his/her attitude & natural disposition, to their undue hazardous exposure(s). Virtually all [97.0%] of the neighbours lamented that the generator-User have never ever [and not even once] made an attempt [and not even the slightest attempt] to eliminate or at least mitigate the unquantifiable hazards, they are helplessly faced with on a daily basis [and in some extreme cases on an hourly basis].

Now, for the reactions and counter-actions due to hazardous exposures suffered by Neighbours: 89.4% of Neighbours verbally confronted the generator-users & openly quarreled with them; 6.4 % formally reported to local authority(ies) or opted for mediation [such as 'ADR' etc.]; 2.6% of them embarked on a revenge-mission [by acquiring their own generator, placing it as close (near) as possible to their generator-users' apartments, running (operating) the generators at odd hours (night-times & very early in the mornings), and positioning the exhaust-fume nozzles to directly face their generator-users' directions etc.]; 1.3% of these neighbours eventually relocated from the premises /buildings/apartments in

protest, or to prove a point that they have other options for accommodation; While only 0.1% of neighbours who could afford it, consequently opted for outright Litigation, so as to strongly prove their points and serve as a deterrent, after repeated warnings to the generator-users . [See Table 13].

Finally considered were the generator-users' opinions, attitudes and responses to their Neighbours' complaints and actions, thus, of all the generator-users: Over half [52.7%] of Users do not believe that they can do anything much [i.e. can substantially intervene] to remedy or ameliorate the situation; One-fifth [20.0%] of them feel unnecessarily challenged by their neighbours; While 18.3% of them really believe that their neighbours are simply jealous and intolerant. Surprisingly, as a direct corroboration & validation of their Neighbours' opinions & claims in 'Table 13' and the above paragraph, because as low as 4.4% of the entire Users genuinely believe that their Neighbours [unconditionally] have the right to complain; While only 3.5% sincerely wished that something could be done to improve their neighbours' plights; and barely 1.1% sympathetically wished something could be done to salvage the situation & truly intervened by acting promptly; as is clearly illustrated in Table 14.

3.2.7 Financial Issues / Considerations

With the nation's economy in what appears to be a state of 'perpetual recession', worsened by entrenched corruption, rising inflation rates, income inequality and dwindling oil revenues etc.; most of the User-respondents [who happen to be Nigerian citizens resident in the study-area] were emphatically lamenting, when the investigation team-members verbally engaged them and documented the financial burdens they have borne to acquire, run (operate) & maintain their fossil-

fuel generators, within these three (3) years from 2012 - 2015. The results are summarized as follows: 32.4% of all User-respondents (generator-Users) spent between "$309.09 - $484.85" to purchase their generators, 37.2% of them spent between "$6.07 - $30.30" to haul (transport) them home, 45.1% paid electrical-engineers/electricians between "$0.00 - $6.06" to install and/or connect the generators [as an alternative mains supply source to their apartments/buildings/premises], another 46.9% spend an average of "$6.07 - $18.18" everyday [i.e. on a daily basis] to fuel their generators, while 35.2% expend an average of "$3.65 - $6.06" to lubricate the engines of their generators on a bi-weekly basis [i.e. every fortnight/two weeks], and 33.3% spend an average of "$6.07 - $18.18" to routine maintenance(servicing) and/or repairs of their generators on a monthly basis. [See Table 15].

Furthermore, 66.6% of only 24,000 [out of the entire 34,200] User-respondents [separately quizzed for this particular analysis], feared that 'The Cost of replacing their generators when it becomes old, faulty and/or unserviceable with a new generator [of the same technical specifications], will increase by "10 - 20%" in the next 12 months'; 42.9% of them estimated that 'They spend an extra "20 – 50%" to run (operate) their generators longer and more often during the peak dry and 'harmattan (i.e. dry-dusty)' seasons'; while 45.8% of them estimated that 'They spend an additional "20 – 50%" to run (operate) their generators longer and more often during the festive seasons'; and 51.7% of them practically wept that, 'They against their wish, they are eventually forced to spend a conservative estimate of "200 – 500% extra to run (operate) their generators during periods of [acute] fuel scarcity/crises(hoarding)'. [See Table 16].

