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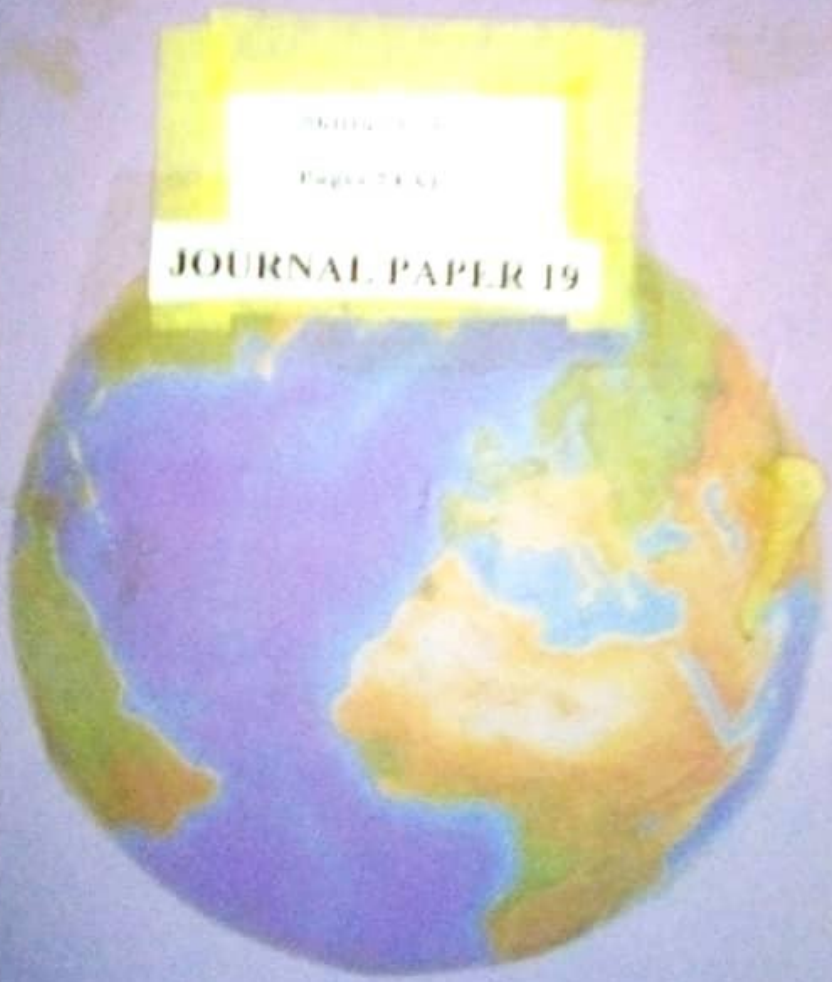

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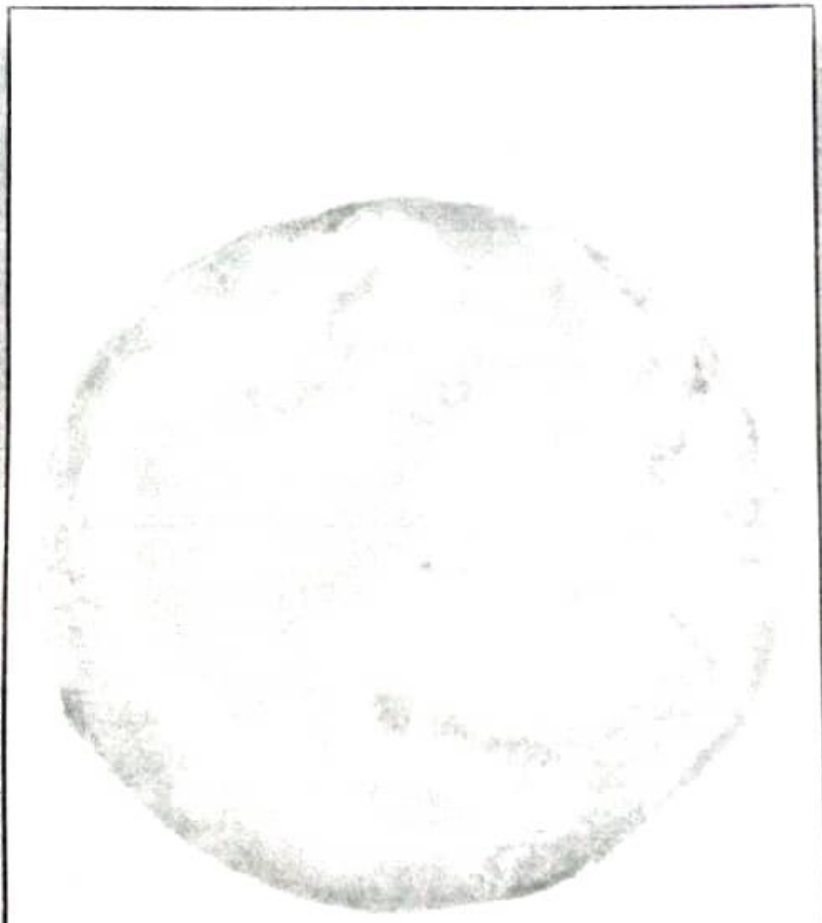

