

Statistical Analysis of Fire Outbreaks in Homes and Public Buildings in Nigeria: A Case Study of Lagos State

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ABSTRACT

The fire has often been described as the greatest servant but the worst master difficult to control when it turns into a conflagration, burning and destroying everything in its path. In the rage of its fury, it has no respect for anyone, not even the monarchy. Buildings as infrastructure along with people's lives need protection against fire outbreaks. Data on fatal fire outbreaks in Lagos metropolis from 2009 to 2014 were obtained from various rescue agencies in the state. Interviews were conducted alongside the structured questionnaires administered to a good number of citizens of the state. A statistical tool adopted in this research is the statistical package for social sciences (SPSS). The analysis made using the information from the agencies consulted shows that most fatal fires in homes often start in a bed, sofa, other loose fittings or clothing. The homes where fatal fires occur are rarely protected by smoke detectors. Fire death rates are higher for males than females and are also higher for the elderly than for younger people. Most home fires attended by the firefighters are quite small. In blocks of flats, the most common cause is a cooking appliance being left on. Arson is also a common cause in blocks of flats, though arson is most often observed in stairwells and cellars and is rarely directed at living accommodation. Arson is the most common cause of fires in public buildings. Several remedies were specified to alleviate fire outbreaks in homes and public buildings.

Keywords: Fatal fire, Public building, Statistics. *Statistical Analysis.*

1. INTRODUCTION

Fire is the rapid oxidation of a material in the exothermic chemical process of combustion, releasing heat, light, and various reaction products (Charles Jennings, 2000). Fires start when a flammable and/or a combustible material, in combination with a sufficient quantity of an oxidizer such as oxygen gas or another oxygen-rich compound is exposed to a source of heat or ambient temperature above the flash point for the fuel and is able to sustain a rate of rapid oxidation that produces a chain reaction (Yusuf Olagbade, 2012). This is commonly called the fire tetrahedron. Fire cannot exist without all of these elements in place and in the right proportions.



Figure 1.1: A figure showing all the elements causing fire

Cases of fire outbreaks in the Lagos state have become a perennial problem. This is, indeed, worrisome. Generally, fires are initiated with a single fuel object. The smoke produced from the burning object is transported by a smoke plume and collects the upper portion of the space as a layer. The smoke plume also transports the heat produced by the fire into the smoke layer, causing the smoke layer to increase in depth and also temperature [1]. This smoke layer radiates energy back to unburned fuels in the space, causing them to increase in temperature. Fire spreads to other objects either by radiation from flames attached to the originally burning item or from the smoke layer. As other objects ignite, the temperature of the smoke layer increases further, radiating more heat to other objects [1]. In small compartments, the unburned objects may ignite nearly simultaneously. This situation is called flashover. In large compartments, it is more likely that objects will ignite sequentially. The sequence of the ignition depends on the fuel arrangement and composition and ventilation available to support combustion of available fuels [1].

Dry weather has been identified as the major cause of the recent spate of incidents while storing of petrol in living houses and markets, careless disposal of cigarette stubs, adulterated fuel, power surge, electric sparks and illegal connection of electricity are all sources of fire outbreaks.

Many people have faulted the responsiveness of fire services and emergency first responders in the country, who have been reputed to always arrive late and without sufficient equipment to the scene of fire incidents. There have also been renewed calls for the federal and state governments to adequately fund the fire department and emergency agencies, while the culture of insuring properties is not imbibed by Lagos residents to mitigate the damage and misery of the misfortune [8].

According to experts, fire safety is considered to be dependent on: How individuals behave, how organizations behave, the vulnerability of the people exposed to the fire, the fire properties of products, the technical fire safety in the building, the fire service's ability to respond to a fire.

Focusing on any one of these points and neglecting the others will lead to suboptimal safety [8].

Over recent decades public buildings have become larger and more complex. Fire compartments have increased greatly in size and more people can be taken in than before. The great danger with fires in public buildings is if fire gases spread to corridors, stairwells and other open spaces. This makes evacuation more difficult and allows the fire to spread to other parts of the building. The rapid rate at which fires develop means that people often fail to realize how quickly they must respond to a fire. The division of responsibility among those involved is also a problem. Visitors rely on those responsible for the activities in the building. However, personnel in a building often lack proper training on how to deal with a fire. Fire protection in public buildings is dependent on organizational factors and technical measures. The fire fighters play more important role for life saving in public buildings than in homes. The early detection of any fire is clearly vital in public buildings. Education and information are also important so that personnel can deal with a fire in the initial stage of development.

