



ISSN 2278 – 0211 (Online)

Urban Fire Safety Management and Preparedness: Case Study of Asaba Metropolis, Delta State, Nigeria

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Abstract:

This study reported fire safety management and preparedness in Asaba Metropolis, Delta State, Nigeria. This was carried out with the use of structured questionnaire, checklist, observations, oral interviews and secondary data from Delta State fire service Asaba. The respondents were asked questions in the following areas: fire hazard identification, fire risk, fire hazard elimination and general knowledge of fire safety. The results show that electrical source of fire incident was about 90%, implying the major source of fire incident in the Metropolis. Emergency preparedness by way of evacuation plan in case of fire outbreak do not vary significantly ($P>0.05$) for all the assessed sites, provision of fire suppressant system range between 14 – 32%. Provision of Fire alarm system ranges between 15 – 23% in all the location assessed. However, housekeeping methods were above average in all the sites visited within the Metropolis. Ways to improve fire safety in the Metropolis were suggested.

Keywords: Asaba, delta state, Nigeria, fire safety, emergency preparedness

1. Introduction

According to Daniel (2015) fire is a rapid chemical reaction that releases great quantities of heat. This chemical reaction nearly always involves the oxidation of some fuel (the fuel reacts with). Fires cause over 300,000 deaths annually and are the fourth-largest cause of accidental injury globally (after road accidents, falls, and drowning) (Twigg, Christie, Haworth, Osuteye and Skarlatidou, 2017). To initiate fire, an ignition source must heat the fuel to a temperature hot enough to sustain the reaction. The main products of the chemical reaction are smoke and heat. The heat generation would virtually always be sufficient to maintain the high temperatures of the fuel and the oxidant, thus continuing the reaction (keeping the fire going).

Fire incidents always initiate the likelihood of burn injury. Currently, there is rapid growth in crowded regions especially in urban areas. This has however, initiated high risk of burn injury in urban settlements (Xin and Huang, 2013). Fires hazards in residential complexes are one of the major urban disasters due to the high population density and high economic value of buildings and their items. This high population density has greatly influenced the efficiency of firefighting and evacuation operations (Yi and Li, 2011).

Fire can happen at any time at any place. The recent major fires that occurred in various parts of country during the last few months reinforce the view that a fire can happen at any place (Siddiqui, Abhishek, Madhuben and Abhinav, 2014). However, when it comes to residential buildings, the problem becomes more complex and poses very high risk to the life and property of its occupants.

2. Materials and Methods

2.1. Materials

Urban fire risk assessment methodology adopted for this study is designed exclusively for commercial environment. It employs a detailed checklist for the inspection of fire risk and a structured questionnaire for fire risk awareness in a commercial building.

2.2 Approach

The primary data was collected by using questionnaire survey forms administered in a self-completion and structured format to the respondents in a commercial environment. Questionnaires were given to traders with the opportunity to complete the survey on a voluntary basis during work hours. The checklist was used in the inspection of fire risk preparedness of commercial buildings by inspection of fire safety preparedness, fire equipment availability and fire installations.

2.3. Questionnaire

The fire safety questionnaire was used for collecting responses from respondents. It assesses different response sections such as fire hazards identification, fire risk, fire hazards elimination and general fire safety. The detailed standard questionnaire was used for this survey and these questions were rated using 5-point Likert scale (5: Strongly Agree and 1: Strongly Disagree). The data was analyzed using Statistical Package for the Social Sciences (SPSS).

2.4. Checklist

The checklist used for this study was coined from different checklist and assigned percentage ratings/scores. The checklist is subdivided into various sections such as administration, storage, house-keeping, electrical, entrance and exit, fire alarm system and fire suppression system. This enables easy assessment of the commercial environment for fire risk.

2.5. Data Presentation

Data collected from answered questionnaire from respondents was cross tabulated on the average response values and standard error. The calculated average response was then represented with a bar chart.

2.6. Data Analysis

Data obtained as scores from questionnaires and checklist was analyzed using the analysis of variance test to estimate significant difference.

