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Classification of Causes and Strategies for Curbing Market Fire in Nigeria

Nnamdi ILodiuba[1], Ify L. Nwaogazie[1*] and John Ugbebor[1]

[1]Centre for Occupational Safety, Health and Environment, University of Port Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author NI carried out literature survey, data collection and performed the statistical analysis, wrote the protocol as well as the first draft of the manuscript. Author ILN served as main supervisor, reviewed the research design, statistical analyses and documentation. Author JU as assistant supervisor managed the data collection and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Classification of causes of market fire in Nigeria is a study aimed at identifying and classifying the causes of market fire in Nigeria from the market users' perspective. The study considered markets with high commercial activities and they were selected from three major cities, namely Lagos, Port Harcourt and Onitsha. Sixty questions on the causes of market fire were designed and distributed to 1074 shop owner/traders (respondents). The factor analysis method was adopted to streamline the questions into six categories and they were ranked. Results showed that the most common cause of market fire in Nigerian is "general storing" and this category attained a commonality ratio of 0.09284. Other causes of fire in markets included electrical installation which ranked second with a commonality ratio of 0.08071. The third to the sixth in that order are, disposal and knowledge of market locations, market exit points, regulations regarding markets and awareness and fire emergency plan. A design plan for an ideal market is provided taking cognizance of the following: ventilation, fire wall and roofs, building in clusters, electrical wiring in conduits, firefighting tools in place, general storage facilities, and dedicated parking area and that for smoking, etc. It is recommended that Government should institute fire professionals to handle design and operation of markets.

**Corresponding author: Email: ifynwaogazie@yahoo.com;*

Keywords: Market; fire; factor analysis; respondents; Nigeria.

1. INTRODUCTION

As described by Channing [1] fire is one of the most destructive, disruptive and costly causes of damage to any building and yet fire doesn't just happen, it is caused by a human based factor [2]. Fire has been seen as the leading cause of loss of lives and properties at commercial and industrial facilities worldwide [3].The records of losses from fire incidences in Nigeria are so numerous [4-8] and this indicates that more work needs to be done by researchers to find more prevention techniques.

The market is a commercial place where buying and selling take place. In the past many markets both in and outside Nigeria have recorded significant losses from fire; The case of the Kumasi central market fire in Ghana, while in Nigeria, we have the mile one market fire in port Harcourt, the *Ariaria* market fire in Aba and so on. The issue of concern is "if fire is caused by human beings", then what are the factors responsible and how can we control these factors when designing markets in Nigeria.

Past researches [9,10] on market fire have considered human factors that cause fire such as children playing with fire, smoking, intentional acts, reckless use of electrical appliances, careless disposal of cigarette stumps, gases from gas cylinders, improper storing of fuel, overloading of electrical sockets, faulty electrical wiring, illegal connections of electricity and lack of general safety awareness. They are of the view that the most common causes of fire are electrical related [8,11,12].

This study considered 60 causes of market fire and tried to streamline them into major categories to eliminate the variables that have indirect relationship which cause dependency to be hidden among these variables [13]. The major statistical concept used is that of the principal component analysis which has been adopted by researchers such as Scholz and Sadowski [14] for transformation approach.

2. MATERIALS AND METHODS

2.1 Study Area

The study areas for this study were Lagos, Port Harcourt and Onitsha, which were selected as typical but densely populated cities with high commercial activities in Nigeria. Lagos lies between latitude 6° 50'52.46"N - 6° 51'0.88"N and longitude 3° 4'51.21"E - 3° 5'34.56"E. Lagos is densely populated with over 1,000,000 people [15]. The presence of an operational sea port has made growth of commercial activities very significant and this has explained the level of buying and selling activities in their markets.

Port Harcourt lies between latitude 4.420N – 4.421N and longitude 6.416E - 6.413E. Port Harcourt has a population above 500,000 people [15]. The presence of a refinery, some oil companies have made growth of commercial activities very significant which is seen in its market activities.

Onitsha lies on longitude 6° 27'11.77"N - 6° 27'15.40"N and longitude 7° 31'2.27"E - 7°19'31.54"E. Onitsha has a population of above 1,000,000 people (NPC, 2010). The indigenous people are entrepreneurial in nature and this has been evident in the large volume of trading that go on in their markets. The markets located in these study areas are recognized for their high level commercial activities that even attract buyers and sellers from other cities and states. Fig. 1 is the map of southern Nigeria showing the three study locations.

2.2 Data Collection

The primary data were obtained through questionnaires distributed (See Table 1) to the respondents (shop owners/sellers) educated, non-educated and certified professionals (See Table 2). A total of 60 questions were designed and distributed randomly and the format of answers were; yes; no; and undecided.

