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INTEGRATED COLLABORATIVE RESPONSE MODEL: PANACEA FOR URBAN FIRE DISASTER RESPONSE CHALLENGES IN KANO METROPOLIS, NIGERIA

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ABSTRACT

Globally, fire service departments are faced with tremendous challenges which have significantly increased human and property exposure to fire disasters. This study aimed at identifying and examining the challenges faced by fire service department in Kano metropolis with a view to evolving solutions and proposing a prospective operational model for fire disaster risk reduction and sustainable development. Quantitative and qualitative data were collected in addition to conducting GPS surveying which obtained the locational attributes of fire incidents. Cluster and random sampling were used to select incident clusters from which respondents were derived, and fire stations where key informants were selected respectively. Simple statistics and ratio analysis were conducted for adequacy assessments, while content analysis was conducted to identify major challenges faced. It was found that presently, in Kano metropolis, firefighter-population and fire truck-population ratios are approximately 1:10,830 and 1:393,130 respectively which is approximately 39 times the ratio proposed by UFOA in 2011. It is concluded that the existing centralized response strategy, apparatuses and personnel were found to be obsolete, inadequate and responsible for the inefficiency. Provision of adequate personnel and updated apparatus in addition to embracing integrated collaborative response approach is recommended for efficient response system.

Keywords: Professional Responders, Accessibility, Pre-notification Delay, Response Time, Integrated Collaborative Response Model

INTRODUCTION

Today's fire departments are facing enormous challenges; therefore, fire chiefs must be extremely resourceful to keep their firefighters ready, response times low, and communities safe (Starnes, 2019). As a result of reduced budgets and diminishing funds, many fire departments around the world are short-staffed, which has resulted in the partial or complete closure of fire stations in some cases. Depending on the region, governance, and level of development, firefighters and fire departments face a variety of challenges among which include training and certification of firefighters, lack of funding, organizational structure, and aging equipment (Yunus, 2019a; Yunus, 2019b and Porter, 2019). Similarly, Starnes (2019) identified the four critical issues affecting fire services across the United States to include securing funding and retention, ensuring firefighter safety, improving fire department communication, and coordinating agency resources. In Ghana, part of the fire service's challenges are delays, which are attributed to a lack of appropriate logistics to fight fires, poor collaboration with major stakeholders, inaccessibility to fire sites, inadequate training facilities, and the inability of the firefighters to conduct fire risk assessments prior to operations (Oppong et al., 2017). However, in Nigeria, the fire service department lacks modern and automated information systems and facilities, thereby causing problems that hinder effective fire disaster prevention, detection, and control (Isa et al., 2016).

In Kano metropolis, the challenges faced by fire service departments and firefighters have not received adequate attention

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because firefighters are faced with challenges related to resource and facility allocation, technical and administrative, facility maintenance, refill and repair, personnel recruitment, motivation, insurance, and, above all, operational and collaborative challenges. Studies targeting the challenges have been conducted in different parts of the world (Guidotti & Clough, 1992; Svensson, 2002; CSNR, 2008; Milen, 2009; Wang *et al.,* 2011; Guidotti, 2014; Akhter, 2014; Baker, 2014; Mtani & Mbuya 2018; Schermerhorn-Collins, 2017; Menya, 2016; Devine *et al.,* 2018; Dong *et al*., 2018). However, none of such a kind of studies was conducted in Kano metropolis. Although Isa et al. (2016) assessed firefighter-population ratio to firefighter adequacy, however, this was not based on any standard. Apart from this effort, no other studies have attempted dwelling on the challenges faced through assessing the adequacy of existing firefighters, firefighting apparatus, and infrastructures especially in relation to the population served, particularly using any standard (for example NFPA, UFOA among other standards).

In Kano metropolis, water hydrants, although important infrastructure in fire disaster emergency response, have been completely ignored. Their existence, distribution, and conditions have never been considered in any of the previous studies. Apart from accessibility challenges, the firefighters face challenges such as outdated equipment, insufficient training, residents' negative attitudes toward firefighters, insufficient resource allocation, and poor governance (Osaro, 2013 and Yunus, 2019a). Emergency notification delays and the sources (as identified by Yunus, 2019a and Yunus, 2019b in Dutse town) have not also received significant attention in Kano metropolis. Additionally, modes of operation and response approach are key to determining the efficiency in a fire disaster response system. Studies on response approaches and modes of operation includes that of Plan, 2006; Allen, 2011; Mikkelsen-Lopez *et al*. 2011; Bedwell *et al*., 2011; Eide *et al.* 2013, 2014; DCLG, 2014; ESC, 2014; Carlson, 2014; Kapucu *et al*., 2010; Kapucu, 2011; Kapacu and Garayev 2011; Keyton et al., 2015; Yousefi, 2016; Bae *et al.* 2016; Holder, 2016; LGA, 2017; Akpoghome & Nwano 2017 among others). However, no such kind of a study has not been conducted in Kano Metropolis. As such, this study focused on identifying the challenges and evaluating the efficacy of the current mode of response to propose an operational response framework for sustainable development.