3. Results and Discussions

3.1. Results

Average result of demographic description, response from questionnaire answered and inspection for checklist across all urban buildings assessed. Average scores were obtained for the 5-point likert and given below;

Gender	A	B	C	D	Mean
Male	16	3	2	14	8.75
Female	3	17	18	5	10.75

Table 1: Demographic Description of Respondents (Gender)

Age	A	B	C	D	Mean	%
18 - 23	0	4	2	2	2	10.1
24-27	7	4	9	5	6.25	31.6
28-35	12	10	9	8	9.75	49.4
36	0	2	0	5	1.75	8.9

Table 2: Demographic Description of Respondents (Age)

Marital Status	A	B	C	D	Mean	%
Single	4	13	12	9	9.5	48.7
Married	15	7	8	9	9.75	50
Divorced	0	0	0	1	0.25	1.3

Table 3: Demographic Description of Respondents (Marital Status)

Key:

- A = Delta Development Property Authority Housing Estate
- B = Okpanam Market
- C = Ogbegonogo Market
- D = Dome Event Centre

Item	URBAN CENTRE					
	A	B	C	D	Mean	SD
Identifying Fire Hazards						
All combustible materials and flammable liquids and gases are safety stored	4.58	3.37	4.05	3.95	3.99	0.5
There is a system to control the amount of combustibles kept around	1.79	4.16	3.37	4.58	3.47	1.23
Electrical wiring and installations are periodically inspected.	4.16	3.26	3.16	4.21	3.70	0.56
Suitable measures are in place to protect against arson	4.79	2.11	2.95	1.00	2.71	1.6
Measures are in place to ensure smoke and fire do not spread from one compartment to another	2.79	2.11	3.26	2.32	2.62	0.52
The environment is free from litters and combustible waste	5.00	5.16	4.63	4.63	4.86	0.27
There is designated smoking area	3.84	3.21	3.53	2.00	3.14	0.81
	3.85	3.34	3.56	3.24	3.50	0.78
Identifying People at Risk						
Escape routes are clearly signed	2.16	3.79	3.84	2.00	2.95	1.01
Doors for escape routes open in direction of travel	5.00	4.47	4.47	2.37	4.08	1.17
Steps and Stairs are in good state	5.00	4.63	4.32	4.05	4.5	0.41
Exits leads to a place of safety	5.00	3.16	3.95	5.00	4.28	0.9
The premises are frequently used by visitors	5.00	5.26	4.53	5.00	4.95	0.31
Persons within the premises are on full time basis	5.00	3.53	3.79	2.05	3.59	1.21
There are sufficient numbers of exits for occupants and visitors	5.00	3.47	4.11	3.32	3.97	0.76
	4.59	4.05	4.14	3.40	4.05	0.82
Fire Hazard Elimination and Control						
There is backup power for fire detection and warning system	2	2.63	2.68	1.95	2.32	0.4
There are effective means for giving warning to occupants	2	3.32	3.05	2.11	2.62	0.66
Warning signals can be giving to everyone from one point	4.21	2.95	2.63	3.63	3.36	0.71
Procedures and practices avoid combustible materials and processes that giving heat	2.26	3.37	3.26	5	3.47	1.13
there is a fire emergency plan.	4.63	1.84	2.53	2.84	2.96	1.19
there are efficient fire detection systems	1.68	2.47	2.32	3.05	2.38	0.56
there is a means of escape arrangement in emergency plan	2.16	2.47	2.84	2	2.37	0.37
	2.71	2.72	2.76	2.94	2.78	0.72
Fire Records and Control						
There is continuous conduct of fire risk assessment	2	2.58	2.26	2	2.21	0.28
findings of fire risk assessment are recorded	2.95	2.37	2.79	2	2.53	0.43
Findings are communicated to all for safety cautiousness	2	2.11	2.47	2.53	2.28	0.26
Everyone is aware of fire hazards around the environment	3.16	2.42	3.42	4.63	3.41	0.92
fire risk is communicated even to visitors	4.84	2.26	2.26	2.79	3.04	1.23
	2.99	2.35	2.64	2.79	2.69	0.62
Emergency Preparedness Plan						
There are emergency plans in place	4.37	3.11	2.37	2.74	3.14	0.87
Emergency plans are clearly displayed	4	2.37	2.37	2.84	2.89	0.77
	4.18	2.74	2.37	2.79	3.02	0.82