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NOTES FOR CONTRIBUTORS

JOES is published twice a year (June and December).

AIMS AND SCOPE

The Journal of Environmental Sciences (JOES) is devoted to the publication of papers, which advance knowledge on the theoretical and practical aspects of the natural and built environment. The aims of the journal are to provide an avenue for the dissemination of academic research findings dealing with environmental problems, planning, and development, opportunity for increasing and making available relevant data and information on environmental conditions/problems and advancing effective management solutions to them with special reference to Nigeria; and to provide a forum for meaningful discussions and debates between academics and field practitioners of the natural and built environments.

The Journal will therefore accept for publication results of original research in all aspects of both the natural and built environment. It will also accept for publication book reviews, comments and letters, well-written research and practice notes, and short communications on any aspect of the environment.

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Paper should be arranged as follows:

1. Title, author(s), affiliation(s) and full address(es).
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3. The text, suitably divided into appropriate sections/headings.
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6. Tables and illustrations (each on a separate sheet containing no text).

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Only the SI units as defined by **ISO Standard** would be accepted. If you use is made of any symbol or unit that may not be generally recognized, an explanatory note should be included in the margin the first time it is used. Abbreviations should be written in full at first mention.

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Tables should be numbered consecutively throughout the paper (with Arabic numerals) referring to them in the text as Table 1, Table 2, etc., with a caption at the top of each table. Avoid the use of vertical rules.

Tables should not duplicate results presented in graphs.

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Analysis of Fire Incidences in Domestic and Public Buildings of Some Selected States in North-Central Nigeria

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ABSTRACT:

This paper examined trends in fire outbreaks in three states (Kwara, Niger and Plateau), in relation to the use of building and the causes of reported fire incidents from 1990 to 1999. The relationships between these variables were determined using simple regression analysis. Significant relationship ($F > \alpha$ at 0.05) was observed in all the three states between the total number of fire incidents and the proportion of those fires that occurred in domestic buildings. By comparison, the proportion of such fires that occurred in public buildings was significant only in Niger and Kwara States. Electrical faults were a significant cause of fire outbreaks in all three states sampled, while gas faults was significant only in Niger and Kwara States. It was concluded that the greater proportion of fire outbreaks in all the three states (i) is due to electrical faults, and (ii) occurs in domestic, rather than public buildings. This paper then recommended that special team of researchers should be set up by the government of each of these states to investigate the reasons why electrical faults fire and domestic buildings fire are more frequent and at the same time find a lasting solution to reduce it to the barest minimum.

BACKGROUND OF THE STUDY:

Harmathy (1985) described a building as a multi-functional agent of environmental change, which acts principally as the modifier of the natural environment. Domestic buildings are buildings, which accommodate an individual or a family, a permanent place for resting, sleeping, eating and keeping personal property. These can be in the form of bungalows, storey buildings, flats and huts of various architectural designs. On the other hand, a public building is one of the following kinds: mosques, churches, school buildings, ministries or government office buildings, market buildings, hospitals, hotels, restaurants etc. They are constructed for the purpose of official transactions between or among persons usually living in different homes.

Fire is the oxidation of a substance often with the evolution of heat and light in varying degrees of intensities. According to the Chambers Twentieth Century Dictionary, fire is a mass of burning matter as of fuel, flame incandescence or conflagration. Oyeyode (2003) defined fire as the result of flammable material being combusted and the essential ingredient for the propagation of fire is air, which is sufficient to start ignition or means of ignition and oxidation. The University of Gulph (2003) described fire as the oxidation of substances often with the evolution of heat and light in varying degrees of intensities. The slightest contact of highly inflammable liquid contents, (such as gasoline (petrol), paraffin (kerosene), gas, etc.) with fire brings explosive services of destruction, inferno and loss of lives and properties. Adeleke (1993).

