ADVANCE AFRICAN RESEARCH BULLETIN

Causes and Extent of Fire-Fighting Equipment Availability among Public Buildings in Federal Capital Territory, Nigeria

[a] Udoh, I. H*., [ab] Obafemi, A. A. and [ab] Mbee, M. D.

[a] Centre for Disaster Risk Management and Development Studies, University of Port Harcourt, Port Harcourt, Nigeria
[b] Department of Geography and Environmental Management, University of Port Harcourt, Port Harcourt, Nigeria
[c] Department of Geography and Environmental Management, University of Port Harcourt, Port Harcourt, Nigeria

*Corresponding Author: **Udoh, I. H** (hopeudoh64@gmail.com)

Abstract

Public buildings are very crucial in the social and economy of every country and have been subjected to various hazards including fire incidents leading to various degree of destructions. The study examines the causes and extent of fire-fighting equipment availability among public buildings in the Federal Capital Territory, Nigeria. Four hundred (400) questionnaires were administered among randomly selected respondents (public building occupants); however, 376 were returned and analysed using descriptive and inferential statistics such as frequency count, percentage and one-sample t-test. The outcome of the study showed that electrical fault (22.9%), careless in the use of fire (20.2%), negligence (17.5%) and overload of electrical appliance (17.3%) are perceived as major causes of fire incidents. Respondents are not satisfied (76.9%) with the extent of fire-fighting equipment available in their building where fire hydrant (72.1%), flame detector (94.7%), smoke detector (67.0%) and fire alarm system (69.1%) are not available. Most buildings are equipped with fire safety signs (76.9%), fire extinguisher (89.1%) and sand (72.3%) and they are functioning. In conclusion, fire incidents among public building is caused by electrical fault, careless in the use of fire and negligence and the impact is exacerbated due to insufficient fire-fighting equipment. Therefore, public building should be well fitted with various firefighting equipment, maintained, tested and upgraded frequently to avoid failure when needed.

Keywords: Fire Disaster, Public Building, Socio-economic, Abuja

Introduction

Fire can be described as the phenomenon that occurs when a combustible material, which serves as fuel, comes into contact with heat in the presence of oxygen, and emitting out light, heat and smoke (Monisola, 2023). It is the by-product of a chemical reaction in which heat stored in a combustible fuel is converted to a heat and accompanied by light (Obasa et al., 2020). A fire's flame refers to the visual indication of light that occurs once the gas is heated, and is evidence that a fire has taken place. Fire can cause significant

property damage and loss in addition to injuring or killing people who are occupying the affected building (DiGuiseppi et al., 2012). As a result, the multiple advantages of fire often overshadow its enormous potential for destruction, which poses a threat to a country's fragile economy (Monisola, 2023).

Reports by Industrial Anthropogenic Fire Regimes (IAFRS) states that in 2015 there were about 4 fire incidents per 1000 inhabitants of 31 countries studied, resulting in 18,454 deaths and over 44,000 injuries (Brushlinsky et al., 2017). According to United Nations International Strategy for Disaster Reduction (UNISDR, 2008), when fire disaster occurs, human beings are among the most vulnerable population group, especially those present in times of the fire event. Furthermore, during fire disasters, buildings are destroyed, lives are lost, and access to activities even at the aftermath of fire disaster is stalled (Dowd, 2012; Obasa et al., 2020). It has been estimated that every year, fire causes about 300,000 deaths globally and most of these occur in the residential areas (Zhang et al., 2006; Adamu & Yunus, 2017). Fire, either caused by humans or nature, can pose hazard to people, properties and environment, possibly resulting in psychological damage, physical injuries, even death and significant economic losses. For example, in United States of America, in every 2 hours 42 minutes, there is an average of one death due to fire and in every 32 minutes an average of one injured person due to fire (Karter & Stein, 2008). Also, in the US another data from the National Fire Protection Association show that in 2013 there were 1.24 million fire incidents causing about 15,925 injuries, 3,240 deaths, and property damages worth about 11.5 billion dollars (Karter, 2014; Adamu & Yunus, 2017). In the United Kingdom it is estimated that between 2013 and 2014, about 212,500 fire disasters have occurred, affecting over 9,700 people and leading to about 322 deaths (Karter, 2014). In Nigeria, urban fire is responsible for deaths, injuries and billions in fire related property damage (Adamu & Yunus, 2017). Nigeria records over 8,000 fire

outbreak incidents yearly according to National Emergency Management Agency (NEMA), and this often leads to over 1,000 deaths and billions of naira worth of financial loss (Adamu & Yunus, 2017; Daramola & Ibrahim, 2021).

