SPATIAL DISTRIBUTION AND UTILIZATION OF FIRE SERVICES IN BENIN METROPOLIS, EDO STATE, NIGERIA

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BENIN CITY

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RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING, FACULTY OF SOCIAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.S.C.) HONOURS DEGREE IN GEOGRAPHY AND REGIONAL PLANNING

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CERTIFICATION

This is to certify that this project research was carried out by ISAGBA ELO-OGHENE HENRIETTA, Matriculation number: SSC1708094 in the Department of Geography and regional planning, Faculty of Social Sciences, University of Benin, Benin City, Nigeria.

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DEDICATION

It is with tremendous pleasure that I dedicate this project work to God Almighty, whose love, mercy, strength, and salvation have guided me through my life and Academic pursuit to this stage irrespective of the challenges and obstacles. This work is also dedicated to my lovely and caring parents and wonderful sisters.

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The inspiration of writing this report came from many resources. However, I must first thank God for his continued strength. To Him is my unreserved gratitude and appreciation in recognition of His Bounty, his grace and Holy Spirit, granted me strength, wisdom, knowledge and understanding throughout my course of writing this project

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ABSTRACT

This study examines the spatial distribution and utilization of fire services in Benin City. The aim of this study is to examine the way fire services are spatially distributed across space, if they are evenly distributed or sparsely distributed. Are fire services in Benin City enough to cover and attend to the needs of all the people in Benin City and where the fire services are located can they reach the people on time to avoid casualties; to examine the usefulness and utilization of fire services in Benin City, are fire services efficient in the sense of executing maximum productivity when performing their duties; to examine the efficiency and availability of firefighting equipment in fire services in cases of fire outbreak, are there enough equipment to combat the fire and how useful are this equipment and to evaluate the causes of fire services in Benin City and how it should be prevented. It will also discuss the challenges faced by fire services and the solutions to resolve these challenges. A total of 409 questionnaires were administered to respondents and coordinates of fire service stations were also collected for spatial analysis. It was discovered that fire service stations in the study area are clustered. The stations were also affirmed to be understaffed and ill-equipped especially in Ovia North East Local Government Area where there is only one fire service station. It was severally suggested that the government should adequately equip fire stations as this will ensure their optimal operation. Adequate education and sensitization on fire safety was also suggested as an action plan to combat fire hazards in Benin Metropolis.

CHAPTER ONE

INTRODUCTION

1.1.Background to the Study

The primary mission of fire services in the world, especially Nigeria, is the protection of lives and properties, as well as natural resources within urban and rural settlements in the built environment. The effectiveness of these fire services depends largely on preparedness and adequate planning procedures of residents as well as authorities concerned. In order to curtail disasters and emergencies, urban safety (refers to a built environment which guarantees the safety of the population) is a key factor to ensure this. By definition, urban safety is any of those natural, architectural, social, environmental, techno genic, infrastructural and urban factors that can be used to measure the degree of safety in a particular geographical location. Basically, adverse factors forming urban safety of an area affect firstly human health. It is important to note that urban safety does not just refer to a personal state and security for the population, it is complex, usually defined by various factors and formed in a given territory of the area inhabited. Olenkov (n.d) asserts urban safety as the state in which the population feels safe, the environment is not subject to environmental hazards. Also Vilner (n.d) states that urban safety is a state in which the assets of an environments of a settlement in the urban area is safe.

NFPA 921 cited by DeHaan and Icove (2012) states that fire is “A high-speed oxidation process, which is a chemical reaction resulting in the evolution of light and heat

in varying intensities." Similarly, Babrauskas (2003) defines fire as an "unconstrained combustion". Combustion that is checked occurs in heating appliances such as a furnace, boiler, or range etc.; but in disparity, unchecked combustion does not take place in appliances designed for this purpose. According to Ezeagu & Eze (2009), Fire is an oxidation process that emits energy in different intensities in the form of light (with wavelength also outside the visual spectrum) and heat and often creates smoke. It is commonly used to describe either a fuel in a state of combustion. Investigation has shown that most fire outbreaks happen as a result of electrical problems and individual carelessness. Fire involves burning which is typically characterized by flame. It is not just the end-result of fire, it is the fire itself; without the flame's heat the fire would go out (Adams 2002). Fire is man's friend when under control but if out of control, it kills and destroys; therefore, fire is regarded as a good and bad servant and bye- product of affluence (FSW, 2011). Also, fire can be instituted both by lighting and humans, however in Nigeria, fires are mainly caused by human interference and its recurrence is rapidly increasing (Balogun & Ahmed, 2004). Fire presents a significant hazard in metropolitan region where the loss of human life and personal property can be very severe.

The density of population in the city is alarming and the growth has brought the attention of urban development agents to provide adequate and equitable services to all groups. In United State, in 2006 one person died in a fire accident approximately every 162 minutes on average, and one person was injured every 32 minutes (Karter and Stein, 2008). Every year, fire causes about 300,000 deaths globally and majority of these

usually occur in homes (Zhang et al, 2006). Fire disaster results in heavy causalities and great loss of social wealth, that is why the plan of fire service stations are significant to the city development. Fire service in an organized public service has the main goal of adverting fires from occurring and mitigating the loss of life and property that arise from fire. Providing immediate and effective response to fires is very important because emergency is a situation that poses an immediate risk to health, life, property and the environment where it is situated. Therefore, fire-fighting operatives are saddled with the responsibility to rescue, suppress fires; and conserve properties in buildings, enclosed structures, aircraft interiors, vehicles, vessels, aircraft, or like properties that are involved in an emergency situation (Jackson, 1999).

Fire outbreaks has now become a common phenomenon throughout the history of the world. The possibility of fire in urban areas has grown over the years and the rising cost of fire losses would seem to suggest that they are growing at a greater rate than the measure drawn up to control them (Thapar, 2000). Cities grow in size and complexity day by day therefore they need to be managed more efficiently. In line with the forgoing, urban fire is one of the most important problems not only for developing countries but also for developed countries (Nisanci, 2010). Notwithstanding, it is good to state that fire has been a constant companion of humans; it has been used in many ways to man's advantage even though it happens to be a threat when mismanaged. Fires in urban areas can cause significant economic, physical and psychological damage. It also causes heavy

causalities and great loss of social wealth, which have adverse effects to properties of great value and human life in its entirety.

Popoola et al. (2016) pointed those human activities such as burning, improper electrical works, high voltage electricity, in-door or outdoor explosions are some of the causes of fire disasters. Incidences of fire are not restricted to time or season. They also made mention that increase in the cases of settlement fire disaster has marked the era of urbanization. Urban centers due to congestion are prone to disaster outbreaks as a result of pressure, and nonchalant dangerous actions of residents. Fire disaster as an example of an urban disaster can be human-induced or climate driven.

1.2 Statement of Research Problem

Fire outbreaks has gained global attention in recent years in the sense that it has now become an issue to both the environment and economy (Agyekum et al., 2016). Fire service operations take place in dangerous, time-sensitive environments. A slight delay in operations, especially when the first fire apparatus is arriving and positioning, can adversely affect subsequent operations and the outcome of the incident. Following the state of fire outbreaks in Benin metropolis in recent times, authorities of the Edo State Fire Service have attributed its inability to meet most of the seeming challenges to the absence of facilities and manpower (Idris, 2012). Delays caused by poorly-located fire hydrants, confusing fire alarm system information, and ineffective communication systems, or inaccessible equipment may have had ripple effects on other aspects of the operation. The Channels Television in its website (www.channels.tv), on the 14th of

March, 2022 published a story of multi-millions worth properties destroyed at a building located on Plymouth Road in Benin City. It was reported that nine shops were affected by the fire accident. It was said by an eyewitness that the incident started when a fire from electric cables on a pole outside the building fell on the building when power was restored at the early hours of that day.

On the 23rd of October 2019, The Vanguard Newspapers Online published a story on how 'Santana Market along Sapele road in Benin City was razed by fire which destroyed a significant part of the market leaving damaged goods worth several hundreds of millions of Naira. It was reported that nothing less than fifty stalls were burnt down to rubles. Eyewitnesses said that firefighters were nowhere in sight to quench the raging inferno, and only one from the Nigerian Petroleum Development Company (NPDC) prevented the fire from entering into neighboring residences. Also, another report from the Punch Newspapers on the 22nd of June, 2020 reported how fire gut Oba Market in Ring Road, Benin City which left several goods damaged. All these and more are damaging effects of fire outbreaks in Benin City which are often associated within market environments. This is not to say it happens in market only, but due to the congestion, there could be a spark resulting from an electrical appliance which can further result in a major disaster. Till the present moment of this research, it seems the Edo State Government have not found a lasting solution to mitigate the spread of fires in the area, and also firefighting appliances are sparsely used, and the fire-fighters themselves have not woken up fully to their responsibilities.

Adama, U. J., Onuwe J. O., Ogunbode E. B., & Vivan A. L. (2018) carried out a research to critically evaluate the occurrence of fire disaster in low rise residential properties in Minna. This was to ascertain the measures put in place to mitigate the extent of loss and the level of preparedness amongst managers and occupants of residential properties against fire disaster. From findings of the study, they came to the conclusion that despite the seemingly awareness of fire and its effect, no suitable measure has been put in place to mitigate fire disasters in the area. The lack of proactive measures like the use of fire alarm, smoke detectors and fire extinguishers in residential buildings seem to be the causes of major fire disasters in residential buildings and business places of which markets are included. Therefore, if there must be any reasonable improvement and mitigation tendencies towards fire disasters in Benin City, the function of the fire service must be reconditioned for successful service delivery.

The bothering questions to be answered is how fire services are spatially distributed; are they enough, are they positioned in places to with alacrity, attend to fire crisis in Edo State, particularly Benin City? Are fire services being utilized effectively for the purpose for which it was designed? What exactly are the reasons for fire outbreaks in Benin City? Are they challenges faced by the Edo State Fire Service that need to be addressed? All these and more accumulates to what this research must have addressed on completion.

1.3 Research Questions

In order to actualize the desired objectives, the following research questions were raised:

i. How are fire services spatially distributed across Benin City?

ii. How are fire services utilized in Benin City?

iii. What are the causes, prevention and mitigation of fire outbreaks in Benin City?

iv. What are the challenges faced by fire services in Benin City?

v. What are the recommendations to be made?

1.4 Aims and Objectives

The major aim of this study is to determine fire services operations, as well as its utilization in Benin metropolis. In line with the research topic, and a bid to actualize the goal of this research endeavor, the specific objectives therefore are to:

i. Examine the spatial distribution of fire services in Benin City.

ii. Examine the utilization of fire services in Benin City.

iii. Find out the causes, as well as ways to prevent and mitigate fire outbreaks in Benin City.

iv. Evaluate the challenges faced by fire services in Benin City.

v. Make appropriate recommendations.

1.5 Hypothesis

H_0: The spatial distribution of fire services across space in Benin metropolis is random.

1.6 Significance of Study

The public interest is served by reducing fires. Urban fires are economic “bad” because they carry a negative price, and the prevention and removal of such “bad” including fires, noise, crime, dead leaves in autumn, smog, and negative externalities in general create profitable opportunities for progressive (market) or regressive (governmental) entrepreneurs (Cobin, 2009). Jinke, Jean-Philippe, Richard, & Jiping Zhu (2021) asserts that designing efficient urban fire service systems is of crucial importance as prompt responses to emergencies and accidents can drastically reduce property loss and the rate of mortality. To achieve these goals, holistic location-allocation models for cooperative fire services must consider multiple factors, such as fire station size, vehicle quantity, vehicle type, response time, service reliability, and traffic condition. The fire stations in Benin metropolis cannot adequately and effectively render its service of protection, prevention and saving of lives and properties within Benin City. The relevance and significance of this study on spatial distribution of fire services in Benin City is to make known the roles the state government and that of the fire-fighters need to play in order to minimize and prevent loss of life and property caused by fire outbreak.

To investigate the cause of fire incidence and provide recommendations to forestall future occurrences, and as well promote fire prevention and basic firefighting mechanisms in homes, markets, schools, industries, corporate organizations and the hospitality industry, there need to be a symbiotic interaction between the Edo State government and the Benin City Fire Service Station (Ibrahim & Faisal, 1990). This

research aims to build on empirical evidence from past works to provide a comprehensive study of fire services particularly in Benin City being that fire and rescue services are fundamental to the safety of humans, property, and the natural environment. Efficient fire prevention and protection can significantly mitigate the loss of lives and reduce economic damage.

This study would therefore be of significance to home dwellers, corporate organizations, the Edo State Government, Edo State Fire Service, and the society at large.

1.7 Scope of Study

The fire service department in Edo State is incorporated into the Federal Fire Service. Also, there are other public owned fire service department across Benin City like the one located in the University of Benin, Ugbowo Campus, Benin City, Nigeria. This study would focus mainly on the spatial distribution of fire services, including the Federal fire service department, Edo State and others, as well as the utilization of fire services in Benin City, Edo State's Capital. Edo State is divided into eighteen (18) local government areas (LGAs). For the purpose of this study, only four (4) local government areas in Benin metropolis would be covered which are; Oredo, Egor, Ikpoba-Okha and Ovia North East Local Governments.

On this platform, the researcher intends to make use of the cross-sectional study pattern for this research.

1.8 . Study Area

Benin City is the capital and largest city of Edo State in Southern Nigeria. It is the fourth largest city in Nigeria after Lagos, Kano and Ibadan. It has a total area of 1,204km2. Benin City formerly known as the Kingdom of Benin, or the Benin Empire was a kingdom in what is now in South Western Nigeria. It is regarded as one of the oldest and most developed states in the coastal hinterland of West Africa (Wikipedia.com). Benin City (formerly Edo) sprang up by around 1000, in a forest that could be easily defended. The dense vegetation and narrow paths made the city easy to defend against attacks. The rainforest, which Benin City was situated in, help in the development of the city because of its vast resources – fish from rivers and creeks, animals to hunt, leaves for roofing, plants for medicine, ivory for carving and trading and wood for boat building – that could be exploited.

It is also good to mention that the study area in the ancient times have been recognized by Westerners since around 1500 when the Portuguese explorer, Duarte Pacheco Pereira described the walls of the city. But a very prominent description of the Benin Kingdom was given around 1600 when a Dutch explorer, Dierick Ruiters gave Pereira's account of the walls stating that the city is about a league long from gate to gate, and that it has no wall but surrounded by a large moat, very wide and deep, which suffices for its defense.

Talking about the study area, it is very necessary to briefly talk about how Benin City gained global attention. This started when the Portuguese visited Benin City around

1485. The city grew rich during the 16th and 17th centuries due to trade within Southern Nigeria, as well as through trade with the Europeans, mostly in pepper and ivory. In the early 16th century, the Oba sent an ambassador to Lisbon, and the King of Portugal sent Christian missionaries to Benin. Some residents of Benin could still speak pidgin Portuguese in the late 19th century. Many Portuguese loan words can still be found today in the languages of the area. A Portuguese captain described the city in 1691 which reads: "Great Benin, where the king resides, is larger than Lisbon, all the streets run straight and as far as the eye can see. The houses are large, especially that of the king, which is richly decorated and has fine columns. The city is wealthy and industrious. It is so well governed that theft is unknown and the people live in such security that they have no doors to their houses".

The map of the study area is presented below in Figure 1.1 and 1.2.

