Appraisal of the Distribution and Nexus of Emergency Response Facilities in Ungogo Local Government Area, Kano State, Nigeria

[*a]Raji, A. U. and [b]Dalhatu, A. U.
[a]Department of Architecture, Faculty of Earth and
Environmental Sciences, Bayero University Kano, Nigeria
[b]Department of Environmental Management
Faculty of Earth and Environmental Sciences, Bayero University Kano, Nigeria
*Correspondence email: auraji.esm@buk.edu.ng

Abstract

This study assesses the spatial distribution and interrelationship of emergency response facilities in Ungogo Local Government (LGA), of Kano metropolis facing challenges with emergency services. Previous research on emergency spatial distribution has not adequately examined the relationship among primary healthcare, police services, and fire services facilities. The objective of this paper is to analyze the existing spatial distribution of emergency service facilities in the study area, as well as determine the interrelationship between primary healthcare centers (PHC), fire stations, and police stations. A survey research design was employed, with a population of 42 respondents selected through purposive sampling. Nearest Neighbor Analysis (NNA) was employed, and the findings reveal both clustered and dispersed distribution patterns of PHC and police stations in the LGA. The study identifies a correlation between poor response time in primary healthcare services and the services rendered by the PHC, while the fire station demonstrates the most efficient response time of less than 4 minutes. Pearson correlation analysis confirms a positive relationship among the three emergency service facilities. Based on a 5-kilometer buffer analysis, the distribution of PHC indicates adequacy, whereas the distribution of fire service stations indicates significant inadequacy. The study recommends the provision of adequate facilities in underserved areas and the establishment of a centralized means of communication to enhance emergency coordination.

Keywords: Emergency services, Response time, Facilities, Kano, Nearest Neighbour Analysis

INTRODUCTION

An emergency is an unplanned event that poses immediate risks to health, life, property, or the environment (Aliyu, 2015). The primary objective of emergency service provision is to minimize injuries, protect the community, and ensure business continuity (WHS). Emergency service units, such as firefighters, law enforcement officials, and medical personnel, aim to reach the emergency incident within a standardized response time (Ganeshkumar and Ramesh, 2010). The response phase is a crucial stage in disaster reduction and management systems (Ejikeme, Igbokwe, and Johnson, 2012). Quick response time plays a vital role in saving lives and reducing losses and damages during emergencies (Mahmud and Indriasari, 2009). The function of these emergency services is to protect the lives of people and their properties.

The fundamental issue in emergency services is the need for adequate preparation before a disaster occurs (Onuoha, 2012). Emergencies encompass various events such as transportation accidents, floods, home accidents, geological movements, riots, industrial accidents, fire outbreaks, and sabotage (UNEP, 2010). The provision of emergency services involves multiple essential components in rescue operations. The coordination between these components and providers directly influences the effectiveness of emergency response (Pious, 2018). According to Mahmud

and Indriasari (2009), the geographical coverage of emergency facilities is influenced by road accessibility. Response time, particularly the time it takes to reach an incident, is one of the most critical variables. The location of emergency facilities has a significant impact on response time (NFPA, 2003; 2014).

Current disaster management systems focus on the coordination of stakeholders involved in emergency response scenarios (Lamidi and Benson, 2014). Flashover, defined as the transition from a growing fire to a fully developed fire involving all combustible items in a compartment, is considered the most dangerous phase of a fire and marks the end of effective search and rescue operations in a room, potentially resulting in fatalities (Wanton, Thomas & Ohmiya, 2016). Response time consists of dispatch time, turnout time, and travel time to the emergency scene (Cigdem, 2010).

Travel time refers to the duration, in minutes, from the dispatch of the first vehicle to its arrival at the emergency scene, which is approximately 240 seconds. Therefore, the total response time is estimated at 5 minutes and 20 seconds, excluding dispatch time. Dispatch time begins when an emergency alarm is received and ends when sufficient information about the incident location is known, and applicable units (firefighters, law enforcement officials, and medical personnel) are notified (NFPA, 2003). Turnout time starts when units are notified of the incident and ends when travel time begins. According to the National Fire Protection Agency (2014), the average turnout time is approximately 80 seconds.