Public buildings are very crucial in the economy of every country; they have been contributing to the economy of nations through trades (Baah-Ennumh & Adom-Asamoah, 2012; Sunday & Lawan, 2019). Many developing nations do not have strategies to protect their citizens that work in public buildings of which markets, institutions, school buildings are inclusive, and they are exposed to several calamities that generate from fires among others without insurance cover of any kind (Leo, 2014, Sunday & Lawan, 2019). As a result of this, whenever any unforeseen calamity such as fire strikes the people who are barely above the poverty line, they sink into the poverty trap (Sunday & Lawan, 2019). There are numerous causes of fire outbreak; while some are caused by mankind, others are as a result of nature. In a built-up environment, fire outbreak cannot be eliminated outrightly but could be prevented, reduced or mitigated through preparedness measures, and preventing fire outbreak totally can be very costly or even unattainable. However, necessary measures to prevent the occurrence of fire in the buildings and the neighbourhoods must be engaged to subdue the menace (Monisola, 2023; Obasa et al., 2020; Chen et al., 2012). Considering various fire disaster events in recent time, the study examines the causes and extent of fire-fighting equipment availability among public buildings in Federal Capital Territory, Nigeria.

Materials and Method

Study Area

Abuja, located centrally in Nigeria, is the nation's capital city (Figure 1). Kaduna borders Abuja to the north, Niger state to the west, Nasarawa state to the east and southeast, and Kogi state to the southwest. Abuja was officially named the capital of Nigeria on

December 12, 1991 (Wambebe & Duan, 2020). Abuja is found on latitude 7° 25'' and 9° 20'' North of the Equator and longitude 5° 45'' and 7° 39'' East of the Greenwich. The overall land area is 7315 km2. Abuja's population currently surpasses 2.5 million people, according to Wambebe & Duan (2020). Abuja's population has grown by over 140%, making it the fastest-growing metropolis in Africa and one of the most rapidly expanding globally (Wambebe & Duan, 2020).

Study Design, Population and Sample Size

The study adopted cross-sectional survey research. Cross-sectional survey research is a specific type of field study that involves the collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire (Visser et al., 2002). The population of the study comprised of all the occupants from the selected public buildings in the city phases and selected districts of FCT (Asokoro, Central Area, Garki, Guzape, Maitama, Wuse I, Wuse II, Utako) (Figure 1).

To have proper coverage, the National Population Commission data of 2006 of AMAC was used as the base year (778,567) and projected to 2023 using an annual growth rate of 3.2% using the Malthus Exponential Model. To get an optimum sample of the target population (1,339,135) the T. Yamane (1967) formula for sample size determination will be adopted;