However, respite came when: 92.1% of only 12,000 [out of the entire 34,200] User-respondents [independently questioned for this particular analysis], cheerfully recounted that, they enjoyed a discount of "5 -10%", When they re-purchased another new generator, for their long-standing patronage as faithful clients/customers'; and another 100.0% of them said that', "5 -10%" was slashed-off the average [market] price, when they purchased their new generators, for being the first client/customer to patronize the seller, in the morning of that day'. [**NOTE:** "This is a superstitious belief & practice which most sellers hold in high esteem, as a good omen or proper way to start their 'business-day' "]. Also, 87.3% of them noted that 'They received a discount of "5 – 10%", when they purchased a new generator, due to poor sales recorded by the seller in the previous months, weeks & days'. [**NOTE**: This is usually the practice, as a survival strategy to stay afloat in business, by encouraging patronage, when sales records are at an all-time low]. Again, 95.5% remarked that 'Their electrical-engineers/electricians offered them a discount of "5 – 10%", while they were installing and/or connecting another new generator, for their long-standing patronage as faithful clients/customers'. [See Table 17].

3.2.8 Safety Concerns

This study amongst other things has clearly shown that majority of the respondents [both Users and Neighbours alike] seem (appear) to be highly ignorant of, or carelessly undermine the risk-levels of most of the unsafe acts and environmentally-unfriendly practices related to generator-use; as is evident in their far-from-accurate risk-level ratings (indices) of those listed in Table 16. This is with an exception to only the two obviously dangerous acts/practices of: 'Ignition of a naked flame within the immediate vicinity of a fuelled generator'

and 'Running (operating) a generator in an enclosed or poorly-ventilated space with a person(s) inside', which 67.6% and 98.8% respectively of all respondents dread and accurately labelled as 'Fatal Risk'.

But the reverse is regrettably the case for most other of these unsafe acts & practices, summarized below as follows: As many as 53.0% of all respondents [both generator-users and their neighbours] believe that it is safe to 'Smoke near a fuelled [and running] generator'; Exactly half [50.0%] of them believe that it is very safe to 'Receive and/or make GSM-phone calls while fuelling a running generator'; Over half [58.9%] believe that 're-fuelling a generator while it is still running (on)', is a safe act; and as low as 46.4% think that 'The [continuous] leakage of exhaust-fumes from a running generator into a perfect or partial enclosure with a person(s) within is very safe and poses no risk.

Furthermore, as high as 83.5% of respondents claim that it is very safe 'to use the torchlight of a GSM-phone for illumination, while re-fuelling a generator at night'. While 70.7% say that 're-fuelling a running generator from a wide-aperture (large-opening) fuel-container without a funnel is safe and poses no serious risk'; and a record high 85.2% simply believe that 'it is very safe [and not risky] to siphon fuel through mouth-sipping of a fuel-hose during maintenance/repairs of a generator by technicians or by the Users during periods of 'fuel-scarcity/hoarding'. In addition, an overwhelming majority of 98.5% of all respondents quizzed hold the common view (opinion) that the cultural practice of disposing spent (used) engine-oil on farmlands, green-areas, vegetation, sewers or drains etc., is simply safe, and does not pose any significant/considerable risk to man and the environment [See Table 18].

Thus, substantiating our inferred claims of ignorance and/or carelessness on the part of the respondents [i.e. generator-Users and their Neighbours], with respect to the actual (accurate) risk-assessment-ratings (levels/indices) of the 'Unsafe acts and practices' highlighted in Table 19, & Figures 2A – 2F, and discussed in the preceding paragraphs, is a Profiling of all reported cases of generator-related accidents [that occurred during the thirty six (36) months of this study,] as follows: although only 3.6% of all 504 reported cases of 'Fire incidences' became escalated explosive & uncontrollable; and nearly one-third [30.8%] of all 1,080 reported cases of 'Skin burns' from generator exhaust-fume nozzles were 'serious burns'; well above one-tenth [13.9%] of all 5,400 reported cases of 'Fuel-ingestions' arising from mouth-sipping of fuel-hoses, filters & carburetors etc., were diagnosed to be to critically dangerous levels; exactly one-quarter [25.0%] of all 216 reported cases of 'Dizziness and/or fainting' linked to generator-use, were noted to be a sequential combination of both 'dizziness' and 'fainting'. Also, over one-twentieth [5.8%] of all 936 reported cases of 'Cuts & injuries' suffered as direct consequences of generator-use were noted to be 'major Cuts & injuries' requiring specialized treatments/surgeries; 6.0% and 3.5% of all 594 reported cases of 'Electrocutions' related to generators, were to critically dangerous levels, and resulted in outright death (fatality) respectively; and finally, 40.9% of all 198 reported cases of generator-related 'Deaths (Fatalities)' were identified as the resultant consequences of 'Choking' by generator exhaust-fumes & excessive $CO_{(g)}$ inhalation. [See Table 19 and Figures 2A - 2F].