According to Yunus (2019), developed countries have streamlined and centralized emergency response numbers, whereas in most developing countries, these numbers are not centralized and often difficult to access due to various factors. In developing areas, contingency planning plays a crucial role in addressing the demands of incidents or disasters, serving as the foundation for government policies regarding emergency services, which are perceived to be lacking in Nigeria. While abstract plans may not fully align with specific circumstances that give rise to disasters, they serve as important starting points for emergency services (Oruonye, Anikemuah, and Ahmed, 2021). Government agencies in Nigeria are responsible for managing emergencies, encompassing not only fire-fighting but also the provision of services during and after emergencies, such as rehabilitation and recovery (Oruonye, Anikemuah, and Ahmed, 2021).

The Concept of Emergency Services

Emergency services are organizations dedicated to ensuring public health and safety by addressing various emergencies (Davis, 2015). Some agencies specialize in specific types of emergencies, while others handle ad hoc emergencies as part of their regular responsibilities. According to Williams (2019), emergency services comprise a community of highly skilled and trained personnel, along with physical and cyber resources, that provide a wide range of prevention, preparedness, response, and recovery services during both daily operations and incident responses. These services encompass geographically dispersed facilities and equipment, involving both paid and volunteer capacities, primarily organized at the federal, state, local, and territorial levels of government. Additionally, private sector resources such as industrial fire departments, private security organizations, and private emergency medical services providers are also part of the emergency services. Many of these agencies engage in community awareness and prevention programs to help the public avoid emergencies.

Primary Health Care

Primary health care is defined as "essential health care" that is universally accessible to individuals and families in communities, based on practical, scientifically sound, and socially acceptable methods and technologies, at a cost that the community and country can afford (WHO, 1978). Local government authorities own, control, and fund primary health care facilities, including dispensaries and health centers, which provide general preventive, promotive, rehabilitative, and pre-referral care as the entry point to the health care system (Adamu, 2003; Adamu and Olaniran, 2020). However, one of the main challenges in healthcare in developing nations is the mal-distribution of facilities, making it difficult for those in need to access quality and comprehensive care (WHO, 1993).

Fire Service

The fire service is an organization dedicated to preventing unwanted fires and extinguishing them to safeguard lives, property, and the environment (USA Fire Department USA, 2019). Fire service departments provide a range of services, including search and rescue, firefighting, fire prevention, disaster education, emergency response to hazardous materials, disaster response, terrorism information, wildfire prevention, suppression, swift water rescue, industrial fire and life safety, and aircraft rescue and mitigation (Agbili, 2013; USA White Paper, 2017).

Police Services

The police department's primary duty is to ensure the safety of citizens in the community and actively work to reduce crime in their jurisdiction (Jackson, 2019). They often provide support to the fire department, including backup and crowd control. During emergencies, the police coordinate traffic, communicate progress updates, and liaise with other emergency services. In public emergency situations, except those involving fire, the police are responsible for incident control, with senior police officers leading the incident response and coordination with other emergency services through the police control center (Yusuf, 2018).

METHODOLOGY

The methodology incorporates both inferential and descriptive research design. The population for this study consists of all the emergency service facilities in Ungogo Local Government, including Main Ungogo Town, Fanisau, Kadawa, Karo, Tudun-Fulani, Bacirawa, Rangaza, Rijiyar-zaki, Yadakunya, Zango, and Gayawa, totaling 45 facilities. Additionally, the population includes 150 nurses/midwives, 57 doctors, 295 police officers, and 22 firefighters. The target population specifically focuses on the heads of the emergency service facilities, such as primary healthcare centers, police stations, and fire stations, in Ungogo Local Government, Kano State, Nigeria.

To select the participants for this study, a purposive sampling technique was employed, ensuring that the heads of the functional facilities in Ungogo Local Government were included. GPS technology was utilized to record the coordinates of the existing facilities, and a checklist was used to collect data on the total number of facilities present and their responsiveness to emergencies. Based on the information presented in Table 1, one fire service facility, 37 out of 38 functional primary healthcare facilities, and 5 out of 6 functional police stations were selected as respondents for the administered questionnaires.

Table 1: Facility respondent table

Personnel	No of staffs	No of Facilities	Respondents
Fire fighters	22	1	1
Medical personnel	207	38	37
Police officers	295	6	5

RESULTS

Spatial distribution of the existing emergency service facilities

The total number of 38 primary health cares, 6 present police station and one single fire station at the various wards was revealed Starting with Rijiyar zaki with Four primary health cares, Tudunfulani, Bacirawa, Kadawa, Main Ungogo, Karo, Panisau, Gayawa, Zango and Yada having 5, 4,3,3,3,4,2,4, and 2 primary healthcares respectively. and Rangaza with the presence of 3 with primary healthcares with a single facility found closed at the ward. Zango ward, Rangaza, Ungogo, Bacirawa and Rijiyar zaki are wards with a police stations present and Rijiyar zaki as the only ward with fire station in Ungogo local government area.