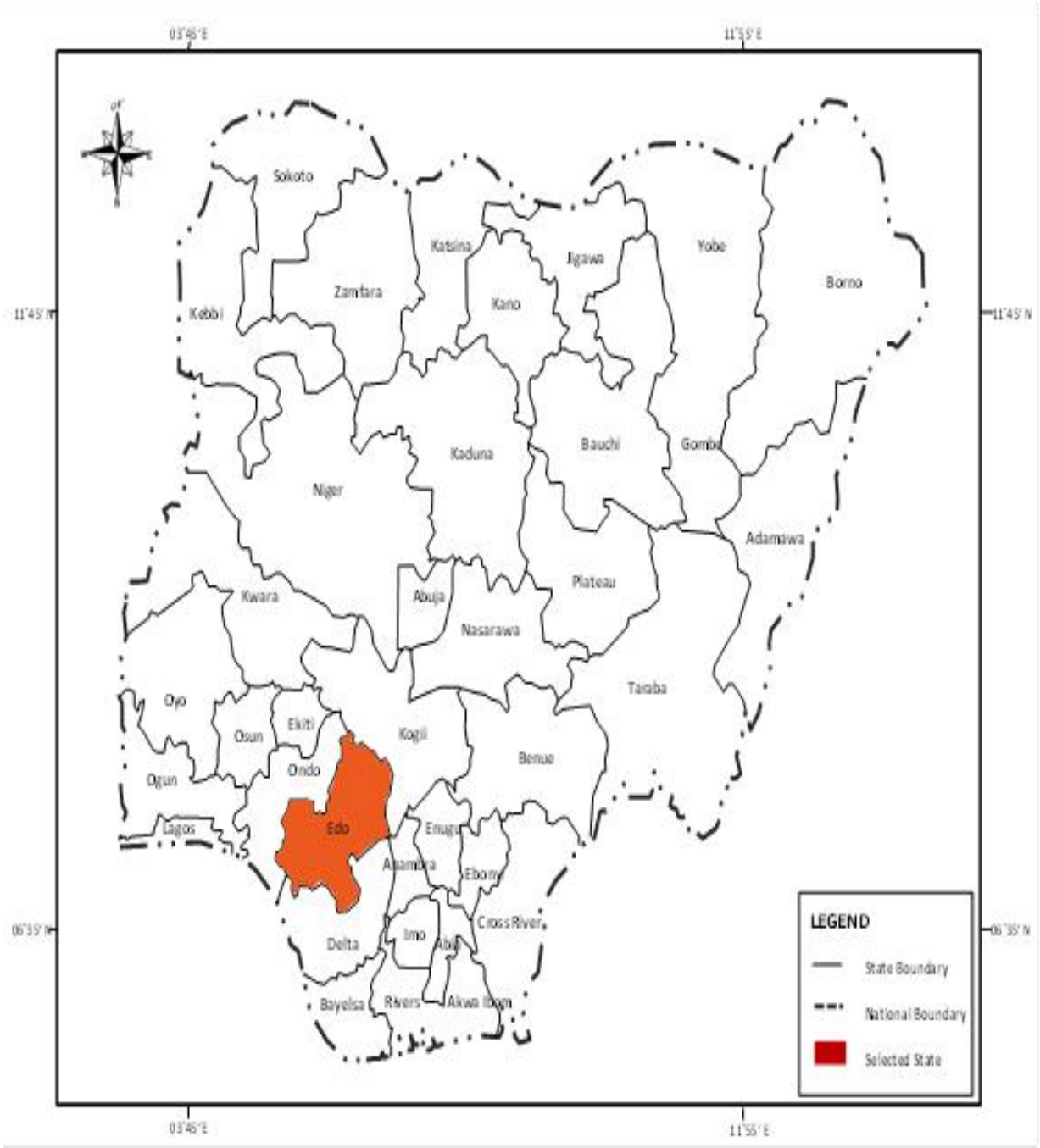

Fig. 1.1: Map of Nigeria showing the Edo State

Source: Google Map reconstructed by Author, 2022.

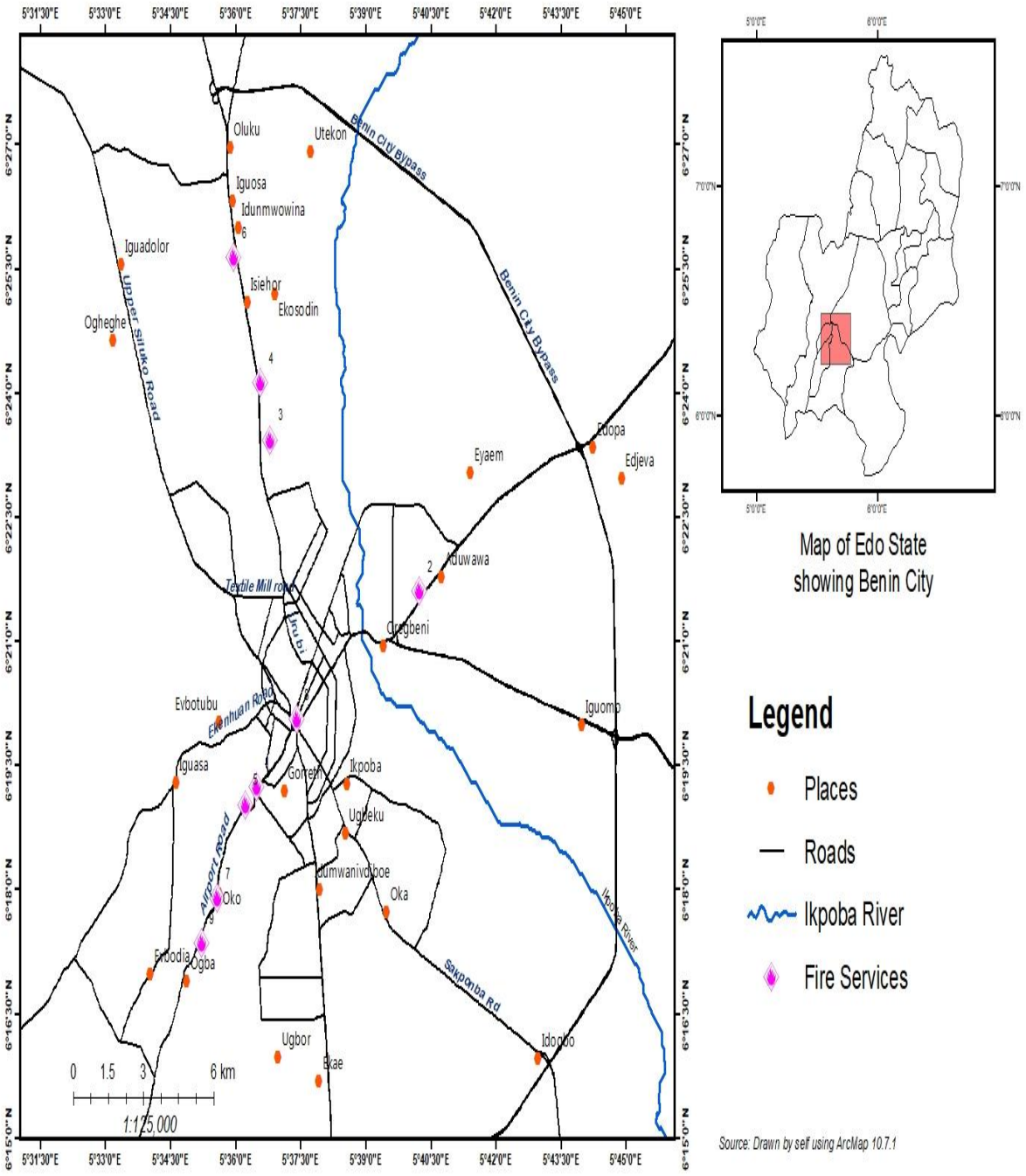

Fig 1.2: Map of Benin City showing the Local Governments and the Areas of Study

Source: Google Map reconstructed by Author, 2022.

1.8.1 Location

It is located between latitude 6.3350°N and longitude 5.6037°E. It is located in the Southern part of Nigeria. It is situated approximately in 40km North of Benin River and 320km by road East of Lagos.

1.8.2 Population

The historical importance of Benin City and its easy access to other parts of the country led to the increase of its population but compared to other large cities in the country, the rate and growth of population is not impressive. In 1950 it had a population of 49,148. As at 2015, it had a total population of 1,495,800, as at 2021, it has an estimate population of 1,782,000, Benin City has grown by 54,830 since 2015, which is a 3.17 percent change. These population estimates are gotten from the UN world urbanization prospects.

1.8.3 Historical Importance

Benin City is a famous ancient town dating as far back as the 10^{th} century A.D, it was the seat of government of one of the most ancient and powerful West African kingdoms. Benin City has a unique political system that is centered around the Oba. It was the most important city of the Edo kingdom, it flourished from 13^{th} to 19^{th} century. It had important trade relations with Portugal during the last centuries before being razed by a British punitive in 1897. The people of Benin City speak Edo language. They have one of the richest dress cultures of the African continent. They are known for subsistence farming of yam and cassava.

1.8.4 Socio-Economic Activities

Benin City is not particularly known for industries, although it has the infrastructures and things to facilitate industrialization like lands, good transportation facilities and skilled labour. This could be as a result from the rate at which they are moving from primary processing industries to major manufacturing establishments. In its early history, Benin had big rubber processing factories and timber sawmills. The economy of Benin still remains quite underdeveloped and is still dependent on subsistence agriculture and cotton. Cotton accounts for about approximately forty percent of Benin's GDP and approximately about eighty percent of official export receipts. There is also the production of textiles, palm produce, and cocoa beans. Maize (corn), beans, rice, peanuts, cashews, pineapples, cassava, yams, and other various tubers are grown for local subsistence agriculture. Benin began producing a reasonable quantity of offshore oil in October 1982. In recent years' production ceased but recently exploration of new sites is ongoing. About seventy percent of the working population in Benin City still depends on agriculture. Since the mid-1980s Benin has produced yams, cassava, corn (maize), millet, beans, and rice to achieve self-sufficiency in staple foods. Among cash crops, the previous predominant palm product output reduced considerably in the 1980s, but cotton output was on the rise.

1.8.5 Fire Services in Edo State

Nigeria was a British colony until achieving independence in 1960, and its initial fire safety services and some rudimentary building regulation began under the British rule. First, the Federal Fire Service started in 1901, initially in joint operation with the Police but attaining independence in 1963. There are several private and public fire services not owned by the government, but it is official that the Edo State Government has just one fire service station located in Benin City which is located at the Ministry of Transport, Ewaise Road, Oredo.

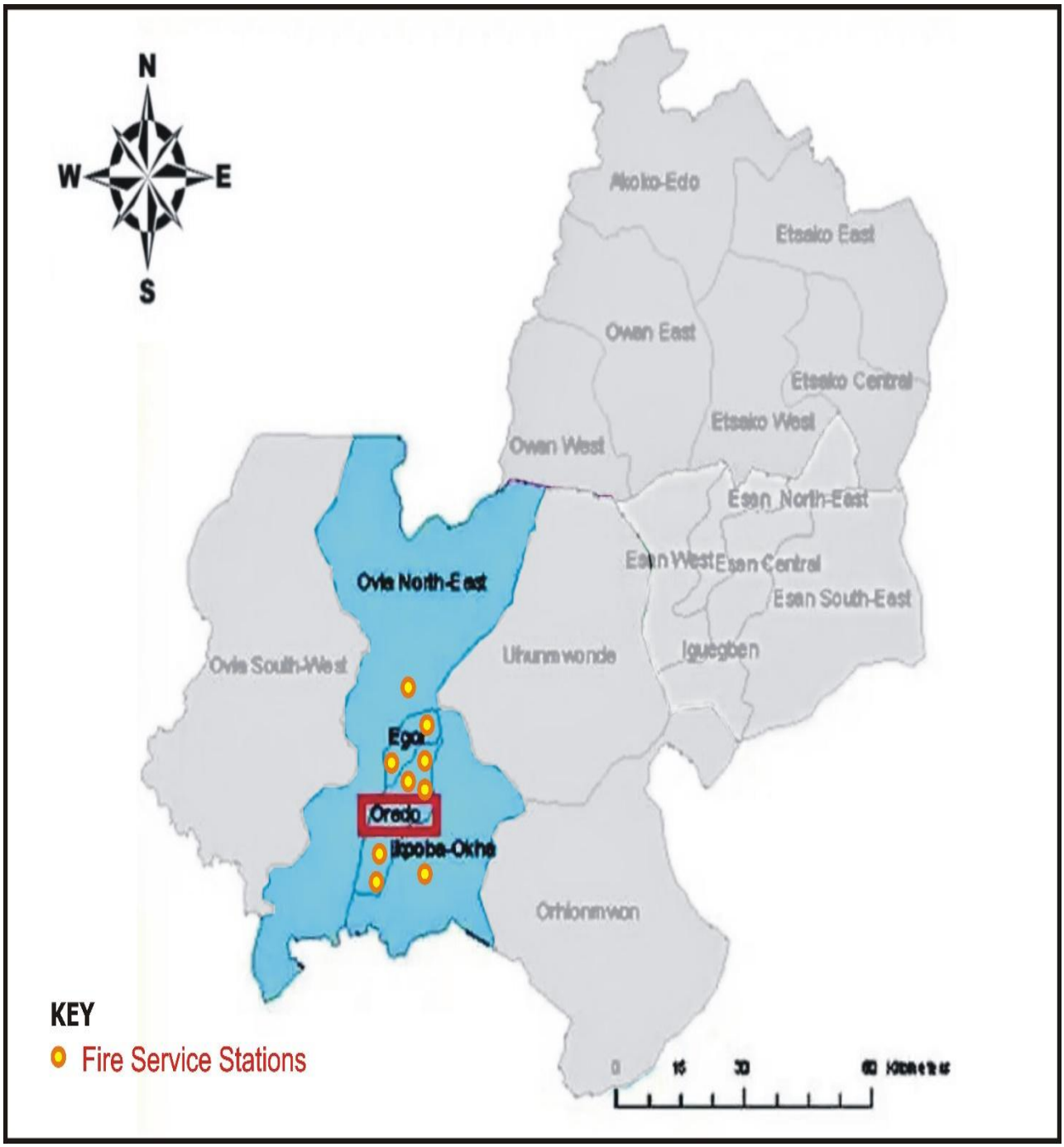

Fig 1.3: Distribution of Fire Services in Edo State
Source: Google Map reconstructed by Author, 2022.

CHAPTER TWO

DEFINITION OF TERMS, THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Introduction

Fire safety studies have been carried out by several researchers. This chapter presents studies that have been carried out previously by other authors and reviews from literatures, and how it is related to this study. This knowledge therefore is vital especially to the general public;

2.1 Definition of Terms

2.1.1 Fire

According to Ezeagu & Eze (2009), Fire is an oxidation process that releases energy in varying intensities in the form of light (with wavelength also outside the visual spectrum) and heat and often creates smoke. It is commonly used to describe either a fuel in a state of combustion. Investigation has shown that most fire outbreaks happen as a result of electrical problems and individual carelessness.

2.1.2 Fire Load

Fire load is a stem used to describe how much combustible materials is contained in a building and usually applies to the building contents. If the fire load is minimized then fire impact will be reduced. It is the fire load and how it is arranged (e.g. furniture layout) or in the case of a storage area, how the combustible goods are stored which

determines the rate of fire growth and hence, the rate of heat release from the burning materials. (Isiwele, Adamolekun & Akhimien, 2017).

2.1.3 Fire Pump

Fire pumps are instruments used in water distribution systems and at buildings or complexes to boost the water pressure to sprinkler and standpipe systems. The latter is necessary when the system is fed by an atmospheric (non-pressurized) water tank or when the water supply feeding the system has inadequate pressure. A fire pump may be driven by an electric motor, diesel engine, or steam turbine (OSHA, 2015).

2.1.4 Fire Flow

Fire flow is "the rate and amount of water the fire service needs to manually extinguish anticipated fires. The fire flow must be available in excess of that required for other purposes such as industrial, commercial, and domestic water demands" (OSHA, 2015).

2.1.5 Fire-fighter

A person whose job is to put out fires: Firefighter is a person who provides response in fire emergency with fire tenders along with all necessary equipment especially Self Contained Breathing Apparatus (SCBA) to enter in building, perform rescue activities and put off fire. The firefighter is tasked with the responsibility of putting out fires and also mitigating the harm it could bring to individuals, (Toups & Kerne, 2007)

2.1.6 Firefighting Systems

Firefighting systems are those which influence in the fire growth process. Such systems can be used by trained occupants or attending firefighters and include a fire extinguisher, fire hose reel, or fire hydrant. Other systems may be automatic such as a fire sprinkler system. (Isiwele, Adamolekun & Akhimien, 2017).

2.1.7 Fire Safety Training

All employees should be given fire safety training by a person who is competent in the subject and who understands effective training methods. If relevant expertise is not available within the organization, an independent expert – for example from the fire brigade should be engaged to provide training. (Isiwele, Adamolekun & Akhimien, 2017).

2.2 Theoretical Framework

2.2.1 The Central Place theory

The Central place theory is a collection of loosely related, informal, descriptive models of city size, city location, and market area based on the trade between increasing returns to scale in production and the cost of transport of goods from market to home. Land markets are often absent. At its core, central place theory is an empirically motivated description of production in Southern Germany. It is a remarkable empirical regularity in search of a formal theory; a better name would be central place regularity. (Berliant, 2014).