Table 4: Average Result from Response from Questionnaire

CHECKLIST					
S/N	ITEMS	URBAN HOUSING			
	ADMINISTRATION	A	B	C	D
1	The building has a current and up to date evacuation plan	25	15	20	25
2	Regular fire drill has been completed within the last year	25	17	20	65
3	Evacuation maps and signs are posted for event of fire emergencies	25	15	20	45
4	The building has a visible address on the outside	83.5	50.5	50.75	90
5	Are there accumulations of combustible materials in outer part of building?	42	21	54.25	30
6	Are fire hydrants protected from accidental damage and access to them unobstructed	25	18	20	20
		37.6	22.8	30.8	45.8
HOUSEKEEPING					
7	Storage of combustible materials is kept neat and orderly	85	64.25	63	95
8	Are fire doors free from obstructions that would prevent closure?	79.75	24.5	43	95
9	Are exit doors unlocked when the building is occupied?	66	68.5	66.5	15
10	Are at least two fire exits provided for each smoke compartment?	78.25	31.25	40.5	65
11	Oily rags are in proper containers that are emptied regularly	45	15	20	85
12	Fire department access roads, hydrants, and fire department connections are visible and unobstructed	59	16	20	15
		68.8	36.6	42.2	61.7
STORAGE					
13	There are at least 18 inches of clearance between storage and fire sprinklers or 24 inches clearance between storage and ceiling for sprinklered buildings	25.5	15	20	25
14	All shelves holding chemicals or other hazardous items have lips preventing them from falling	63.75	25.25	36.75	85
15	Are storage rooms, trash rooms, and similar areas separated from other areas by one-hour fire barriers or protected by automatic sprinklers?	25	17	20	45
16	Are supplies and stock located at least 3 ft (0.9 m) from heating units and ductwork?	25	21	20	25
17	Is the inside storage of flammable or combustible liquids limited so that not more than 120 gal (454 L) of such liquids are stored in any one cabinet	25	15	20	25
18	Incompatible compressed gas cylinders are stored separately.	26	15	20	85
19	Compressed gas cylinders are properly secured and labeled.	50	15	20	85
		34.3	17.6	22.4	53.6
ELECTRICAL					
20	All electrical cords are in good condition	83	60.75	59.25	90
21	Extension cords and power strips are appropriate for the load	76.5	46.5	64.25	90
22	There are at least 3 feet of clearance in front of all electrical panels	74	22.75	26	90
23	All electrical panels have a panel cover/door placed on them	83	54.25	51.75	90
24	There are no open junction boxes or exposed electrical wiring.	70	40.5	41.5	90
		77.3	44.95	48.55	90
FIRE SUPPRESSION SYSTEM					
25	Are fire extinguishers fully charged and checked)?	31	15	20	15
26	Are fire extinguishers conveniently located and readily accessible?	45	15	20	15
27	Are fire extinguishers appropriate for the types of hazards present?	43.25	15	20	70
28	Are there fire sprinklers (functional or not)	25	15	20	15
29	Is there a maintenance and service contract for the sprinkler system?	25	15	20	20
		33.9	15	20	27
ENTRANCE AND EXIT					
30	Entrance and Exit pathway and emergency lights are maintained.	85	15	20	85
31	Entrance and Exit signs are illuminated, in good repair, and indicate correct direction of exit	85	22	25.25	85
32	Entrance and Exit are free from obstructions	85	84.5	81.25	85
		85	40.5	42.17	85
FIRE ALARM SYSTEM					
33	Are fire alarm zones (areas) clearly marked?	25	15	20	10
34	Does the alarm system include both manual and automatic initiation devices that provide immediate evacuation notification to the occupants?	25	15	20	70
35	The fire alarm system has been maintained and does not show any trouble	25	15	20	85
36	The room containing the fire alarm panel has a sign posted outside the room indicating the location of the panel.	25	15	20	45
		25	15	20	52.5