Coordinates of the facilities are inserted into ArcGIS environment, to create a map to locate various facilities of the present facilities, as facilities showed clustered distribution pattern using the nearest neighbour analysis as shown in figure 2 below. A negative z score was revealed as -2.26, this indicates that the primary healthcare facilities are easily accessible by the people in the study area.

Nearest Neighbour analysis revealed a dispersed distribution pattern of distribution of the present police stations with a z score value of 1.95. which implies that the police facility is not easily accessible by the people in the area. As there is No pattern of distribution of the fire service, as a result of single fire station present in Rijiyar zaki ward.

Adequacy of the existing spatially distributed emergency service facilities and population in Ungogo local government

According to the data collected from the National Population Commission (NPC), Ungogo local government has the population of about 365,737 people during the 2006 population census which was projected to be 548,241 by 2022 according to the National population commission. Health facility ratio to standards (NAPHCDA, NFPA, WHO, and U.S standard) was used to determine the adequacy of the existing emergency service facilities and the population of the study area as results showed adequate primary healthcare according to the (37 PHC:11 Wards) NAPHCDA standard, inadequate fire station of 1:100,00 inhabitant (UNFPA, 2014) and insufficient police officers, with the total of 295 present police officers according to the U S standard i.e. 1:450 standard.

Relationship Between the Emergency Service Facilities (Police, PHC and Fire station)

Attributes on the facilities was used to identify the relationship of the three facilities based on their mode of services to relate the relationship between the multiple facilities such as years of experience, Emergency calls per day, Sources of emergency alert, Response time, Causes of late arrival, ways to cater for high population, Donations of equipment from the community, satisfaction with the functional spaces and the key functions of each emergency facility.

i. Sources of emergency calls per day:
Most of the emergency calls are received from individuals and district head according to the PHC's as shown in the bar chart below with district head having the highest frequency. While 100% of the five police stations and fire service receives emergency calls from individuals.

ii. Emergency calls per day: The police receive the highest emergency calls, 90% of the facilities revealed 10 times calls per day, 10% receive the minimum of single call per day. Out of the 37 PHC's receive the highest calls per day (7 times) with a minimum call of two calls per day according to the 15 PHC's. The fire service receives the highest call per day of 9 times calls compared to the 6 PHC's out of the 37 facilities that receive a single call per day.

iii Response time: According to the data collected from the fire service station response time of less than 4 minutes was revealed which is in contrary to the real world of one single facility to serve the local government of Ungogo. Out of the total PHC of 37 primary healthcare 15, 13,6 and 4 primary healthcare respond to emergencies within the time range of 15>20 minutes, 10>15 minutes, 20>30 minutes and 4>10 minutes respectively. Which shows lack of centralization of services between the emergency service facilities as response time vary between the fire station and Primary healthcare. The three police stations respond to emergency within the time range of 20>30 minutes which indicates poor response time

iv. Late arrival: Late information was the major factor affecting arrival time according to the emergency facilities (PHC, fire service and police), also far distance, lack of modern vehicle also affects arrival at the actual standard time according to the PHC and police station.

iv. ways to cater high population: Building more structures, procurement of modern gadget and massive employment of staffs are the ways to cater high population according to the police and Primary healthcare. Direct order to enhance performance was suggested as a means to cater high population according to the fire service.

Vi. Donation of equipment from the community: The police revealed a close relationship between the community with 90% supports donation of equipment to the police in case of an emergency. 100% support was recorded according to fire service from the community, out of which 7 out of the primary healthcare also report similar. With 31, primary is not in support of donation participation from the community.

Vii. Satisfaction with the Facility: The fire station revealed a 100% satisfaction with the present facility, 60% of the police are unsatisfied with the present functional facility while 2 out of the 5 facilities are satisfied with the present facility. Adequate satisfaction with the functional space was also revealed according to the 26 primary healthcare's presents with adequate PHC according to the 12 remaining primary health care facilities.