2.3 Procedure

The questionnaires collected were tabulated on the Excel 2014 software and the component analysis software was adopted for analysis. The responses were weighted from 1 to 3 as follows; Yes=3, no=2, and undecided=1. The component analysis software grouped respondents' views on related questions together and further on, the grouped questions were given group names relating to major categories of causes of market fire. For example, all electrical related questions were grouped into electrical installations and related issues. The component analysis software was further used to check the strength of

commonality between respondent in order to rank the most important factors when considering causes of market fire in Nigeria.

2.4 Analysis

The sixty questions as shown in Appendix 1 constituted input data for Factor Analysis tool (FA). The results from the analysis are presented as Fig. 2 and Table 3. The questions with bolder factors (see Table 3) are those with the most loading. These factors are sorted out with the best group category name. The six factors are grouped into categories (See Table 4). From Table 3, the respondents' views show that 35 questions fall under factor 1, four questions under factor 2, four questions under factor 3, six questions under factor 4, 6 questions under factor 5 and four questions under factor 6, respectively.

The questions grouping under the different factors were subjected to factor analysis again to check the commonality ratios. Table 4 shows a summary of the commonality ratio of the group questions.

3. DISCUSSION

3.1 General

This study has considered many possible causes of market fire and has tried to factor them in order of importance using the method of factor analysis and ranking. The Nigerian environment is a unique case and as such proper analysis needs to be carried out based on those hazardous activities that can be witnessed which might not be tolerated in the developed countries; such activities are cooking in the market, storing of generators and jerry cans of fuel in stores and smoking within the market. Past analyses have implicated electrical installations and related issues to be the major cause of market fire [9,16]. This is not far from the truth in the Nigeria case as this ranked the second most important variable that causes market fire with a commonality ratio of 0.0903. Results from our analysis showed that the most common cause of fire in the Nigerian markets is general storing. Shop owners/Traders in Nigeria have not been well educated on storing techniques (what to store, where to store and how to store). For instance, where and how to store petrol for individual generator use and an acceptable way on how to use private generator within the market are unresolved issues.

With the general power issue in the country every market user owns a generator set which is stored in the shop till the next business day. From the respondent views these are the most common hazardous activity and the commonality ratio ranked it the highest (0.0928). Other causes of market fire like disposal and knowledge of market locations ranked third with a commonality ratio of 0.0810; Market exit points and muster points ranked fourth with a commonality ratio of 0.0540; regulations regarding markets ranked fifth with a commonality ratio of 0.0537; and awareness and fire emergency plan ranked sixth with a commonality ratio of 0.0458.

3.2 Strategies for Curbing Fire in Nigerian Markets

Given the questionnaire responses and factor analysis the major causes of fire in Nigerian markets have been uncovered and these causes were used as variables to create a quality plan that will guide professionals in the design/construction and operation of markets in Nigeria. The prevention of market fire should start at the design stage of the market. There should be instituted professional bodies to regulate and control the design stage of any given market. At the design stage of the market critical items as those listed below should be checked:

1) Proper Ventilation of shops; 2) Installed fire walls; 3) Limitations to high rise buildings; 4) Increased building in clusters; 5) Wiring in conduits and not surface; 6) Central point for storing generators and fuel; 7) Proper firefighting tools in place; 8) Dedicated space for cigarette smoking and 9) Dedicated spaces for parking vehicles and loading bays.

At the operational stage an experienced management team should be put in place to manage activities that go on in the Nigerian markets. They should establish procedures for carrying out different activities within the market such as welding. These procedures shall be communicated to shop owners/traders through quality manuals. The management team shall designate different areas where different items will be sold, they shall enforce rules such as no cooking and smoking within the market. Above all, the management team shall carry out

frequent fire drills to measure the level of preparedness by the shop owners/traders and lastly awareness programs should be conducted frequently to educate the shop owners/traders how to prevent fire.

In effect, a simple design chart is developed (see Fig. 3) to show all the procedures required to curb market fire. These procedures may be converted to audit checklist for audit processes to check if a market meets standard as recommended in this study.

3.3 Design of a Typical Market

A typical market is designed to show the listed criteria in curbing fire in Nigeria market as provided in this study (See Appendix 2). The market design drawings show a plan view (Fig. 2A), a 3 dimensional view of the entire market (Fig. 2B) and a 3 Dimensional section of the market (Fig. 2C). Labelling on Figs. 2A-2C show different tools that have been stated in this research to curb market fire.