Historically, the very first disastrous fire occurred as far back as 587 B.C where the temple and city of Jerusalem were utterly destroyed [7]. This tragic incident brought about loss of lives and properties. In 1906, the San Francisco earthquake and fire is another major fire incident to be remembered. Not in history has a modern imperial city been so completely destroyed. San Francisco went down the drain (World fire statistics report, 2001).

Among the first (primary) responders to fire outbreaks in Lagos state are: Lagos State Fire Services, Lagos state traffic management authority (LASTMA), Nigeria Security and Civil Defense Corps, Ministry of the Environment, Health Monitoring Unit, Red Cross, Lagos State Environmental protection agency and the Power Holding Company of Nigeria. The Secondary Responders are: National Emergency Management Agency (NEMA), Emergency Service Department of General Hospitals, Julius Berger Nig. Ltd, Nigerian and the Tertiary Responders are organizations such as: NEMA, United nation international children emergency fund(UNICEF) and the world health organization(WHO).

The incessant cases of fatal fires in homes and public buildings in Lagos state resulting into loss of lives and property is the encouraging reason to conduct this study. This paper is intended to conduct statistical analysis of fire outbreak in homes and public buildings in Lagos State. The objectives are: a) to investigate fatal fires in homes and public buildings b) to investigate room of origin, object of origin and causes of fires in buildings. c) To provide recommendations to curb fatal fires.



Figure 1.2: A Scene of fatal fire in Lagos

2.0. METHODOLOGY

The following four criteria are used to decide whether a fire and one or more victims should be included in the dataset:

- ✓ The victims shall have died due to a fire or explosive combustion process.
- ✓ The deaths must occur within a month of the event.
- ✓ If a fire occurs as the result of a road accident then it must be clear that the victims were living when flames or fire gases reached the body.
- ✓ People who are already dead as a result of trauma from road accidents, electricity, illness, hanging or other events are not included, even if the body afterwards was exposed to fire or an explosion.

2.1. Stages Of The Study

- ❖ Visiting some locations of fire outbreak in Lagos state.
- ❖ Visiting relevant agencies in Lagos state to obtain data on fire outbreaks in the state from 2009 to 2014.
- ❖ Administering questionnaires and interviews on incidences of fire outbreaks within Lagos metropolis.
- ❖ Performing statistical analysis using the information obtained.
- ❖ Providing recommendations to curb the menace of fire outbreak in the state.

2.2 Data Presentation And Analysis

Table 2.2: Fatal fires by the number of deaths per fire, Lagos, 2009-2014

Source: Lagos State Fire and Safety services [3]

Number killed in fire	2009	2010	2011	2012	2013	2014	Total number of fires	Proportion of fatal fires
1	95	95	102	116	103	193	704	93.7%
2	1	2	10	8	13	4	38	5.11%
3		2	1	2	1		6	0.8%
4			1				1	0.13%
5	1						1	0.13%
6	1						1	0.13%
Total number	98	99	114	126	117	197	751	100%

of fires								
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Table 2.2 show that the vast majority of fatal fires lead to only one death [5]. The fires with more than three fatalities recorded in the database are all following road accidents. The table above illustrates how frequent fires with multiple deaths are.

Table 2.3: Number of fatal fires and fire deaths in building fires per building category, Lagos, 2014 and average for 2009-2014

Source: National Emergency management agency [5]

	Number of fires 2014	Number of deaths 2014	Average number of fires 2009-2014	Average number of deaths 2009- 2014
Block of flats	19	19	35.0	37.0
Duplex	16	18	34.2	39.6
High rise building	5	5	3.6	3.8
Factory & Ware house	2	2	4.0	4.4
Bungalow	1	1	6.0	6.0
Other public building	2	3	2.4	2.8
Industrial building	1	1	1.2	1.4
Self contained room	1	1	3.4	3.4
Total	47	50	89.8	98.4

Table 2.3 above shows the number of fatal fires and fire deaths in different building categories. The majority of fatal fires occur in homes [5].