MATERIALS AND METHODS

Study Area

The Kano metropolis, which consists of eight (8) local government areas (Dala, Fagge, Gwale, Kano Municipal, Nassarawa, Tarauni, Kumbotso and Ungoggo), is situated on the longitudes of 8^0 25' E and 8^0 40' E and latitudes 11^0 50' N and 12^0 10' N (Maigari, 2016). It has a spatial extent of about 499 km^2 and an urban area covering of about 137 km^2 (Figure 1). As at 2016, the population was projected to have reached 4, 331, 790 by 2020 (NBS, 2016). Kano metropolis is among the fastest growing urban canters in the West African sub-continent, both economically and in terms of population. The constant intensification of human activities makes proper management difficult, resulting in a degraded environment (Barau *et al*., 2015) and an increased risk of various disasters including fire outbreaks (Yunus and Falola, 2022). Apart from being the state capital, the metropolis' growth is attributed to several factors, including natural population growth, immigration, the presence of educational institutions, and

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the location of industries and international markets (Ayila, Oluseyi & Anas, 2014).

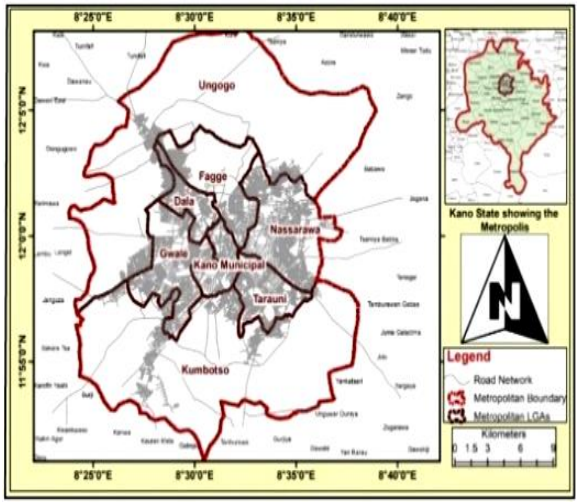

Figure 1: Kano Metropolis

The density of residential units varies across the metropolis. The urbanized area is mostly concentrated in the six core LGAs (Dala, Municipal, Nassarawa, Gwale, Fagge, and Trauni), with a population density of about 19, 000 people per square kilometer in an area of about 145 square kilometers (NIAF, 2011). This area is found to be the most affected by fire outbreaks due to. population density, intensities of socioeconomic activities, demand, and utilization of various energy sources during various seasons. (Yunus and Falola, 2022).

Data Types and Sources

Quantitative data of fire disaster incidents record (2009-2019) was obtained from the daily records of each of the existing fire stations within the metropolis and the locational attributes (latitude and longitude) of each of the incidents was captured using GPS surveying to enable mapping and identification of spatial clusters from which sampling areas were selected. Secondly, inventory of firefighters and firefighting apparatus/facilities within each of the fire stations was obtained from the state command and was used along with the projected population data (NBS 2016) to enable assessing adequacy of facilities with respect to the population served. Furthermore, questionnaire survey yielded data from some of the affected households about peoples' perception of the fire service. Finally, qualitative data on the challenges faced and prospects for achieving efficient and optimal response coverage were obtained via Key Informant Interviews (KII). The KII was conducted with five (5) officers in charge (OICs) of randomly selected fire stations (representing about 50% of all the existing stations) within the metropolis. The data types used, as well as the resultant information yielded with respect to the challenges faced and finally proposed prospective integrated model for efficient response to fire disaster within the metropolis are presented in Figure 2.

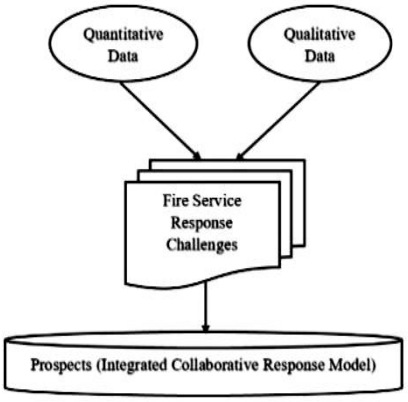

Figure 2: Flowchart of Methodology

Source: Authors Compilation

Sampling Methods

Cluster sampling was used to select the three (3) major fire incident clusters identified for questionnaire surveying (Figure 3). The selected clusters comprise of the Kurna (366 incidents), Rijiyar Zaki (351 incidents) and the city center cluster (1200 incidents). The goal was to get feedback from affected residents and their neighborhood about their knowledge and perspectives on the causes of fire outbreaks, observed challenges among others.