3.2.9 Security [and Psychological] Concerns

While sampling the subjective perceived opinion of each generator-User and Neighbour on the possibility & probability of occurrence of each the various groupings/classes of Security threats/breaches & Crimes associated with generator-use, it was keenly noted that: Over two-third [i.e. 77.4%] of all respondents [Users and Neighbours] strongly agree [Mode = '1'] that 'Armed-robbers, thieves, burglars, rapists & kidnappers may operate unnoticed, under the cover of darkness coupled with the noises (sounds) emitted by generators running (operated) late at night or in the evenings' [Mean = '1.23']; Above one-third [40.8%] of respondents strongly disagree ['5'] that 'When several loud noise-emitting generators are running (operated) simultaneously within a relatively 'small area', gunshot sounds may not be easily distinguishable' ['3.95']; Less than half [42.3%] agree ['2'] that 'Armed-robbers, thieves and burglars oftentimes, may have an easy & unchallenged entry-access into household/apartment/building/premises, when someone comes out to switch (turn)-off the generator late in the evening or at about midnight' ['1.77']; Over one-third [40.6%] strongly disagree ['5'] that 'Running (operating) an expensive generator with high technical specifications may attract burglars to a household/apartment/building/premises in the absence of its occupants/residents' ['3.95']; Nearly half [47.5%] strongly disagree ['5'] that 'A generator may be suddenly stolen and carted away in a wheel-barrow, motor-bike or taxi-cab etc., with the power-cord (cable) snapped; while it is still running (being operated)' ['4.01']; and [43.1%] strongly agree ['1'] that 'A mobile (non-stationary) generator may be quietly stolen and hurriedly carted away, while it is temporarily left outside to cool down, after being switched (turned)-off' ['2.16']. [See Table 20].

A careful examination of the compiled cases of Security breaches/lapses and crimes linked to generator-usage (operation), as reported by respondents (Users

and Neighbours), to have been perpetuated or committed during the thirty six (36) months of this study, revealed that the predominant cases are: Gunshot-violence [i.e. threats, scares & stampedes etc., and not necessarily involving 'killing'] easily carried-out at night, under the cover of loud noises (sounds) emitted by several running(operational) generators [41.8%]; and the stealing of moveable (non-stationary) generators with/without the power cords (cables), while they are temporarily left outside to cool down, after being switched (turned)-off [29.1%]; both crimes amounting to 70.9% of all 13,158 Crimes committed. Others which add up to account for the remaining 29.1% of all reported cases of Security breaches/lapses, in descending order of occurrence-frequency are: 'Armed-robbery, theft & burglary' [8.7%]; 'Seeming attraction of burglars to an apartment/building/premises' [7.2%]; 'Kidnapping' [5.4%]; 'Stealing of a moveable (non-stationary) generator with/without the power cord (cable), while it is still running (in operation)' [3.9%]; 'Rapes easily carried out at night-times, under the cover of loud Noise (sounds) emitted by running (operational) generators' [2.4%]; and the least of all being 'Gunshot-killings [i.e. murders & manslaughters] easily carried-out often at night-times, under the cover of loud noises (sounds) emitted by several running(operational) generators [1.5%]. [See Table 21 and Figure 3].

3.2.10 Psychological Opinion-polls

An inquiry of the subjective perceptions of the respondents [i.e. generator-Users and their Neighbours] on an individual basis concerning the seemingly indispensable role that 'Generators' currently play in their lives, led us to a conclusion that: Majority [i.e. 83.3%] of all respondents strongly agree [Mode = '1'] that "When the generator [which is often used to power (electrify) the fans and/or air-conditioners during a power outage] is switched (turned)-off, they will still

[eventually] perspire (sweat) and feel uncomfortable, particularly during the peak dry season" [Mean = '1.21']; An overwhelming majority [90.6%] strongly agree ['1'] that " A generator is not a luxury, but rather should be an essential device in every Nigerian home, considering the present epileptic power supply across the country, coupled with the daily need to power (electrify) certain home appliances like freezers/refrigerators & water borehole pumps etc." ['1.10'].