The central place theory was propagated by Walter Christaller in 1933. This work however was published in German. He introduced his discussions with the question, “Are

there laws which determine the size, number and distribution of central places?" He believed that there were such laws to be discovered and that logic could be he believed that there was a connection between the size, number and distributions thus paving way for them to be weaved together into a theory. This theory, in turn, could be tested and verified with observations on the urban settlement pattern of the Southern Germany of his time. The cornerstone of Christaller's theory was the idea of a functional interdependence between a town and the surrounding rural area. This was by no means an innovation in the fields of settlement studies and rural sociology, as has been noted already, but Christaller formalized the notion in a decidedly new way. Upon the basic premise that "the chief profession, or chief characteristic, of a town is to be the center of a region" (Baskin, 1966, p. 116), he constructed a completely new framework for the study of settlement geography. Christaller did not ignore the fact that in contrast to central places per se, there exist various other types of settlements-for example, the "pointy bounded places" such as agricultural villages, or the "really bounded places" which include mining towns, bridge and fortress towns, harbors and ports, border and custom towns but these other places were disregarded in his discussion.

The focal point of Christaller's attention was the central place with its central goods and services. Christaller believed that each central place, or city, exists to serve a specific function or purpose. In the development of any theory of the real world it is always necessary to make certain limiting assumptions in order to be able to focus on those features that are of interest. Thus, for example, in attempting to develop a theory of

central places that emphasizes the economic interrelationships between them and the rural areas, it would be inappropriate to include such features as the importance of a defensible site or the existence of mineral springs thought to have healing powers as the reasons for the locations of particular towns. These factors might be important in other discussions, but they were irrelevant to the development of Christaller's theory and were ruled out by a number of his assumptions. This research will build upon Sanli and Al-Tamimi (1990) use of central place model in the study of location and allocation model in the metropolitan areas.

The relevance of the central place theory cannot be overemphasized in modern-day theories and laws as it enables authorities concerned to factor areas which are backward in development perhaps correcting regional lopsidedness, thereby reducing the disparity in different locale. Factoring the central place theory into this research, it can allow us to pinpoint areas devoid of the presence of fire services and thus correct. For example, in Benin City, it is obvious from the Map in Chapter 1, Section 1.8.5 that there is one fire service station located in Oredo Local Government Area. The Central Place Theory emphasizes that for every region, city, or locality, there should be a central location for the distribution of goods and services. The Fire Department is a service to the people and therefore, there should be equal distribution of central places that are interdependent in Benin City; that is a central place for operation in Oredo Local Government Area, another one centrally located in Ikpoba-Okha Local Government Area, then another one centrally located in Ovia North East Local Government Area, then

another to be centrally located in Egor Local Government Area; then other Local Government Areas in Edo State. With that, the spate of fire outbreaks in Edo State would be reduced to the barest minimum. Therefore, cognizance will be given to the size of each local government areas, their population and their level of connectivity.

In summary, the Central Place Theory is an attempt to explain the spatial arrangement, size and number of settlements, as well as the goods and services distribution within these settlements. Christaller emphasized that central places should be arranged according to the traffic principle, the more goods and settlements at a given point (p), the more services to be centrally located at such points. For example, in Benin City, places where traffic are recorded the most are in market places like Santana market along Benin-Sapele Road; Uselu market along Benin-Lagos Road in Egor Local Government, Oba market and other markets in the Benin City and Edo State.

The theory consists of two basic concepts: threshold (the minimum population that is required to bring about the provision of certain good or services) and range of good or services (the average maximum distance people will travel to purchase goods and services). There should be a specific procedure to follow in the positioning of fire services in any given geographical region or area, and as well a defined route where residents and in-dwellers can access such the services rendered by the fire department when the need arises. When a population exceeds the threshold for a given service (e.g. the fire service), there is bound to be disaster for which would take time before it would be attended to. And also, when the distance to access such services is too distant from the

people, there tends to be problems as well. The fire services therefore should have a small range, the distance of fire services to the people should not be too much.

2.2.2 Industrial Location Theory

The industrial location theory was postulated by Alfred Weber in 1909 and it's often classified as one of the building blocks for modern location theories. This theory focuses cost minimization through adequate location of an industry. In this case, the industry will be the fire service.

Weber's Theory of Industrial Location

Alfred Weber, a German economist was the first who gave scientific exposition to the theory of location and thus filled a theoretical gap created by classical economists. He propounded his famous industrial location theory in 1909 which was published in German language, book entitled 'Uber den standart der Industrien'. The theory was translated into English language which was published as 'The Theory of the Location of Industries' in 1929. Since then, the work on industrial location has been critically reviewed and highly commended. His theory, which is also known as 'Pure Theory' and 'Least Cost Theory' has analytical approach to the problem. The basis of his theory is the study of general factors which pull an industry towards different geographical regions. It is thus deductive in approach. In his theory, he has taken into consideration factors that decide the actual setting up of an industry in a particular area. Gorter and Nijkamp (2002) states that in line with Alfred Webers theory, industries will align themselves to areas

with more potential. This therefore is to say location of industries is also dependent responses and adjustments to the market demand.

Weber (2020) draws inspiration from Alfred Weber's theory and posits that there are three kinds of location decisions. The first is the decision to build or buy a new establishment. Location theory has traditionally concentrated on this type of decision. Second, the firm can reorganize production, by altering the products produced at its various establishments or by closing some factories and concentrating production at others. The third decision is the decision to close down an establishment to reduce capacity. Often, but not always, this decision is involuntary, being forced by bankruptcy. The industrial location theory has become an important concept to consider. In relating the theory to this research, an ideal location which will of course minimize the cost of operations and services is emphasized.

Relevance of Weber's Theory & Assumptions to this Present Study

Like other deductive theories, Weber offered certain assumptions which was used to analyze different cost minimizing factors and processes and their impact on industrial location. The researcher would only bring out and link Weber's assumptions that are closely-related to this study. They include:

(a) The area is typically uniform or isotropic in form of terrain or relief, climate, soils, economic system, technology and distribution of population. In relation to this this study. Citing a fire service in a given location (x) must be cited in a location with good motorable roads easy to ply, not a marshy or swampy area. It

terms of technology, it must be a place with good network connectivity where fire-fighting officials can receive calls from troubled residents without break in network connectivity. Also, it must be cited in a place where residents are, not an isolated location where it would take a long time before they can reach residents in emergency spots.

(b) Raw materials are not evenly distributed in space, but a few known and fixed locations which are available at equal transportation cost throughout. This simplistically means that fire services should be positioned in places where they can access their raw materials. The major raw materials for fire services is water. So therefore, they should be positioned in places like a riverine area within the city.

(c) Transportation route is the shortest distance to destination. In relation to this study, a fire service hub should be very close to the people having a defined route with the shortest distance possible.

(d) Each commodity has uniform demand and price and where there is perfect market competition. Bringing this to this study, a fire service should be cited in places where there is likely to be fire outbreaks (like places that have previously experienced fire disasters before, e.g., markets and business places in Benin City). There would certainly be 'high demand' from those locations, i.e., emergency callers who would be calling from time to time.

This again can be related to this present study where fire services operations will be cited in areas where cost is minimal mainly in transportation amongst others and also where demand (service) is high.

2.3 Literature Review

According to Habibi et al (2008), the main criteria for fire station location are "distance among the stations, level of fire risk in the different parts of a city, accessibility, the coverage area, population, and the size of plot and the directions of city expansion". The researchers based their studies on the pre-existing fire stations, they ascertained that the demand begins with an examination of the effectiveness for each of these fire stations, either by using time or distance limits as a criteria. Benin City has been experiencing a population growth, since the creation of the state in 1991. There has been steady growth in various land uses such as the residential, commercial, industrial and institutional land uses invariably leading to urban sprawl and expansion. The simultaneous increase in population and settlement expansion of the town has a direct effect on the increase in emergencies.

Deng, Li, And Dou (2008) posits urban fire station lay outing and planning is a vital element in the planning of urban fire protection. The researchers states that an urban fire station layout planning should include selection of the location of fire station and the division of fire station responsibility area, based on scientific and reasonable spatial analysis. According to the Revised Standards of the Urban Fire Station, a fire station should be set up in line with factors like the hazardous nature of fire in the responsibility

area, key companies and organizations, population density, building condition, road traffic, water source, topography and so on.

In accounting for the spatial distribution of fire services, Habibi, Lotfi and Koohsari (2008) asserts that an integral Analytical Hierarchy Process model and index overlay logic in GIS be used to present a model for fire station location planning. A comprehensive GIS-based fire stations location study can be the central component for a master plan for the station locations. This will show both the advantages and disadvantages of the locational accessibility of current fire stations and time taken for a specified travel time therefore providing a model for future fire station allocation. More recently, Corcoran et al. (2007) apply spatial analysis methods to investigate spatial dynamics and patterns of fire occurrences in South Wales. In a further research, Corcoran et al. (2007) apply spatio-temporal methods to understand the interaction between four principal fire incident categories, namely property, vehicle, secondary fires, and malicious false alarms. They employ simple line and circular plots for different periods of time (i.e., hourly, daily, and monthly) to investigate temporal patterns; cumulative sum technique coupled with the kernel density method to investigate spatial patterns; the co-map technique which illustrates the entire time period under study in a single visualization for the interaction of space and time. Asgary et al. (2010) opines that although there is extensive research in fire and disaster management, cognizance has not been really paid with regards to the spatial, temporal, and spatio-temporal data analysis techniques into fire clustering.

According to Mahmud and Indriasari (2009), the shape of total service area covered by emergency facilities such as fire stations is influenced by the road accessibility. The results reveals that coverage could be improved by providing better locations for fire stations even if the number of fire stations and their travel times are same as the existing situation. According to Enviro-lssues and Juan (2008), the new fire station is expected to maintain or improve current service levels and response times for the primary response area and maintain or improve response times, system-wide.

Fire services has been unable to meet the safety and protect need of the local community in Nigeria (Human Right Watch, 2005). In the same vein, Nigerian fire fighters are not particularly effective in fighting fire. Fire services in Nigeria are not well equipped with modern and automated information system. This is one of the basic problems militating against the effective and prevention, detection and control of fire. Many variables, including staffing, training and equipment, are considered in determining whether coverage is adequate (NFPA, 2010) and highlighting where and when specific future emergency will take place. One of the most crucial variables is response time, specifically the time it takes to get from the fire station to the fire incidence point (NFPA, 2010). Ideally, officials would place a fully staffed and equipped fire station on every corner. However this is mostly impossible because of limited resources, so there is a need to assess and address inadequacies in fire coverage with available resources. In addition to average travel time, obtained by measuring travel times between fire stations and actual incidents, travel times between fire stations and potential fire hazard areas (such as

hospitals, schools, chemical plants, homes, and high rise buildings), are important as measures of fire department performance and in deployment analysis

Michael, Karter, & Molis (2013) examines the dangers of Firefighting as firefighters are exposed to hazards at incident site. Firefighting profession is highly technical, structured and supplied with various artifacts, which help to decide actions in unpredictable and complex situation.(NFPA, 2010) notes that in Nigeria, the role of the knowledge of geography is clearly under estimated in the fire service, and which is to considerable extent responsible for the inability of the fire fighters to prevent and control the alarming increase of fire and other emergencies in the society It was established that a large proportion of the men in the fire service can hardly ascertain the areas under the jurisdiction of their stations or define the shortest route from their stations to be specific.

In modern times, Fire service operations come across a lot of significant problems, for which the adequate and appropriate solutions need to be suggested. Furthermore, experts must provide answers to the questions of the structure, activities and the overall management as well as improvement of fire service operations and rescue, by which natural indicators and practical experiences are of utmost importance. (Mlađan, Subošić, and Jakovljević, 2012). The researchers went further to posits some vital questions necessary for the smooth running and operations of fire service such as “What type and level of forces required for adequate safety of different types of local and community groups?, what strengths and resources necessary to provide basic fire and rescue services to the community, the indicators and characteristics are adequate, can a professional and

volunteer firefighters composition-rescuers, working together organized and productive amongst others". Fire service operations seem to have a correlation with certain residential characteristics. Research has proven that older houses are often linked with fire injuries (Shai & Lupinacci, 2003). The researchers asserts that older houses, which were built when there was less demand for electricity and having fewer original electrical outlets will have to make up for it by using extension cord and when these extension cords are overloaded, the tendency to result to a fire is more. Kerber (2013) also draws a correlational study where he analyses change in residential fire environment over the past decades and its impact on firefighting. Kerber (2013) states that "larger homes, open geometries, increased fuel load and new building materials can result in faster fire propagation."

Adekunle, Umanah, Ibe and Rukewe (2015) presented statistical evidence that there is limited fire management capacity in public buildings, as far as public awareness and availability of means and facilities are concerned. It was observed that majority of fatal fires among other building categories occur in homes. Also, three-quarters fatal home fires start in the living room, bedroom or kitchen. Beds, followed by sofas are the most common object of origin in most fatal home fires. A significant number of buildings considered were not protected by smoke detectors. Most common causes of fire outbreak in public buildings are arson and technical fault while that of homes is technical fault. Jimoh (2012) in a study in collaboration with the Federal and State Fire Service attributed the occurrence of fire disasters in the country ranging from accidents and

carelessness, wrong wiring, illogical use of electrical appliances and heating gadgets, unattended stoves and gas cookers. This research he undertook taking cognizance of the six geopolitical zones of Nigeria.

Fire service operations are heavily dependent on the availability of equipment thus; fire fighters must hand carry all equipment beyond the point where access for apparatus ends. It is important to note that increased distances and steeply sloped terrain result in additional time and effort to set fire service equipment and thus can lead to time wasting which will impact the operations of search, rescue, and mitigation tactics. Therefore when places are easier to access, fire services are able to work seamlessly (OSHA, 2015). Also, Obstructions and hazards that are often found around buildings that may hinder fire service operation especially fences. The building features may also present itself as a clog in fire service operations.

While a lot has been said about fire service operations, it must been be noted that the fire tenders require the necessary tools such as fire hoses, nozzles, fireman axes, fire hook, fire breaching Inlet and outlet, extinguishing agent like water and Aqueous film forming foam (AFFF), personal protective equipment, communication equipment, specific vehicles for search and rescue operations. Diverse contributions must be geared towards the overall running of firefighting. (Rawalpindi Development Authority Building and Zoning Regulations, 2007). To buttress the above, Johanssson and Svesson (2018) inferred that the work of the fire service has undergone a massive change resulting in

complexities from an essentially minute or small scale service to large scale service comprising of a variety of activities in order to increase fire safety in the society.

Assumptions for Positioning of Fire Services in Benin City: The Researcher's View

In Benin City for example, fire services are being overused. Citing the Fire Service Stations in Ovia North East Local Government with a population of over a million people negates Christaller's Hexagonal Structure of placement and arrangement of settlements in line with goods and services to be rendered. It is surprising to know that the Fire Service Station positioned in Ovia North East Local Government is not even for the Federal or State Governments, rather it is one supposed to be for the University of Benin which is to supply services to the University of Benin axis alone.