According to McKay (1993), early detection and warning of an outbreak are essential to prevent or reduce loss of lives and if extensive damage and complete burn down are to be avoided. Stein et.al (1986) added that fire alarm system services primarily to protect lives and secondarily to prevent property loss. Since buildings vary in occupancy, flammability, types of construction and value, the fire alarm system must be tailored to the need of a specific facility. Therefore, residential fire alarm system should provide sufficient time for evacuation of the residents and for appropriate counter measures to be initiated. Wood (1986) contributed that an automatic fire detection system may not be needed if the installation is always manned or where the power supply is always disconnected when premises are not occupied. Fire detectors can be of heat or smoke or flame detection type as pointed out by Shield et.al (1987). Ernst and Neufert (2002) reported that there are automatic and non-automatic fire detectors and they must be installed at sufficient

numbers and be suited to the general arrangement of the area to be monitored.

Some modern smoke detectors now in use are photoelectric and ionization detectors. Photoelectric detectors use small light source, which shines its light in to a dark chamber not normally exposed to light. Ionization detectors use small amount of radioactive material to make the air within sensing chamber conduct electricity (Wikipedia Free Encyclopedia, 2006). Wikipedia Free Encyclopedia (2006) further classified fire extinguishers according to their use on the four or five classes of fire as explained below.

Class A fires consist of normal combustibles such as paper, cloth, rubber and many plastics. Water extinguishers are typically applied to such fires.

Class B fires are caused by flammable liquids such as gasoline, grease and cooking oils. Suggested extinguishers employ Carbon dioxide (CO_2).

Class C fires involve energized electrical equipments, and suitable extinguishers are based on their ability to be non-conductive.

Class D fires involve metals such as potassium, magnesium, titanium and sodium; Extinguishers for Class D usually employ sodium chloride as an agent.

Class K fires involve cooking oils. Though, by definition Class K is a sub-class of Class B.

The National Building Code (2006) added that all buildings and structures shall also be graded in accordance with the degree of fire hazard as contained in Part 1, Section 7 of the National Fire Code. The National Building Code (2006) stressed further that under the Building Construction Classifications, all buildings and structures erected or to be erected, altered or extended in height or area shall be classified in any one or in a combination of the five construction types (TYPE 1 to TYPE 5) as defined by the various building elements.

The need for the study arises from the great deal of concern expressed by well-meaning Nigerians from National dailies, television as well as past studies (research work). Omata (1991) reported on the problem of fire in homes and surroundings; Mogbo (1999) authored a paper in N.I.Q.S. journal on the environment and fire incidence in Nigeria; Anyawata (2000) researched the incidence of fire outbreaks in the Niger – Delta, while Shittu (2001) studied fire outbreaks in domestic and public buildings of Kwara State where it was discovered that the amount of financial loss due to fire on the average in Kwara State for the period 1990 to 1999 was about 4% of the capital expenditure (i.e =N= 14,548,694.00). As a result of these, calls have been made to the government and individuals to take necessary and urgent action to reverse or halt this situation. This paper moves along that direction.

Some instances of fire outbreak in Nigeria include the Jos Central market fire, the burning down of the office of academic building of the Federal Polytechnic Bida, the inferno that razed down the great cocoa house of Ibadan, the Sheik Abubakar Gumi Central Market fire in Kaduna, the instances of fire disaster which affected both office and academic buildings of the Federal Polytechnic Offa during a crisis between the students and the community in year 2000, the Sokoto Central Market Fire of year 2006, and the recent Offa – Erin-Ile communal clashes in Kwara State which resulted in serious outbreak leading to destruction of lives and properties. A very recent incidence of fire outbreak in Nigeria was the fire which struck the six storey building of the Nigerian Port Authority (NPA) in Marina on Thursday the 19th day of June, 2008. The fire was suspected to have been caused by arson as reported by Oduerne and Ebimomi (2008).

The aim of this paper was to examine trends in fire incidences in Kwara, Niger and Plateau States in relation to the use of building and causes of fire between the period of 1990 and 1999.