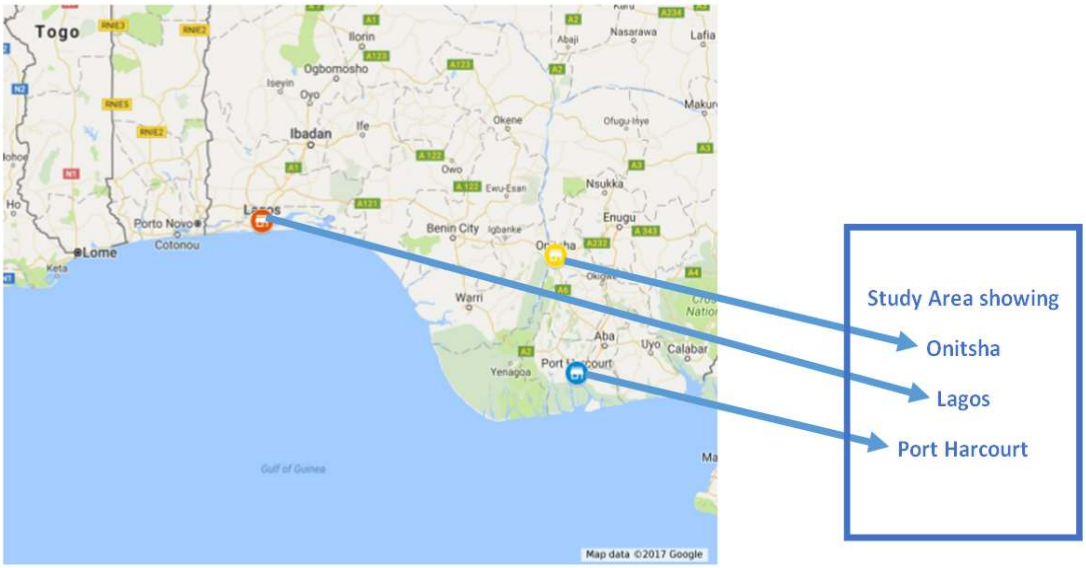

Fig. 1. Map showing the three study locations

Table 1. Summary of distributed questionnaires

Location	Administered	Retrieved	Properly filled	% retrieval
Lagos	600	567	542	51.13
Port Harcourt	320	282	280	25.43
Onitsha	300	260	252	23.44
Total	1220	1109	1074	100

Table 2. Respondents categories/educational background[±]

Educational level	Frequency
Not educated (no formal education)	283
Senior School Certificate Examination (SSCE)	374
Diploma	203
Bachelor's degree/ higher diploma	153
Post graduate	32
Professional certifications relating to safety	29
Total	1074