The way it is supposed to be, each local government should have its own fire service base centrally located in their respective areas; a central administrative office and sub-locations where fire trucks would be stationed to address emergency situations. Also, there should be clearly defined pathways designed specially as access routes to disaster locations where fire trucks can thread. Without clearly defined access routes for fire services in Benin City, there would be delays in rendering assistance to residents when the need arises. The distance of one fire service to another shouldn't be far apart, i.e., it should be equidistant from one another. This is so because one might need the assistance and support of another to attend to disasters. This is summarized in Fig 1.4 below;

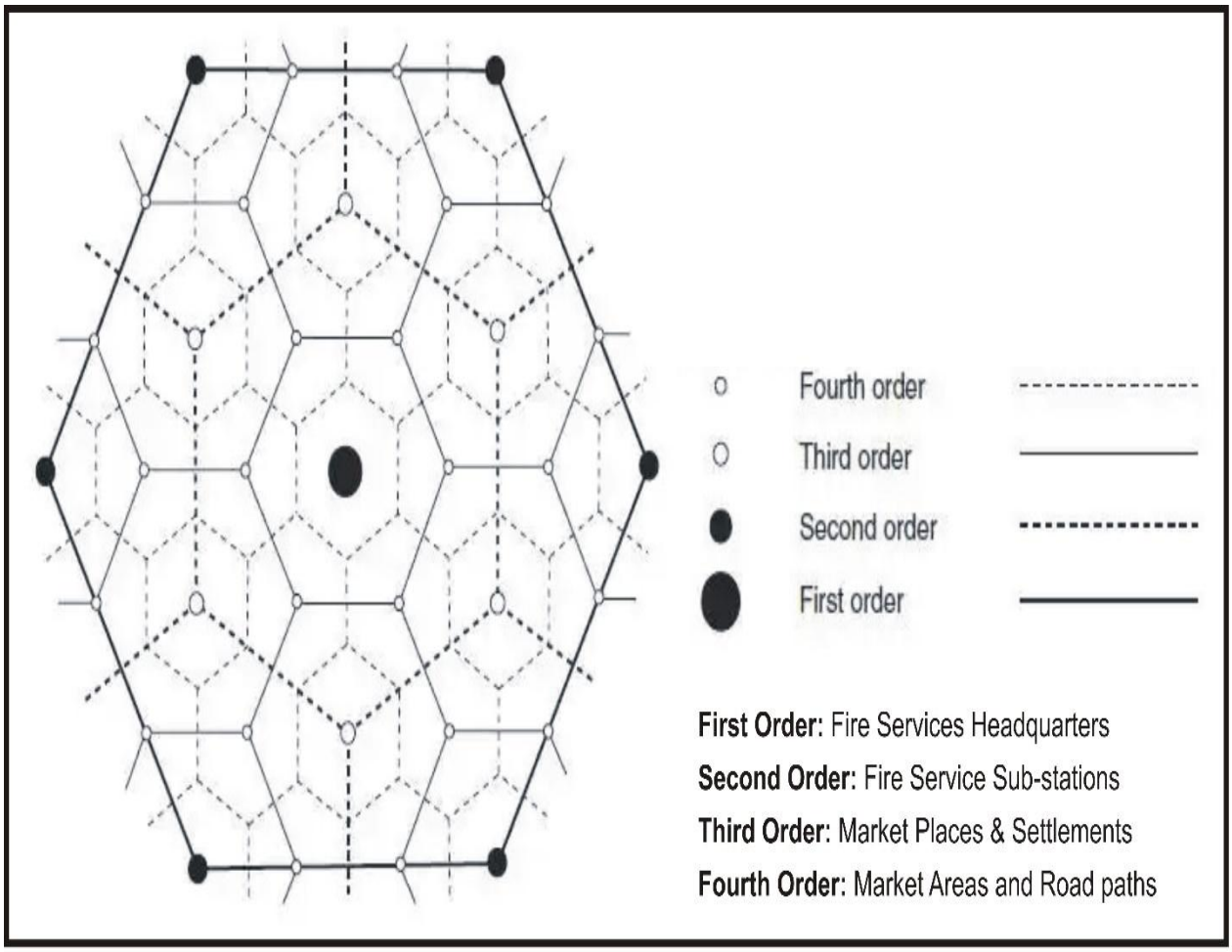

Fig 2.1: Christaller's Hexagonal Hierarchical Spatial Agreement of Settlements (Adopted)

Source: Drawn and reconstructed by the researcher, 2022.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes in detail the methodological framework used in attaining the already stated aims and objectives of the study. It discussed extensively how fire services are spatially distributed and used in Benin Metropolis, Edo State, Nigeria. To start with, research methodology is referred to as the procedures or techniques that is used to identify or analyze information about a research. In a research paper, the research methodology allows for the reader to critically evaluate a research work validity and reliability. The research methodology answers two questions like how the data was collected or generated, and how the data was analyzed. It is how a researcher systematically designs a study to ensure reliable results that addresses the research aims and objectives. A research methodology should provide a scientifically sound finding. It is a systematic way to solve a problem. It is also a science of studying how research is to be carried out. It can also be defined as the study of methods by which knowledge is gained.

The purpose of this chapter is to effectively evaluate the method used in this research. The use of survey is employed in carrying out this research. A survey is a list of questions which is aimed at extracting specific data from a particular set or group of people; it can be through the internet, mail, questionnaires, and so on. Therefore, questionnaires will be used in this research. A questionnaire is a research instrument that consists of a

compilation of a series of questions used for the purpose of gathering information from respondents through survey or statistical study. Other methodological details for carrying out this study are discussed in details below;

3.1 Sources of Data

Primary and secondary data were sourced for this study.

3.1.1 Primary Data

Primary data are data collected on the source which has not been subjected to processing or any manipulation (Kelly, 2005). It involves the use of personal observations and questionnaires in collecting information from the respondents.

3.1.2 Secondary Data

The secondary source of data involves the use of information from the internet.

3.2 Research Design

This research study design will take a quantitative approach. Quantitative research is the process of collecting and analyzing numeric data. It can be used to find patterns and averages, make predictions, test casual relationships and generalize results to wider populations. Quantitative research methods can be used for descriptive, correlational or experimental research. Nevertheless, Polit and Hungler (1997), made it known that a questionnaire survey obtains information from a sample of people by means of self-report. The people respond to series of laid out questions. The reason for using questionnaire survey in this research is to evaluate and examine the subject's perception on the spatial

distribution and utilization of fire services and this study will be structured to meet its aims and objectives.

3.3 Population of Study

Population of study refers to the study of a group of people taken from the general population who share similar characteristics such as age, sex and so on. The population of this study therefore would be peoples from the selected local government areas in Benin Metropolis which are Oredo, Egor, Ikpoba-Okha and Ovia North East Local Government Areas.

3.4 Sample Size Determination

This is the act of choosing the number of observations to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample.

The researcher intends making use of one hundred (100) respondents each from the four (4) local government areas in Benin metropolis, then the researcher also intends distributing questionnaires to fire service officials too within the study area. The sampling technique that would be adopted for this study would be the accidental sampling method.

3.5 Research Setting

The research will be carried out in fire service stations in Benin City. The fire services selected are located on different parts of Benin City. They are selected to represent different ways in which fire services are managed and how they attend to the

needs of the people in the case of fire outbreak and how fire services are spatially distributed across space.

3.6 Analytical Techniques

3.6.1 Nearest Neighbor Analysis

It measures the spread or distribution of something over a geographical space. It provides a numerical value that describes the extent to which a set of points are clustered or uniformly spaced. Researchers use nearest neighbor analysis to determine whether the frequency with which something is observed spatially is comparable with other locations. It can provide a researcher with a numerical value for the clustering of a geographical phenomenon, allowing this value to be compared more accurately with other places. In this research the nearest neighbor analysis is used to determine the spatial distribution of fire services in Benin City. Nearest- Neighbor analysis (NNA) refers to a method for assessing the degree to which a spatial point pattern departs from randomness in the direction of being either clustered or regular (Philo & Philo, 2021).

Basic Formula:

•R = Observed Distances/ Expected Distances

If R< 1 then: pattern exhibits clustering If R > 1 then: pattern is ordered

Calculations:

• Average Nearest Neighbor = Distance / # Points

• Expected Avg Nearest Neighbor = (1/2)[Sqr Root (Area/ # Points)]

Z score = (Avg NN – Expected) / Standard Deviation

Nearest Neighbor Index = AvgNN/ Expected (Chang, 2008)

CHAPTER FOUR

DATA ANALYSIS AND RESULT DISCUSSION

4.0 Preliminary Survey Details

This chapter deals with the presentation of results and discussion of findings. A total of 400 questionnaires were administered to respondents across various local government areas and neighborhoods in the study area of Benin City.

Table 4.1: Local Government Area

	Frequency	Percent
Egor	100	25.0
Oredo	100	25.0
Ikpoba Okha	100	25.0
Ovia North East	100	25.0
Total	400	100.0

Source: Author's Field Survey, 2022.

The socio-demographics of the respondents are presented below.

4.1 Socio-demographics of Respondents

Figure 4.1 shows the gender distribution of respondents in the study area.

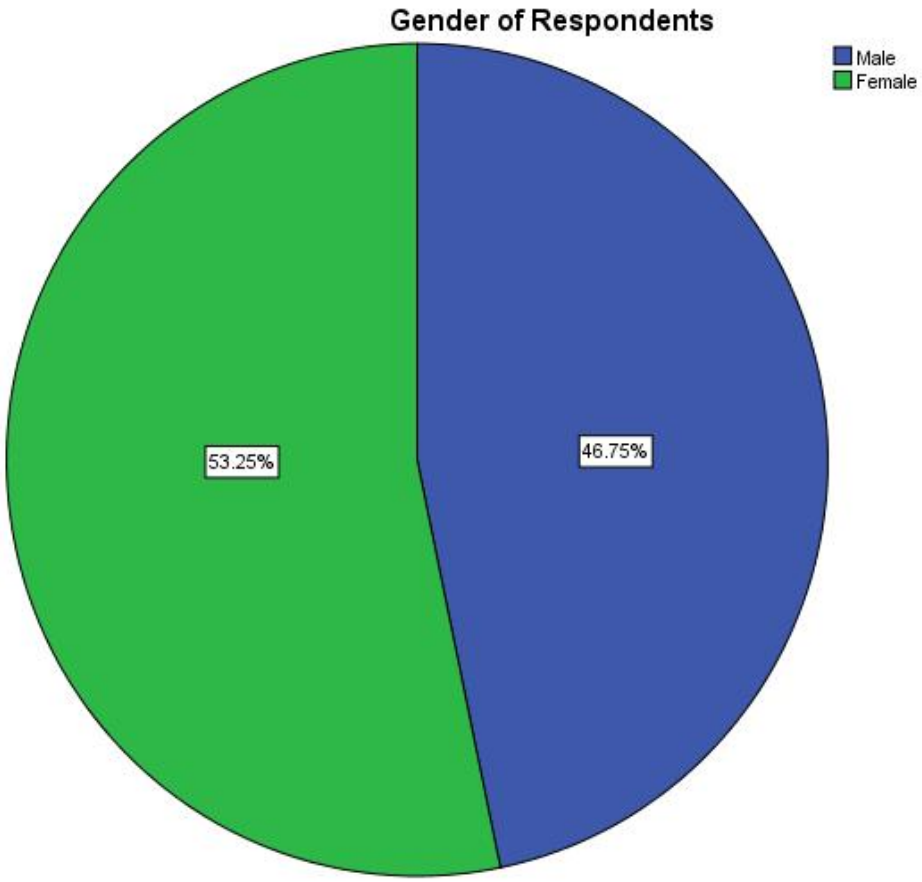

Fig 4.1: Gender of Respondents
Source: Author's Field Survey, 2022.

The proportion of respondents who are males is presented as 46.7% while the proportion of females is given as 53.3%. It can be implied from this that the proportion of females willing to participate in the survey were more than that of males who were willing to participate in the survey. This was also affirmed to be the case from observation in the field as females were more receptive and willing to participate in the survey.

The description of respondents' educational status is presented in Table 4.2.

Table 4.2: Educational Status of Respondents

	Frequency	Percent
Non-Formal Education	11	2.8
Primary	10	2.5
Secondary	153	38.3
Tertiary	226	56.5
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, the proportion of the sampled respondents who have no formal education is represented as 2.8%, the proportion who have at most a primary education is given as 2.5% with the proportion of the sampled population having at most a secondary education within the study area represented as 38.3% while the proportion of the respondents with a tertiary education have a representation of 56.5%.

From the above interpretation, the majority of respondents from the sampled population have attained a tertiary education as buttressed by the 56.5% representation of respondents. It can also be implied that the population of the study area is an educated one given that 794.8% of the population have at least a secondary school education.

The religion of respondents is presented in Figure 4.2 below.

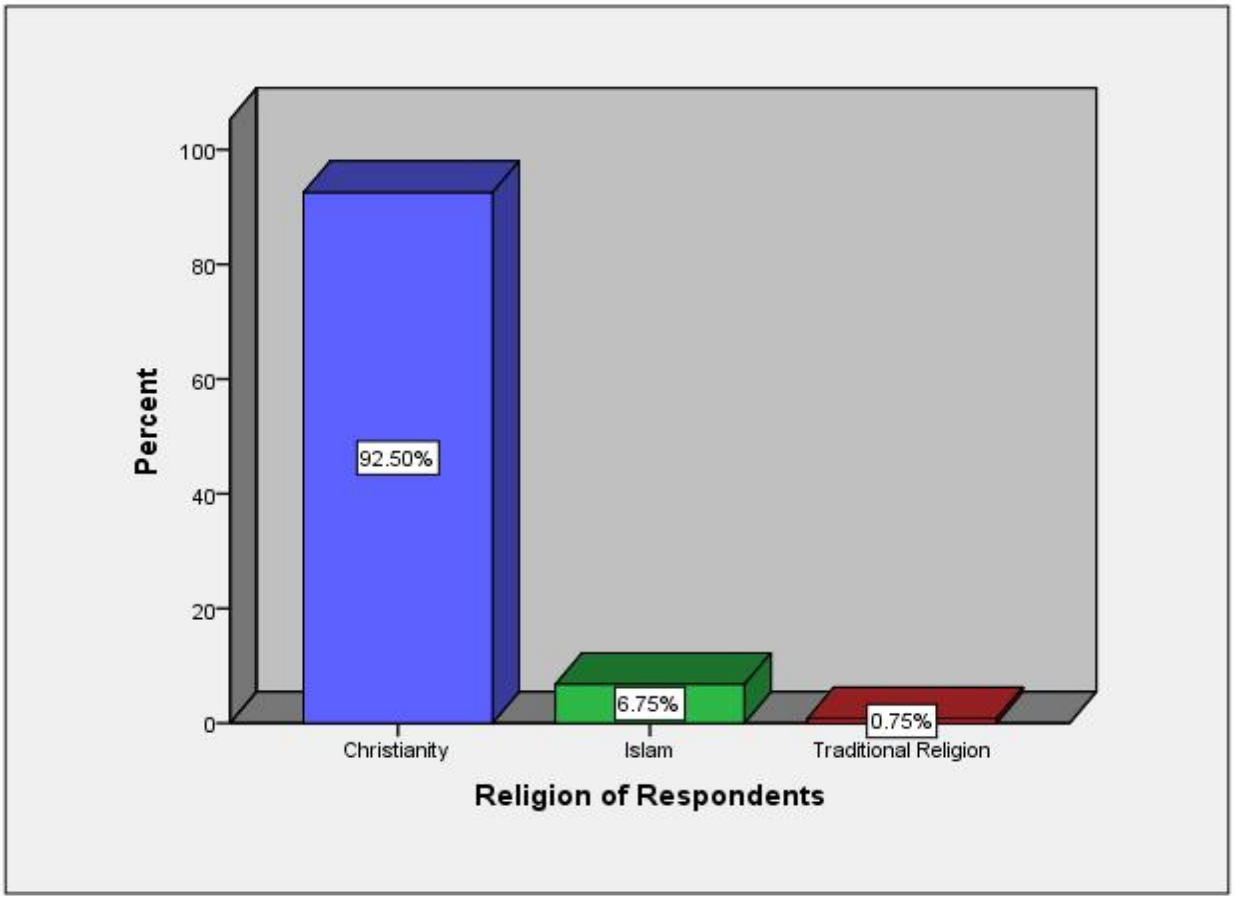

Fig 4.2: Religion of Respondent
Source: Author's Field Survey, 2022.

Table 4.3 shows the religious affiliation of respondents in the study area, from the table, an overwhelming 92.5% of the study population are Christians with 6.8% associating themselves with Islam while a further 0.7% affirmed their position as traditionalists.

From the above analysis, it can be deducted that the study area is predominantly a Christian inhabitation. The average monthly income of respondents in the study area is presented in Table 4.3 below.

Table 4.3: Income of Respondents

	Frequency	Percent
Less than #30, 000	53	13.3
#30, 000-#60, 000	65	16.3
#61, 000-#90, 000	138	34.5
#91, 000-#120, 000	51	12.8
#121, 000-#150, 000	54	13.5
#151,000- #180,000	30	7.5
Above #180,000	9	2.3
Total	400	100.0

Source: Author's Field Survey, 2022.

Table 4.7 presents the monthly income of respondents in the study area. The proportion of respondents who earn less than ₦30,000 is represented as 13.3%, with the highest percentage of respondents at 34.5% earning a monthly income of ₦61,000-₦90,000.

From the above analysis, it can be deduced that the proportion of respondents in the study area who have a monthly income higher than ₦90,000 is given as 36.1% while the proportion of respondents with a monthly income of ₦90,000 or less is represented as

63.9%. It can thus be concluded from the above that the majority of the residents in the study area are low-income earners.

Respondents′ familiarity with the fire service is shown in Figure 4.3 below.