$$n = \frac{N}{1 + N\,(e)^{2}}$$

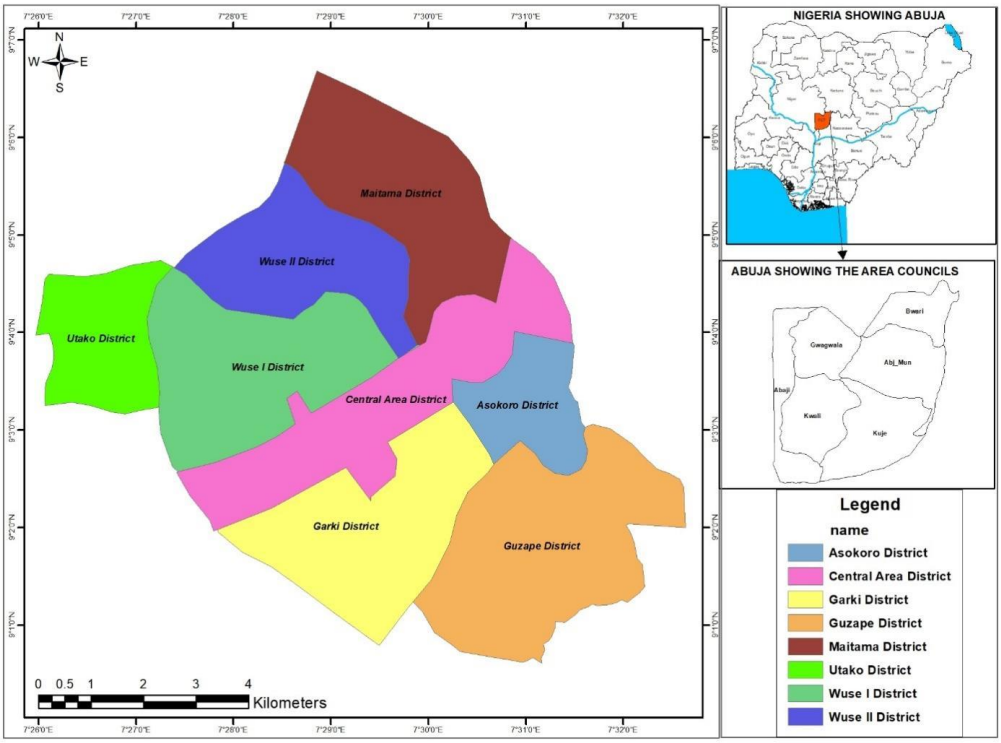

Figure 1: Overview of the Study Area and Selected Districts

Where: e= Level of precision (0.05), N= Population, n= Sample size, 1= Constant

$$n = \frac{1339135}{1 + 1339135\ (0.05)^2}$$

$$n = \frac{1339135}{1 + 1339135 \times 0.0025}$$

$$n = \frac{1339135}{1 + 3347.84}$$

$$n = \frac{1339135}{3348.94}$$

$$n = 400$$

The sample size was equally distributed among the districts where fifty (50) respondents were randomly selected from each district making a total sample size of 400. A total of Four Hundred (400) questionnaires were administered across the study area districts and the sourced respondents; however, Three Hundred and Seventy-six (376) of the questionnaires were properly filled, returned and subjected to further analysis.

Approximately, the retrieved questionnaire represents 94% of the aggregated amount administered.

Data Collection Procedure

Questionnaire was used to elicit information from the respondents. The questionnaire adopted for the study made use of closed-ended format and Likert 3-points which was divided into sections: Section A: the section captured the demographic details of the respondents (occupants) so as to be able to describe respondents in terms of gender, age, level of education, type of building, years of occupancy and status. Section B: the section set out questions that provided answers to the research question regarding the causes and frequent of fire outbreak events and extent of fire-fighting equipment availability among public building in FCT using close-ended and Likert 3-points scale.

Data Analysis

The retrieved questionnaires were coded and subjected to Statistical Package for the Social Sciences (SPSS) for proper analysis. The questionnaire coding was done with MS Excel before being transferred to the Data entry of SPSS. The data of the study were analyzed through descriptive and inferential statistics: Using the SPSS window (Version 22), the descriptive statistics tool such as frequency counts and percentages of response was adopted for the analysis. The use of such statistics allows the researcher to present the evidence of the study in a way that can be understandable and makes conclusion concerning the variables of study (Baridam, 2001). The hypothesis of the study was tested using one-sample t-test. As inferential statistics, t-test allows for exploring the statistical difference in the mean from data collected from a single group variable. The analysis was carried out at 95% confidence level.

Results

Socio-Demographic Details of the Respondents

The socio-economic details of the respondents were presented in Table 1. The analysis revealed that 51.1% of the respondents were male while 48.9% were female. Also, the age of the respondents indicated that most respondents are within age group 30-40 years which represents 37.8% of the respondents. Considering the level of education of the respondents, the outcome revealed that 34.8% have attained bachelors' degree while the least respondents have attained doctorate degree of education representing 5.9% of the total population. From the outcome, 6.6% of the respondents are occupants/staff in government-owned public building, 8.2% of the occupants represents school building, 21.8% represents healthcare facilities, 34.3% represents commercial buildings such as banks, warehouse, shopping mall and offices while 25.3% and 2.9% of the respondents represent recreational facilities such as hotels, parks, and cinema and religious building respectively. Considering the years occupancy, 34.6% of the respondents indicates to have occupied the building for less than 5 years, 39.4% of the respondents have occupied the building in the last 5- 10 years while 16.2% and 9.8% of the respondents indicated to have occupied the building in 11-15years and 16 years above respectively. From the analysis, 22.3% of the respondents had ownership status to their public building while 60.6% of the respondents had renter status to their public building.

Causes and Frequent of Fire Disaster among Public Building

The causes and frequent of fire disaster among the public building was examined and the outcome was presented in Table 4.2 and 4.3. From the outcome, 53.7% of the respondents indicated to be aware of fire incidents and accidents among public buildings in the districts while 46.3% are not aware of fire incidents and accidents among public buildings. Considering the perceived cause of the fire events, 5.3% of the respondents indicated the

fire was caused by arson, 22.9% of the respondents indicated electrical fault, 17.5% indicated negligence, 17.3% indicated overload of electrical appliance, 13.6% indicated substandard electrical and building material while 3.2% and 20.2% of the respondents indicated defective generators and careless in the use of fire as the perceived causes of fire incidents among public buildings respectively.