Viii. Key Attributes of the emergency facilities: From the table 2, below 4.33, 4.03 and 3.39 are the mean score of the Fire station, police and PHC respectively. Pearson correlation was used to correlate the facilities which indicates a positive correlation coefficient of .0667 which indicates a positive relationship exist between the facilities (PHC, fire service and police) which is not practiced in the Ungogo Local government as related emergency services.

Table 2: Mean score Table of the attributes of the emergency facilities

S/N	Mean score	Facilities
1	3.389	Primary Healthcare
2	4.03	Police
3	4.33	Fire service

Adequate distribution of emergency facilities in the study area

The 5-kilometer buffer zone standard according to the world health organization (2014) was used to delineate services rendered within the existing emergency services.

i. Primary healthcare's buffers

The 5-kilometer distance shows no area that is away from a primary health care farther than 5 kilometer (figure 1), according to the standard of 5-kilometer interval between each facility (WHO,2014).

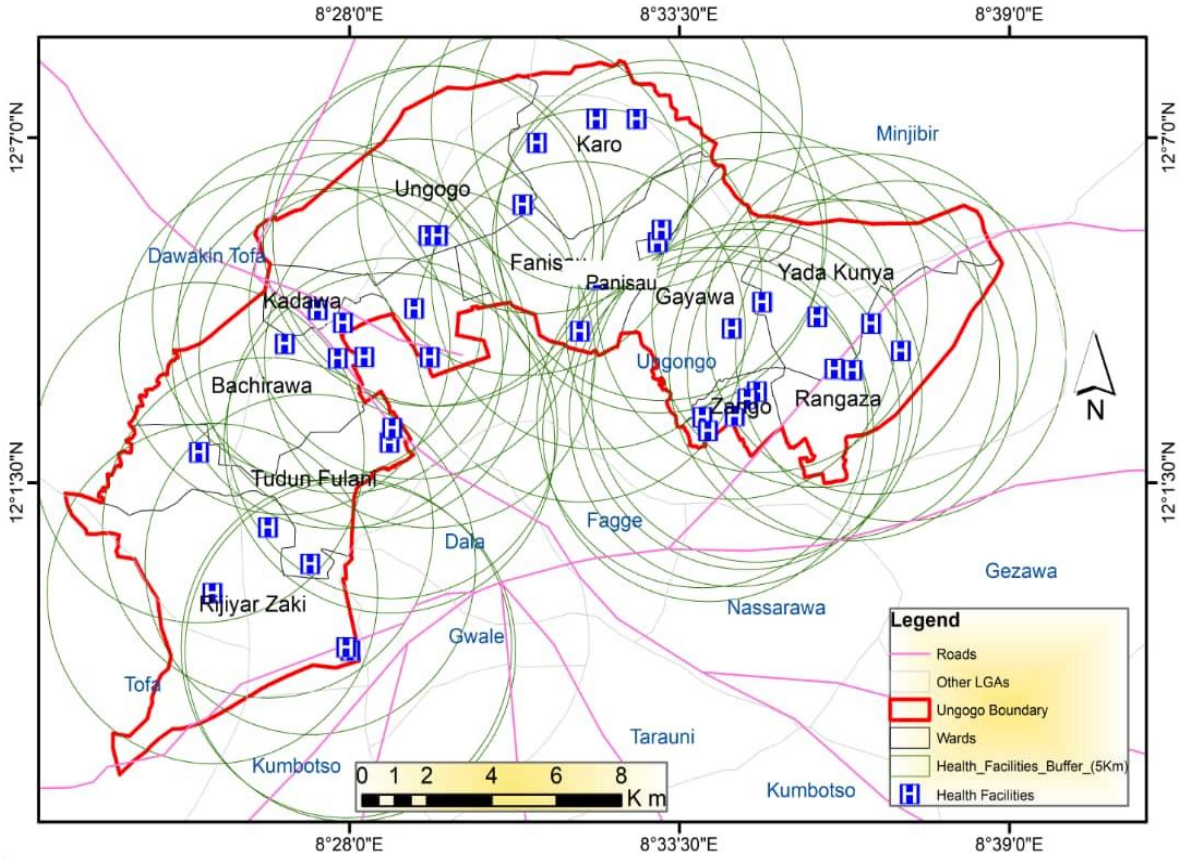

Figure 1. Primary Health Buffer

ii. Police buffers

According to figure 2, of map showing police facilities of 5kilometer buffer zones, only some parts of Rijiyar zaki, Bacirawa, Karo, panisau, Gayawa, and Yada kunya are not included in the 5 Kilometer buffer zones.