4.2: Result Discussion

General Information on the Location and Functionality of Fire Service

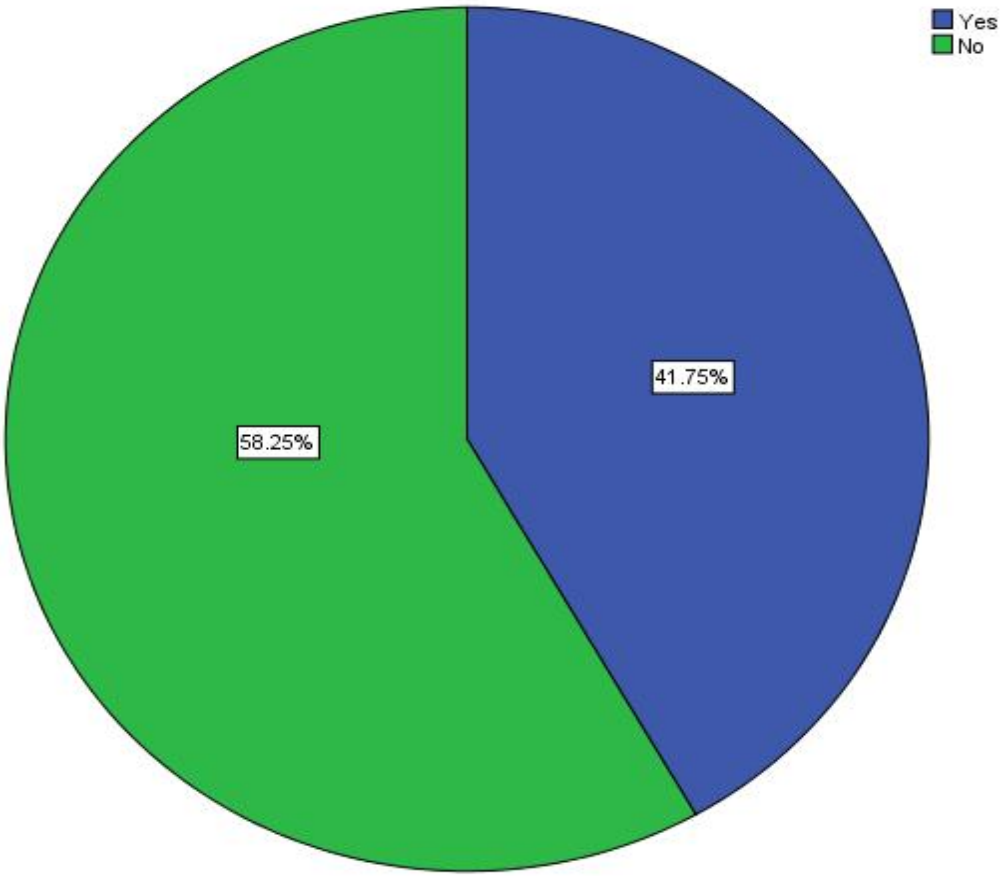

Fig. 4.3: Familiarity with Fire Service
Source: Author's Field Survey, 2022.

As presented in Figure 4.3, the proportion of respondents who affirmed that they are familiar with fire service in the study area is presented as 41.8% while respondents who noted that they are not familiar with fire service in Benin City have a representation of 58.2%.

From the above, it can be inferred that the highest proportion of respondents in the study area (58.2%) are not familiar with fire service and their operations in Benin City.

The length of time respondents has been residing in the study area is presented in Table 4.4.

Table 4.4: Respondents' Length of Stay in Neighborhood

	Frequency	Percent
Less than 5 Years	108	27.0
6-10 Years	134	33.5
11-15 Years	37	9.3
15-20 Years	78	19.5
Above 20 Years	43	10.8
Total	400	100.0

Source: Author's Field Survey, 2022.

Table 4.4 shows respondents' length of stay in the study area. From the table, 27.0% of the respondents have been residing in the study area for less than 5 years, 33.5% have been living in the study area for 6-10 years while 19.5% have been staying in the area for 15- 20 years.

From the above analysis, it can be deduced that the highest proportion of respondents in the study area at 33.5% have either stayed in their neighborhood for an

average of 6-10 years. This makes them the ideal respondents for this survey as they have spent enough time in the study area to have the necessary information on fire service in Benin City.

Figure 4.4 presents respondents' perception of fire outbreak in Benin City.

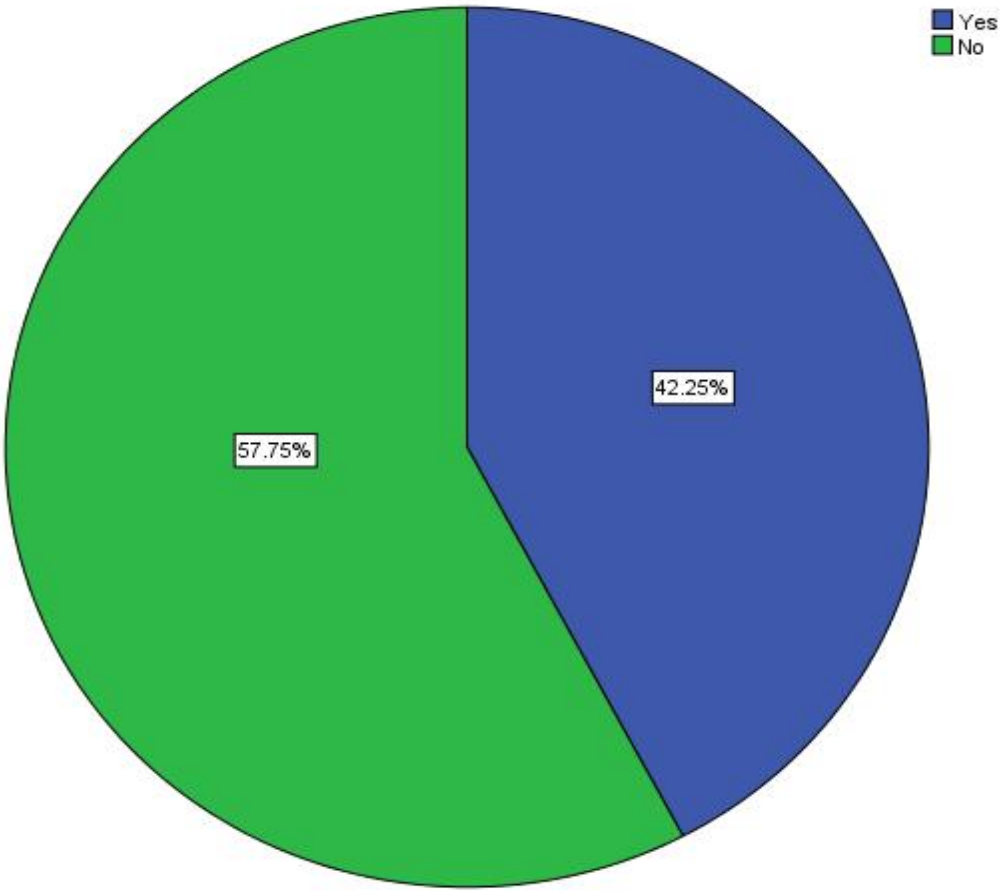

Fig 4.4: Occurrence of Fire Outbreak
Source: Author's Field Survey, 2022.

From the chart, 57.8% of the sampled population affirmed that they have not witnessed the occurrence of a fire outbreak in their neighborhood while the proportion of respondents who have witnessed fire outbreaks in their neighborhood is presented as 42.2%.

It can be inferred from the above that fire outbreaks in the study area has reduced in terms of frequency of occurrence given that the majority of the sampled population

have not had the experience in their neighborhoods. Respondents' knowledge of the number of times fire outbreak has occurred in the last year is presented in Table 4.5 below.

Table 4.5: Number of Times Fire Outbreak has Occurred in the Last One Year

	Frequency	Percent
No Idea	172	43.0
One	157	39.3
Two	60	15.0
Three	7	1.8
Four	2	.5
Five	2	.5
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, the highest proportion of the sampled population at 43.0% noted that they do not have an idea of the number of times, fire outbreak has occurred in the last year. For respondents who have a knowledge of the fire outbreaks, 39.3% affirmed there has been just one outbreak in the last year, 15.0% stated that there have been two fire outbreaks in the last one year.

It can be inferred from the above that fire outbreaks in the study area is not a frequent occurrence given that the majority of the sampled population at 54.3% have a knowledge of at most two outbreaks in the last one year.

Respondents' knowledge of fire service emergency number is presented in Figure 4.5 below.

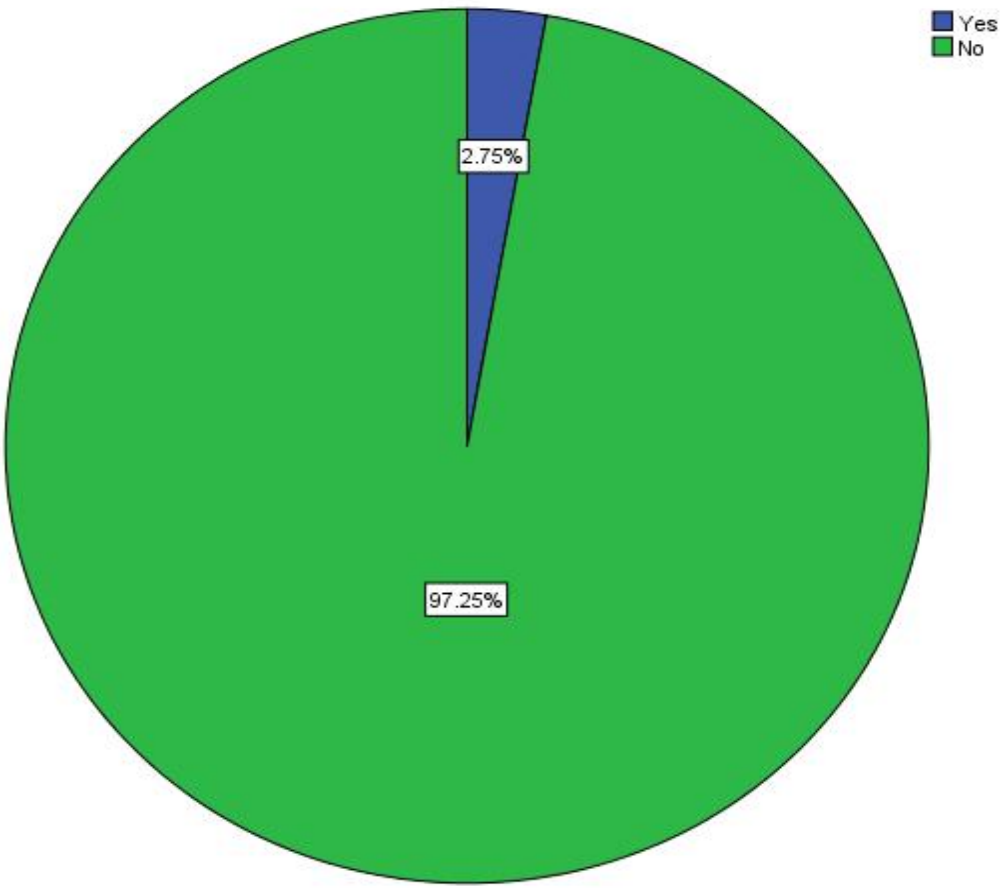

Fig 4.5: Knowledge of Fire Service's Emergency Number
Source: Author's Field Survey, 2022.

As presented in the chart, an overwhelming 97.3% of the sampled population affirmed that they do not have any knowledge of the emergency number of the fire service in Benin City while the proportion of respondents who attested to having a knowledge of their emergency number is given as 2.7%.

It can be concluded from the above that the proportion of residents of Benin City who have a knowledge of the emergency number of the fire service is very small and in the case of a fire outbreak, contacting the fire service will prove very difficult. Respondents usage of the emergency number is presented in Figure 4.6 below.

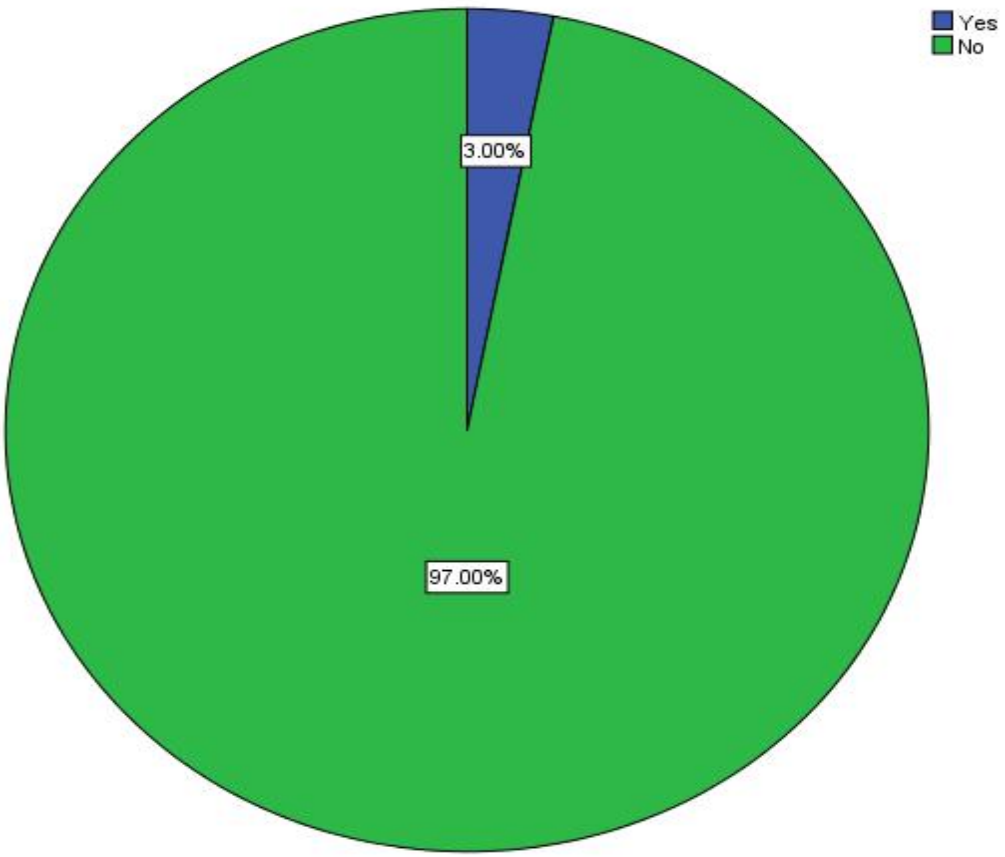

Fig 4.6: Respondents' Use of the Fire Service Emergency Number
Source: Author's Field Survey, 2022.

From the chart, the proportion of the sampled population who have used the emergency contacts of the fire service is presented as 3.0% with an overwhelming proportion at 97.0% noting that they have never called the emergency lines of the fire service.

The underwhelming usage of the emergency lines in the advent of a fire outbreak in the study area can be ascribed to the gross lack of knowledge of the fire service emergency numbers in the study area.

The distance from respondents houses to the nearest fire station is presents in Table 4.6 below.

Table 4.6: Distance from House to Nearest Fire Station

	Frequency	Percent
5 Minutes	13	3.3
10 Minutes	28	7.0
15 Minutes	14	3.5
20 Minutes	39	9.8
25 Minutes	101	25.3
30 Minutes	166	41.5
Above 30 Minutes	39	9.8
Total	400	100.0

Source: Author's Field Survey, 2022.

As presented in the table, the highest proportion of respondents at 41.5% are of the opinion that the nearest fire service station to their places of residences is 30 minutes away. 25.3% of respondents noted that the closest fire service station is 25 minutes away from their place. The proportion of the sampled population who affirmed that the nearest fire service station is at most 15 minutes away from their places of residences is presented as 13.8%.

On the whole, the majority of respondents at 86.4% are of the opinion that the nearest fire service station from their places of residences is at least 20 minutes. It can thus be concluded that fire service station in Benin City are not easily accessible for the

majority of residents and in the case of emergencies, it is very difficult to successfully enlist their services in firefighting.

Table 4.7 presents the common cause of fire outbreaks in the study area.

Table 4.7: Common Causes of Fire

	Frequency	Percent
Lightening	40	10.0
Holiday Fireworks	14	3.5
Smoking	27	6.8
Chemicals and Gasses	26	6.5
Candles	32	8.0
Appliances and Equipment	137	34.3
Children	22	5.5
Electrical Systems and Devices	98	24.5
Others	4	1.0
Total	400	100.0

Source: Author's Field Survey, 2022.