Table 1: Socio-Demographic Details of the Respondents

Variable	Frequency (n=376)	Percentage (%)
Sex of Respondents		
Male	192	51.1
Female	184	48.9
Age (years)		
18- 29years	110	29.3
30-40years	142	37.8
41-50years	90	23.9
51-60years	26	6.9
61years and Above	8	2.1
Level of Educational		
Secondary School	85	22.6
Diploma/A-Level/STPM	91	24.2
Bachelor's Degree	131	34.8
Master's Degree	47	12.5
Doctoral Degree/PhD	22	5.9
Types of Public Building		
Government Buildings	25	6.6
School Building	31	8.2
Healthcare Facilities	82	21.8
Commercial Building	129	34.3
Recreational Facilities	95	25.3
Religious	11	2.9
Other (Please Specify	3	0.8
Years of Occupancy		
Below 5years	130	34.6
5-10years	148	39.4
11-15years	61	16.2
16years above	37	9.8
Occupancy Status		
Building Owner	84	22.3
Building Renter	228	60.6
Other (Please Specify)	64	17.0

Among the respondents, 2.9% indicated that the fire incidents/accidents occur in less than 6-months, 10.6% of the respondents indicate that the frequency of the fire incidents among public buildings is within one years, 46.3% indicated between 2-3 years while 16.8% and 23.4% of the respondents indicate that the frequency of the fire incidents among public buildings is 4-5years and 6years above respectively. Considering the

satisfaction of the respondents with available fire-fighting equipment available in the building, 19.7% of the respondents indicated to be satisfied while 76.9% and 3.4% of the respondents are not satisfied and undecided respectively.

Table 4.2: Causes and Frequent of Fire Disaster among Public Building

Variable	Frequency (n=376)	Percentage (%)
Aware of Fire Accidents/Incidents		
Yes	202	53.7
No	174	46.3
Perceived Cause of the Fire Accidents/Incidents		
Arson	20	5.3
Electrical Fault	86	22.9
Negligence	66	17.5
Overload of Electrical Appliance	65	17.3
Substandard Electrical and Building Materials	51	13.6
Defective Generators	12	3.2
Carelessness in the use of Fire	76	20.2
Frequency of Fire Accidents/Incidents		
Less than 6-Months	11	2.9
Within 1year	40	10.6
2-3years	174	46.3
4-5years	63	16.8
6years and Above	88	23.4
Satisfy with Fire-Fighting Equipment Available in the Building		
Yes, Satisfied	74	19.7
No, Not Satisfied	289	76.9
Undecided	13	3.4

Fire-Fighting Equipment Availability Among The Public Buildings

From Table 3, the outcome on the fire-fighting equipment available among the public building revealed that 23.1% of the respondents indicated that emergency light is available in their building and functioning while 76.9% revealed that the equipment is not available. 76.9% of the respondents indicated their building has fire safety signs while 9.6% and 13.6% of the respondents indicate that fire safety signs are not available or available but not functioning in their building. 3.2% of the respondents revealed that fire hydrant is available and functioning in their building while 72.1% and 23.1% revealed that fire hydrant is not available and available but not functioning respectively. Among the respondents, 89.1% indicated fire extinguisher is available and functioning in their building while 7.4% and 3.5% indicated that its not available and available but not

functioning respectively. 20.2% of the respondents revealed that fire detector is available and functioning in their building while 66.2% and 13.6% revealed that fire detector is not available and available but not functioning respectively. Among the respondents, 94.7% indicated that sprinkler not available while 5.3% revealed that sprinkler is available but not functioning. 28.2% of the respondents revealed that smoke detector is available and functioning in their building while 67.0% and 4.8% revealed that smoke detector is not available and available but not functioning respectively. Among the respondents, 92.5% indicated that fire blanket not available while 7.4% revealed that fire blanket is available but not functioning. 17.3% of the respondents revealed that fire alarm system is available and functioning in their building while 69.1% and 13.6% revealed that fire alarm system is not available and available but not functioning respectively. Among the respondents, 72.3% indicated that sand is available for fire-fighting purpose in the building while 27.7% revealed that sand is not available in the building.