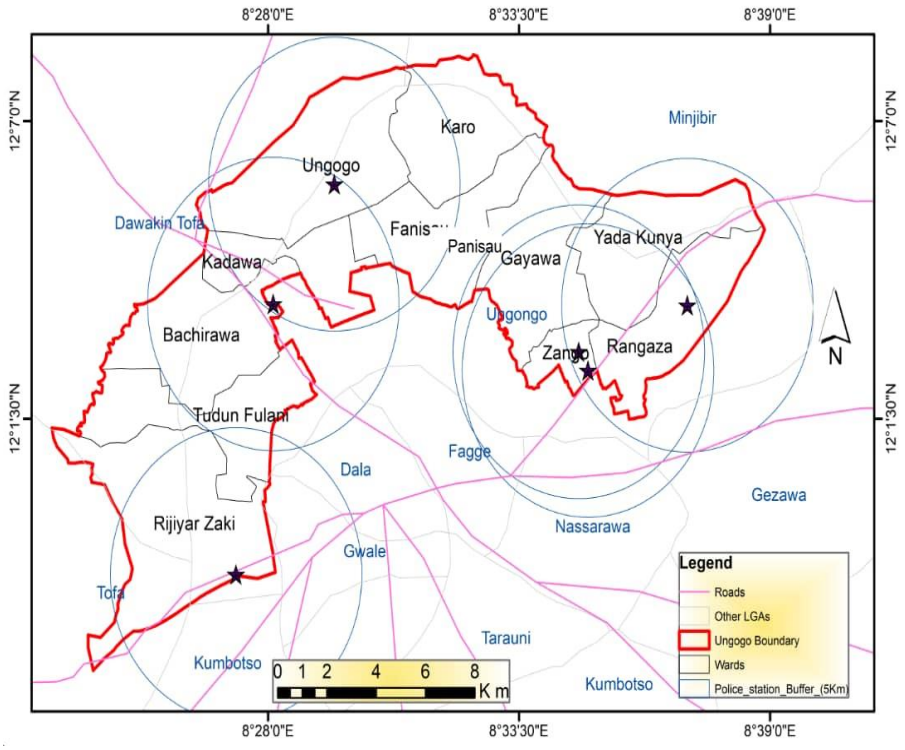

Figure 2. Police Buffer

iii. Fire service buffer

With the presence of single fire service station areas within the Ungogo local government area, fire services are only within the Rijiyar ward.

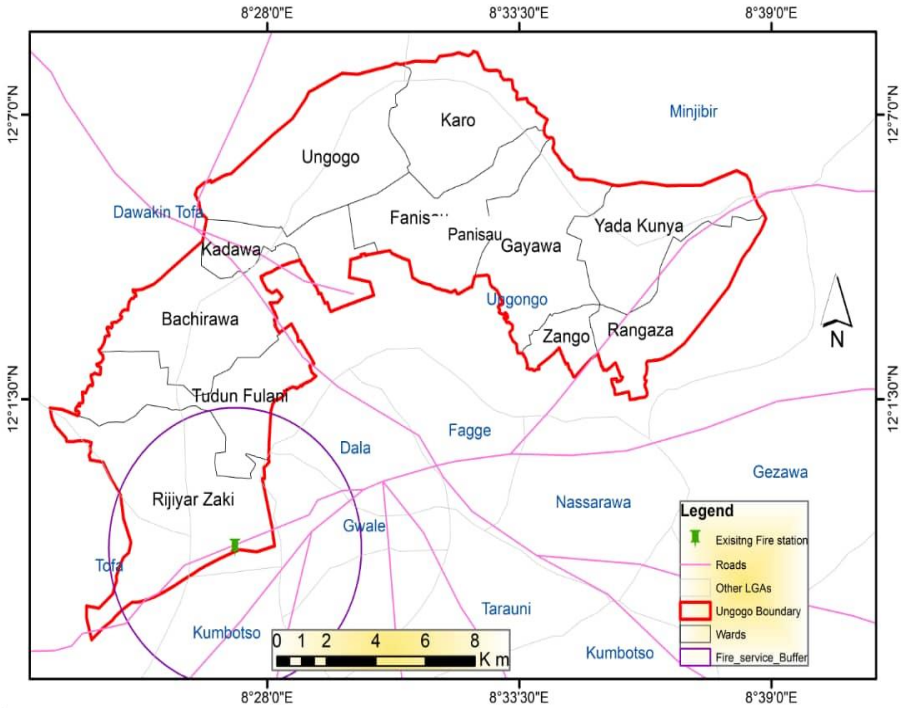

Figure 3. Fire Station Buffer

iv. Proposed Fire service station

Using the only present fire station in the sudy area, the standard of 5-kilometer distance interval was used to propose and identify optimum locations for new fire stations, which is situated at Rangaza, Karo and Bacirawa.