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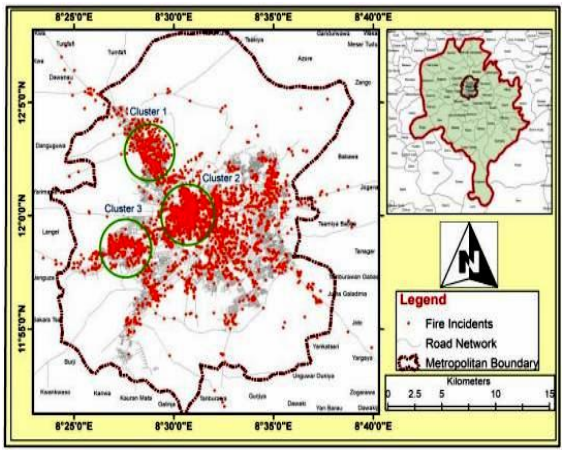

Figure 3: Clusters of Fires in Kano Metropolis (2009-2019)

Source: GIS Lab, Bayero University Kano

Purposive sampling method was used to select all the existing state-owned fire stations within the metropolis because they are saddled with the responsibility of fighting fire and fire safety awareness within the state. Inventories of firefighting apparatus/facilities, and firefighters was collected to assess the facilities' adequacy in relation to the population served at the local government level. Random sampling was used to select five (5) fire stations that accounted for approximately 50% of the total population of the fire stations for the Key Informant Interview (i.e 11).

Data Collection Instruments and Methods

Fire incident records, firefighters and firefighting apparatus/facilities inventories, questionnaire and checklists were among the major data collection instruments used. The incident record and inventory consultation were used to obtain data about the number and distribution of fire incidents, as well as counts of firefighters and firefighting apparatus/facilities per station, which allows for adequacy assessment. Residents were polled using a questionnaire survey to learn about their perceptions of the challenges. In this case, 450 households were chosen (250 from the city center and one hundred each from the Kurna and Rijiyar Zaki clusters), accounting for about 10% of the total incidents investigated (4335 incidents). Depending on availability, the questionnaire was given to the resident heads or their delegates from each of the clusters. Finally, a Key Informant Interview was conducted to gather information about the fire service's challenges. The checklist's questions centred on inquiring about the challenges the fire service faces from the public, government, and other responders, as well as factors influencing the fire response system's efficiency.

Data Analysis

Quantitative data gathered through questionnaire survey was cleaned, coded, and subjected to a simple statistical analysis, which included percentages and frequencies, with the results displayed in charts and graphs. Ratio analysis was conducted to assess the adequacy challenges faced by firefighters with respect to the population served at the local government and metropolitan level. NVivo Pro v11 (qualitative data analysis software) was used to translate, transcribe, and format qualitative data collected through Key Informant Interviews. The data was then auto coded using the previously identified thematic areas. Content analysis and series of queries were posed to determine the challenges and to examine perspectives and identify the most influencing challenge(s) affecting urban fire disaster management. Explore diagrams were used to compare responses, and the results were displayed as word clouds.

RESULTS

A fire disaster response system's overall goal is to provide efficient service by maximizing coverage and ensuring prompt response. However, depending on the social, physical, political, and economic environment, fire departments around the

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world face a variety of challenges (Porter, 2019). The types and magnitude of disasters are determined by the effectiveness of the city's disaster management system. The challenges faced by the fire service department of Kano metropolis were examined in this study, and the findings revealed that the department faces multiple challenges that impede its efficiency. These challenges are classified based on their sources and they include challenges from the General Public, the Government and other Professional Responders.

Challenges from the General Public

As part of the response system, the public contributes to the efficiency (or lack thereof) of urban fire disaster management. The ways in which the public contributes to the inefficiency and smoothness of fire disaster response in Kano were identified, and the results were summarized and presented in Figure 4.

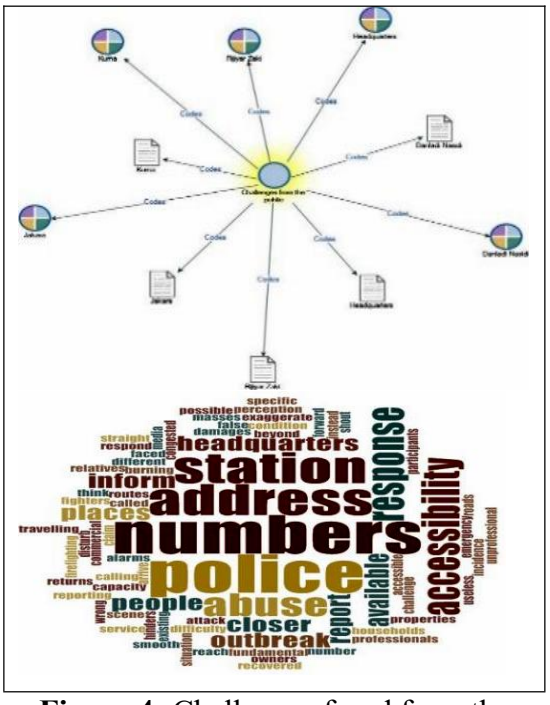

Figure 4: Challenges faced from the Public

The key challenges identified were derived based on their emphasis and or the frequency of occurrence during the interview. As depicted in figure 4, the most highlighted keywords are the major challenges emphasized and are further discussed under the following:

