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Spatio-Temporal Analysis of Fire Outbreaks in Markets of Kano Metropolis, Kano State, Nigeria

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Abstract

Recurrent fire outbreaks in market places have been a major threat to commercial activities within Kano metropolis. This necessitated the need to examine the spatio-temporal pattern of the outbreaks in relation to the nature and importance of the markets with a view to mitigating its consequences for sustainable commercial development. Fire incidence records (1974-2017) comprising of incidence dates, time, year, location, causes and consequences was obtained from the Kano State Fire Service Department. Electronic and GPS surveying was conducted to determine the absolute locations for spatial and temporal analyses. The result from spatial analysis indicated a clustered pattern of fire outbreaks within the major markets with Nearest Neighbor Ratio of 0.179. Temporally, there were more fire incidence recurrence (about 20.9%) and property damage between 2007and 2017, thereby making it the most devastating period of market fire outbreaks in Kano. Based on the nature of markets, the overall result depicted that mixed markets and single commodity market experienced 76.5% and 23.5% fire incidence respectively. This was attributed to the extent of commercial activities, the use of electricity, and the flammability of the products. The study thus recommends fire safety education and fire prevention practices throughout the markets for risk reduction and sustainable economic development.

Keywords: GPS Surveying, Mixed Markets, Nearest Neighbor Ratio, Sustainable Markets

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Analyse spatio-temporelle des incendies sur les marchés de la métropole de Kano dans l'Etat de Kano, Nigeria

Resumé

Les incendies récurrents sur les marchés ont constitué une menace majeure pour les activités commerciales dans la métropole de Kano. Cela a nécessité la nécessité d'examiner le schéma spatio-temporel des incendies en relation avec la nature et l'importance des marchés en vue d'atténuer ses conséquences sur le développement commercial durable. Les dossiers des incendies (1974-2017) y compris les dates, l'heure, l'année, le lieu, les causes et les conséquences des incendies ont été obtenus auprès du service d'incendie de l'État de Kano. Des levés électroniques et GPS ont été effectués pour déterminer les emplacements absolus pour les analyses spatiales et temporelles. Le résultat de l'analyse spatiale a indiqué un modèle groupé d'incendies dans les principaux marchés avec une proportion de voisin le plus proche de 0,179. Temporellement, il y a eu plus de récurrence d'incendie (environ 20,9%) et de dommages matériels entre 2007 et 2017, ce qui fait de cette période, la plus dévastatrice d'incendies de marché à Kano. Sur la base de la nature des marchés, le résultat global a montré que les marchés à produits mixtes et le marché a produit unique ont connu respectivement 76,5% et 23,5% des incendies. Cela a été attribué à l'étendue des activités commerciales, à l'utilisation de l'électricité et à l'inflammabilité des produits. L'étude recommande ainsi une éducation à la sécurité incendie et des pratiques de prévention des incendies sur l'ensemble des marchés pour la réduction des risques et le développement économique durable.

Mots clés : Arpentage GPS, Marchés à produits mixtes, proportion de voisin le plus proche, marchés durables.

1.0 INTRODUCTION

Markets have been major means of business transactions and livelihood to many people of developing countries. The relevance of markets cannot be over emphasized as markets serve as avenues for interaction, income earning, companionship for entertainment, and other activities (Ngugi, 2015; Kamarudin, Wahab and Zakariya, 2015; Raipat, 2016). Despite this relevance, recurrent fire outbreaks have significantly affected not only the markets but also the lives and properties of people in different cities of the world. The recurrent fire outbreaks have been a major source of concern to business investors especially with respect to the fast-growing rate of markets and shopping centers in most urban centers of the world due to increased population and development (Tabassum *et al*., 2014, Murray and Watson, 2019 and Ishola *et al.,* 2020). The hazard of fire disaster in commercial areas poses high risk on lives and properties which can be destroyed within a short time (FPASA, 2017).

In most cases, market fires are attributed to carelessness (in handling electrical appliances) by shop-owners, faulty or sub-standard electric wiring and storage of highly flammable substances in unsafe manners (Adamu, 2013). Consequently, many of the affected businesses especially those without adequate insurance cover are forced out of business thereby rendering them jobless and in the long-run intensifying the issue of poverty (Oladokun and Emmanuel 2014, Oladokun and Ishola, 2010 and Botzen *et al.,* 2019). According to Dapatem (2014), about 4,500 traders in Ghana were affected by market fire outbreaks particularly in Kumasi and Accra markets such that their livelihoods were endangered. Additionally, in Accra (Ghana) and Makola (Ibadan, Nigeria) markets in 2013 and 2014 respectively, there were fire outbreaks which were attributed to combustible materials kept in the market by the traders that resulted in an extensive damage to properties thereby sending many people out of business (Aidoo, 2013 and Guyiri, 2014).