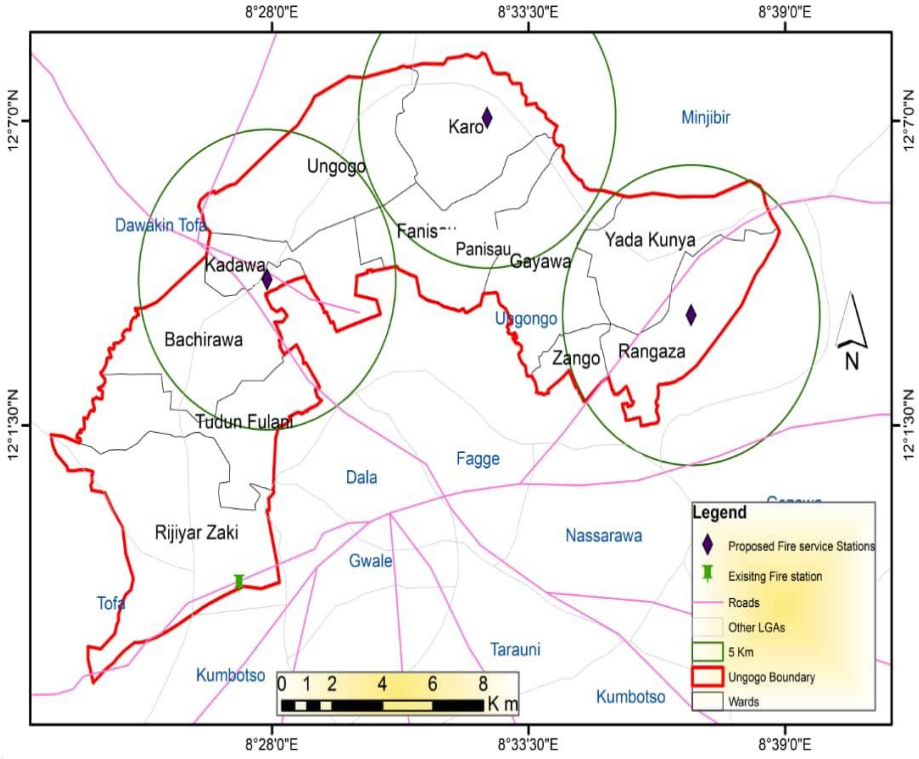

Figure 4. Proposed Fire Station

CONCLUSION

There are insufficient police facilities and police officers in the local government with a poor response time to emergencies. Inadequate fire stations was observed, Overlap rendering of services from the fire service department was used as a result of single fire service present that response time was meets. Adequate primary health cares are present in Response time in emergency service of less than four minutes is only observed to be used by the fire service emergency service, less than 15 minutes according to the police services rendered in terms of emergency, which is in accordance to the standard response time according to Federal Emergency Management (FEMA), and poor response time according to the primary health cares with a response time of less than 20 minutes. Primary health care facilities are adequately distributed using five-kilometer buffer zones to analysed areas that are covered within five-kilometer buffer zones. Some parts of Bachirawa, Rijiyar zaki, Tudun fulani, Panisau, Karo and Gayawa are observed to be away from 5km buffers according to the world health organization (Alagboso, 2015). With a Single Fire station, most of the wards in Ungogo are Underserved in terms of fire rescue emergencies.

It is recommended that the government should adhere to standards of emergencies such as World health organization, National primary health care development agency and federal emergency management agency.

Findings have shown that insufficient fire fighters, police officers and health personnel's, lack of modern facilities, far distance to facility, inadequate functional spaces as the main problem facing the study area. Government should increase the numbers of facility personnel's, building of more facility where there are insufficient to achieve a standard ratio of facilities to population ratio. This will aid in reducing the response time to its standard of less than four minutes according to National Fire Protection Agency.

References

Adamu A. M and Olaniran-A. F (2020) Technical And Vocational Education And Training (TVET) And The Problem Of Unemployment Among Youth In Nigeria

Adamu, Y.M (2003). A Geographical analysis of maternal Mortality in Kano state unpublished Ph.D thesis submitted to the department of Geography, Bayero University, and Kano.