[±]*For the purpose of this study, Respondents are same as shop owners/ traders*

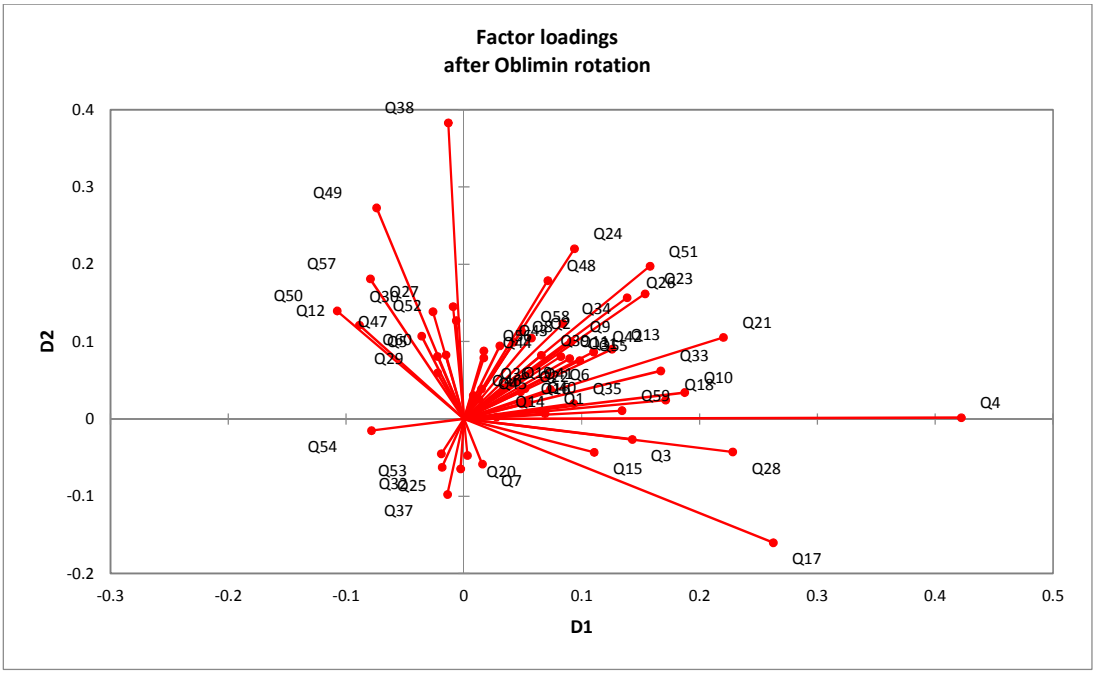

Fig. 2. Factor loading on respondent questions

Table 3. Factor pattern for questionnaire responses

Questions	Factors					
	F1	F2	F3	F4	F5	F6
Q1	**0.1905**	0.0604	-0.0336	-0.0617	0.0444	-0.0153
Q2	**0.1774**	-0.0223	-0.0001	-0.0011	-0.1209	0.0683
Q3	0.1067	0.0659	0.0580	-0.0305	**0.1093**	0.0266
Q4	**0.2574**	0.1383	0.2167	0.0821	0.0601	0.1957
Q5	0.1472	-0.0001	0.0026	-0.0711	**-0.1737**	-0.0250
Q6	**0.1470**	0.0036	0.0013	-0.1424	-0.0317	0.1305
Q7	**0.1926**	0.1427	-0.0529	-0.1257	-0.0453	-0.0713
Q8	**0.1319**	-0.0410	0.0746	-0.1059	-0.0310	-0.0192
Q9	**0.2100**	0.0193	0.0910	-0.0725	-0.1761	0.0306
Q10	0.1695	-0.0032	0.0251	-0.0481	**0.2011**	0.1151
Q11	**0.1976**	-0.0086	0.0280	-0.1491	-0.0647	0.1016
Q12	0.0642	-0.1026	-0.0092	**-0.1270**	-0.1038	-0.0165
Q13	0.1070	-0.0196	**0.1802**	-0.0497	-0.0057	-0.0299
Q14	0.1276	0.0755	-0.0177	-0.0178	**-0.1889**	0.0554
Q15	**0.2326**	0.1556	-0.0653	0.0323	-0.0961	0.0555
Q16	0.1391	0.0605	0.0660	-0.1424	**-0.1493**	0.0289
Q17	0.1797	**0.2431**	0.0655	0.0112	0.1920	-0.0050
Q18	**0.1838**	0.0756	0.1157	0.0339	0.0885	-0.0955
Q19	0.1438	-0.0428	-0.0428	**-0.2819**	0.0854	0.1441
Q20	0.1205	0.0998	-0.0176	**-0.1218**	-0.0111	-0.0775
Q21	**0.2305**	0.0317	0.1301	0.1981	0.0518	-0.0861
Q22	**0.1212**	-0.0086	-0.0214	-0.0634	0.0795	0.0144
Q23	**0.2223**	-0.0478	0.1213	0.0572	0.0041	-0.0358

Questions	Factors					
	F1	F2	F3	F4	F5	F6
Q24	**0.2047**	-0.1494	0.0488	0.0274	0.0517	0.0142
Q25	0.1316	0.0741	**-0.2241**	0.0443	0.1060	0.0376
Q26	**0.2164**	-0.0519	0.1327	-0.0342	-0.0096	-0.0145
Q27	**0.2459**	-0.0455	-0.0814	-0.0119	-0.1357	0.0090