Table 2.4: Number of fatal fires and fire deaths not in buildings per category, Lagos, 2014 and average for 2009-2014

Source: Nigeria security and civil defense corps [6]

	Number of fires 2004	Number of deaths 2004	Average number of fires 2009-2014	Average number of deaths 2009-2014
Car	3	3	3.6	4.2
Ship/boat	0	0	0.6	1.4
Aircraft	0	0	0.2	0.2
Other road vehicle	3	3	1.8	1.8
Other	3	3	2.8	3.4
Total	9	9	9.0	11.0

A total of nine people died in other fires or explosive combustion processes in 2014. In two cases this was due to fireworks. In two other cases elderly men died when they lost control of fires they had lit in the dry season to get rid of last year's dead grass. This is an indication that the rate of fire outbreak not in building category is much less than that of building category ([5]).

Table 2.5: Number of fatal home fires per room of origin, Lagos, 2014 and average for 2009-2014

Source: Lagos State Fire and Safety services [3]

Room of origin	2004	Average 2000-2004
Living room	16	24.8
Bedroom	18	20.6
Kitchen	4	14.4
Corridor	2	2.1

Boiler room	1	1.0
Freestanding store house		1.0
Basement		0.6
Balcony	2	0.6
Bathroom/Toilet	1	0.4
Laundry room		0.2
Attic		0.2
Out of building		0.2
Store room	1	0.1
Chimney		0.1
Freestanding garage		0.1
Other		2.4
Unknown	3	11.2
Total	48	80

As shown in table 2.5 above, the majority of fatal fires occur in the home. It is therefore worth studying these fires in more detail. Three quarters of fatal home fires start in the living room, a bedroom or the kitchen [5].

Table 2.6: Number of fatal home fires per object of origin, Lagos, 2014 and average for 2009-2014

Source: Lagos state emergency management agency. [2]

Object of origin	2014	Average 2009-2014
Bed	13	18.0
Sofa, armchair	9	9.0
Other loose fittings	9	9.0
Cooker	3	7.4
Clothing	1	4.0
Flammable liquid	4	3.4
TV	1	1.8
Other electrical installation		1.6
Heating appliance	2	1.4
Fire place		1.0
Paper/cardboard		0.6
Smoke channel		0.2
Generating plant		0.2
Microwave-oven		0.2
Washing machine		0.2
Fridge/freezer		0.2
Stereo/video		0.2
Lamp bulb		0.2
Rubbish		0.2
Air-conditioner		0.2
Other	1	6.4
Unknown	13	24.0
Total	56	89.4

Table 2.6 above in most fatal home fires where an object of origin is identified – beds are the most common, followed by sofas, other loose fittings, cookers and clothes [6].

Table2.7: Number of fatal home fires per fire cause, Lagos, 2014 and average for 2009-2014

Source: Ministry of the Environment, Health Monitoring Unit [4]

Fire cause	Number of fires 2014	Average number of fires 2009-2014
Electrical Technical fault	25	28.4
Heat transfer	2	9.0
Sparks	7	8.8
Gas cylinders	5	7.8
Arson	2	4.4
Cooking appliance left on	2	3.8
Candle	1	1.6
Power surge	1	1.2
Sparks	1	1.2
Lighted match	2	2.1
Others	2	5.0
Unknown	12	24.8
Total	62	98.1

Table2.7 above shows a fire cause identified in about 70 % of fatal home fires, with Electrical Technical fault being by far the most common cause [6].

A fire in the home environment can develop rapidly and in a short space of time become life threatening, especially if the people at risk are sleeping. It is clearly important for occupants to be made aware of any fire without delay. Fortunately in recent years domestic smoke detectors have become cheap and readily available. Many fire fighters in the state work actively to promote domestic smoke detectors in the belief that they will reduce fire deaths. It is therefore valuable to investigate smoke detectors' function in fatal fires. Over the last six years, the fire investigators have observed the following results:

Table 2.8: Fatal home fires by smoke detector function, Lagos, 2009-2014

Source: Lagos State Fire and Safety services [3]

	Percentage of fatal fires
No smoke detector present	61%
Smoke detector present and functioned	14%
Smoke detector present but failed to function	4%
Smoke detector present, function unknown	5%
Unknown whether smoke detector was present	16%