In Nigeria and particularly Kano State, many major markets and commercial buildings have been gutted by market fire outbreaks destroying lives and properties worth several billions of Naira (National Emergency Management Agency, 2006). These market fires outbreaks have continued to render many people jobless, damage the environment, and disrupt economic activities thereby worsening the problem of poverty (Oladokun and Ishola, 2010). According to Osaro (2013), Balogun Market in Lagos Island has twice been gutted by fire which was reported to have affected at least 100 shops and properties worth hundreds of millions of Naira. In the same year, the Global System of Mobile Communication (GSM) market in the city of Maiduguri was gutted by fire, destroying 14 shops containing tens of thousands of handsets, laptops and other mobile phone accessories. Sunday (2017) identified some of the major market fire outbreaks in different parts of Nigeria including the incidences of Ose Okwuodu Food Stuff Market, Onitsha (Anambra State) incidence which occurred in April, 2014 and destroyed about 200 shops and goods worth

several million Naira; Alaba International Market Ojo, Lagos, (Lagos State) which occurred in June, 2014 resulting in destruction of five phone accessories shops, Atakumosa Market Ilesa Area of Osun State, Nigeria incidence in August, 2015 with no casualty reported but properties worth millions of naira razed; Area 1 Market Garki, F.C.T, Abuja incidence in December, 2015 with properties worth millions of Naira destroyed, Yola South Main Market in Yola, Adamawa State- incidence which occurred in January, 2016 and affected goods worth millions of Naira; and the fire incidence at Jakande Market Ikosi-Ketu, Lagos State which occurred in January, 2016, although no injury and life was lost, but goods worth millions of Naira were destroyed.

Kano metropolis being the second largest commercial centre in Nigeria (after Lagos) and the most dominant commercial area in Northern Nigeria have experienced a number of market fire outbreak. These have significantly affected commercial activities thereby weakening the economic strength of the state. According to Ibrahim (2015), frequent fire outbreak is one of the leading factors affecting the growth and development of markets as well as the sustainability index of the entire Kano business landscape. Tracking the trend and pattern market fire outbreak will go a long way in the development of policy strategies for fire outbreak management in kano metropolis. Based on the foregoing, analysis of the spatio-temporal recurrence of fire outbreaks and associated consequences within markets places in Kano metropolis (from 1974-2017) becomes necessary. This paper thus analysed spatio-temporal pattern of fire outbreaks in markets of Kano Metropolis, Kano State with a view to generate policy response that will mitigate the impact of the recurrent fire outbreaks in the area.

2.0 STUDY AREA

Kano metropolis is located between Longitude 8^0 25' E to 8^0 40' E and Latitude 11^0 50' N and 12^0 10' N. The metropolis comprises of eight (8) local government areas (Dala, Fagge, Gwale, Kano Municipal, Nassarawa, Tarauni) and parts of Kumbotso and Ungoggo (Maigari, 2016). The metropolis covers a total area of about 499 km^2, with an urban area of about 137km^2. Kano metropolis is one of the fastest growing urban centres in West Africa both in economy and population. It is the most populous area in the northern Nigeria (Barau *et al.,* 2015). Kano metropolis with the projected population of about 4, 331, 790 (NPC, 2013) by 2018 has in few decades undergone drastic transformation and growth. Kano metropolis is characterized by semi-arid type of climate with daily mean temperature of about 30 ^{0}C. Lowest temperatures (i.e 20 ^{0}C) are recorded between December and February (Liman *et al.,* 2014).

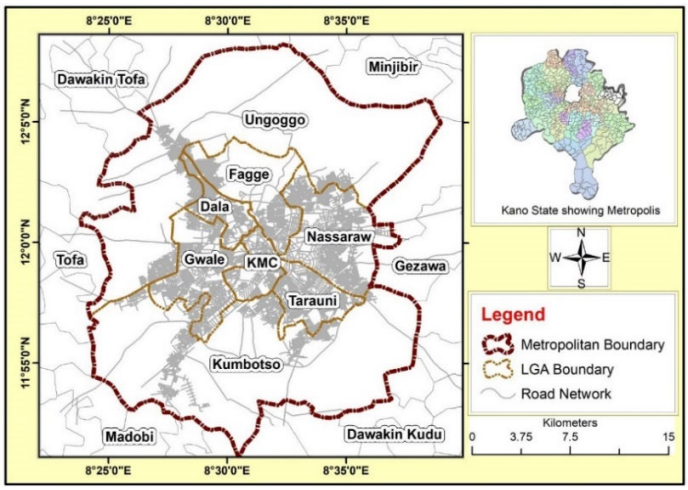

Figure 1: Kano Metropolis (Study Area)

The state is the most eminent commercial and industrial (cottage, commerce, agriculture and industries) centre in the whole of the Northern Nigeria during the precolonial times and the state's influence extended to neighboring countries including Niger Republic, Chad and Benin Republic. Later, after 1945, there was rapid growth of modern industries such as the Bompai industrial estate. In 1970s, after the oil boom, there came the establishments of import substitution factories. The establishment of the Bompai estate led to the development and expansion of the Kano urban center and promoted the process of urbanization. Other industrial estates include: Sharada, Challawa and Hadejia road/Gunguwawa industrial estates. Goods manufactured are plastics, sweets, confectionaries, soft drinks, textiles, metal, wooden furniture, paper, perfumes, cosmetics, toiletries, and leather goods among others (Adamu *et al*., 2014). The Kurmi market is one of the oldest ancient markets in Kano Metropolis and Muhammad Abubakar Rimi (Sabon Gari) market are one of the major markets offering almost all kinds of goods and services. There are single commodity markets (specialized) including the Dawanau international grain market, Kwari (fabric and textile market), Yankaba (vegetables), Yanlemo (friuts), Yankatako (timber market) among others. Kano Metropolis, equally has all-purpose markets, offering almost all kinds of services like Gama, Sharada, Tarauni and Wambai. These markets and many others have in one time or the other been gutted by fire disaster leading to destruction of properties worth huge amount of money (Hassan, 2015).

Kano metropolis, like the rest of the world, is exposed to a wide range of natural or human induced disasters in form of flooding, epidemics, dam failure, building collapse, accidents (road and air crashes), bomb explosion, communal clash, fire disaster (residential, commercial and industrial land use), air crashes, amongst others. The threat of urban fire is a serious problem in the metropolis with fires being responsible for deaths, injuries and destruction of properties worth billions of naira. Frequent fire disasters in crowded urban residences and market structures, and have become a major concern to urban planners, researchers and other stakeholders.