In terms of the predominant cause of fire outbreak in the study area as, it was found that appliances and equipment (34.3%) and electrical systems and devices (24.5) are the major causes of fire outbreaks in Benin City. Lightening was also affirmed by 10.0% of respondents to be a common source of fire outbreak.

From the above, it can be concluded that faulty and unattended appliances, electrical systems and devices are a major cause of fire outbreaks in Benin City.

Respondents knowledge of the potential loss of lives as a result of fire outbreaks is assessed in Figure 4.7.

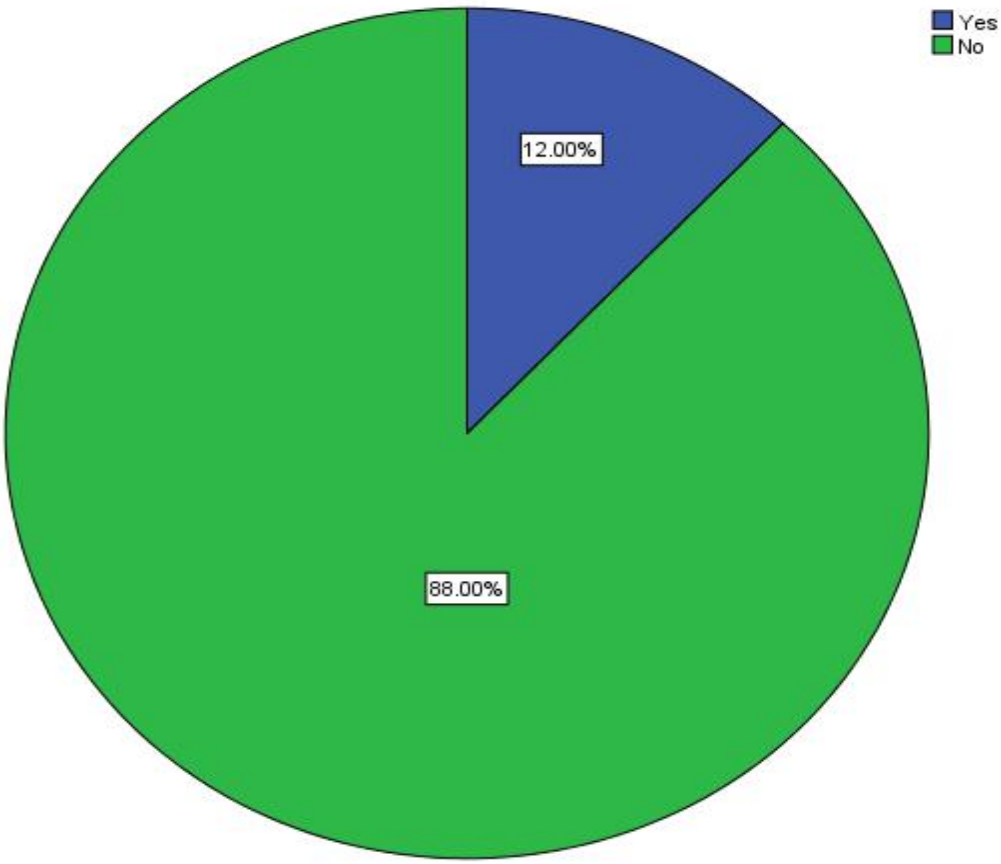

Fig 4.7: Loss of Lives
Source: Author's Field Survey, 2022.

From the table, the majority of the sampled population at 88.0% noted that they have not had an experience where a life was lost from a fire outbreak while the proportion of respondents who have witnessed a loss of life as a result of fire outbreak is presented as 12.0%.

It can be inferred from the above that there is minimal loss of life from fire outbreaks in the study area. Respondents knowledge of the potential loss of properties as a result of fire outbreaks is assessed in Figure 4.8.

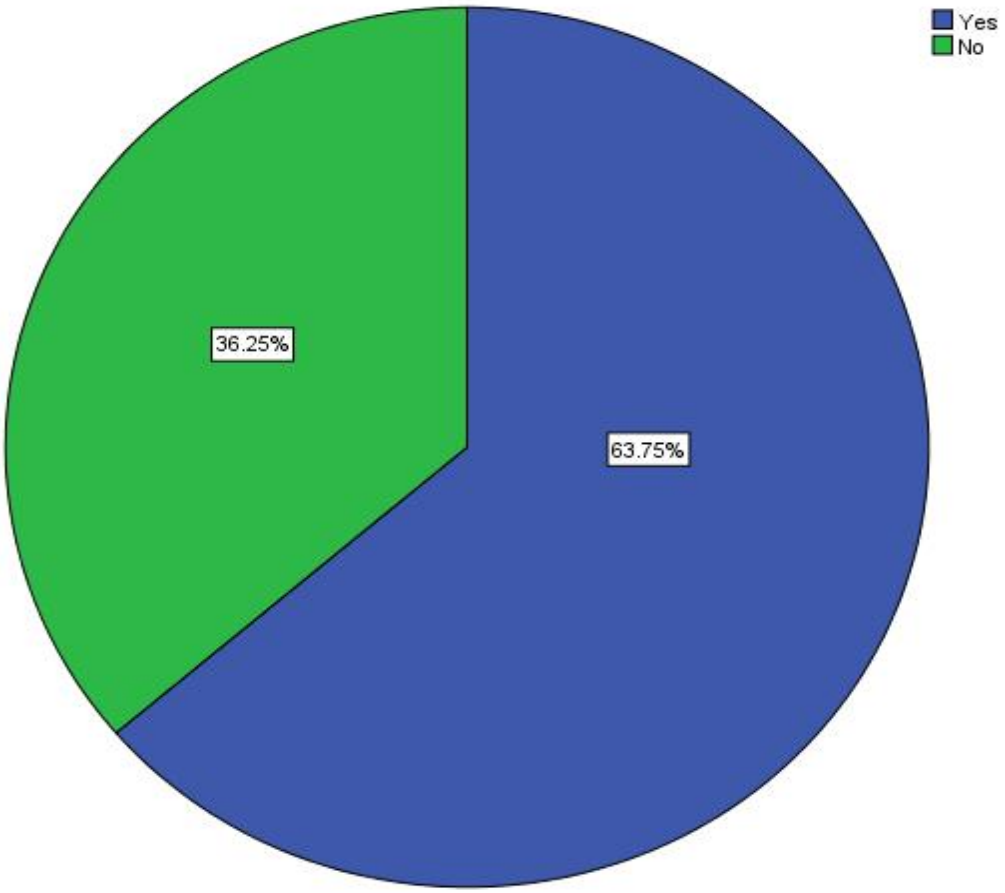

Fig. 4.8: Loss of Properties
Source: Author's Field Survey, 2022.

From the table, the majority of the sampled population at 44.9% affirmed that they have had an experience of loss of properties from a fire outbreak while the proportion of respondents who have not witnessed a loss of property as a result of fire outbreak is presented as 38.9%.

It can be inferred from the above that in a fire outbreak in the study area, more properties are lost to the fire than lives. This can be adjudged to the importance attached to first preserving lives of victims before attempting to save their properties.

The response time of fire service to fire outbreaks in the study area is presented in Table 4.8 below.

Table 4.8: Response Time of Fire Service to Fire Outbreaks

	Frequency	Percent
No Idea	121	30.3
Less than 10 Minutes	15	3.8
10-19 Minutes	31	7.8
20-29 Minutes	42	10.5
30-39 Minutes	39	9.8
Above 40 Minutes	17	4.3
They did not respond	135	33.8
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, it was affirmed by the highest proportion of the sampled population at 33.8% that the fire service did not respond to calls. However, for respondents who affirmed that they showed up to the scene, the time taken was put at 20-29 minutes by 10.5% with a further 9.8% stating that it took the fire service 30-39 minutes to show up to the scene of the fire outbreak.

From the above, it can be concluded that many of the times there is a fire incidence, the fire service fails to show up while in a situation where they do show up, their response time is usually delayed given that it takes them an average of 30 minutes to arrive at the scene of the incidence. Their delayed response can be ascribed to traffic problems.

The success of the fire service in putting out the fire is rated by respondents in Table 4.9.

Table 4.9: Rating of Fire Service Success in Putting out the Fire

	Frequency	Percent
No idea	108	27.0
Unsuccessful	178	44.5
Fairly Successful	68	17.0
Successful	46	11.5
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, the highest proportion of the sampled population at 44.5% noted that the fire service was not successful in putting out the fire with a further 17.0% stating that the fire service was fairly successful in combating the fire while the proportion of respondents who affirmed that the fire service was successful in putting out the fire is presented as 11.5%.

It can be concluded from the above that the fire service has a low success rate in putting out fires before total damage to properties in the study area. This can be due to the extended time it takes them to arrive at the scene of the incidence.

Figure 4.9 presents how the fire outbreak was put out.

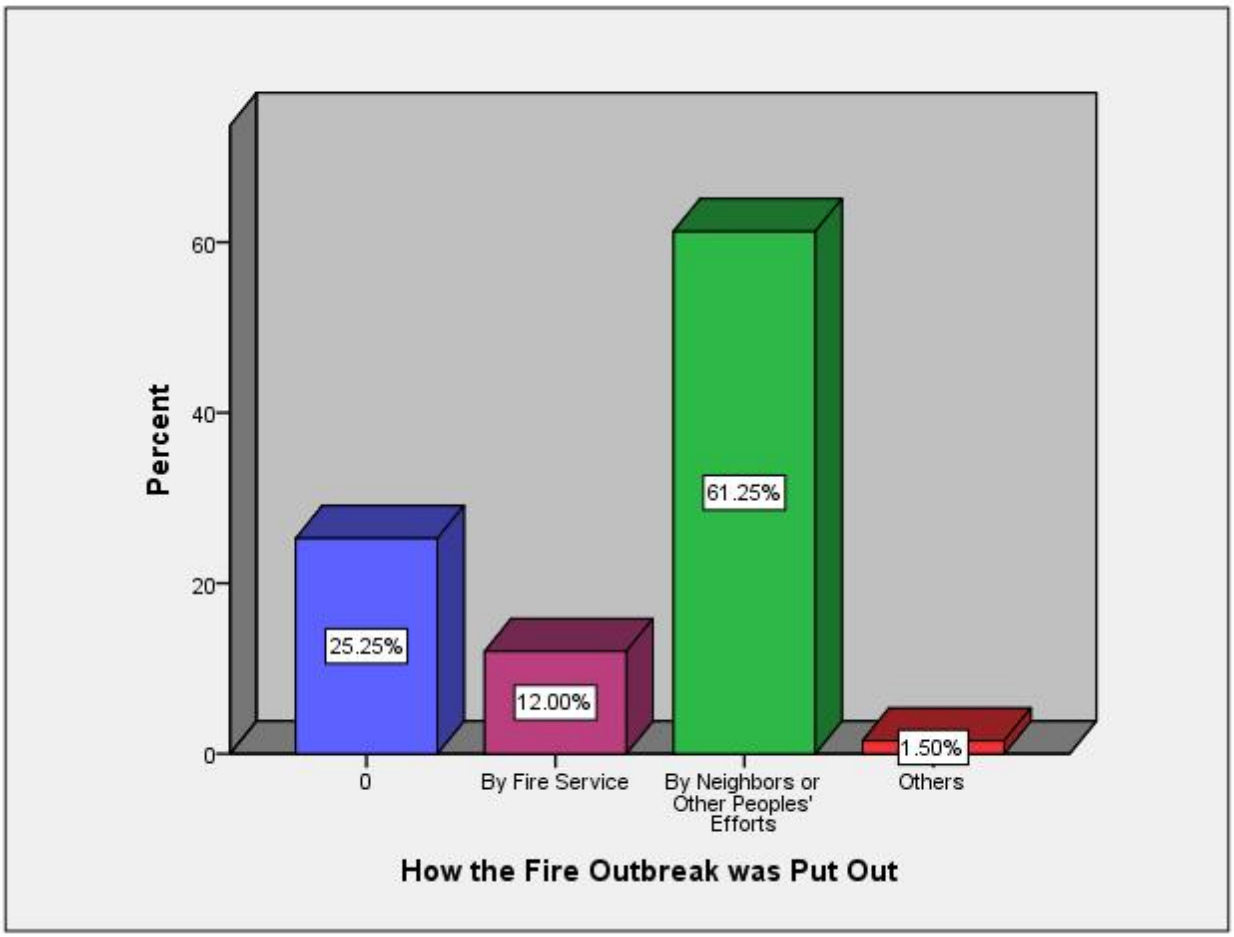

Fig 4.9: How the Fire Outbreak was Put Out
Source: Author's Field Survey, 2022.

From the chart, the majority of the sampled population at 61.3% affirmed that the fire outbreak they witnessed was put out by neighbors and other persons who came together to combat the fire incidence while 12.0% noted that the fire was put out by the fire service.

It can be concluded from the above that during a fire incidence, neighbors and people in the neighborhoods are the first responders before the fire service and they usually have a high success rate in combating the fire outbreak.

The fire safety equipment available in the respondents; neighborhoods is presented in Table 4.10.

Table 4.10: Fire Safety Equipment Available in Neighborhood of Respondents

	Frequency	Percent
Fire Alarm	6	1.5
Fire Hose and Cable	3	.8
Fire Hydrant	11	2.8
Fire Extinguisher	294	73.5
Smoke Detector	3	.8
Fire Sprinkler System	1	.3
Gloves	9	2.3
Fire Blankets	11	2.8
First Aid Kits	31	7.8
Others	31	7.8
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, the most available fire safety equipment in respondents' neighborhoods is the fire extinguisher as affirmed by 73.5% of respondents. First aid kits,

fire hydrants and fire blankets are other prominent equipment affirmed to be available in neighborhoods by sizable proportions of the sampled population.

It can be inferred from the above that the availability of fire extinguishers in neighborhoods is one of the major reasons why residents in the study area are able to successfully combat fire outbreaks before the arrival of the fire service. The respondents' knowledge of whether they have been trained on how to respond to fire outbreaks is presented in Figure 4.10 below.

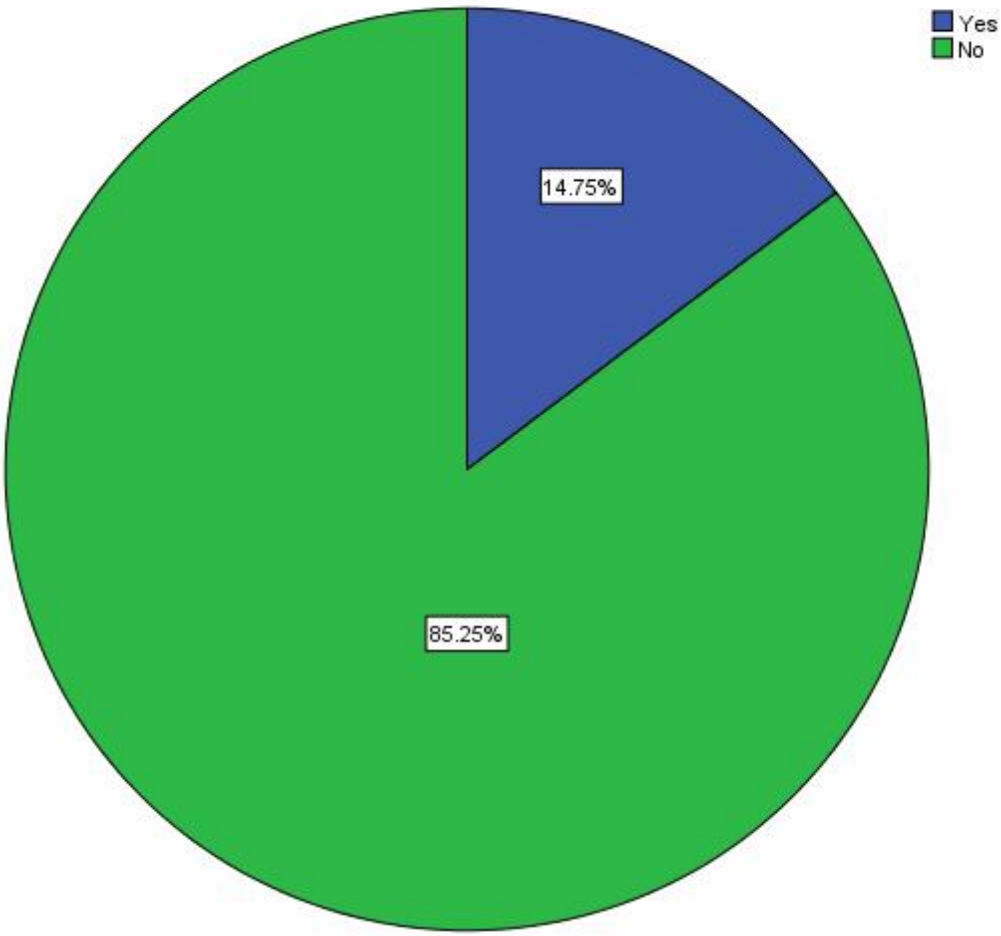

Fig 4.10: Training on Fire Response
Source: Author's Field Survey, 2022.