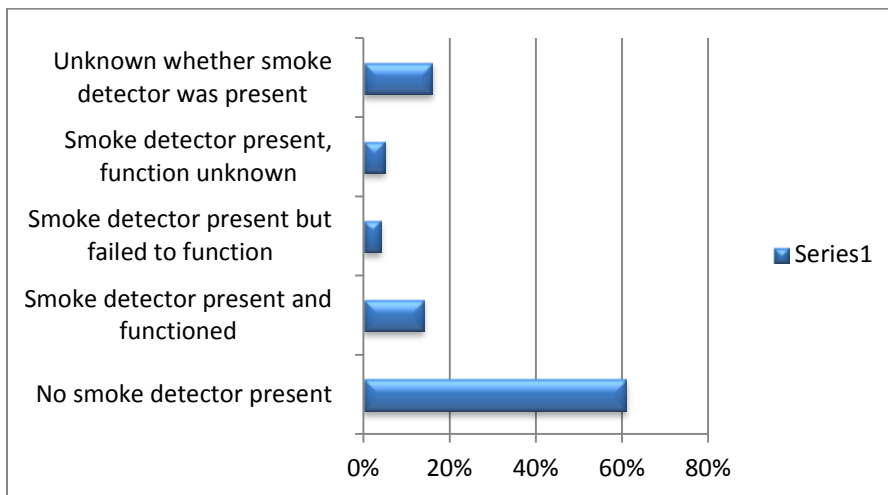


Figure 2.3: A bar chart showing percentage of fatal fires by smoke detector function

It is striking that such a large proportion of these homes were not protected by smoke detectors as indicated in table 2.8 and figure 2.3. It is clearly imperative to make efforts to increase smoke detector possession for homes at particular risk [6]. It can be claimed that many of those who died might have been saved by smoke detectors, but it is important to note that in one in seven fatal fires, someone dies despite a smoke detector functioning properly.

Table 2.9: Fire death rate per thousand populations by age group and sex, Lagos, 2000-2014
 Source: Lagos State Fire and Safety services [3]

Age group	Male death rate	Female death rate
0-14	4.6	3.3
15-64	15.2	4.6
65+	41.1	21.7

Table 2.9 shows that children have the lowest death rates and elders the highest (Yusuf Olagbade, 2012). It is interesting to note that the male age groups have a much higher rate than the corresponding female groups.

In order to learn more about fire deaths it is important to study the **medical diagnosis** of what actually led to the death. Fires can cause different kinds of injuries - people can die as a result of burns sustained in a fire, they can be overcome by toxic fire gases or they can die in other ways, for example when throwing themselves out of a high building in an attempt to escape from a fire. The two dominating diagnosis in the cause of death register are “burns” and “toxic effects of carbon monoxide”. The proportions for the different diagnoses are shown in the diagram below.

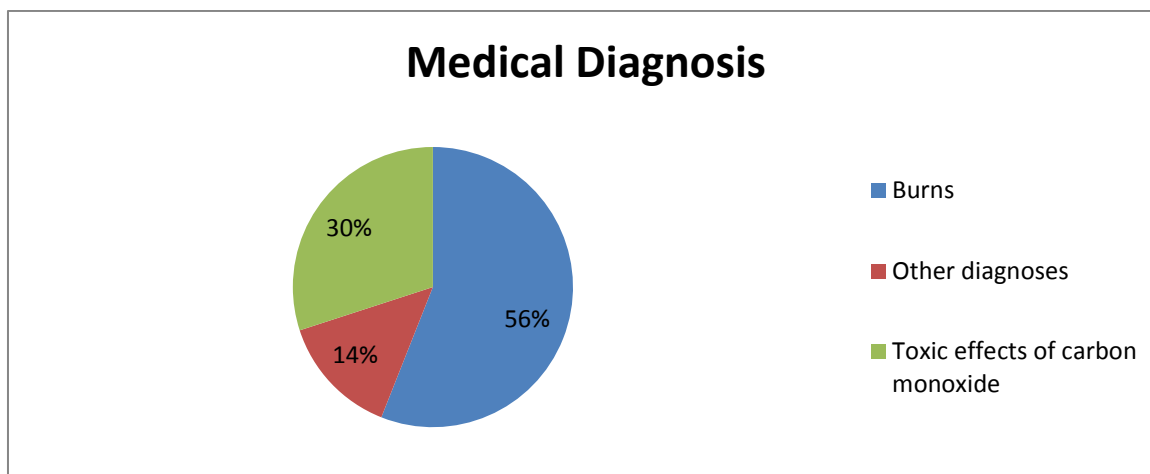


Figure 2.4: Medical diagnosis with fire as an external cause of death, Lagos, 2000-2014

Source: Ministry of the Environment, Health Monitoring Unit [4]

The main sources for information on home fires are statistics based on turn-out report forms from *Lagos State Fire and Safety services*.