Communication gap due to lack of possession of emergency phone numbers

Figure 4 depicted 'numbers' as one of the most highlighted keywords because it is regarded as one of the most important challenges. The lack of possession of emergency response numbers (codes) results to a communication gap between the fire service and the public, thereby lengthening pre-notification delays (Yunus, 2019a) and increasing the number of unreported fire incidents. This has exacerbated the city's problems of insufficient fire incident records and a lack of precise estimates of the consequences in terms of lives lost, injuries, and property damage. The lack of possession of the emergency response numbers among the public has also influenced the magnitude of fire disasters. Based on a questionnaire survey conducted to validate firefighters' views on non-possession of emergency numbers as a challenge revealed that currently, about 73 percent of respondents in Kano metropolis do not possess any of the fire disaster emergency response numbers (Figure 5).

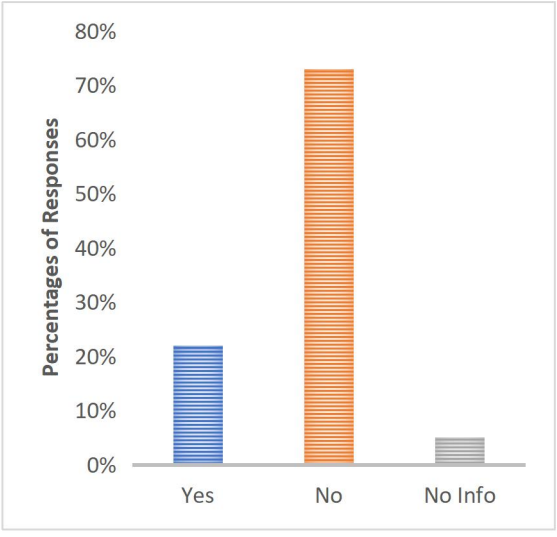

Figure 5: Possession of Emergency Response Numbers among the Residents of Kano Metropolis.

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This implies that out of every ten randomly selected people in the city, only three are likely to possess fire response emergency numbers. This finding is like that of Yunus (2019a), who discovered that about 90 percent of respondents in both commercial and residential areas of Dutse town lacked emergency phone numbers in their possession. Instead, people physically travel to the fire station to report the occurrence of an incident during an outbreak. This therefore signifies dual delay (traveling to and from) before the fire is extinguished. In other cases, people only seeks to get the numbers during an fire outbreak. This has undoubtedly contributed to the increasing magnitudes of outbreaks because of the prolonged burning time between notification and the arrival of responders. It is expected that notifying responders and providing a description of the incident location will take no more than 60 seconds (NFPA, 2016). However, this can only be accomplished if most of the population have in possession emergency response numbers of at least the closest fire station to their neighborhood.

During emergency situations in Kano metropolis, responders are typically notified by a 'running caller' (who physically travels from the incident point to the nearest fire station to report an emergency), a 'telephone caller' by a resident or bye-passer who has the numbers and notices an outbreak, or a 'visible caller' (outbreaks noticed by the fire service themselves due to rising smoke). Despite the fact that none of these methods of notification is as simple and as quick as telephone call, but unfortunately, even those who possess the emergency numbers couldn't in most cases distinguish between the emergency numbers of the existing stations, particularly the closest one. Therefore, instead of notifying the nearest fire station during an outbreak, they ended up calling a station that is far away whose designated service area doesn't fall within the location of incident.

Wrong or incomplete Incident Address/Location Description

Incident 'address' tracking remains a very serious problem (Figure 4) faced by the fire service. The lack of a Computer Aided Dispatch System (CADS) which tracks incident locations through emergency caller, has resulted into difficulties in obtaining precise descriptions of fire incident locations during emergency situations. People rarely provide a straightforward address or direction of incident scene to the fire service during emergency due to panic and other related tensions. Similarly, firefighters are in most cases nofamiliar with the address of places withinthe metropolis due to a lack of clearly defined service coverage areas. They usually have a tough time understanding or locating fire incident locations which results into introducingan additional delay to the ideal travel time of 240-second as proposed by NFPA, (2010). The resultant delay in this case, known as Intra Reflex Sequence Delay (Yunus, 2019a), is also to blame for the increased magnitude of fire disasters.