As presented in the table, the majority of the sampled population with a representation of 85.3% affirmed that they do not have any training on fire response during an outbreak while the proportion of respondents who affirmed the having a training on how to respond to an outbreak is presented as 14.7%.

It can be concluded from the above that the majority of residents in Benin City do not have the adequate training on how to respond during a fire outbreak. Respondents perception of calling the fire service during a fire outbreak is presented in Table 4.11.

Table 4.11: Perception of Calling Fire Service during Fire Outbreaks

	Frequency	Percent
Very Satisfactory	23	5.8
Fairly Satisfactory	100	25.0
Not Satisfactory	176	44.0
Very Poor	101	25.3
Total	400	100.0

Source: Author's Field Survey, 2022.

From the table, the highest proportion of respondents at 44.0% noted that they were not satisfied in their bid to get the fire service to respond to a fire outbreak with 25.0% stating they were fairly satisfied while the proportion of respondents who affirmed their satisfaction are minimally represented at 5.8%.

It can be concluded from the above that the majority of residents in the study area at 69.3% are not satisfied with the response of the fire service when they are called to handle an emergency. Coupled with the late arrival, it is glaring that residents in the study area do not have faith in the fire service in Benin City.

The occurrences after a fire outbreak was assessed by respondents in Table 4.12.

Table 4.12: What Happens in the Aftermath of Fire Outbreaks

	Frequency	Percent
Insurance Pays	16	4.0
Victim get Compensation	15	3.8
Loss of Jobs	95	23.8
Others	274	68.5
Total	400	100.0

Source: Author's Field Survey, 2022.

According to 23.8% of the sampled population, there is usually a loss of jobs for employees after a fire incidence in commercial establishments as they try to recover from the tragedy. For others, as noted by 68.5% of respondents, they try to renovate and get things back in track. The proportion of respondents who noted that victims get compensation is presented as 3.8% with a further 4.0% affirming that insurance pays victims that had their properties insured.

It can be concluded from the above that after a fire outbreak, the victims usually get to bear the brunt of the loss and to also find ways to move on from the incidence. Compensation and insurance is only paid in a situation where lost properties are insured or the fire was caused by a someone else.

Information from Fire Service Departments

Table 4.13: Location of Fire Service by Local Government Area

	Frequency	Percent
Egor	2	22.2
Oredo	5	55.6
Ikpoba Okha	1	11.1
Ovia North East	1	11.1
Total	9	100.0

Source: Author's Field Survey, 2022.

As presented in Table 4.13, majority of the fire service stations at 55.6% are located within Oredo Local Government Area with 22.2% being located in Egor while Ikpoba Okha and Ovia North East have 11.1% of fire services respectively.

It can be inferred that across the study area, Oredo Local Government Area has the highest number of fire service departments in Benin City. This is however not the best given that other Local Government Areas are grossly under served and are in need of more fire service stations.

The name of fire service departments and their Local Government of location is presented in Table 4.14 below.

Table 4.14: Name of Fire Service

Fire Service Station	Location (LGA)	Year of Establishment
107 AMG NIG. AIR FORCE	Oredo	1980
Edo State Fire Service	Oredo	1963
Federal Airports Authority of Nigeria	Oredo	1935
Federal Fire Service	Ikpoba Okha	1963
Integrated Data Services Limited	Oredo	2002
NPDC	Oredo	1989
S and T Fire Department	Egor	1987
UBTH Fire Service	Egor	1973
UNIBEN Fire Service	Ovia North East	1992

Source: Author's Field Survey, 2022.

Of the nine fire service stations in the study area, five are located in Oredo Local Government Area including 107 AMG NIG. AIR FORCE, Federal Airports Authority of Nigeria, Edo State Fire Service, Integrated Data Services Limited and NPDC. In Egor Local Government Area, the fire service department include S and T Fire Department and UBTH Fire Service. Ikpoba Okha Local Government Area has the Federal Fire Service while the UNIBEN Fire Service is located in Local Government Area. The designation of the respondents is shown in Table 4.15 below.

Table 4.15: Respondent's Status in the Establishment

	Frequency	Percent
Chief Fire Officer	1	11.1
Fireman	1	11.1
Head (Policy, Regulatory and Inspectorate)	1	11.1
Head of Department	1	11.1
Head of Fire Service (DCSO)	1	11.1
Instructor	1	11.1
Principal Airport Fire Officer	1	11.1
Supervisor	2	22.2
Total	9	100.0

Source: Author's Field Survey, 2022.

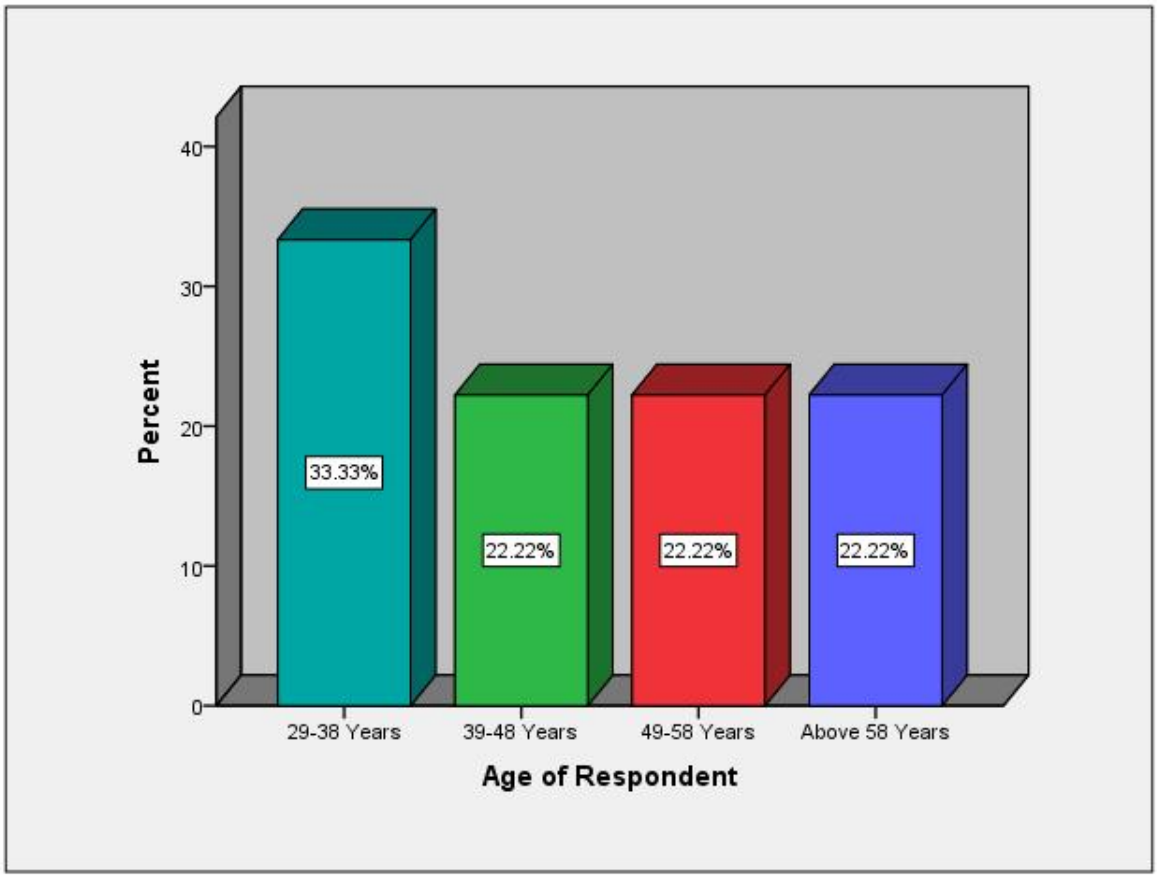

Fig 4.11: Age of Respondent
Source: Author's Field Survey, 2022.

As presented in Figure 4.11, the highest proportion of the sampled population are between 29-38 years with the other age groups having a representation of 22.2% respectively.

It is evident from this that the fire service department across the study area is majorly headed by people of median age. This is commendable given that the nature of the job demands agility and youthfulness.

Respondents' level of education is presented in Figure 4.12 below.

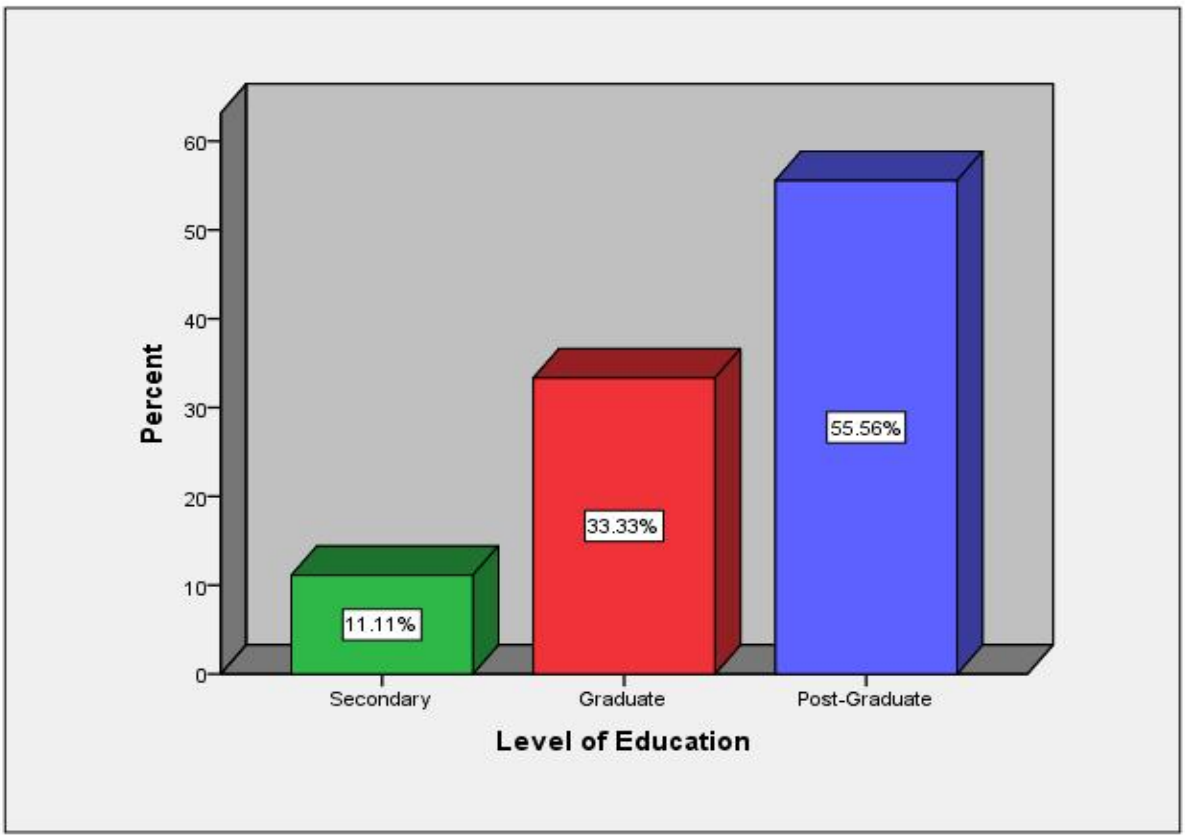

Fig 4.12: Respondents' Level of Education
Source: Author's Field Survey, 2022.

The proportion of the sampled population who have at most a secondary education is presented as 11.1% with the proportion of respondents having a graduate certificate given as 33.3% while the proportion of respondents who have a post graduate certificate have a representation of 55.6%, thus accounting for the majority.

It can be concluded from the above that the respondents from the various institutions are well educated given that the majority (88.9%) have a graduate certificate. Respondents' length of time spent in the fire service is presented in Table 4.16 below.

Table 4.16: Length of Time in the Fire Service

	Frequency	Percent
Less than 5 Years	2	22.2
5-10 Years	2	22.2
11-15 Years	2	22.2
16-20 Years	1	11.1
Above 20 Years	2	22.2
Total	9	100.0

Source: Author's Field Survey, 2022.

From the table, 22.2% of respondents have spent more than 20 years in the fire service, accounting for the longest time a respondent has spent in the service, a further 22.2% affirmed that they have spent less than 5 years with 11.1% of respondents noting that they have spent 16-20 years in the fire service. The proportion of respondents who have spent 5-10 years and 11-15 years is respectively represented as 22.2%.

The ownership of the fire service department across the study area is presented in Figure 4.13 below.

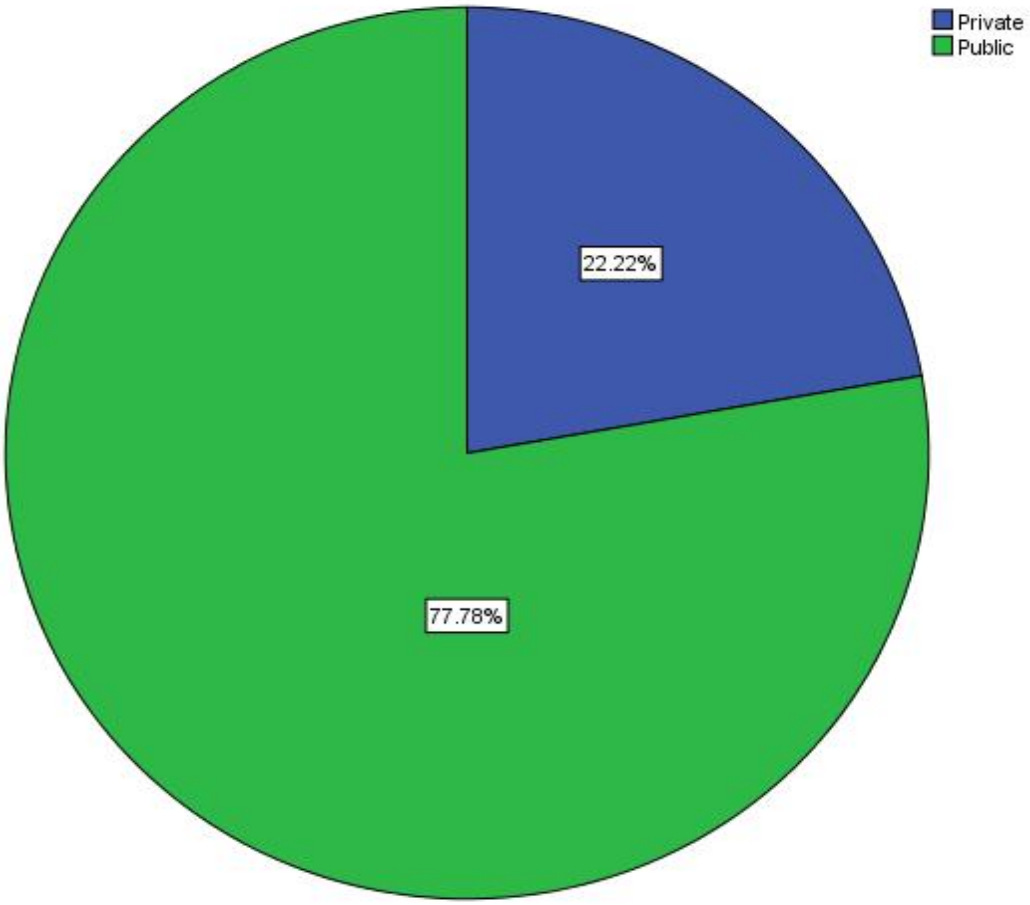

Fig 4.13: Ownership of Fire Service Departments
Source: Author's Field Survey, 2022.

From the chart, it was affirmed by respondents that 77.8% of the fire service stations in Benin City are owned by the government while 22.2% are owned by the private sector. This was found to be the case from observation as the majority of fire service stations were found to be funded by the government.

The staff strength of each fire service department is presented in Table 4.17 below.

Table 4.17: Staff Strength of Fire Service Stations across the Study Area

Fire Service Station	Frequency
107 AMG NIG. AIR FORCE	15
Edo State Fire Service	38
Federal Airports Authority of Nigeria	30
Federal Fire Service	73
Integrated Data Services Limited	13
NPDC	10
S and T Fire Department	16
UBTH Fire Service	24
UNIBEN Fire Service	19

Source: Author's Field Survey, 2022.