Table 5: Average Result from Response from Checklist

4. Discussion of Results

4.1. Demographic Description

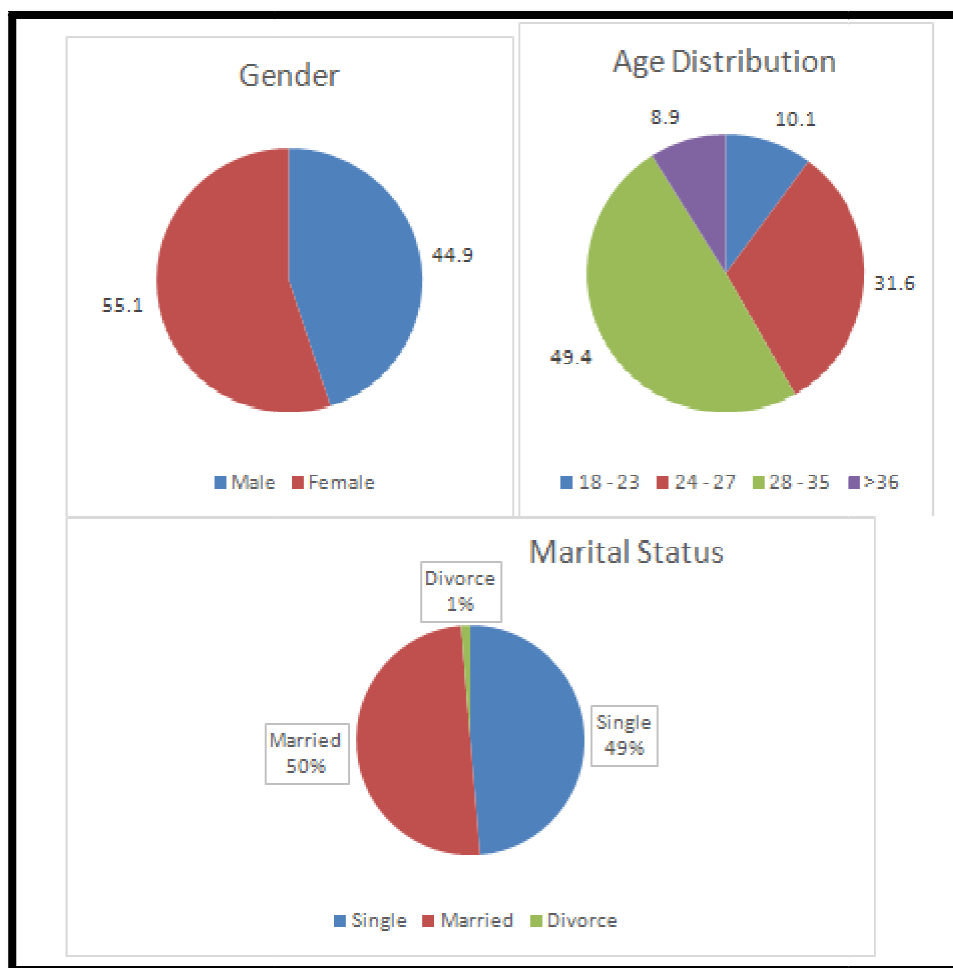


Figure 1: Demographic Description of Respondents

Examined questionnaire classified the demographic description of respondents according to their gender, age distribution and marital status. Twenty questionnaires were distributed in study areas and nineteen were retrieved in some assessed areas. Result indicates that majority of respondents were female. Although this result was mostly distributed at market areas. In housing estates and event center, most respondents were seen to be males. Age distribution also reveals that 49.4% respondents were between the age of 28 and 35 which indicates the likelihood of a good response based on perception of safety within their location. Also, 31.6% of respondents were between the age of 24 to 27 years. Hence, in total, 81% of respondents were above the age of 24. This denotes that 81% of respondents were adults and may be fully conscious of their response. Results also reveals that majority of married respondents were largely found in housing estates than in market areas. This is because personal interviews received that these respondents were mostly hire sales representatives who mostly occupy their respective employers in market areas. This is similar to findings obtained by Nimlyat, Audu, Ola-Adisa and Gwatau (2017) on the evaluation of fire safety measures in high-rise buildings in Nigeria with 38% of respondents between the age of 25-53.