Over two-third [70.5%] strongly agree ['1'] that "They cannot do (live) without a generator [in Nigeria], for now, because they are 'allergic to darkness', and they rarely ever enjoy adequate electricity supply from the national grid" ['1.73']; More than half [53.7%] strongly agree ['1'] that "It is compulsory to run a generator in their homes daily, because their 'evenings' are virtually incomplete and boring, without the Television and Hi-fi set entertainments, which are likely to be powered (electrified) by it" ['2.21']; Slightly above one-third [36.0%] strongly agree ['1'] that "It is prestigious to own (possess) and run (operate) a generator in their neighbourhoods" ['2.84']; and about one-quarter [25.3%] strongly disagree ['5'] that "If their generator is left running beyond 22:00 Hours (10:00pm), then, they stand the great risk of having it stolen, even while it is still running (in operation)" ['3.11'].

Below half [47.8%] strongly agree ['1'] that "Generators have become an integral part of their family lives, simply because they cannot get their children ready for school [early enough] and cope with their early morning chores, [without adequate illumination]' since power-outages(cuts) have become the order of the day in Nigeria" ['2.79']; Another half [50.2%] strongly agree ['1'] that "Continuously running and maintaining/servicing/repairing their generator is consuming a comparatively large chunk(part) of their monthly income(pay)"

['2.14']; Nearly two-third [62.6%] strongly agree ['1'] that "Generators play a critical role in their daily lives, since as Nigerians, they often depend on generators to power(electrify) heavy-load appliances such as Pressing-iron, electric-stove(cooker) water-heater and washing-machine etc." ['1.68'].

Less than one-third [30.8%] strongly disagree ['5'] that "As a student, I cannot read with candles and hurricane-lamps, and I struggle to read with rechargeable lamps but effortlessly & effectively read with(using) filament bulbs, fluorescent tubes or LED bulbs powered by electricity even if it means(requires) switching(turning)-on a fossil-fuel generator' ['3.11']; Over two-third [70.2%] greatly fear (strongly agree) ['1'] that "The power crises situation in the country may never improve, so generators have come to stay in Nigeria' ['1.52']; Over one-third [40.4%] strongly agree ['1'] that "Although some Nigerians do not yet own a generator, however, if only the costs of buying(acquiring) and fuelling it becomes cheaper, they would gladly get(own) & use(operate) one, they really do not care/bother about the so-called hazards and negative consequences claimed to be associated with its use(operation)" ['2.63%]; while another majority [72.0%] strongly believe ['1'] that "without prejudice to the global efforts against Green House Gas emissions and Climate change, the hopeless situation in Nigeria's power sector has forced the average Nigerian to own & use a generator daily" ['1.63']. [See Table 22].

Also considered were the respondents' varying relative [weighted] supports for different suggestions for the mitigation of generator-use related hazards in Nigeria, summarized as follows: Majority [77.4%] of all respondents strongly agree [Modal Weight of suggested-idea's ranking = '1'] that "Connecting more settlement-clusters (communities) to the national grid, will mitigate generator-use related hazards" [Mean Value = '1.23']; Over one-third [40.8%] strongly disagree ['5'] that

"Imposing regulations on generator sales, will [successfully] mitigate generator-use related hazards" ['3.95']; Virtually all [i.e. everyone of] [100.0%] the respondents quizzed strongly agree ['1'] that "Ensuring improvement of Power supply from the national grid, will [eventually] mitigate generator-use related hazards" ['1.00']; Over one-third [40.6%] strongly disagree ['5'] that "Imposing strict regulations on generator-use, will consequently mitigate generator-use related hazards" ['3.95']; Nearly half [47.5%] strongly disagree ['5'] that " Ensuring and enforcing appropriate restrictions on generator importation, will mitigate generator-use hazards" ['4.01']; about half [43.1%] strongly agree that "Investing more in less hazardous alternatives sources of electric power generation, will [on the long run] mitigate generator-use related hazards" ['2.14']; while over one-third [39.0%] are undecided ['3'] about (on) if "Creating the much needed awareness and embarking on public enlightenment campaigns, will mitigate generator-use related hazards" ['2.98']. [See Table 23].