The following objectives were set out to achieve the aim:

(i) To determine the relationship which exists between the total number of fire cases and the number of fire cases in each of the types of buildings considered for this paper in each of the three States.

(ii) To determine the relationship which exists between the total number of fire cases and the number of fire cases due to each of the causes considered for this paper in each of the three States.

The scope of the paper focuses on Kwara, Niger and Plateau States from 1990 to 1999 only. The causes of fire considered are electrical and gas faults. Domestic and public buildings are the types of buildings considered. The data used for this paper are statistical data on recorded fire cases compiled by the fire institution of each of the States considered and so the researcher could not pin-point little discrepancies where they may arise. Due to the nature of the raw data received, the researcher could not ascertain how many fire cases incident on domestic and public buildings were caused by either electrical faults or gas faults.

It was assumed that the data received represent the actual totals that occurred during the period under study. Other factors such as

population, size of the area, number of the buildings, volume of combustible materials in buildings, bad means of communication etc are assumed to be constant over the period under study.

METHODOLOGY:

Data Collection and Sampling Frame:

This study employed the use of secondary data on recorded fire cases compiled by the fire service departments of Kwara, Niger and Plateau States. The data collected covered total number of recorded fire incidences, gas and electrical faults as causes of fire and domestic and public building fire cases from 1990 to 1999 in the three states studied which are very important states in North Central part of Nigeria. The data collected for the study are presented below as Tables 1 - 3.

Table 1: Fire Statistics in Kwara State

Year	Fircalkw	Dombfkw	Pubbfkw	Elecfkw	Gasfkw
1990	107	34	1	10	2
1991	142	53	7	43	4
1992	160	70	11	73	4
1993	128	38	0	24	1
1994	77	25	4	17	0
1995	45	9	0	8	0
1996	67	33	7	21	1
1997	84	32	5	21	3
1998	78	30	15	23	0
1999	73	44	8	26	0
TOTAL	**961**	**368**	**58**	**266**	**15**

SOURCE: Kwara State Fire Service, Ilorin (2001)

KEY:

Fircalkw.....Number of fire calls in Kwara State

Dombfkw.....Number of fires in Domestic buildings of Kwara State

Pubbfkw.....Number of fires in Public buildings of Kwara State

Elecfkw..... Number of fires caused by electrical faults in Kwara State

Gasfkw..... Number of fires caused by gas faults in Kwara State

Table 2: Fire Statistics in Niger State

Year	Fircalng	Dombfng	Pubbfng	Elecfng	Gasfng
1990	94	62	31	73	6
1991	193	78	25	86	13
1992	228	102	32	107	10
1993	135	46	24	24	41
1994	94	24	8	50	2
1995	49	19	6	22	2
1996	69	40	13	35	2
1997	60	33	14	41	0
1998	75	40	4	36	0
1999	81	38	19	36	3
TOTAL	**1078**	**482**	**176**	**510**	**79**

SOURCE: Niger State Fire Service, Minna (2006)

KEY:

Fircalng.....Number of fire calls in Niger State

Dombfng.....Number of fires in Domestic buildings of Niger State

Pubbfng.....Number of fires in Public buildings of Niger State

Elecfng ..... Number of fires caused by electrical faults in Niger State
Gasfng ..... Number of fires caused by gas faults in Niger State

TABLE 3: Fire Statistics in Plateau State

Year	Fircalpl	Dombfpl	Pubbfpl	Elecfpl	Gasfpl
1990	221	148	31	90	40
1991	206	135	29	105	20
1992	213	127	29	125	10
1993	269	200	32	180	15
1994	155	110	12	85	10
1995	201	165	11	120	15
1996	168	140	13	100	15
1997	172	126	5	105	10
1998	206	121	47	113	29
1999	177	125	21	98	13
TOTAL	**1988**	**1397**	**230**	**1121**	**177**

SOURCE: Plateau State Fire Training School, Bukuru (2000)

KEY:
Fircalpl.....Number of fire calls in Plateau State
Dombfpl.....Number of fires in Domestic buildings of Plateau State
Pubbfpl..... Number of fires in Public buildings of Plateau State
Elecfpl..... Number of fires caused by electrical faults in Plateau State
Gasfpl..... Number of fires caused by gas faults in Plateau State