Q28	**0.2092**	0.1570	0.0269	0.1408	-0.0090	0.0802
Q29	**0.2148**	-0.0395	-0.1401	-0.1630	0.2065	-0.0652
Q30	**0.1917**	-0.0549	-0.0121	-0.0183	-0.0258	-0.1466
Q31	0.0594	-0.0733	-0.0685	0.1741	0.0186	**0.1870**
Q32	0.0242	0.1149	0.1146	-0.1192	-0.0384	**-0.2225**
Q33	0.0774	-0.0175	**0.1569**	-0.0083	0.0427	0.0637
Q34	0.0565	-0.1051	0.0801	-0.0085	-0.0127	**0.1158**
Q35	**0.0692**	0.0126	0.0575	0.0002	0.0333	0.0280
Q36	**0.1823**	0.0146	-0.0744	-0.0438	0.0748	-0.0658
Q37	0.1311	0.1203	**-0.1998**	-0.0386	0.0080	0.0605
Q38	0.2172	**-0.3178**	0.0333	-0.0135	-0.0286	-0.0025
Q39	**0.0785**	-0.0467	0.0576	-0.0169	-0.0324	0.0604
Q40	**0.1824**	0.0636	-0.1010	0.1254	-0.0743	0.0290
Q41	**0.1496**	0.0346	-0.0022	0.0650	0.0320	-0.1066
Q42	0.1341	0.0166	**0.1538**	0.0590	-0.0423	-0.1179
Q43	**0.1729**	-0.0143	-0.0491	0.0599	-0.1150	0.0371
Q44	0.1250	-0.0408	-0.0889	**0.1394**	0.0760	-0.0531
Q45	**0.1289**	0.0189	-0.0172	-0.0535	0.0648	-0.0948
Q46	**0.1375**	0.0317	-0.1130	0.1235	-0.0766	0.0113
Q47	0.0900	-0.0417	0.0448	0.0455	-0.0433	**-0.1923**
Q48	**0.1896**	-0.1001	0.0010	0.1093	-0.0086	0.0029
Q49	0.0967	**-0.2575**	-0.0461	0.0430	-0.0525	0.0239
Q50	0.1202	**-0.1269**	-0.0861	-0.1173	0.0271	-0.0787
Q51	**0.1817**	-0.1269	0.1166	0.0511	0.0973	0.0170
Q52	**0.1159**	-0.0807	-0.0145	0.0698	0.0328	-0.1023
Q53	**0.1484**	0.1418	-0.0809	0.0742	-0.1322	-0.1236
Q54	0.1410	0.0424	**-0.2109**	-0.0354	-0.0372	0.0136
Q55	**0.1305**	-0.0170	-0.0105	0.1006	-0.0494	0.1041
Q56	0.1361	-0.0778	-0.0572	-0.0656	**0.1629**	-0.0213
Q57	**0.1718**	-0.1238	-0.0949	0.0509	-0.0088	-0.1264
Q58	**0.1934**	-0.0475	-0.0822	0.1035	0.0250	0.0086
Q59	**0.1887**	0.0692	0.0196	0.0001	0.0452	0.0119
Q60	**0.1567**	-0.0472	-0.1406	0.0644	0.0474	-0.0099