3.0 MATERIAL AND METHODS

The overall data types and sources, procedure for data collection, and methods for analysis are summarized and presented in Figure 2. Fire incidence record (1974-2017) comprising of incidence date, causes, month, year, market affected and estimated damage recorded in Naira (where available) was obtained from the record office of the Kano State Fire Service (KSFS). The data include all reported fire incidents that occur in metropolitan markets irrespective of their nature (i.e mixed or single product market), age, importance and commodity type offered. Absolute locational attributes (latitude and longitude) of fire incidence locations were also obtained to enable specific incidence mapping and spatio-temporal pattern analysis of market fire incidences.

The sampling population considered for the study comprises of only the incidences responded to and recorded by the Kano State Fire Service response department from 1974-2017. Out of about five hundred and fifty (550) markets incidences responded to, only those that affected the twenty-one (21) existing markets were purposively selected. This was based on their importance, status, nature, flammability of commodities and commodity type offered (see Table 1). Although these markets were not of the same age, but however selected because of their functions and importance in the present commercial status of the state as a whole.

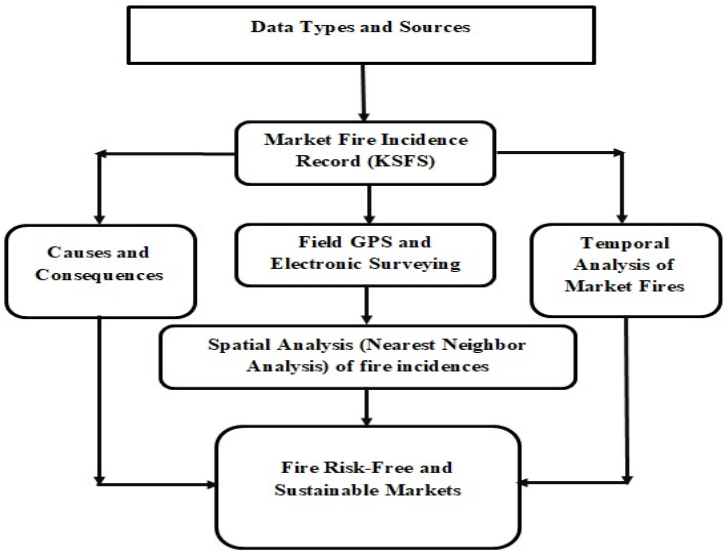

Figure 2: Methodological Flowchart

Global Positioning System (GPS) surveying was conducted to obtain the absolute locational attributes (latitude and longitude) data for all incidents in order to perform spatio-temporal pattern analysis of fire incidences. The major instruments used for this purpose are the GPS and Google Earth application. Secondly, field observation was conducted to determine market electrification levels, nature and commodity types offered by the markets, and commodity flammability levels was determined based on Commodity Classification Standards of New York, United States (http://up.codes/s/commodity-classification).

Spatial and temporal analyses methods were employed to determine the pattern of fire incidents after identifying the major causes and consequences of the fire outbreaks within the markets. The causes as indicated in the incident records were analyzed using Microsoft excel and presented in percentages using charts. The estimated

consequences based on availability in the KSFS record was also computed and presented. With regards to spatial analysis, Nearest Neighbor Analysis (NNA) was conducted using ArcGIS 10.2 software to determine markets and associated fire incidents distribution pattern from 1974-2017. The analysis was conducted to calculate nearest neighbor index based on the average distance from each market/incident point to its nearest neighboring point. This was done after importing the latitude and longitude attributes of all incidents across the study period on the landuse map of the metropolis, and NNA tool within the spatial analyst toolbox was used for the analysis. Temporal analysis (comprising of decadal trend, annual and seasonal variation of incidences among the selected markets) was conducted based on nature (mixed or single commodity) of the markets.

4.0 RESULTS AND DISCUSSION

The result from the analysis is presented in three (3) sections; firstly, markets distribution, attributes and counts of fire incidences from 1974-2017, spatial distribution of market fire incidents and temporal pattern analysis (decadal, annual and seasonal), and major causes and consequences of market fire outbreaks within the metropolis.

4.1 Spatial Distribution of Markets, Attributes and Counts Fire Incidences (1974-2017)

To determine the existing spatial distribution of the markets, Nearest Neighbor Analysis which calculates the nearest neighbor index based on the average distance from each market to its nearest neighbor was conducted. The result revealed a clustered distribution pattern of market within the metropolis (Figure 3) with Nearest Neighbor Ratio of 0.79 which is expressed as the ratio of the Observed Mean Distance (1131.08m) to the Expected Mean Distance (1438.03m). The z-score (-2.04) and p-value (0.04) results are measures of statistical significance which indicate whether or not to reject the null hypothesis, which is however rejected in this case (i.e market are clustered).