Finally, this Opinion-poll ends with a point-by-point analysis of the respondents' individual rating-levels of the various suggested ideas on the way forward to salvage Nigeria's ailing power sector, as is hereby presented: An overwhelming majority [96.1%] of all respondents [generator-users and neighbours] strongly agree [Modal weight of suggested idea-ranking = '1'] that "Boosting the nation's installed and generating capacities, will help to salvage the Power sector" [Mean Value ='1.04']; About two-third [62.8%] strongly disagree ['5'] that "Adequate funding of research on "Cleaner' and 'Green' sources of energy, will help to salvage the Power sector" ['4.26']; Over one-third [43.7%] strongly agree ['1'] that "Hiring expatriate technocrats & foreign experts from technologically-advanced countries to train Nigerian professionals & personnel in the Power sector, is a way forward ['2.70']; Over half [52.2%] strongly agree ['1'] that "Creating a conducive

'investment environment & climate' for private sector participation and full deregulation of the nation's Power sector will make things better" ['2.05']; About One –third [36.4%] strongly agree ['1'] that "Removing the 'Power sector Budget & Administration' from the 'Exclusive list' and placing it in the 'Concurrent list' " ['2.66']; Over two-third [69.9%] disagree ['4'] that "Stepping-up the global campaign against Climate change and Greenhouse Gases (GHG) emissions, on a national scale, will do any good ['3.68']; Majority [82.5%] strongly agree ['1'] that "Investigating and checkmating home-based sabotages and endemic corruption plaguing the nation's Power sector, will greatly improve the situation" ['1.26']; Another majority [70.0%] strongly agree ['1'] that "Boosting investments in critical power infrastructure such as in distribution and transmission lines & networks etc." ['1.41']; and about two-third [65.9%] strongly agree ['1'] that "Developing a realistic long-term sustainable vision for future energy security & self-sufficiency " ['1.58']; while a sizeable majority [74.2%] strongly agree ['1'] that initiating and implementing the needed Power-sector reforms will help to transform the Power sector" ['1.57']. [See Table 24].

4 Conclusion

Candidly, there is presently an acute shortage in the supply of electric power to the vast majority of all households/apartments/buildings/premises in Nigeria's metropolitan cities of Port Harcourt, Uyo & Calabar and their respective environs; in the oil-rich Niger-Delta region of the South-Southern geo-political zone of the country. Thus, out of sheer necessity, majority of these cities' residents have helplessly resorted to the independent use (operation) of fossil-fuel generators as their predominant source of electricity supply. Without doubts, the numerous generator-related Environmental, Health, Psycho-social, Financial, Security & Safety hazards and issues (effects & considerations) are increasingly becoming worrisome, and now constitute serious concerns to both the generator-users

and their neighbours; thus snowballing into topical issues of national interest, that will certainly require unprecedented global attention in the nearest future. Thus, it is evident that, among the city's residents [and by implication 'the Nigerian citizenry'], there is a reasonably high level of awareness, consciousness and experience regarding most of the generator-related Psycho-social, Financial, Security & Psychological hazards, effects and considerations. But this is not so with the Environmental, Health & Safety hazards, effects and concerns; because apart from their general, basic & commonly occurring cases/instances; some of the more technical (advanced, critical & sensitive) and rarely occurring cases/instances are not well known, properly understood and sufficiently experienced by the majority of the city's residents etc.