Accessibility Issues

The issue of 'accessibility' is also a major one which obstructs timely response in most parts of the city (Figure 4). Apart from encroachment by many buildings in various places, refuse dumping, commercial activities along access routes, and other factors, most access routes, especially within the core areas of the metropolis, are very narrow, making it difficult for fire service trucks to access many parts of the city during outbreaks. During traffic jams, people also refuse to give way to fire trucks, slowing down the response process. Alternative routes (where available) must be taken in most cases to get to the fire scene. As part of the Intra-reflex sequence activity, unnecessary

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delays caused by poor accessibility have a significant impact on travel time. According to a similar study by Akhter (2014), accessibility issues such as traffic control for emergency vehicles are always a big issue in Rawalpindi due to a lack of education about traffic rules, unnecessary parking on main roads, media hype for incidents, lack of coordination between traffic police and Emergency Service, non-availability of emergency track in road infrastructure, and a single road with two-way traffic.

Late Notification for Emergency Response

Another major issue that the fire service faces is late notification of emergencies, which leads to a lack of promptness by the firefighter. Promptness is critical in any emergency response and serves as a measure of a system's effectiveness (Yunus, 2019b). In most cases, people (especially youth and volunteer community service groups) try to fight the fire manuallyusing water mixed with detergents or fresh leaves from trees. Until all efforts have failed and the damage has already been done the fire department is notified. This results to firefighters arriving at the scene very late and subsequently being booed or even physically attacked due to the prevailing perception of the people about the late coming of the firefighters.

Exposure to Abuses and Physical Assault/Attack

Another challenge is the firefighters also complained about being subjected to physical assault or attack due to the absence of ‘police’ (in most cases) during most response operations. As a result of the chaos and distractions caused by the public, a smooth firefighting operation is hampered. Similar situation was reported by Akhter (2014). The firefighter's lamented the following;

"*....the police are never available to protect us and keep the crowd under control during an emergency...*"

Challenges from the Government

According to Slack and Cote (2014), the government has the following responsibilities in influencing the efficiency of the response system: provision of physical and social infrastructures, resources allocation, monitoring and encouraging public and stakeholder participation in urban disaster management activities. The challenges faced by the fire service because of a lack of role implementation by the government are assessed in two stages; first, based on firefighters' perceptions and, second, based on physical assessment of the adequacy of existing fire fighting facilities/apparatus.

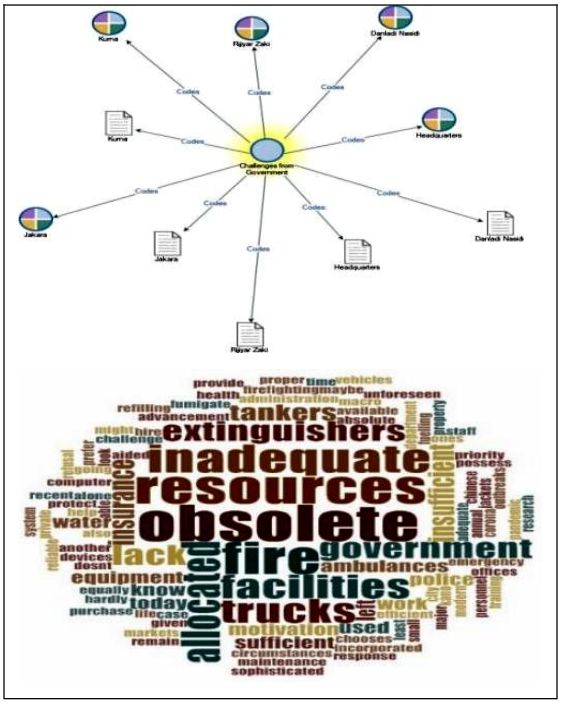

Figure 6: Challenges faced from the Government (the firefighter perspective)

To assess the firefighter’s perspectives of the challenges faced due to government’s lack of commitment (administratively and operationally), content analysis was performed, and summary of the perspective is presented in Figure 6. While the comparison diagram compares the

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responses from the selected stations, the word cloud summarizes and presents the the most recurring challenges emphasized by the firefighters. Some of the major and common challenges raised by all stations were highlighted hierarchically based on importance and emphasis (Figure 6). 'inadequate resources,' 'obsolete trucks,' 'tankers,' 'inadequate' 'facilities,' 'extinguishers,' 'ambulances,' 'lack, 'motivation,' 'welfare,' 'inadequate' 'protection suites,' inadequate 'training, 'firefighters,' promotion issues, and lack of life insurance just to mention a few. Even though these are the most critical infrastructures and resources a fire station requires to operate effectively, however, they remain inadequate in the Kano metropolis. In other words, the general responses comprised of the following.