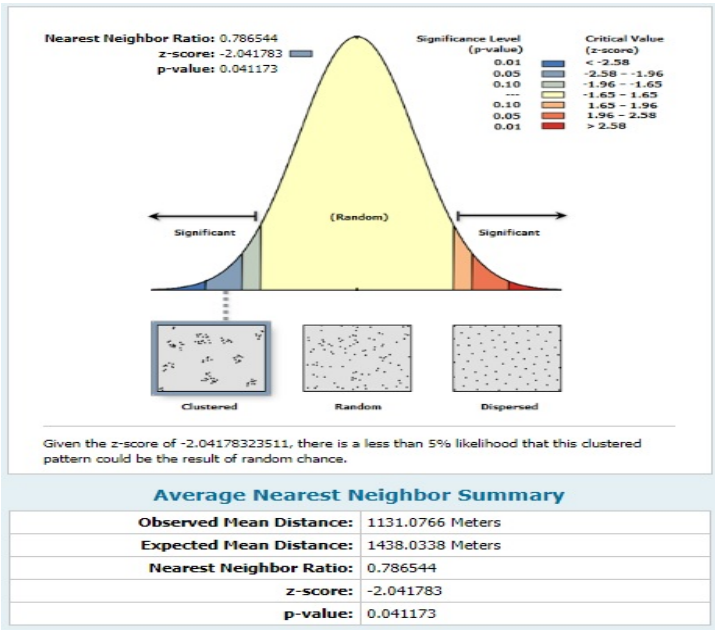

Figure 3: Spatial Distribution of Major Markets in Kano Metropolis (2017)

The clustering pattern of markets especially within the city center is influenced by historical development of the metropolis and population clusters (Figure 4). The markets are mostly located in proximity to residential landuses with high population

densities. However, single product markets like Dawanau grain market, Yan lemo, Yan Kaba and Yan Katako are located along major highways connecting to the neighboring states. The location is influenced by source-destination relationships of the nature of commodities sold in the markets.

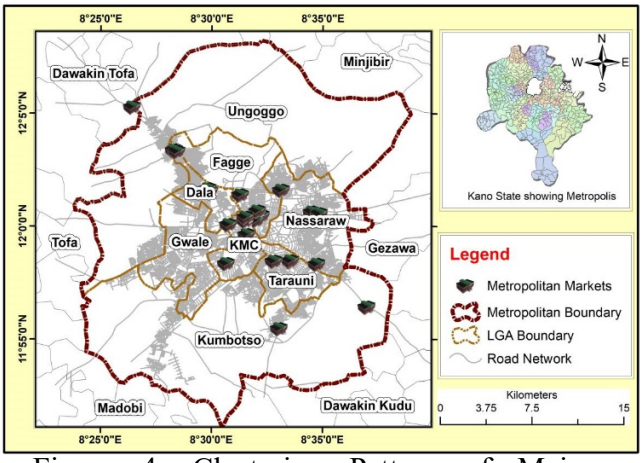

Figure 4: Clustering Pattern of Major Markets within Kano Metropolis

Table 1 presents the markets and their attributes including age, importance, status, nature, commodity type offered and total number of fire incidences recorded by each market from its establishment to 2017. Flammability (based on New York State, United States Commodity Classification Standards) and electrification levels (based on field observation) are categorized into 4 classes respectively. As for flammability, C1 and C2 represent commodities that are not flammable and partially flammable respectively. While C3 and C4 represent commodities sold in the markets that are flammable and highly flammable respectively. On the other hand, with regards to electrification, NE and PE stand for markets that are not electrified and those that are partially electrified respectively. While E and HE represent markets that are electrified and those that are highly electrified respectively.

From Table 1, it is obvious that the number of fire outbreaks varies among the markets depending on the nature of the market (i.e major mixed, minor mixed or single product), level of electrification and also flammability of the commodities offered by the markets depending on the age of each of the markets. On the basis of this perspective, single commodity markets are categorized into four (4). First, single product markets which are not highly electrified and offered C1 commodities (that are not easily ignitable) like Yanlemo, Yankaba and Kofar Ruwa markets recorded only 1, 2 and 13 incidents respectively. These are followed by C2 commodity markets including Mariri and Dawanau with 3 incidences each respectively. These markets recorded generally very low fire outbreaks throughout the study period (1974-2017) due to afore mentioned reasons. Thirdly, C3 commodity market comprising of Yan Katako which experienced about 10 fire outbreaks. Finally, single commodity markets that are electrified and classified as C4 commodity markets (offering highly flammable commodities). This include Kwari market which recorded about 52 major fire incidents within the study period. Based on the nature of markets, the overall result depicts those mixed markets (major and minor) experienced highest number of fire incidences (76.5%) followed by single commodity markets (23.5%). This is attributed to the flammability of the

products and also the extent of the use of electricity in the markets. However, the spatial and temporal patterns of fire outbreaks vary throughout the study period.

It is evident (from Table 1) that Kurmi market, which is among the first-generation markets, is the oldest (established in 1487) major mixed international market which have operated during the trans-Sahara trade. Based on the fire incidence record, the market experienced about 59 incidences from 1974- 2017 out of which 50% were recorded between 2007- 2017 (Figure 7). In other words, more incidences were recorded recently due to increase in economic activities triggered by population increase. Sabon Gari market which is among the second generation, major mixed markets experienced the highest number of fire incidences (117) followed by Rimi (44) all falling within C3 commodity flammability class. Sixty-nine incidences (56%) of Sabon Gari outbreaks occurred between 1974 and 2007 (at occurrence rate of 2.0 annually), while 44% which is the most devastating occurred from 2008 to 2017. Although there was high number of incidences during the earlier period, but the rate of occurrence is more in the later (5.3 annually).