Many fires take place without the state fire services being called or a claim being made to an insurance company. The fire may have been extinguished quickly by someone at the scene or gone out before it was discovered. The property owner may not have bothered to take out insurance cover, or may decide not to make a claim, knowing that the compensation may not be worth the bother as only costs over an excess are paid out.

The studied group was the Lagos state population from 18-79 years of age. A questionnaire was sent out to 2 000 people.

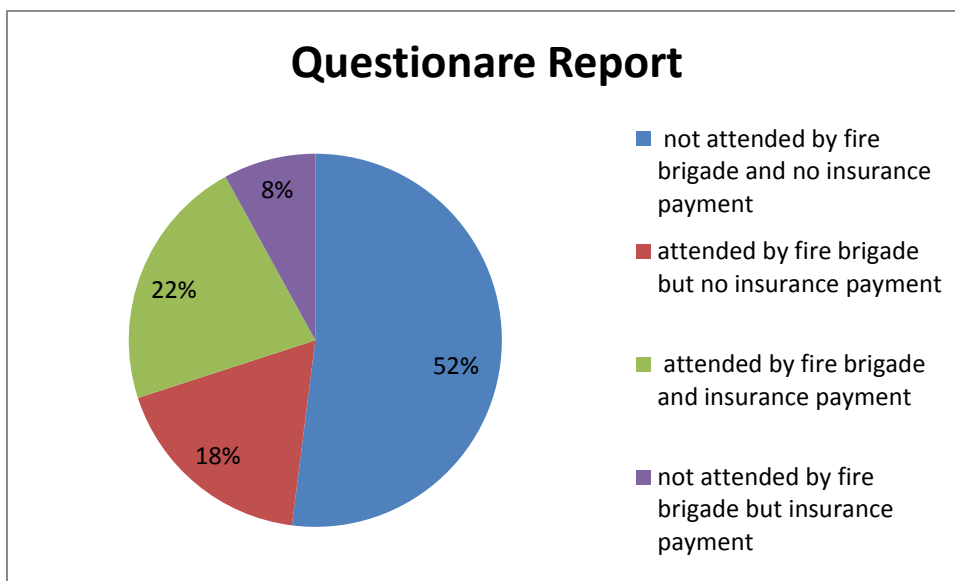


Figure 2.5: Source: questionnaire survey by Lagos State Fire and Safety services [3].

The surveys show that:

The *Lagos State Fire and Safety services* attend far fewer fires in homes than in public buildings [8]. One characteristic of fires in public buildings is the serious threat that they pose – many people may be in the building and a significant proportion may not be able to find their way around in the building. Another characteristic of fires in public buildings is the prevalence of arson. Fire officers identify arson as the fire cause with a greater proportion of fires attended in public buildings than in other building categories.

Table 2.91 Average number fires in public buildings attended by fire officers per year and most commonly identified fire causes, Lagos, 2009-2014 Most common causes

Public buildings	Number	Cause	%	Cause	%	Cause	%
Office	200	Arson	55	Technical fault	35	Cooking appliance left on	10
Shop/boutique/market	150	Arson	62	Technical fault	18	Heat transfer	20
Industry	170	Technical fault	54	Arson	30	Heat transfer	16
Factory	120	Technical fault	48	Arson	40	Heat transfer	12
Restaurant/nightclub	115	Cooking appliance left on	46	Technical fault	40	Heat transfer	14
Hotel/guest house	110	Cooking appliance left on	60	Heat transfer	30	Candle	10
Theatre/cinema/museum	108	Arson	68	Technical fault	20	Cooking appliance left on	12
School	93	Arson	40	Technical fault	35	Child playing with fire	25
Church	79	Arson	50	Technical fault	35	Heat transfer	15
Prison	74	Arson	45	Smoking	30	Technical fault	25
Hospital	60	Arson	55	Technical fault	35	Smoking	10

Motherless home	54	Arson	52	Candle	10	Heat transfer	38
Petrol station	44	Technical fault	60	Arson	15	Heat transfer	25
Airport	43	Technical fault	65	Arson	10	Heat transfer	25
Bank	41	Technical fault	59	Arson	10	Heat transfer	31
Stadium	38	Arson	45	Heat transfer	20	Technical fault	25

Source: Turn-out statistics, Lagos State Fire and Safety services [3].