Agbili, M.O, (2013) Fire service in Nigeria . https : // my. Firefighter nation. com/ profiles/ *blog/ fire- service-in-Nigeria*

Alagboso, C., (2015). The patient doctor ratio in Nigeria is 1 to 4000. Retrieved on 27 october 2016. From www.healthnewsng.com/the -patient- doctor-ratio-in Nigeria is 1-10-400. Green American Gematrics Society, 51(9), 1280-1286.

Aliyu A. (2015). Management disasters and complex emergencies in Africa: The challenges and constraints Ann. Afrmed. 14(3):123-131.

Cigdem, H. (2010). Spatial requirements of fire stations in urban areas: A case study of Ankara, A thesis submitted to the graduate school of natural and applied sciences of middle east technical university.

Davis, R. (2015). "The price of just a few seconds lost: People die". USA Today

Ejikeme, J.O., Igbokwe, J.I. and Johnson, N.G. (2012).Application of Geographic Information System for effective management of fire disaster in Onitsha. Nigerian Institute of surveyors technical proceedings of General meeting and conference on disaster management and global warming held at Illorin, Kwara state, June 25-29:48-55.

Ganeshkumar, B. and Ramesh D. (2010). Emergency response management and information system (ERMIS)- A GIS based software to resolve the emergency recovery challenges in Madurai Tamil Nadu. *International Journal Of Geomatics and Geosciences.*1(1).

Jackson L.L. (2019). An evaluation of the need for proximity protective clothing for Aircraft firefighting Strategic Management of Change. An applied research project submitted to the National Fire Academy as part of the Executive Fire Officer Program. Retrieved from www.usfa.fema.gov/

Lamidi, O.K and Benson, K.S. (2014), Institutional need and relevance of emergency management agency in the Nigerian Local Government System. *International Journal of politics and governance*, 5(52):1-17.

Mahmud, A.R. and Indriasari, V. (2009). Facility location model development to maximize total service area. Urban issues in Asia, pp. 87-100.

National Fire Protection Association report, (NFPA) Fire loss in the United States, 2003.

National Fire Protection Association, (NFPA), 2014.

Onuoha, F. (2012). Oil exploitation, environmental degradation and climate change: Assessing the vulnerability of the Niger Delta Environment to natural disaster. In international conference on the an the Nigerian state, oil industry and the Niger Delta Yenagoa: Niger Delta university. Pp, 25-42.

Oruonye, E.D., Anikemuah, D. and Ahmed Y.M.(2021). Challenges of emergency management in Nigeria; A case study of the federal capital territory, FCT. Federal emergency management agency (FEMA). *International Journal of World Policy and Development studies.* 7(3):35-44.

Pious, O. (2018). A framework for analyzing emergency management with an application to federal budgeting. *Public Administration Review.* 61(6): 728-40.

U.S.A White Paper, (2017). Understanding the Roles, Challenges and needs of our Nation's Fire and Emergency Services. USA Sprinkler Fitters Association.

UNEP (2010). Global assessment report of natural disasters. A publication.

USA Fire Department (2019). Cambridge University Press, (2019) Fire Department Accessed from https://dictionary.cambridge.org/dictionary/english/fire-department

Walton, W. D., Thomas, P. H., & Ohmiya, Y. (2016). *Estimating temperatures in compartment fires* (pp. 996-1023). Springer New York.

WHO (1978). Declaration of Alma Ata report of the international conference on primary health care September 612, Alma ata, USSR, Geneva Switzerland.

WHO(1993) The urban health crisis: strategies for health for all in the face of Rapid urbanization. WHO Geneva.

Williams, O. (2019). At Risk: Natural Hazards, People's Vulnerability and Disasters. Rutledge, New York.

World Health statistics (2018). Monitoring health for SDGs, sustainable development goals, Geneva: world health Organisation;2018.

Yunus S. (2019). Response delay model: Bridging the gap in urban fire disaster response system. World academy of science, engineering *and technology. International journal of humanities and social sciences,* 13(12).

Yusuf, G. (2018). Emergency management and Nigeria's national security: Examining NEMA"s role in oil pipeline disasters in South-eastern Nigeria". Ph.D proposal presented to department of political science and defence studies. Nigerian Defence Academy (NDA): Kaduna.