Table1: Showing Markets, their attributes and Total fire Incidences Recorded between 1974-2017

S/N	Market Name	Estab Year	Importance	Status	Nature	Commodity type	Electrification Level	Flammability (up.codes)	Total Fire Incidence (1974-2017)
1	Dakata		Community	Exist	Mixed (minor)		PE	C3	2
2	Dawanau	1977	International	Exist	Single	Grains	PE	C2	3
3	Farm Center	2010	Metropolitan	Exist	Single	Cellphone/Accessories	E	C2	2
4	Gama		Community	Exist	Mixed (minor)		PE	C3	6
5	Hajj Camp		Community	Exist	Mixed (minor)		PE	C2	2
6	Ibr. Taiwo Rd		Metropolitan	Exist	Mixed (minor)	Electronics/Interior	E	C1	4
7	Kofar Ruwa	1977	International	Exist	Single	Automobile spare parts	PE	C3	13
8	Kofar Wambai	1977	International	Exist	Mixed (major)		PE	C3	22
9	Kurmi	1487	International	Exist	Mixed (major)		PE	C4	59
10	Kwari	1934	International	Exist	Single		E	C2	52
11	Mariri		Regional	Exist	Single	Kola nut	NE	C2	3
12	Rijiyar Lemo		Community	Exist	Mixed (minor)		PE	C3	1
13	Rimi	1937	Regional	Exist	Mixed (major)		E	C3	44
14	Sabon Gari	1914	International	Exist	Mixed (major)		HE	C3	117
15	Sharada	1960	Community	Exist	Mixed (minor)		PE	C3	5
16	Sheka Yarkasuwa		Community	Exist	Mixed (minor)		PE	C2	2
17	Singer	1977	International	Exist	Mixed (major)		PE	C3	11
18	Tarauni		Community	Exist	Mixed (minor)		PE	C3	5
19	Yankaba	1977	Metropolitan	Exist	Single	Vegetables	NE	C1	2
20	Yankatako		Regional	Exist	Single	Timber	PE	C3	10
21	Yanlemo	1978	Regional	Exist	Single	Fruits	NE	C1	1
	TOTAL FIRE INCIDENTS								**366**

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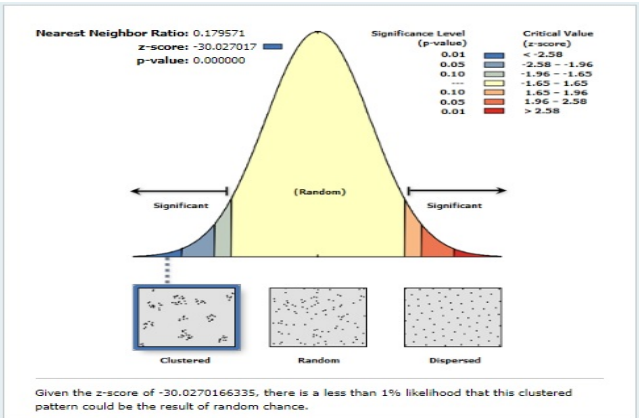
4.2 Spatial Analysis of Market Fire Outbreaks within Kano Metropolis

In attempt to identify the spatial pattern of all the market fire incidents, NNA conducted revealed an average NN ratio of 0.179 signifying a clustered distribution pattern of fire incidents and concentrated mostly within the major markets including Sabon Gari, Rimi, Kwari and Kurmi (Figure 5). The clustering pattern is as a result of the repetitiveness (recurrence) of fire incidents within these markets at closer spatial interval over the study period due to intensity and concentration of commercial activities within these markets.



Average Nearest Neighbor Summary

Observed Mean Distance:	72.3622 Meters
Expected Mean Distance:	402.9716 Meters
Nearest Neighbor Ratio:	0.179571
z-score:	-30.027017
p-value:	0.000000

Figure 5: Distribution of Fire Incidents within Kano Metropolis (1974-2017)

For other markets including Yanlemo, Yan kaba among others, dispersed pattern was identified due to very few fire incidents experienced by these markets throughout the study period (Figure 6).

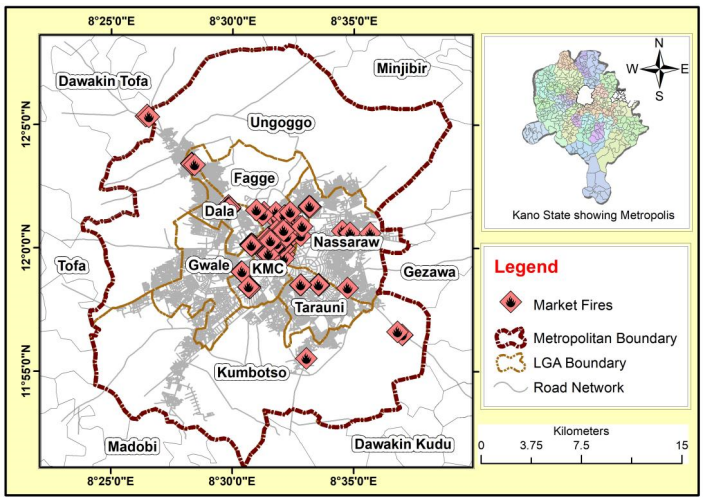


Figure 6: Spatial Pattern of Fire Incidents in Kano Metropolis (2007-2017)

4.3 Temporal Pattern of Market Fires

Here, temporal pattern analysis of market fire outbreaks in Kano metropolis from 1974-2017 was conducted at decadal, annual and seasonal levels.

4.3.1 Decadal Trend of Market Fires in Kano Metropolis

At decadal level, irrespective of the nature, age, and commodity type offered by the markets, fire incidents recurrence rate is more in the most recent decade (2007-2017) with about 20.9 incidents annually. This is due to increase in electricity supply and nature of utilization. This makes it the devastating decade which recorded the highest property loss worth trillions of Naira (KSFS, 2019). This is followed by 1996-2006 (9.1) and 1974-1984 (4.7) decades respectively. The 1985-1995 decade recorded the least recurrence rate and therefore regarded as the most fire risk free decade with less property loss.