Table 4. Ranking the causes of market fire

S/N	Group question	Factor group	Coefficient of commonality	Rank
1	General storing	F3	0.0928	1
2	Electrical installations	F2	0.0903	2
3	Disposal and knowledge of market locations	F5	0.0810	3
4	Market exit points and muster points	F4	0.0540	4
5	Regulations regarding markets	F6	0.0537	5
6	Awareness and fire emergency plans	F1	0.0458	6

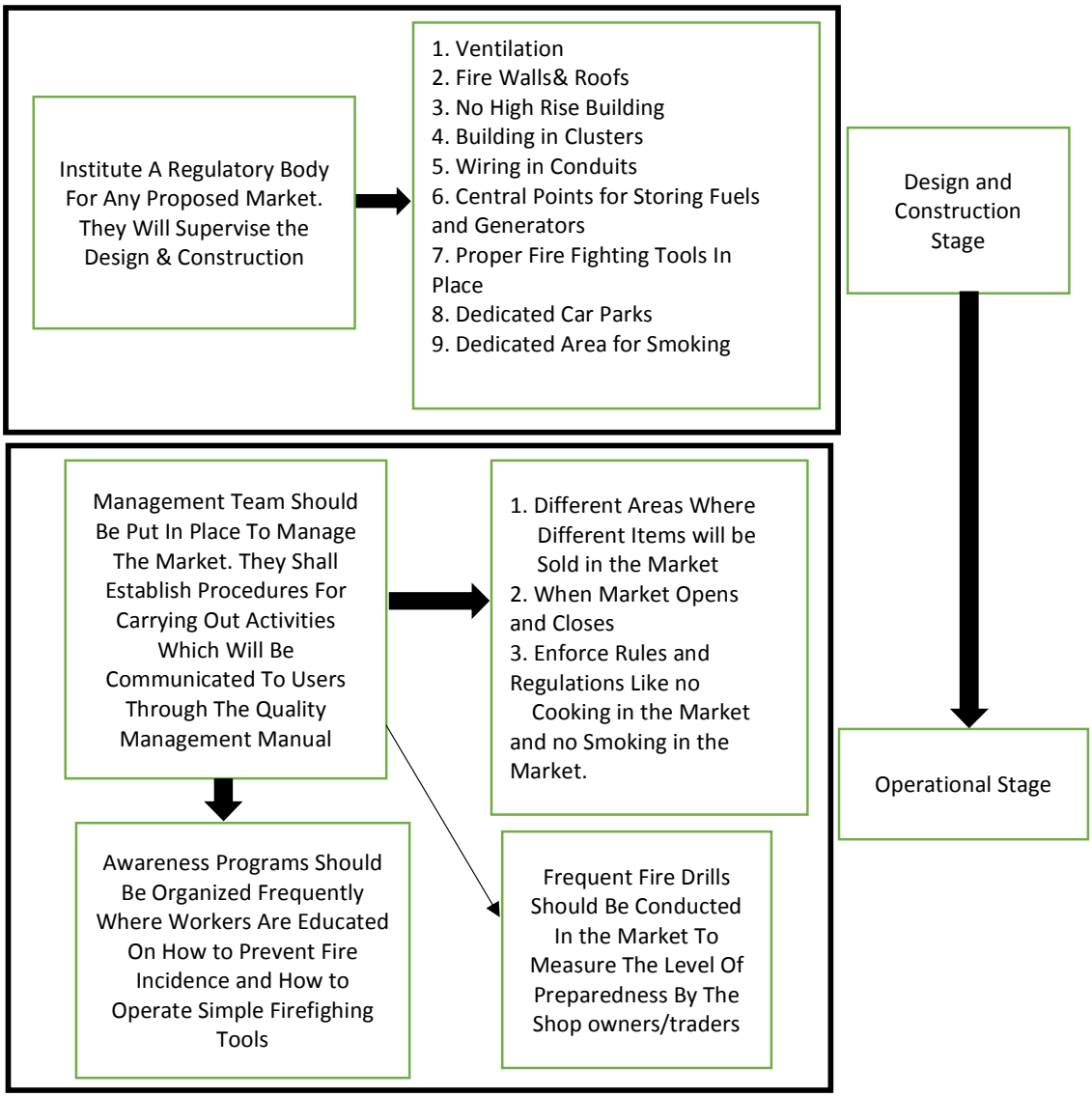

Fig. 3. Design chart for curbing market fire procedures

4. CONCLUSION

From this study the following conclusions can be reached;

1. Shop owners/traders in Nigeria have low level of awareness and preparedness towards causes of market fire.
2. The causes of market fire in Nigeria can be grouped into 6 categories in ranking which are general storing, electrical installations and related issues, disposal and knowledge of market locations, market exit points and muster points, regulations regarding markets, awareness and fire emergency plan.
3. General storing is the most frequent cause of market fire in Nigeria.
4. Curbing of market fire effectively in Nigerian markets should start from the design stage.

5. RECOMMENDATION

To reduce the rate of fire incidences in Nigerian markets the following are recommended;

1. The government should take more seriously the design of markets and adopt points laid out in this study for professionals to consider in their design and operation of markets

2. A safety and quality management team should be instituted to manage every market in Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Channing J. Safety at work, Routledge Taylor & Francis Group, London and New York; 2014.
2. RMS. Risk Management Services, marine municipal association. Best Practice Guide for Workplace Fire Safety and Fire Extinguishers; 2004.
3. Blank M. The role of fire prevention in protecting facilities. 1997.
   Available:http//www.fpemag.com/archives/articles.asp?
   (Accessed: 9th February 2016)
4. Federal fire service. Annual fire outbreaks in Nigeria; 2015.
   Available:fedfire.gov.ng
   (Accessed: 4th march 2016)
5. News Agency of Nigeria. Property worth N996 million was destroyed by fire in 2016; 2016.
   Available:www.dailytrust.com.ng
   (Accessed: 30th April 2017)
   National Association of Nigeria Traders. Birnin Kebbi Central Market Fire in Kidence; 2016.
   Available:www.dailytrust.com.ng
6. Tulashie SK, Addai EK, Annan JS. Exposure assessment, a preventive process in managing workplace safety and health, challenges in Ghana. Sat Sci. 2016;84:210-5.
7. Simson DE. Fire protection and safety. A presentation of Ghana national fire service (GNFS). Ashanti regional office at symposium of building technology student society (BTSS) week celebration, Kwame Nkrumah University of Science and Technology (KNUST) Kumasi; 2007.
8. Addai E, Tulashi S, Annan J, Yeboah I. Trends of fire outbreaks in Ghana and ways to prevent these incidents. Safety and health of work, Science Direct. 2016;7:284-292.
9. Makanjuola S, Aiyetan A, Oke A. Assessment of fire safety practices in public buildings in Western Nigeria. Presented at the RICS COBRA research conference, University of Cape Town. 2009;39-48.
10. Boateng W. Electricity company of Ghana explains causes of fire outbreak. Ghanaian Times; 2013.
11. Anaglatey P, Accra continues to record fire outbreaks. Available on the chronicles of July 30th, 2013; 2013
12. Yang Q, Shao J, Scholz M, Plant C. Featured selection methods for characterizing and classifying adaptive sustainable flood retention basins. Science Direct. 2011; 45: 993-1004.
13. Scholz M. and Sadowski AJ. Conceptual classification model for sustainable flood retention basins. J. Environ. Manage. 2009;90(1):624-633.
14. National Population Commission (NPC) [Nigeria] and ICF International. Nigeria demographic and health survey 2013. Abuja. Nigeria and Rockville, Mrayland. USA: NPC and ICF International; 2014.
15. Camplin J. Worker compensation premiums training daze-facility management maintenance and operations; 2005.
    Available:http://www.facilities.net/com/maintenance.operations.com