2.2 Data Analysis Techniques:

The relationships between the variables in the data collected were determined using Regression Analysis, the Correlation coefficient (R-square) and the test of significance (F-test and P-test). The regression analysis taking into account data in which variables are observed simultaneously in relation to one another (i.e. bivariate data) e.g. Fircalkw Vs Dombfkw and Fircalkw Vs Pubbfkw etc. This paper assures 5% significance test. Hence for any value of P from 0.00 to 0.05 there is significance in the test but for values greater than 0.05 there is no significance in the test. The following null hypotheses where generally tested at the 95% confidence level in order to assist in achievement of the objectives of the study:

(i) There is no significant relationship between the total number of fire cases and the number of fire cases in each of the types of buildings considered for this paper in each of the three States.

(ii) There is no significant relationship between the total number of fire cases and the number of fire cases due to each of the causes considered for this paper in each of the three States.

3.0 RESULTS AND DISCUSSIONS:

3.1 Presentation of Results:

The analysis of the data collected was done under twelve experiments (four per State). The results of the Regression Analysis are given below as Table 4, while the trends between the variables were depicted in charts as figures 1 – 12.

TABLE 4: Summary of Results from Regression Analysis

Exp No	Variables		Type of Model	Observations					Inferences		
	X	Y		Regression Equation	R^2	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Rem	Action On Hyp
1	Fircalkw	Dombfkw	Linear	Dombfkw = 0.088 + 0.082 Fircalkw	73%	21.92	5.32	0.0016	Strong	SS	Reject Ho
2	Fircalkw	Pubbfkw	Linear	Pubbfkw = 3.91 + 0.019 Fircalkw	2.2%	0.18	5.32	0.68	Weak	NS	Accept Ho
3	Fircalkw	Elecfkw	Linear	Elecfkw = - 12.11 + 0.403 Fircalkw	61%	12.7	5.32	0.0070	Strong	SS	Reject Ho
4	Fircalkw	Gasfkw	Linear	Gasfkw = - 1.88 + 0.035 Fircalkw	61%	12.7	5.32	0.007	Strong	SS	Reject Ho
5	Fircalng	Dombfng	Linear	Dombfng = 6.28 + 0.389 Fircalng	82%	36.17	5.32	0.0003	Strong	SS	Reject Ho
6	Fircalng	Pubbfng	Linear	Pubbfng = 4.33 + 0.123 Fircalng	52%	8.64	5.32	0.187	Strong	SS	Reject Ho
7	Fircalng	Elecfng	Linear	Elecfng = 9.10 + 0.389 Fircalng	67%	16	5.32	0.004	Strong	SS	Reject Ho
8	Fircalng	Gasfng	Linear	Gasfng = - 2.38 + 0.095 Fircalng	21%	2.12	5.32	0.18	Weak	NS	Accept Ho
9	Fircalpl	Dombfpl	Linear	Dombfpl = 15.78 + 0.623 Fircalpl	62%	12.9	5.32	0.0071	Strong	SS	Reject Ho
10	Fircalpl	Pubbfpl	Linear	Pubbfpl = - 25.73 + 0.245 Fircalpl	39.6%	5.24	5.32	0.0513	Weak	NS	Accept Ho
11	Fircalpl	Elecfpl	Linear	Elecfpl = - 19.65 + 0.663 Fircalpl	66%	15.58	5.32	0.004	Strong	SS	Reject Ho
12	Fircalpl	Gasfpl	Linear	Gasfpl = - 2.96 + 0.104 Fircalpl	12%	1.13	5.32	0.32	Weak	NS	Accept Ho

Source: Author's Field work (2008)

Key: SS = Statistically Significant
NS = Not Significant

DISCUSSION OF RESULTS:

Relationship between Total Fire Cases and Domestic Building Fires

The relationship between the number of fire outbreaks and the number of fire outbreak in domestic building was linear, positive, strong and significant in each of the three States (Kwara, Niger and Plateau). R-square values observed were 73%, 82% and 62% while Probability values were 0.001, 0.0003 and 0.0071 respectively. The trends were depicted in charts as Figures 1, 5 and 9. The

null hypotheses for the three experiments are therefore rejected.