Table 4.3: Fire-Fighting Equipment Availability Among The Public Buildings

		N (%)		
S/N	**Fire-Fighting Equipment**	**AF**	**NA**	**ANF**
1	Emergency Light	87 (23.1)	289 (76.9)	-
2	Fire Safety Signs	289 (76.9)	36 (9.6)	51 (13.6)
3	Fire Hydrant	12 (3.2)	271 (72.1)	87 (23.1)
4	Fire Extinguisher	335 (89.1)	28 (7.4)	14 (3.5)
5	Flame Detector	76 (20.2)	249 (66.2)	51 (13.6)
6	Sprinkler	-	357 (94.7)	20 (5.3)
7	Smoke Detector	106 (28.2)	252 (67.0)	18 (4.8)
8	Fire Blanket	-	348 (92.5)	28 (7.4)
9	Fire Alarm System	65 (17.3)	260 (69.1)	51 (13.6)
10	Sand	272 (72.3)	104 (27.7)	-

Key: Available and Functioning **(AF)**, Not Available **(NA)**, Available, but not Functioning (**ANF)**

Using One-sample t-test, difference in perceived causes of fire disaster among public buildings were analysed using the following formulated hypothesis.

H_o There is no significant difference in the perceived causes of fire disaster among public buildings in federal capital territory.

H_i There is a significant difference in the perceived causes of fire disaster among public buildings in federal capital territory.

Table 4.4a presented the descriptive analysis of the ANOVA, the mean difference across the samples was 1.58 with standard deviation 0.81. Using the significant value (sig. or p-value) to decide the acceptance or rejection of H_o (where H_o is accepted when p-value > 0.05 or rejected when p-value is ≤ 0.05), the Table 4.4b showed that the p-value was 0.000 (where p ≤ 0.05); hence, the H_1 *Accepted;* that is, there is a significant difference in the perceived causes of fire disaster among public buildings in federal capital territory.

Table 4a: Descriptive Statistics of the Analysis

	N	Mean	Std. Deviation	Std. Error Mean
Perceived Cause of Fire Disaster	376	1.58	0.81	0.04

Table 4b: Test for Significance Difference in Perceived Cause of Fire Disaster

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Perceived Cause of Fire Disaster	37.62	375	0.000	1.57713	1.4947	1.6596

Discussion

The finding revealed respondents are aware of fire incidents and accidents among public buildings in the districts and the leading perceived cause of the fire events are electrical fault, careless in the use of fire , negligence, overload of electrical appliance while others include substandard electrical and building material, arson and defective generators. Similar outcome was reported by the study conducted by Shittu et al. (2022) which indicated electrical fault as leading cause of fire disaster in their study area. the finding corroborated with the study conducted by Yunus and Falola (2022) which identified

negligence as the leading cause of fire disaster in Kano metropolis. Also, Momoh and Ajiboye (2018) indicated overload of electrical appliance as the major causes of fire disaster in their study area. The outcome revealed that the frequent of fire incidents/accidents in the districts is between 2-3 years.

The occupants of the public buildings indicated that unsatisfactory with the available fire-fighting equipment available in their building. The finding share similarity with the study conducted by Sunday et al. (2019) where the respondents were unsatisfactory towards available fire-fighting equipment. Taking account of the available fire-fighting equipment, the finding revealed that fire safety signs, fire extinguisher and sand are available and functioning in the buildings while equipment such as emergency light, fire hydrant, flame detector, sprinkler, fire blanket and fire alarm system are not available in the building. The outcome shared similarity with the study conducted by Adeleye et al. (2020) which indicated the availability and functionality of fire-fighting equipment such fire extinguisher and fire safety signs among public buildings in Ibadan metropolis. Similar outcome was reported by the study conducted by Nimlyat et al. (2017) which identified fire extinguisher as fire safety equipment available amore high-rise buildings. The finding of the study corroborated with that of Daramola and Ibrahim (2021) where all the listed fire0fighting equipment are not available except for portable fire extinguisher. Similar outcome was reported by the study conducted by Alao et al. (2020) which asserted inadequate fire-fighting equipment among Nigeria office building.

The test of the hypothesis regarding the perceived causes of fire disaster among the public building revealed that fire events are caused by various attributes or actions among public building in the districts. The outcome share similarity with the study of Nimlyat et al. (2017), Daramola and Ibrahim (2021), Yunus and Falola (2022) and Shittu

et al. (2022) which all reported various attributes as the causes of fire outbreak from their studies.

Conclusion and Recommendations

Public buildings are very crucial in the economy of every country; they have been contributing to the economy of nations through trades and socio-economic activities. Among many of these buildings, there are still inadequate protection against various form of hazards including fire outbreaks and many public buildings and their occupants have been a victim of fire disaster impact in recent time. Based on the outcome of the study, it was concluded that electrical fault, careless in the use of fire and negligence as the major causes of fire incidents among public buildings and most of the building occupants are not satisfied with the fire-fighting equipment available. Therefore, public building owners and occupants should make certain that their building is well fitted with various firefighting equipment and the equipment should be maintained, tested and upgraded frequently to avoid failure when needed.

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