"*All available fire responding facilities are outdated (obsolete) and Nothing is adequate……no life insurance, but a hazard allowance of less than N1000 despite the exposure…….*"

Secondly, challenges faced from the government due to lack of provision of firefighting facilities was also assessed. The number of stations, firefighters, and facilities in relation to the population served is referred to as adequacy. The ratio of firefighting facilities to the population served is used to determine the adequacy level (Yunus, 2019a). This is measured against a variety of international standards to determine how adequate the current facilities and personnel are in relation to the population served. It is crucial to remember that there is no single universally accepted population-to-facility ratio. The nature of the relationship is determined by the characteristics of the city and level of development. However, the population and the number of facilities/personnel have a direct relationship. To put it another way, all things being equal, the higher the facility/personnel rate, the more efficient a response system is. Several studies on this topic have been conducted in various parts of the world, with different ratios emerging depending on the cities' unique characteristics. According to the Uniformed Fire Officers Association (UFOA, 2011), the population to firefighter ratio was 1:273 in 2009/2010, the population to fire engine ratio was 1:10000, the population to ladder truck ratio was also 1:10000, and the population to fire station ratio was 1:50000. In France, Ersoy (2009) recommended that one fire station serve a minimum of 25000 people and a maximum of 40000 people. According to Habibi et al. (2008), one fire station should serve at least 50000 people. Based on the specific characteristics of Germany, Ersoy (2009) recommended that one fire station serve 2000-10000 people. According to the Queensland Government (2007), one fire station should serve a population of 25000 people. However, in Kano metropolis, adequacy assessment was done under the following subheadings: In Kano metropolis, the adequacy of firefighting apparatus in relation to population was determined at local government level and presented in Table 1. Fromthe table, Kano Municipal LGA has the lowest fire truck/population ratio (1:258200) within Kano metropolis, which is more than twenty-five times the ratio proposed by UFOA, (2011), more than ten times that of Queensland Government, (2007), and more than five times the standards proposed by Habibi et al (2008). However, Dala, Ungoggo, and Gwale had the highest ratios, with 1:582500, 1:508700, and 1:497700, respectively. This depicts the extent to which the city's available fire trucks have been overstretched, resulting in inefficiency in the response system.

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Table 1: Population/Apparatus Adequacy at LGAs level within the Metropolis

LGA	No. of Fire trucks	No. of Water Tankers	No. of Ambulance	No. of Hydrants at Station	Population Served (2016 Prj)	Population/fire truck Ratio	Population/Water tanker Ratio	Population/Ambulance Ratio	Population/Hydrant Ratio
Dala	1	0	0	0	582500	1:582500	0:582500	0:582500	0:582500
Fagge	1	0	0	0	278300	1: 278300	0:278300	0:278300	0:278300
Gwale	1	0	0	1	497700	1:497700	0:497700	0:497700	1:497700
Kano Municipal	2	1	1	2	516400	1:258200	1:258200	1:516400	1:258200
Kumbotso	1	0	0	0	409500	1:409500	0:409500	0:409500	0:409500
Nassarawa	2	0	0	3	829600	1:414800	0:414800	0:414800	1:276533
Tarauni	1	1	0	0	308600	1:308600	1:308600	0:308600	0:308600
Ungoggo	1	0	0	0	508700	1:508700	0:508700	0:508700	0:508700

Kano State Fire Service, 2019 and 2020 Data Analysis

In terms of number of ambulances, Kano Metropolis has only one fire response ambulance, which is stationed at the Headquarters' rescue unit. Only two water tankers are available, one at the Headquarter and the other at the Government House station. Except for the stations at the Headquarters, Bompai, and Sharada, none of the others have water collection points (hydrants) or water tankers. The most fundamental question is: how and where do they get water in an emergency? Furthermore, all stations are housed in substandard rented shops along the road rather than standard structures that include offices, document rooms, ICT rooms, training grounds, and stores, among other things. The lack of government commitment has resulted in extreme inadequacy of facilities, which is to blame for the current inefficiency.

The relationship between firefighter population per station and available essential facilities/infrastructures for efficiency assessment is shown in Table 2. For example, in Kurna station, there are approximately 28 firefighters working in only one office, with no life/fire jackets, no ICT room, and no store for keeping extinguishing equipment and fire incident records. Similarly, the situation is similar at Jakara, Rijiyar Zaki, House of Assemble, and Sharada stations. The headquarters station is the most accommodating, with firefighter-to-office and firefighter-to-life jacket ratios of about 1:4 and 1:6, respectively. Except for the Headquarters, life jackets were not available at all stations. This depicts the firefighters' vulnerability to various risks while performing their duties. However, the entire fire department lacked an ICT room and thus operated primarily manually (using analogue materials).

At the local government level, Table 3 shows the relationship between the number of firefighters per station and the population served. According to the findings, the Kano Municipal and Fagge local governments appear to have a better workforce relationship than the rest, with ratios of about 1:5,323 and 1:6,626 respectively, but these figures are nearly 20 and 24 times higher than the UFOA (2011) standard of

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1:273, or at least three firefighters per 1000 residents. In Kano metropolis, the worst firefighter/population ratio is found in Dala local government (1:20, 803), which is more than 76 times the ratio proposed by UFOA (2011). More staffing is required to meet the demands of an ever-increasing population and a high rate of fire disaster recurrence to improve the response system's efficiency.