3.2.2 Relationship between Total Fire Cases and Public Building Fires

A linear, positive, weak and non-significant relationship exists between the number of fire outbreaks and the number of fire outbreak in public building in Kwara and Plateau States with R-square values of 2.2% and 39.6% respectively and Probability values of 0.68 and 0.0513 respectively. The null hypotheses are therefore accepted, while that of Niger State shows a linear, positive, strong and significant relationship with an R-square value of 52% and a P value of 0.0003. Figure 2 also shows this. The null hypothesis is therefore rejected. The trends were depicted in charts as Figures 2, 6 and 10. The null hypotheses for the three experiments are therefore rejected.

Relationship between Total Fire Cases and Electrical Faults Fires

The relationship between the number of fire outbreaks and the number of fires due to electrical faults was linear, positive, strong and significant in each of the three States (Kwara, Niger and Plateau), R-square values observed were 61%, 67% and 66% while Probability values were 0.007, 0.004 and 0.004 respectively. The trends were depicted in charts as Figures 3, 7 and 11. The null hypotheses for the three experiments are therefore rejected.

Relationship between Total Fire Cases and Gas Faults Fires

The relationship between the number of fire outbreaks and fires due to gas faults was linear, positive, strong and significant in Kwara State with an R-square value of 61% and a Probability value of 0.007. The null hypothesis is rejected; but that of Niger and Plateau States each shows a linear, positive, weak and non-significant relationship with R-square values of 21% and 12% respectively and Probability values of 0.18 and 0.32 respectively. The null hypotheses are therefore accepted. The charts in figures 4, 8 and 12 also show these trends.

CONCLUSIONS:

(i) Number of fire outbreaks in domestic buildings was an important proportion of the total numbers of fire outbreaks in all the three states; in addition the tendency was for increases in total numbers of fire outbreaks to occur mainly in domestic buildings.

(ii) Fire outbreaks due to electrical faults are greater than those as a result of gas faults in all the three sates.

(iii) Number of fire outbreaks in public buildings of Niger State was significantly related to total number of fire outbreaks but relatively low compared to that of domestic buildings.

(iv) The relationship between the number of fire outbreaks and fire outbreaks due to gas faults in Kwara State shows a significant relationship, showing that gas faults fire also carries an important proportion of total numbers of fire outbreaks in Kwara State.

RECOMMENDATIONS:

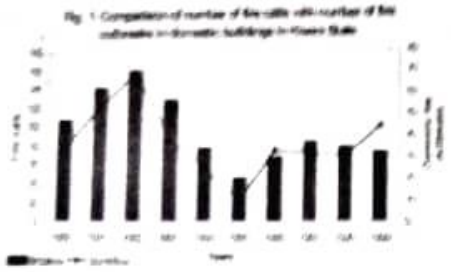
(1) Special team of researchers should be set-up by the government of each of these States (Kwara, Niger and Plateau) to investigate the causes of fire in order to be able to identify the reasons why electrical faults fire and domestic buildings fire are more frequent and at the same time find a lasting solution to reduce it to the barest minimum. Various professionals such as fire safety officers, building professionals etc. should be part of the team to be set – up to study the fire trend by the government of each of the three States.

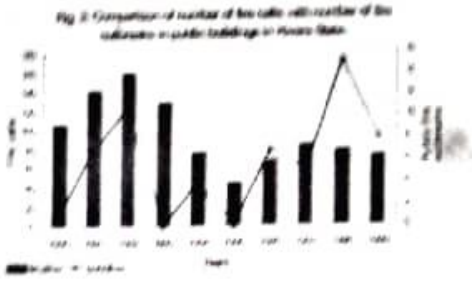
(2) Fire extinguishers of either CO2 or gas powder should be used for the success of fight against electrical fires in the homes and offices, as it was discovered that fires occur more due to electrical faults than gas faults. To make this easier large number of fire extinguishers should be procured by the government and sold to the public at subsidized prices.

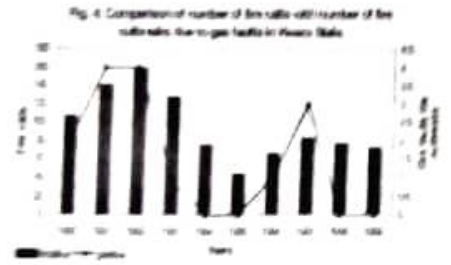
(3) Fire detecting and warning systems in public/domestic buildings should be checked constantly to ensure ready-to-use status. This should be followed by enlightenment programme or a rigorous campaign in the radio, television, magazines and other news media including seminars and workshops to be used by the government to educate the general public on the causes and consequences of fire outbreak in homes and offices (with a major focus on domestic buildings), as well as ways of reducing the incidences of fire outbreak.