Table 2.91 shows that the leading causes of fatal fires in public buildings are arson and Electrical Technical fault [8].

3.0. CONCLUSION

Empirically this research has shown that there is limited fire management capacity in public buildings, as far as public awareness and availability of means and facilities are concerned. It has been observed that majority of fatal fires among other building categories occur in homes. Also, three-quarters fatal home fires start in the living room, bedroom or kitchen. Beds, followed by sofas are the most common object of origin in most fatal home fires.

A significant number of buildings considered were not protected by smoke detectors. Most common causes of fire outbreak in public buildings are arson and technical fault while that of homes is technical fault. Children were found to have the lowest death rates while elders the highest. The male age groups have a much higher rate than the corresponding female group. Burns due to fires have 56% of all medical diagnosis compared to toxic effects of carbon monoxide with 30%. Training institutions have also a major role to play in terms of knowledge dissemination against fire risks.

4.0 RECOMMENDATIONS

Measures to improve fire protection in homes

- Information and education are deemed to be the most important measures. Increased awareness of fire by residents would affect behavior and lead to greater care.
- In homes early detection by smoke detectors is the most important measure. It is of course important that action is taken once the fire is discovered - people should own fire extinguishers and be trained to handle them.
- Education and training for school children is considered especially effective in raising fire awareness across the whole population. Such education should be an obligatory part of all schooling.
- Television, radio, internet, twitter and face book are media which should be used more to spread information on fire protection in the state.
- Fire fighters in the state should be empowered to respond quickly in cases of fire outbreak.

4.10 Measures to improve fire protection in public buildings

- Education, training and information to raise awareness and cautiousness of occupants, employees and those responsible for activities in a building
- Education is the most effective measure to prevent fires in public buildings. This is important for the general public, but even more essential for personnel. Both employees and company leaders need to understand fire risks.
- Systematic self-auditing of fire prevention work. It is important to make it difficult for arsonists to target the building and to check fire prevention in concealed spaces in the building.
- The early detection of any fire is clearly vital in public buildings. Education and information are also important so that personnel can deal with a fire in this phase - employees should be able to put out a fire at this stage.
- It is important to have automatic fire alarms for early detection and equipment and training so that evacuation can start and the fire be put out or its spread limited.
- It is important to have a high level of fire safety in public buildings since otherwise visitors are exposed to danger. People in the building have a right to expect that those who build or lead the activities there have considered the risk of arson and taken measures to protect visitors from it.
- The local fire authorities should develop their work with inspection and supervision so that better judgments can be made.
- The fire brigades must be well prepared for fires in public buildings since in certain situations they may be required to help people escape from a fire.

REFERENCES

- [1] Charles Jennings, "Fire Technology", Malaysia International Conference, Vol. 35, No1, (2000)
- [2] Kelvin Adeoti, "A comparison in Lagos of deaths and insurance payments caused by fire", Lagos State Emergency Agency, Vol. 4, 72-86, (2014)
- [3] Olaoye Ahmed, "Fatal fires and Fire death in homes in Lagos State", *Lagos State Fire and Safety services*, Vol.2, 91-120, (2014)
- [4] Olusegun A., Adesokan O., "An overview of the number of fires together with an estimation of their societal costs in Lagos" Ministry of the Environment, Health Monitoring Unit, Vol.6, 86-98, (2014)
- [5] Patrick Oscar, "Annual report on fatal fire statistics in Lagos State", National Emergency management agency (NEMA), Vol.5, 211-230, (2014)
- [6] Paul Isaac, "Fire outbreak in buildings and non-buildings", Nigeria Security and Civil Defense corps, Vol.3, 124-160, (2014)
- [7] World Fire Statistics Report (WFSR), "List of fire outbreak from 77 countries", Vol.9, 345-450, (2001)
- [8] Yusuf Olagbade, "A literature review of fire incidence with an emphasis on urban residential fires", Vol.8, 116-130, (2012)