4.2. Questionnaire

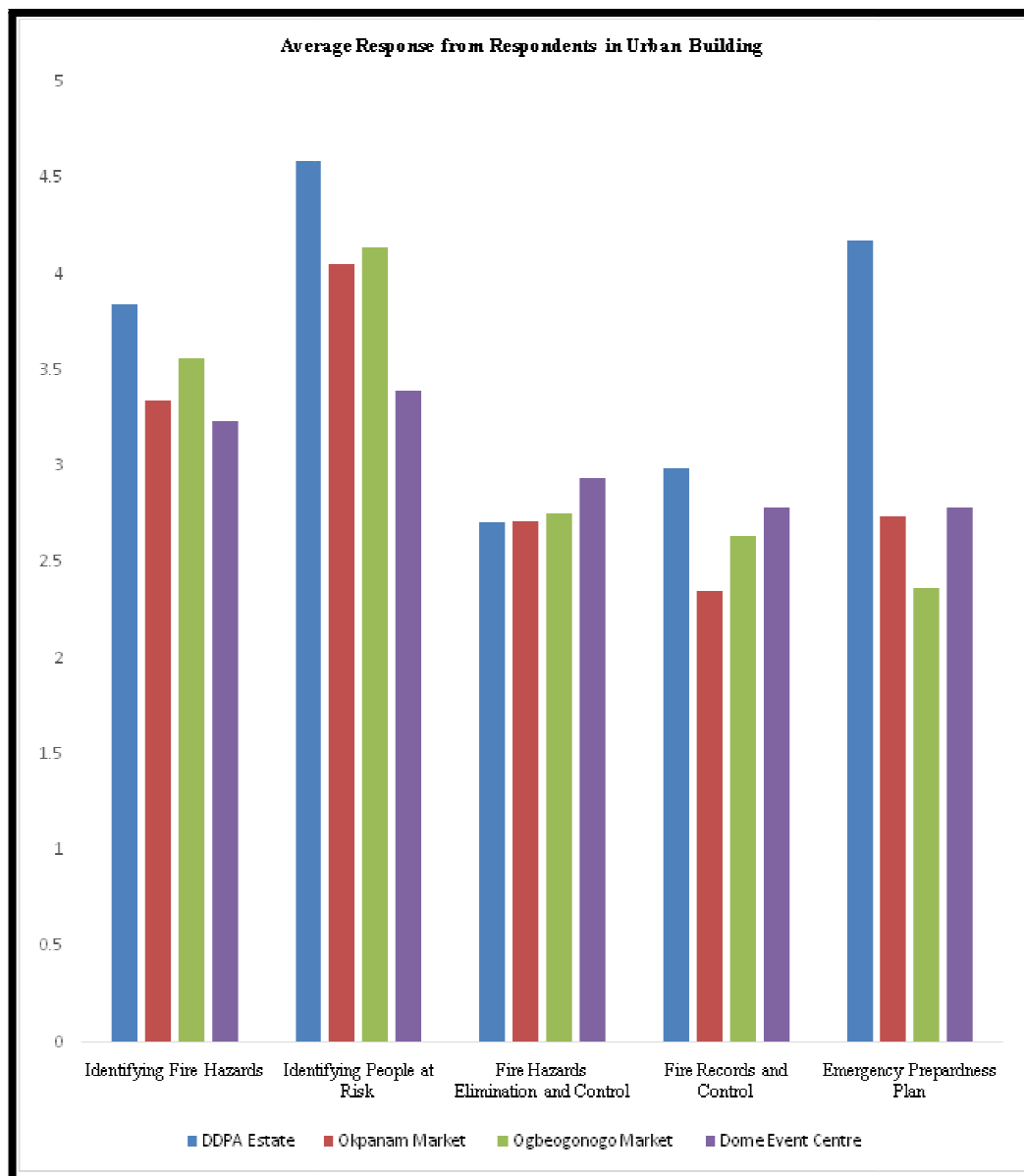


Figure 2: Average Response from Respondents Level of Fire Risk

Result obtained indicates that respondents have a higher tendency of identifying fire risk and noting the categories of persons likely to be affected. This is revealed through obtained average scores corresponding to an agreed and strongly agreed response. Statistical test also reveals that there is no significant difference ($p > 0.05$) to this section across all assessed areas. However, results obtained also reveal that respondents lacked fire hazards elimination and control measures, fire record keeping practice and emergency preparedness. This is obtained from low response from respondents. These lapses were recorded mainly at commercial buildings (markets and events centre) than in residential areas. On emergency preparedness, statistical analysis revealed a significant different ($p < 0.05$) in the assessed location indicating that the preparedness levels across the assessed locations varied significant. This is attributed to safety measures put in place by building owners since some owners ensure safety of persons especially for estates. This is similar to findings by Nimlyatet *al.*, (2017) which indicates that in urban buildings there are more availability of fire extinguishers than detection systems (with results 97.2 for fire extinguishers and 1.9% for smoke detectors). Daniel (2011) on their assessment of fire risk in market environment in Nigeria, indicated that Kaduna central market was not provided at all with fire detection and suppression systems. These claims are supported by result from residential buildings and markets buildings assessed with low level (2) of the provision of fire detection system. Fire risk assessment was also found to be missing in these urban buildings as responded by occupants. Also, it was clearly found that buildings were not clearly signed by building owners as seen and confirmed by study by Nimlyatet *al.*, (2017). This lapse was common in all urban structures as attested to by respondents with statistical test revealing this lapse to be common for all assessed urban buildings.