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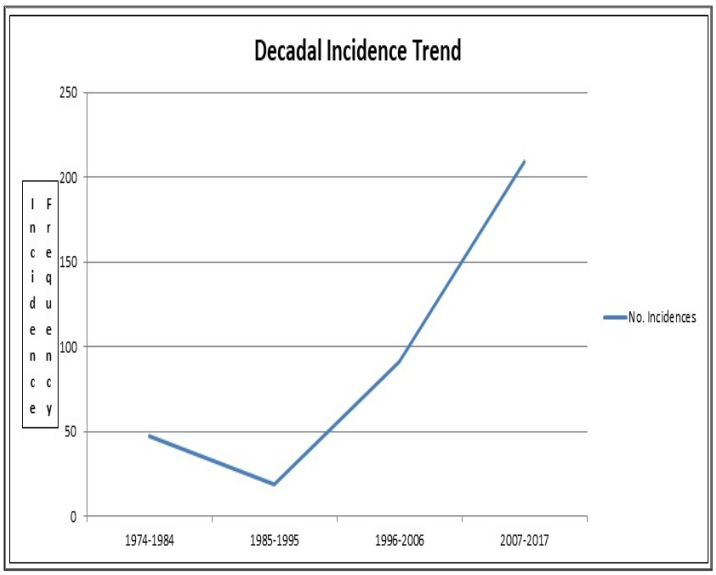

Figure 7: Decadal Trend of Market Fire Disaster in Kano Metropolis (1974-2017)

Figure 7 depicts the decadal trend of market fire incidences indicating a continuous rise in the number of fire disaster recurrence especially from 1995-2017 (which accounted for about 68.6% of the total incidences recorded). Out of the 68.6%, about 57% of the incidences were recorded between 2007 and 2017. This is attributed to increase in commercial activities due to population growth, increase in electricity supply, electrification of most of the markets and increased storage of flammable materials within markets of the metropolis.

4.3.2 Annual Pattern of Market Fire Outbreaks (Based on nature of the market)

With respect to the nature of the markets (mixed or single commodity), the pattern of fire outbreaks varies on annual basis. For the purpose of this study, the markets are categorized into single, mixed, major and minor commodity markets. From Figure 8, almost all single commodity markets have not experienced fire outbreak from 1974 until during the late 1980s and early 1990s, specifically at Yankaba market. During this period, Kwari market experienced the highest number of incidents reaching up to about 8 each in 2008 and 2014 respectively. This is due to the nature and flammability of the commodities offered by the markets in addition to availability and increased improper utilization of electricity for storage and powering of shops. This is followed by K/Ruwa market with about 3 incidents in 2000 and 5 in 2009. Those with least number of fire outbreaks are Yanlemo (with one incidence in 2014) and Yankaba market which recorded 2 incidences (one each in 1991 and 2016 respectively). Lack of recurrent fires in these markets is attributed to the nature of the commodities offered by the markets (i.e fruits and vegetables) and almost total absence of electricity.

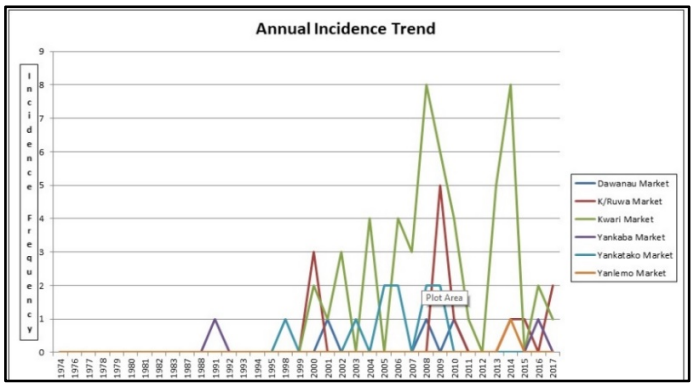

Figure 8: Annual Trend of Fire Disaster among the Single Commodity Markets

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From Figure 9, major mixed markets within the metropolis have also experienced fire outbreaks over the study period. It is observed that fire incidents vary annually and cumulatively among the markets. On annual basis, Sabon Gari market experienced the highest number of fire incidences particularly ten (10) each in 2015 and 2016, followed by 8 incidents each in 2007 and 2014, and 7 each in 2004 and 2017. This is due to flammability of the commodities, electrification of the markets, improper and excessive utilization of electricity. However, there were no fire cases in 1977 to 1987, 1998 and 1999. This was due to fire safety practices, low population (compared to the present time), and lack of excessive utilization of electricity within the markets.

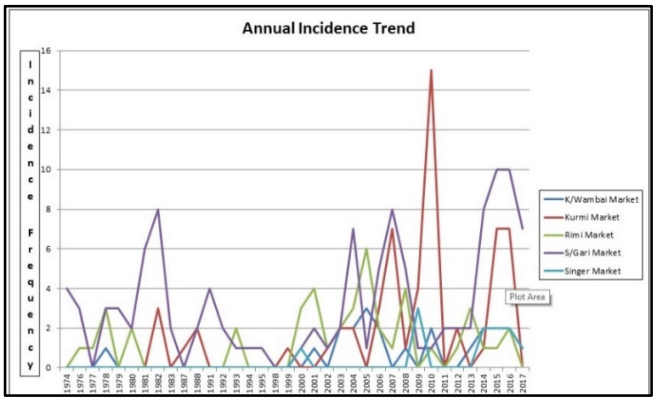

Figure 9: Annual Trend of Fire Disaster among the Major Mixed Commodity Markets

Minor mixed markets within the metropolis have occasionally experienced fire outbreaks which on annual basis is said to be insignificant. Due to the sizes of the markets, the level of economic activities and importance, these markets recorded very few outbreaks ranging from 1-2 incidences occasionally. Gama, Tarauni and Ibrahim Taiwo Road markets falls within this category and experienced about 2 outbreaks in 1980, 2001 and 2016 respectively (Figure 10).