Table 2: Firefighter/Essential Facilities Adequacy

Station	Firefighters	Offices	ICT Room	Stores	Fire Jackets	Firefighter/Office Ratio	Firefighter/Jacket Ratio	Firefighter/ICT Room Ratio	Firefighter/Store Ratio
Headquarter	67	15	0	1	10	1:4	1:6	0:67	1:67
Bompai	43	3	0	0	0	1:14	0:43	0:43	0:43
Sharada	40	3	0	0	0	1:13	0:40	0:40	0:40
Sabon Gari	42	4	0	0	0	1:10	0:42	0:42	0:42
Kurna	28	1	0	0	0	1:28	0:28	0:28	0:28
Rijiyar Zaki	34	2	0	0	0	1:17	0:34	0:34	0:34
Gwale	9	1	0	0	0	1:9	0:9	0:9	0:9
Jakara	30	2	0	0	0	1:15	0:30	0:30	0:30
Government House	20	3	0	0	0	1:6	0:20	0:20	0:20
House of Assembly	23	3	0	0	0	1:7	0:23	0:23	0:23
Danladi Nasidi	27	3	0	0	0	1:9	0:27	0:27	0:27

Kano State Fire Service, 2019 and 2020 Data Analysis

Table 3: Firefighter/Population Ratio at Local Government Level

LGA	No. Firefighters	Population Served (2016 Prj)	Firefighter/Population Ratio
Dala	28	582500	1:20803
Fagge	42	278300	1:6626
Gwale	49	497700	1:10157
Kano Municipal	97	516400	1:5323
Kumbotso	27	409500	1:15166
Nassarawa	66	829600	1:12569
Tarauni	20	308600	1:15430
Ungoggo	34	508700	1:14961

Kano State Fire Service, 2019 and 2020 Data Analysis

At the metropolitan level, the ratio of firefighter to firefighting apparatus/equipment is also determined (Table 4). According to the findings, one firefighter serves approximately 10, 830 people and one fire truck serves approximately 393, 130 people. This was approximately 39 times the ratio proposed by UFOA (2011). The only fire emergency ambulance in the metropolis (headquarters) is expected to serve approximately 3,931,300 people, a significant cause of loss of life and inefficiency in the metropolis' response system.

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Table 4: Firefighter and Firefighting Apparatus/Equipment Ratio at Metropolitan Level

SN	Firefighter and Firefighting Apparatus/Equipment	No. of Firefighter and Firefighting Apparatus/Equipment	Ratio in Relation to Metropolitan Population
1	Firefighters	363	1:10, 830
2	Fire Trucks	10	1: 393, 130
3	Water Tankers	2	1:1, 965, 650
4	Ambulance	1	1: 3,931, 300
5	Water Hydrants	6	1:655, 216

Kano State Fire Service, 2019 and 2020 Data Analysis

Challenges from Other Professional Responders

The fire service faces difficulties due to a lack of cooperation from other professional responders (police and emergency medical personnel), which impedes a smooth and efficient response to fire outbreaks in the city. The key issues that were identified is as a result of inadequate communication and participation of the other responders.

Interaction with firefighters revealed that other professional responders (Police and Medical Personnel) are currently unavailable to perform their duties during a fire disaster. This was due to the responders' lack of a functional and central communication system. They are usually involved near the end of the response process, either by handing over recovered property (to police) or transporting the casualty (on the fire truck) to the nearest emergency units. Due to the non-participation of other responders, the fire service is overburdened, resulting in inefficiency in the response system.

Figure 7 revealed little to no communication and participation by other responders during emergency situations, thereby making the prevailing response system a more centralized (concentrating all tasks to the firefighters)rather than being a decentralized one. This is a significant flaw in the metropolis' response strategy. Due to a lack of police participation during emergency response, firefighters have been exposed to a variety of risks, including abuse and even attacks by the public during a fire disaster. In a similar study, Akhter (2014) discovered that the absence of police was cited by 100 percent of respondents as the primary cause of lack of crowd control and public disruption. Several lives have also been lost because of the lack of medical personnel on the scene during fire disasters to provide first-aid treatment and transport victims to the hospital.

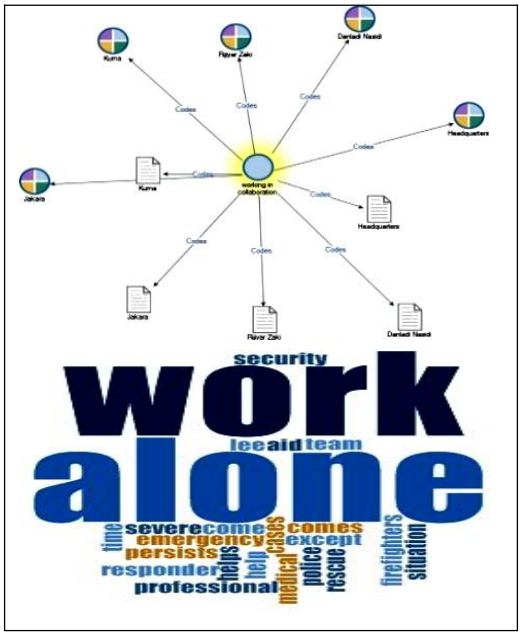

Figure 7: Emphasizing lack of Participation of other First-Responders Using Word Cloud derived from Content Analysis