4.3. Checklist

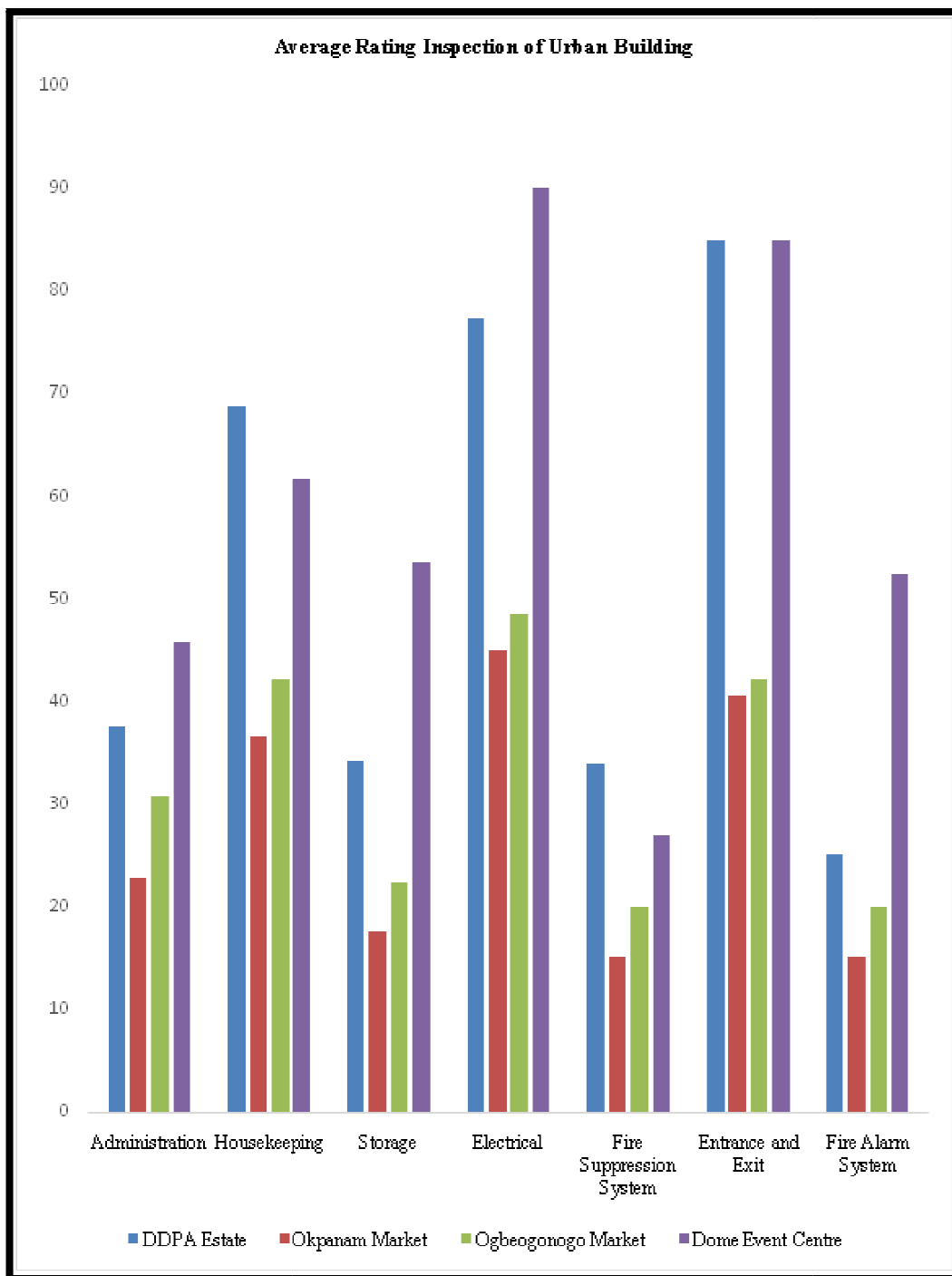


Figure3: Average Result from Inspection of Fire Risk Level of Urban Buildings

Inspection of fire risk in urban buildings assessed administration input on minimizing fire risk, maintenance of good housekeeping, material storage, electrical installations, fire suppression amongst others. In terms of administrative practices such as the presence of an evacuation plan in the event of a fire outbreak, Oduduabasi (2018) revealed that this factor stands as a means that increases the vulnerability of urban buildings through his assessment of both public and private school buildings. Agbonkhese, Yerima, Abba and kawu (2017) through fire risk assessment of residential buildings in Gombe Metropolis in Nigeria. This was reported from results that evacuation plan was absent in buildings in Asaba Metropolis especially in Markets. Statistical analysis indicates that the level of administrative commitment to fire safety do no differs significantly ($P > 0.05$) for the assessed urban buildings. This shows that the levels of compliance to fire safety depends for the owners of the building as the same with similar safety practices such as visible display of address for easy location by firefighting personnel, conduct of fire drills and prevention of the accumulation of combustible materials. For fire suppression system, fire extinguishers were not provided in residential and commercial buildings except for events centre which was provided in minimal amount. Electrical fittings were loose and unarranged. Provision of exit signs with lighting was missing which confirms publications by Nimlyatet *al.*, (2017). However, these lapses are subjective to the building. Fire safety compliance differ significantly revealing that some safety measures are adhered to while others are neglected.

S/N	Location	Number of Incident
1.	Public/government buildings	870
2.	Private dwellings	550