Again, it is noteworthy to mention here and now that, there is a comparatively high average crime rate of 12.8% committed or perpetuated at night-times, under the cover of the loud [combined-interference] noises (sounds) emitted (produced) by several simultaneously running (operational) generators, roughly amounting to a ratio of 1:8, i.e. approximately 1 crime committed/security breach for every 8 generator-users, [a rate which is feared to exponentially rise on an annual basis, ceteris paribus]; out of which gunshot-related violence accounts for 41.8% of all crimes committed, which translates to approximately 1 case of gunshot-violence in every 2 reported cases of crime & security lapse. Furthermore, from the research findings, it can be authoritatively stated that as high as 60.5% of all 8,928 reported cases of generator-related accidents, [roughly translating to a ratio of 3:5, i.e. 3 of every 5 occurring accidents] are 'Fuel-ingestions'; out of which 13.9% roughly amounting to a ratio of 1:6, i.e. 1 in every 6 of these fuel-ingestions is noted (identified) & distinguished to involve critically dangerous levels of fuel consumption; Additionally, a comparison of 'The occurrence-frequency of all generator-related accident cases' to 'The total number of active generator-users' gives an approximate numerical-ratio of 1:4, which by implication amounts to 26.1%; and from all

indications, may continue to soar, if nothing substantial is urgently done to remedy or at least ameliorate the situation.

Conclusively, much louder than words can express, there is the irrepressible subjective willingness (intention) and growing societal consciousness for individuals to co-operate with governments & leaders [at all levels & tiers] to wholeheartedly adopt appropriate measures, operations & options etc., that would strategically address the attendant problematic issues arising from the over-dependent usage (operation) of fossil-fuel generators; including [but not restricted to] Connecting more settlement-clusters (communities) to the national grid, imposing tougher regulations on generator-sales, ensuring improvement of power supply from the national grid, monitoring & imposing strict regulations on generator-use, ensuring & enforcing appropriate restrictions on generator-importation, creating the much needed awareness & embarking on public enlightenment campaigns about the many hazardous consequences & negative effects/implications of fossil-fuel generators.

5 Recommendations

As can be cited from the introduction, it is evident that, over the years, successive Nigerian leaders have attempted to make significant investments, and shown varying levels of commitment aimed at ensuring the provision of adequate and uninterrupted supply of electricity to the ever teeming populace of Nigeria; but these supposedly laudable efforts, have repeatedly proved abortive or fallen far below expectations, being characteristically derailed, whittled or out-rightly truncated by a multiplicity of reasons. Consequently, it is our sincere opinion that if Nigeria must ever achieve the much needed 'Energy-security' and self-sufficiency in the power sector, then, Nigerian governments at all levels & tiers [federal, state & local] must as a matter of utmost urgency proactively consider and sincerely implement the following understated recommendations:

I. Systematically & effectively address deeply-rooted & engrained unpatriotic & anti-national cultures, tendencies & trends such as endemic corruption, national policy inconsistency, internal sabotage and lack of synergistic political-will etc., which individually & collectively greatly undermine the overall transformation of its ailing power sector and by implication, the entire socio-economic & political well-being of Nigeria.
II. Boost investments in critical power infrastructure such as [installed and] generating capacities, distribution and Transmission lines & networks etc.
III. Develop a realistic long term sustainable vision for Nigeria's Energy & Self-sufficiency in the nearest future; and
IV. Draw-up a workable national power-sector reform policy & blue-print, and then diligently stick to its full implementation within the contained timelines.

However, in the interim Nigerian governments should also put in place an effective & efficient machinery to ensure the existence of the appropriate policies and implementation framework for:

V. Addressing (combating) security breaches/lapses and crimes committed under the cover of generator-emitted sounds, particularly at night-times.
VI. Imposing & enforcing necessary regulations on generator importation, sales & use (operation).
VII. Promoting and boosting investments in less hazardous [i.e. cleaner/green] and renewable alternatives sources of electric power generation such as Wind, Geothermal, hydro, Biomass, Solar and Nuclear etc.
VIII. Creating the much needed awareness and aggressively embarking on public enlightenment campaigns, regarding the numerous negatively issues of fossil-fuel generator-use, and with particular reference to its associated health, safety

& environmental hazards [such as undue interference with the Ecosystem & Green House Gas emissions].

Furthermore, it is pertinent (imperative) for the users of fossil-fuel generators to as much as possible, take into consideration the safety and general well-being of their neighbours, their environment & themselves; by operating (using) and mounting their generators, in such a way that reasonably, [and/or significantly] reduces:

IX. Air and Noise pollutions,
X. Indiscriminate dumping (disposal) of spent (used) engine-oil,
XI. Induced structural defects in buildings, and
XII. Green House Gas emissions; while ensuring proper (adequate) ventilation of all living spaces (rooms & enclosures) in their building apartments.

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