APPENDIX

Appendix 1. Sample of the questionnaire adopted for the study

Code	Questions
Q1	Are you aware that it is mandatory for the market building plans to get approval from relevant department(s), such as Fire service/ LGA before they are constructed?
Q2	Are you aware of any regulations or legislations guiding fire safety in Nigeria markets?
Q3	Are you familiar with the muster point locations?
Q4	Have you heard of fire safety concerning the market?
Q5	Are suitable containers provided for waste materials and trash?
Q6	Are there any fire safety policy/ regulation in your market?
Q7	Does your market policy incorporate disaster management issues?
Q8	Are you doing training on awareness for fire preparedness in your market place?
Q9	Do you have any fire safety Training schedule for the market?
Q10	Are there any combustible trash accumulations outside of proper containers?
Q11	Are the fire training scheduled used in the markets?
Q12	Is storage in warehouses orderly with ample aisle space?
Q13	Are there enough access roads within the market for the passage of fire fighting vehicles if the need arises?
Q14	Are flammable liquids safely handled and stored?
Q15	Does your shop/building have fire certification from fire and rescue services in your area?
Q16	Are combustible packing materials kept in safe container?;
Q17	Is there any temporary wiring in any area of the market stalls including overheads?
Q18	Do you have fire/ smoke detectors in the marketplace?
Q19	Is storage in warehouses orderly with ample aisle space?
Q20	Are products properly and safely stored in the shops/ buildings within the market?
Q21	Does your market have designated place for cigarette smoking?
Q22	Are “No Smoking” signs posted in hazardous area?
Q23	Are “No Smoking” regulations enforced in restricted areas?
Q24	Are the wastes in your market burnt or buried in the ground?
Q25	Are all the access roads in good condition and unobstructed?
Q26	If burnt, is the burning supervised by Fire Watch/ Wardens/Market trained personnel?
Q27	Does your market have separate space/ section for hot work such as welding/ cutting?
Q28	Does your market have separate section/ place for cooking/restaurant?
Q29	Is your shop insured against loss from fire disaster?
Q30	Are fire extinguishers provided for use in case of fire?
Q31	Are the stores sometimes overstocked such that there is not enough ventilation?
Q32	Do you involve other relevant departments like Government / private Fire Services in the inspection of your markets?
Q33	Are there clearly identified fire exit points for market operators and their customers in case of need?
Q34	Is your market/ shop registered?
Q35	Are all the extinguishers properly charged and pressurized?
Q36	Are all extinguishers regularly serviced and maintained in good condition and readily accessible?
Q37	Are all fire exits clearly marked?
Q38	Are transformer areas, motors, fuse panels, and switch boxes cleanly maintained?
Q39	Are all fire extinguishers unobstructed, including access to them and discharge from them?
Q40	Have you received practical training on how to use a portable fire extinguisher?
Q41	If yes to question 5, can you identify the major types of portable fire extinguishers?
Q42	Are you familiar with fire safety signs and symbols in and around the market?
Q43	Can you confidently say that you know how to use fire extinguisher?
Q44	Are proper and regular housekeeping/ inspection maintained in the market?
Q45	Does the market have emergency plan?
Q46	Are there emergency Numbers for you to call in case of fire in the market?
Q47	Does your market have muster / Assembly point locations?

Code	Questions
Q48	Have you been involved in fire drills in the market place?
Q49	Is all wiring, including connection to junction boxes, equipment, etc. in good condition?
Q50	Are wiring in the market surface or conduit
Q51	Does your market have a fire emergency procedure?
Q52	Do you have fire alarms/ warning systems in your market place?
Q53	Does your market have any fire service station located in it? If No
Q54	When a shop is rented are there questions on the activities the seller will be carring out
Q55	Do the markets/ Buildings have firefighting/protection equipment?
Q56	Is the packing area cleaned up at closing time?
Q57	Do you know where the fire protection equipment are located?
Q58	Do the shop owners and Traders know how to use these fire protection equipment?
Q59	Are there hydrants provided in this market
Q60	Are the hydrants in good working conditions