3.	Educational establishments	50
4.	Shops/Mall	150
5.	Hotels/Restaurants/Club houses	210
6.	Factories	115
7.	Petrol (gasoline) stations	105
8.	Oil/Gas Installations	110
9.	Automobiles	77
10.	Banks	15
11.	Market places	105
12.	Religious houses	05
13.	Bush burning	55
14.	Farmlands	05
15.	Local Electricity Board Facilities	15
	Total Fire Incidence/Accident	2,437
	Total Number of Death	27 Lives

Table 6: Fire – Outbreak in Asaba Metropolis Delta State in (2015 – 2019)

Source: Fire Service Office

5. Conclusion

This study has shown that fire outbreak poses a high risk especially in dense informal settlements. This shows that such settlements usually lack fire safety awareness and implementations. It was observed that fire risk level in urban buildings in Asaba was significantly high ($P>0.05$). This is because basic fire safety requirements have not been put in place by most of the building owners coupled with poor awareness on fire safety by most of the occupant. It was also observed from inspection report that fire prevention gadget like extinguishers, hydrants and others were lacking in most of the buildings especially in public and government buildings where they were needed most, the absence of exit light especially in commercial buildings were also lacking. The responses from the respondents shows that their knowledge of fire protection and prevention were grossly inadequate. However, the housekeeping in most of the sites visited were above average, therefore government and non-government organizations (NGO) must embark on serious education and advocacy on urban fire safety and management to reduce the risk of urban fire outbreaks in Asaba Metropolis.

6. Acknowledgment

The authors express their gratitude to all our respondents and the Asaba Metropolis fire safety office for providing the fire outbreak data in Asaba Metropolis used in this work.

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