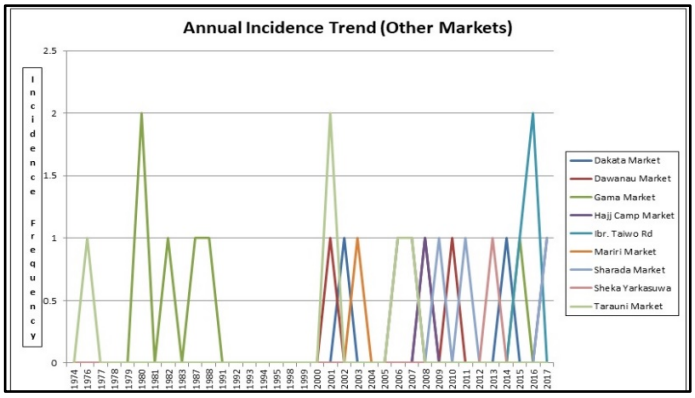

Figure 10: Annual Trend of Fire Disaster among the Minor Mixed Commodity Markets

It is very important to note that there was no fire outbreak within the mixed minor markets for a whole decade (i.e. 1991-2000). This signifies the low fire risk level in these markets compared to the major mixed and single commodity markets.

4.3.3 Seasonal Pattern Based on Commodity Type

Season is one of the factors influencing the pattern of fire disaster recurrence within the metropolitan markets. From Figure 11, the highest number of fire disaster (about 33% of the total) occurred during the hot and dry season which is as a result of the use of electric appliances (e.g. fans) for cooling of shops due to heat during

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the day time, and use of refrigerators and other appliances over-night for storage. This is followed by the incidents in the rainy season (29%), cool and dry season (26%) and finally the warm and dry season (the least affected season) with about 12%. The result is unlike that which was obtained from the residential land use of the metropolis where the most affected season is the cool and dry season (with about 32% of the total fire incidences), followed by Rainy season, and then Hot and Dry with 30.4% each, then Warm and Dry season with about 7.2% (Yunus *et al.,* 2021).

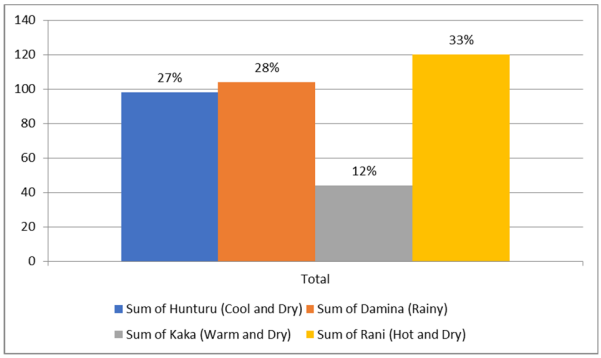

Figure 11: Seasonal Variation of Fire Disaster Recurrence within the Markets

The spatial distribution of market fire incidents based on season is also of great concern for emergency response planning and fire safety planning, education and enforcement. From Figure 12, it is evident that fire out breaks during the Hot and Dry season is dominant within the major markets (both mixed and single commodity) at the centre of the metropolis. This is because markets including Sabon Gari, Kurmi, Kwari, Rimi, K/wambai among others comprises the commercial hub of the city with great deal of population engaging in various commercial activities. Other minor mixed markets like Gama and Tarauni were most affected during the Warm and Dry season.

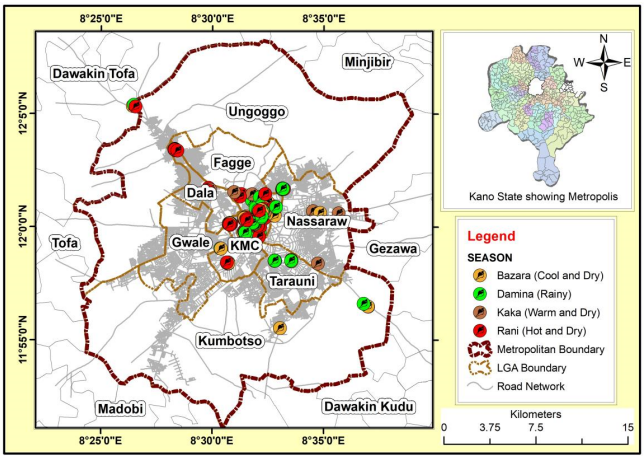

Figure 12: Seasonal Distribution of Fire Incidences

4.3.4 Major Causes and Consequences of Market Fire Outbreaks

The major causes of fire disaster within the metropolitan markets are broadly categorized into three (3) as depicted in Figure 13. Electric related faults constituted the major trigger of fire disaster through sparks from naked and substandard wiring and bursting of electric bulbs due to supply of unstable and epileptic electricity, use of heavy-duty local appliances, forgetting/refusing to switch-off sockets and bulbs, storage of commodities using refrigerators working over-night among others (due to negligence) caused about 78% of the total fire incidents recorded. On the other hand, the cause of some of the fire outbreaks were said to be unknown (about 18%), and others (about 4%) were caused by

refuse/bush burning, over heated generators and storage of flammable materials.