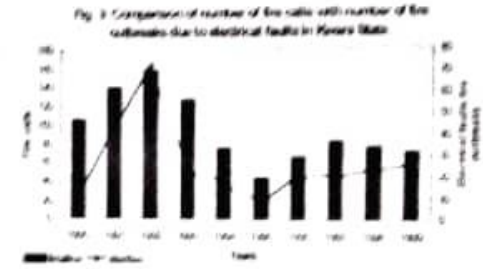
(4) Regular and periodic inspection of building conditions and fire fighting installation in both domestic and public buildings should be made to avoid fires, which may result from faults not detected in good time. This could be possible if state-owned fire services are made more responsive and efficient in fire fighting matters by the state government by providing additional fire fighting vehicles and other equipments that can meet different conditions.

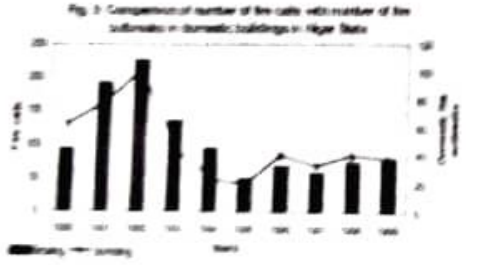
(5) Finally, further effort should be directed at establishing other factors in a domestic building are responsible for the high rate of occurrence of fires

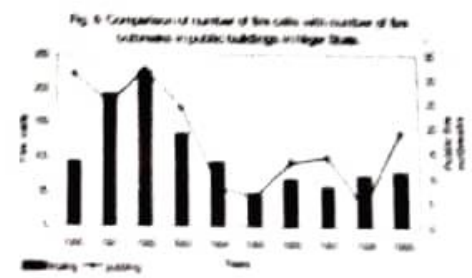


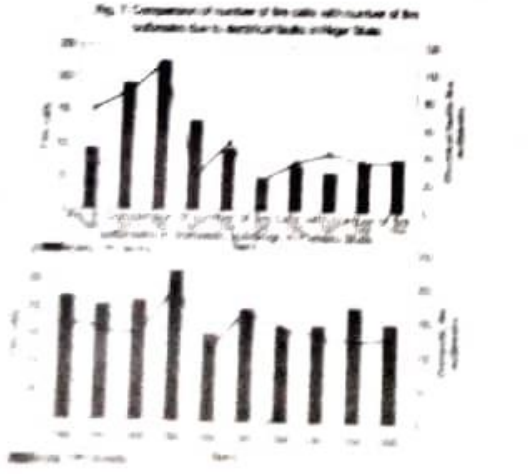


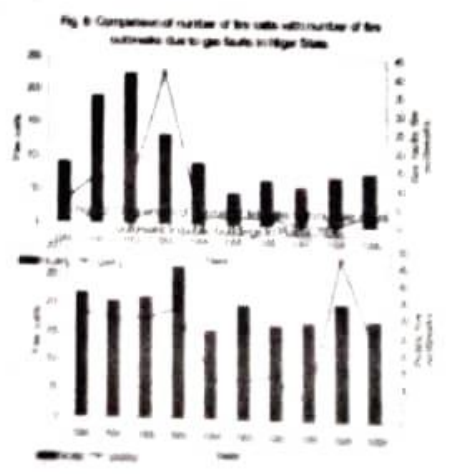


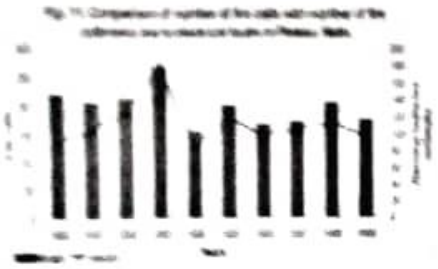


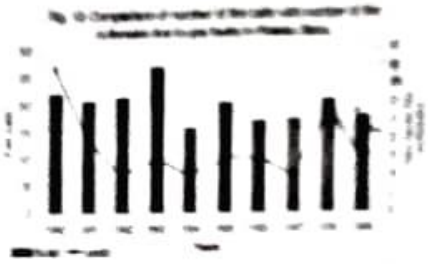












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