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Other major factors contributing to the firefighters' excessive workload were their lack of understanding of their specific responsibilities and the state government's lack of coordination. This finding is similar to that of Akter (2014), who stated that coordination is an important part of fire emergency response, and that coordination is lacking among emergency response organizations due to a lack of information about their role in an emergency. A thorough investigation into the response strategy revealed a centralized response strategy in which firefighters respond to fire disasters within the metropolis on their own without the assistance of others. The burden of performing these tasks has resulted in inefficiency due to unnecessary delays and inconsistencies, which has led to an increase in the magnitude of fire disasters over time and the risk of lives and property being exposed. As a result, a decentralized and collaborative approach is required in addition to adequate provision of firefighting facilities for a sustainable and effective response.

Prospect for Effective Fire Disaster Response in Kano Metropolis

Considering the prevailing inefficient centralized response system due to lack of emergency response participation and communication gap, this study proposed an integrated response model emphasizing collective response activities among all stakeholders, in addition to providing all necessary infrastructure. The Integrated Collaborative Response Model proposes decentralization in fire disaster emergency response, in contrast to the existing (centralized) approach in Kano metropolis. The model focuses on collective participation and synergy, incorporating the roles of all responders and other stakeholders in responding to a fire disaster. Communication, participation, cooperation, coordination, and collaboration are all described as falling along a continuum of increased interaction in the model, which is based on hierarchical levels of interaction through participation in emergency responses. The interaction between communication and time are seen as critical in determining the levels of participation among stakeholders for efficient collaborative response system. Communication is fundamental at the x axis and the lowest end of the continuum, serving as a medium of connection through which individual units communicate emergency information to one another. Time, on the other hand, is represented along the y axis, indicating that communication and time have a strong influence on increased interaction. Because units can only participate after being notified of an emergency, participation is placed immediately after communication (Figure 8).

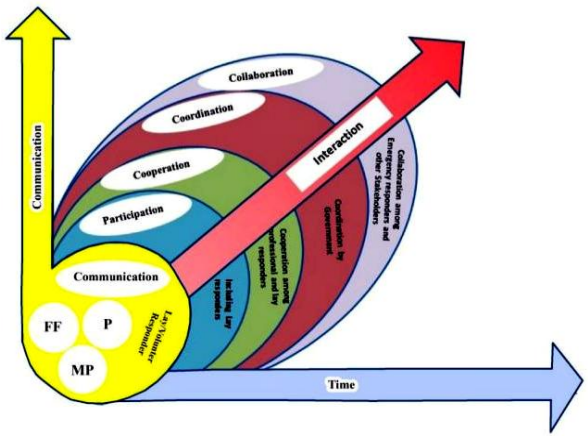

Figure 8: Integrated Collaborative Response Model for Urban Fire Disaster

The greater the level of communication among first responders over time, the higher their participation in fire disaster response. The need for cooperation among responders grows as the level of participation rises. Cooperation is defined as a collaborative effort between participants to achieve emergency response and recovery goals within the constraints of existing structures

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and policies. In other words, it is the ability of individual responders to work together within an emergency response system to achieve a common goal. After cooperation has been achieved, coordination, which is about interaction between participants in which formal linkages are mobilized because some government assistance is required to achieve emergency response goals, becomes necessary. Collaboration is the highest level of interaction on the continuum, and it is achieved over time through effective communication among stakeholders. According to McNamara (2012), in the words of Gray, (1989), collaboration is all about interaction between participants (individuals or organizations) working together towards achieving complex goals based on common interests and collective responsibility for interconnected tasks that cannot be executed individually.

CONCLUSION

It is concluded that the fire service in Kano metropolis is faced with challenges from the public, government and other responders which have significantly affect the efficiency of the prevailing response system. Firefighting facilities and infrastructure are inadequate and mostly obsolete, and therefore cannot cater for the ever-growing population within the metropolis. Centralized response approach is inadequate and lacks the methodology to suffice the response complexity within the metropolis. Integrated response approach decentralizes and incorporates the participation of all responders for sustainable development of the area. The study therefore recommends for automation of fire disaster incidents record collection and employ more advanced fire incident tracking technology (computer-aided dispatch system). There is need for adequate provision of modern firefighting apparatus/equipment through deploying most recent technologies such as Robotic firefighter, non-flammable fire jackets, sophisticated helmets, protective gears as well fire extinguishing grenade among others. Government should put into consideration the welfare, motivation, training and life insurance of firefighters to improve their commitment and dedication to their duties. Integrated Collaborative Response approach with a great deal of decentralization of responsibilities for efficient and sustainable response throughout the metropolis should be embraced.

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