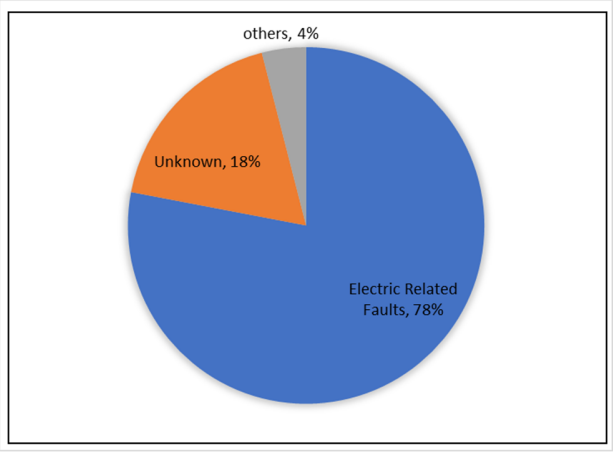

Figure 13: Causes of Market Fire Outbreaks in Kano Metropolis

differently by individuals, market associations, government agencies, emergency response organizations, media houses and NGOs (both local and international). However, the true picture of the damages is yet to be precisely quantified. Unfortunately, the estimated damage of many of the outbreaks doesn't exist in the KSFS records. As a result, only few estimates were recorded as presented on Table 2.

Table 2: Consequences of Fire Disaster within some Markets of Kano Metropolis

SN	Market Name	Incident Date	No. Of Shops and Warehouses Destroyed	Worth of Properties Damaged (N)
1	S/Gari Market	November, 2008	400 shops	Not reported
2	S/Gari Market	March, 2016	3800 shops	2 trillion Naira
3	Singer Market	February, 2016	200 shops and warehouses	5billion Naira
4	Kwari Market	March, 2010	Not reported	Multi Billion Naira
5	Yankatako Market	February, 2019	70 shops	Not reported
6	Singer Market	April, 2000	Not reported	N7,000,000
7	Kwari Market	May, 2000	Not reported	N5,000,000
8	K/Ruwa Market	October, 2000	Not reported	N3,000,000
9	Kwari Market	October, 2000	Not reported	N400,000
10	K/Ruwa Market	November, 2000	Not reported	N150,000
11	Rimi Market	January, 2000	Not reported	N100,000
12	Tarauni Market	January, 2001	Not reported	N1,500,000
13	Rimi Market	January, 2001	Not reported	N150,000
14	K/Wambai Market	January, 2001	Not reported	N60,000
15	Rimi Market	February, 2001	Not reported	N40,000

16	Kwari Market	October, 2002	Not reported	N2,300,000
17	S/Gari Market	November, 2002	Not reported	N60,000
18	Rimi Market	December, 2002	Not reported	N100,000
19	S/Gari Market	January, 2004	Not reported	N220,000
20	Rimi Market	March, 2004	Not reported	N5,823,300
21	Kwari Market	August, 2004	Not reported	N80,000
22	K/Wambai Market	November, 2004	Not reported	N4,000,000
23	Kwari Market	December, 2004	Not reported	N1,000,000
24	Yankatako Market	February, 2005	Not reported	N4,113,655
25	Rimi Market	April, 2005	Not reported	N567,000
26	Rimi Market	December, 2005	Not reported	N950,000
27	Rimi Market	June, 2006	Not reported	N10,661,122
28	Kurmi Market	July, 2006	Not reported	N7,400,000
29	Kurmi Market	November, 2006	Not reported	N5,845,000
30	Mariri Market	February, 2007	Not reported	N3,500,000
31	S/Gari Market	February, 2007	Not reported	N900,000
32	Hajj Camp Market	April, 2008	Not reported	N800,000
33	Kwari Market	June, 2008	Not reported	N4,000,000
34	S/Gari Market	November, 2008	Not reported	N13,000,000
35	Sharada Market	February, 2009	Not reported	N1,500,000
36	K/Ruwa Market	March, 2009	Not reported	N388,500
37	Yankatako Market	March, 2009	Not reported	N50,165,790
38	K/Ruwa Market	April, 2009	Not reported	N7,000,000
39	S/Gari Market	December, 2009	Not reported	N200,000
40	K/Wambai Market	February, 2010	Not reported	N3,500,000
41	Kurmi Market	March, 2010	Not reported	N1,430,000
42	Kurmi Market	November, 2010	Not reported	N32,000,000

(Source: KSFS, 2019)

There are no less than 10, 000 shops and properties worth more than 10 trillion Naira destroyed by fire disaster within the metropolitan markets in few recent decades. This has significantly affected the commercial activities and the economy of Kano State as a whole. As a result, campaign for sustainable economic activities within Kano metropolis becomes necessary for sustainable economic development.

5.0 CONCLUSION AND RECOMMENDATIONS

Conclusively, fire disaster has been (and is still) a major threat to the commercial activities within the Kano metropolis thereby

making the area risky and unattractive for business and other commercial activities. Seasonal variation as a major influencing factor, nature of markets, level of electrification and flammability of commodities have also contributed to fire disaster recurrence throughout the study period. Electricity and other related faults comprise the dominant trigger of fire outbreaks throughout the metropolitan markets. Therefore, in order to reduce the recurrence, building codes and especially proper electricity facilities installation and connections should be frequently enforced and checked respectively. Finally, fire safety education and practices should be enforced for sustainable economic development.

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