Appendix 2. Plan view of a typical proposed ideal market

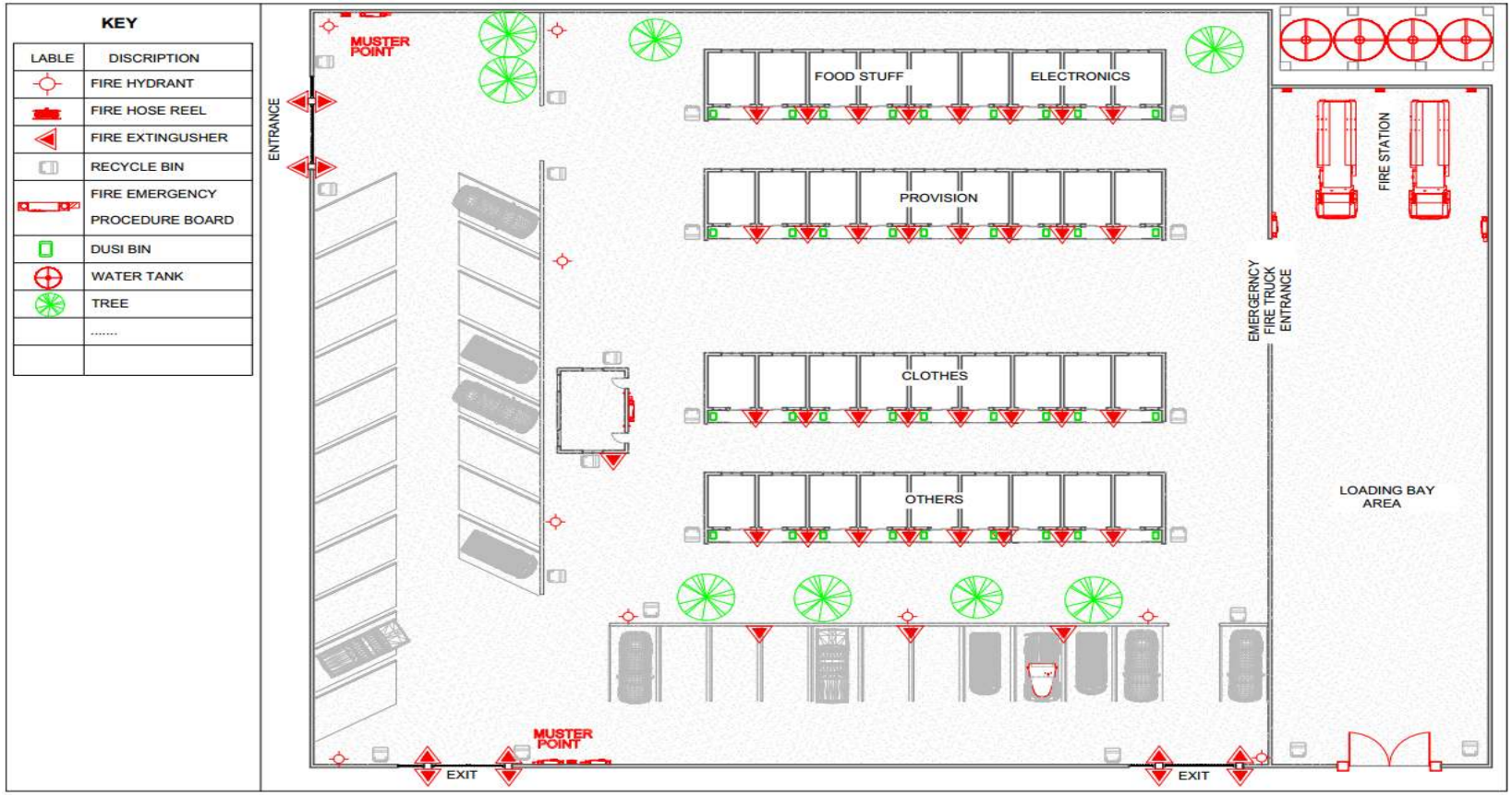

Fig. 2A. Plan veiw of an ideal market that will curb market fire

Fig. 2B. 3D dimemsional veiw showing typical plan of an ideal market that will curb market fire

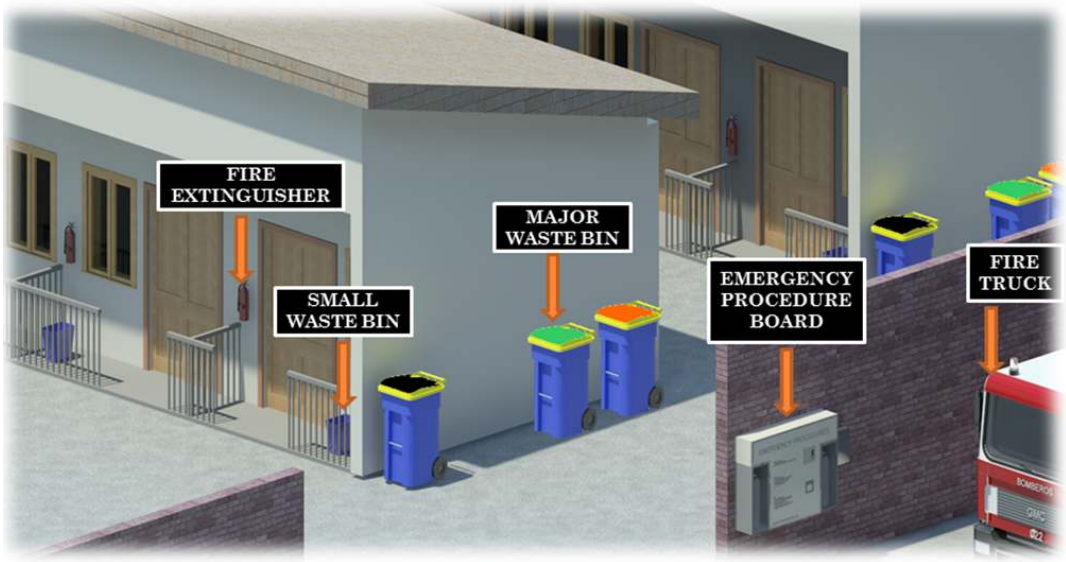

Fig. 2C. 3D dimensional veiw showing a cut out section ofan ideal market

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