From the table, the NPDC fire service station located in Oredo Local Government Area has the lowest staff strength with 10 personnel. This is followed by the fire service station at Integrated Data Services Limited also in Oredo Local Government Area with a staff strength of 13. The Federal Fire Service has the highest staff strength with 73 personnel.

According to the respondents, their staff strength in each fire service station is small and in they are in need of more personnel due to the fact that the available personnel are being overstretched with work. In terms of the location of the fire stations, it was affirmed by all the respondents that the fire service stations are well location and they are satisfied with their various locations. They further noted that the fire service stations are easily accessible to residents in the study area and although their staff strength is small, the personnel are engaged in shifts in order to maximize their

productivity. The area of operation for each fire service station in Benin City is presented in Table 4.18.

Table 4.18: Operation Area of Fire Service Stations across the Study Area

Fire Service Station	Frequency
107 AMG NIG. AIR FORCE	Benin Metropolis
Edo State Fire Service	Edo State
Federal Airports Authority of Nigeria	Airport and its environs
Federal Fire Service	Edo State
Integrated Data Services Limited	Office location and its environs
NPDC	Benin City
S and T Fire Department	Benin City
UBTH Fire Service	Hospital and its environs
UNIBEN Fire Service	Both campuses and their neighborhoods

Source: Author's Field Survey, 2022.

From the table, all the fire service stations operate within Benin City and their immediate environment with the exception of Edo State Fire Service and Federal Fire Service with operations across the entire state.

It can be concluded from the above that the fire service department do not have compelling restrictions in terms of jurisdiction of operation as they are allowed to answer calls and engage fire outbreaks outside their jurisdiction. This was affirmed to be the case by all respondents.

The number of firefighting engines in the fire service is presented in Figure 4.13.

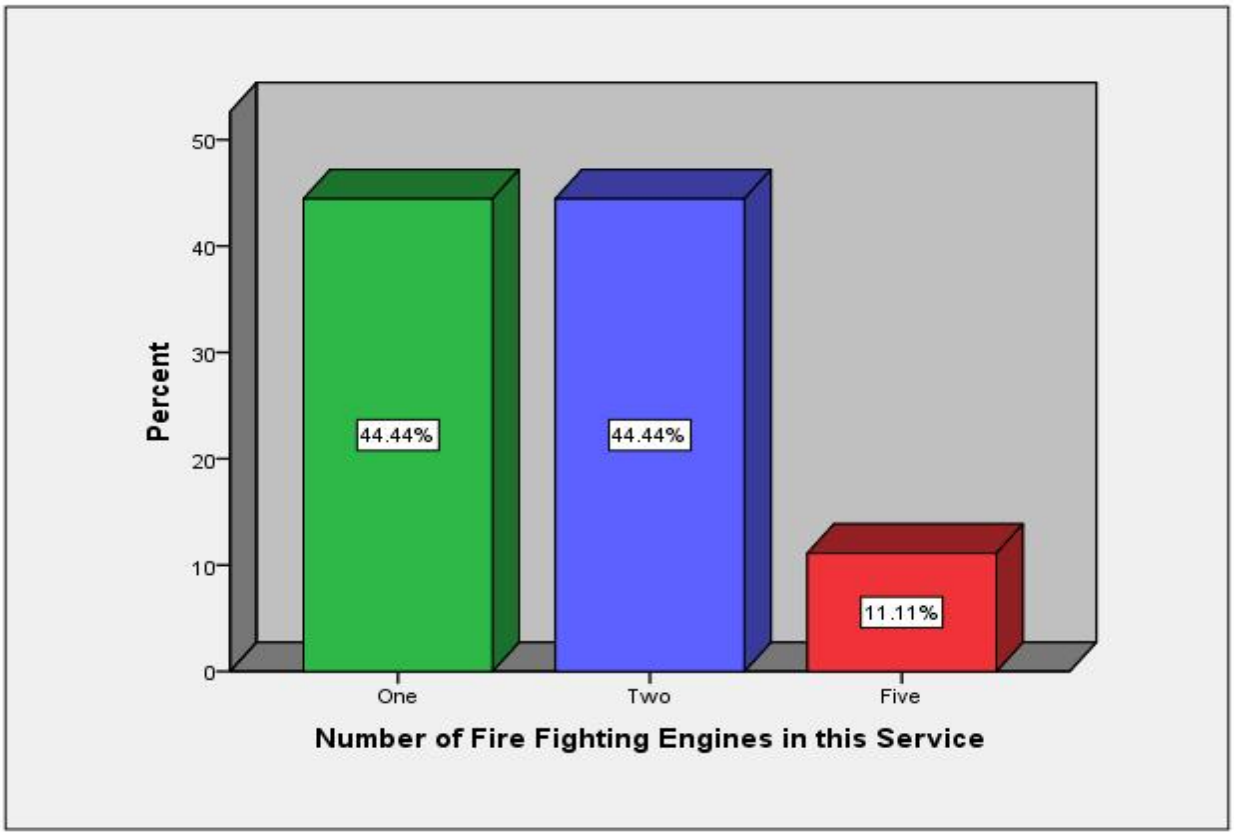

Fig 4.14: Number of Firefighting Engines in Fire Service Stations
Source: Author's Field Survey, 2022.

As presented in the chart, 44.4% of the sampled respondents affirmed that they have just one firefighting engine in their fire station with a further 44.4% stating that they have two firefighting engines in their fire stations while the proportion of respondents who affirmed that they have five firefighting engines in their fire stations is presented as 11.1%.

From the above, it can be concluded that an overwhelming majority (88.8%) of fire service stations in Benin City do not have more than two firefighting engines. This

figure is very underwhelming when the population of the city is taken into consideration. Having so few firefighting engines will and has invariably impacted on the functionality and effectiveness of firefighting engines in Benin City. The frequency of fire outbreak in Benin City is shown in Figure 4.14.

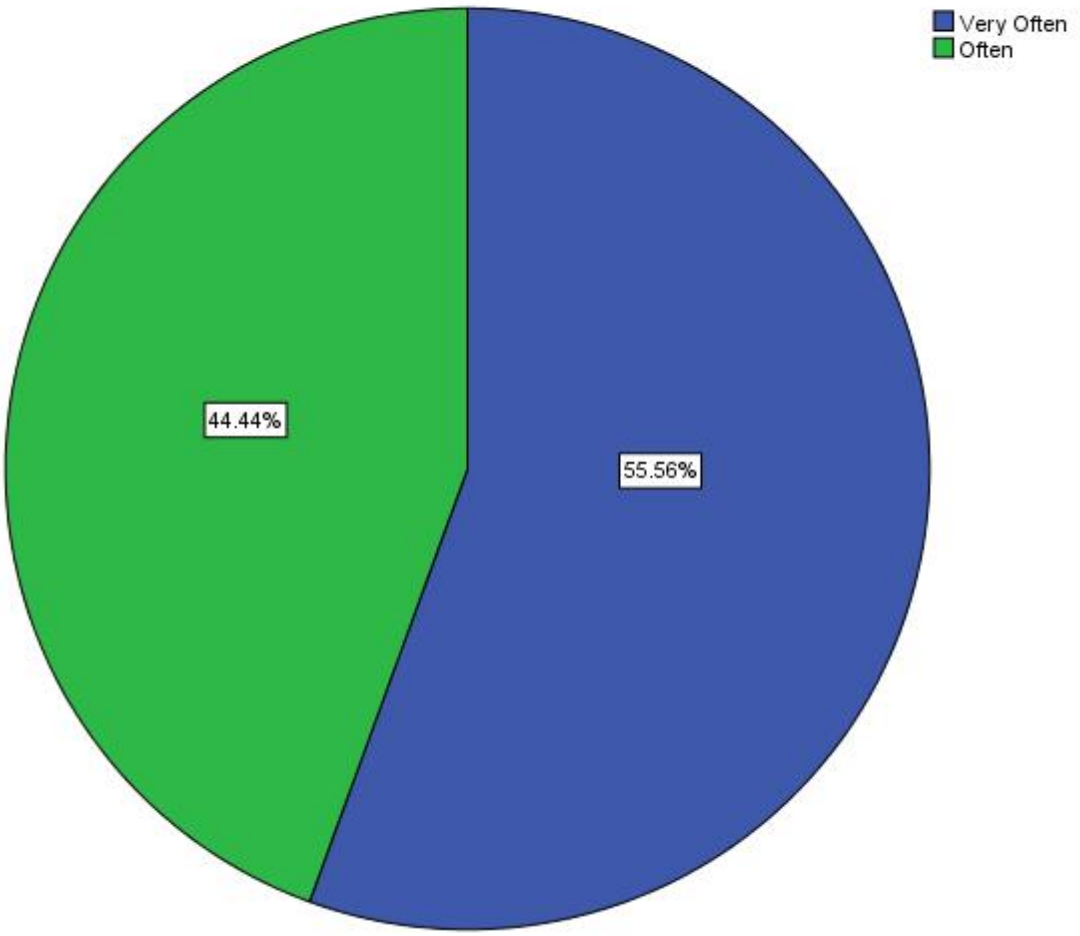

Fig 4.15: Frequency of Fire Outbreaks in the Study Area
Source: Author's Field Survey, 2022.

According to 55.6% of the sampled population, fire outbreak occurs very often in Benin City while 44.4% of respondents affirmed that fire outbreak occurs often across the city.

It can be inferred from the above submission that fire outbreak is a common occurrence in the study area. It is thus imperative that fire service stations have the necessary equipment needed to combat fire outbreaks across the city.

The equipment possessed by fire service stations in Benin City is presented in Table 4.19 below.

Table 4.19: Equipment Possessed by Fire Service

	Frequency	Percent
Fire trucks, fire hose, fire hydrant, fire extinguisher, smoke detector, helmets, gloves	1	11.1
Fire trucks, fire hose, fire extinguisher, helmets, gloves, fire blankets, first aid kit	3	33.3
Fire trucks, fire hose, fire hydrant, fire extinguisher, helmets, gloves, fire blankets, first aid kit, axe, sand buckets	4	44.4
Fire trucks, fire hose, fire hydrant, fire extinguisher, smoke detector, helmets, gloves	1	11.1
Total	9	100.0

Source: Author's Field Survey, 2022.

According to 44.4% of respondents, the equipment possessed in their fire service station include, fire trucks, fire hose, fire hydrant, fire extinguisher, helmets, gloves, fire

blankets, first aid kit, axe and sand buckets with 33.3% noting that they have fire trucks, fire hose, fire extinguisher, helmets, gloves, fire blankets and first aid kits in their department, the other 11.1% of respondents affirmed that they have fire trucks, fire hose, fire hydrant, fire extinguisher, smoke detector, helmets, and gloves in their fire service stations.

It can be concluded from the above that the fire service stations in the study area are equipped with the basic machineries needed to combat a fire outbreak, however, they are lacking some key and modern equipment.

The possession of an emergency number by the fire service is presented in Figure 4.14.

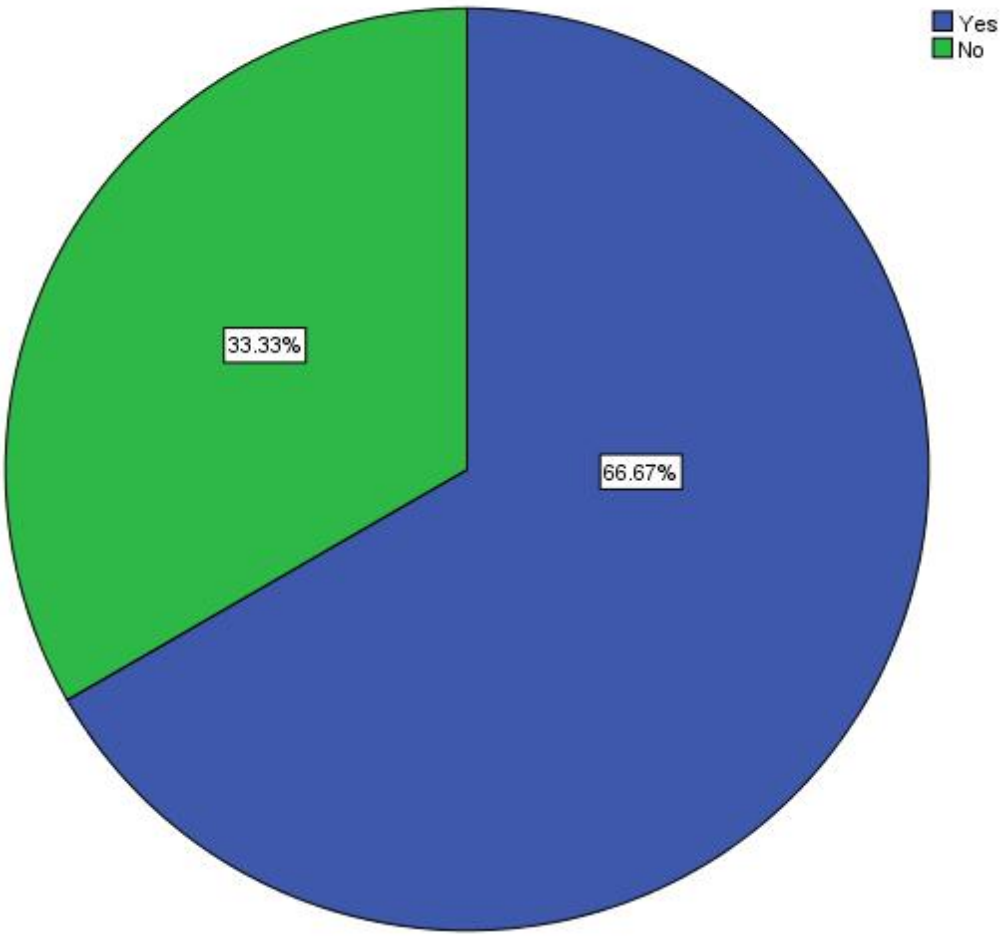

Fig 4.16: Possession of Emergency Number by the Fire Service
Source: Author's Field Survey, 2022.

As shown in the chart, 66.7% of respondents affirmed that their fire service stations have an emergency contact number while 33.3% stated that their fire stations do not have an emergency contact number.

From the above, it can be concluded that the majority of fire service stations in the study area have an emergency contact number with which the public can reach them in the event of a fire outbreak.

The emergency contact number for the different fire service stations across Benin city is presented in Table 4.20 below.

Table 4.20: Emergency Contact of Fire Service Stations across the Study Area

Fire Service Station	Emergency Contact
107 AMG NIG. AIR FORCE	08057234793
Edo State Fire Service	08024904706, 08092189656
Federal Airports Authority of Nigeria	07054652190
Federal Fire Service	08108378588
Integrated Data Services Limited	07018525065
NPDC	None
S and T Fire Department	None
UBTH Fire Service	08075383399
UNIBEN Fire Service	None

Source: Author's Field Survey, 2022.

From the table, all the fire service stations have emergency numbers with the public can contact them in the event of a fire outbreak, however, three fire service stations did not provide their emergency numbers for this study on the premise that their service area is limited.

The common cause of fire outbreak in the study area is shown in Table 4.21 below.

Table 4.21: Common Cause of Fire Outbreak

	Frequency	Percent
Appliances and Equipment	3	33.3
Children	1	11.1
Electrical Systems and Devices	5	55.6
Total	9	100.0

Source: Author's Field Survey, 2022.

According to 55.6% of respondents, the most common cause of fire outbreak is electrical systems and devices. This is followed by appliances and equipment as affirmed by 33.3%.

It can be concluded therefore that the leading cause of fire incidents in the study area is faulty electrical systems and devices as well as faulty appliances and equipment in the house.

As affirmed by the respondents, the number of lives lost due to fire incidence on an annual basis is more than a hundred with the supervisor at the 107 AMG Nig. Air Force fire station putting the figure at 178.2 persons for 2021 while the estimation in terms of properties lost was put at millions of naira worth of properties with the Supervisor at the Federal Fire Service putting the figure at #712,460,000 worth of properties lost in 2021.

According to the respondents, in a bid to reduce the incidence of fire outbreak in the study area, the fire service departments as well as key stakeholders in the state have engaged in public enlightenment on fire safety and prevention of fire outbreaks as well the proper installation of electrical appliances in homes.

Victims' experience in the aftermath of a fire outbreak is presented in Figure

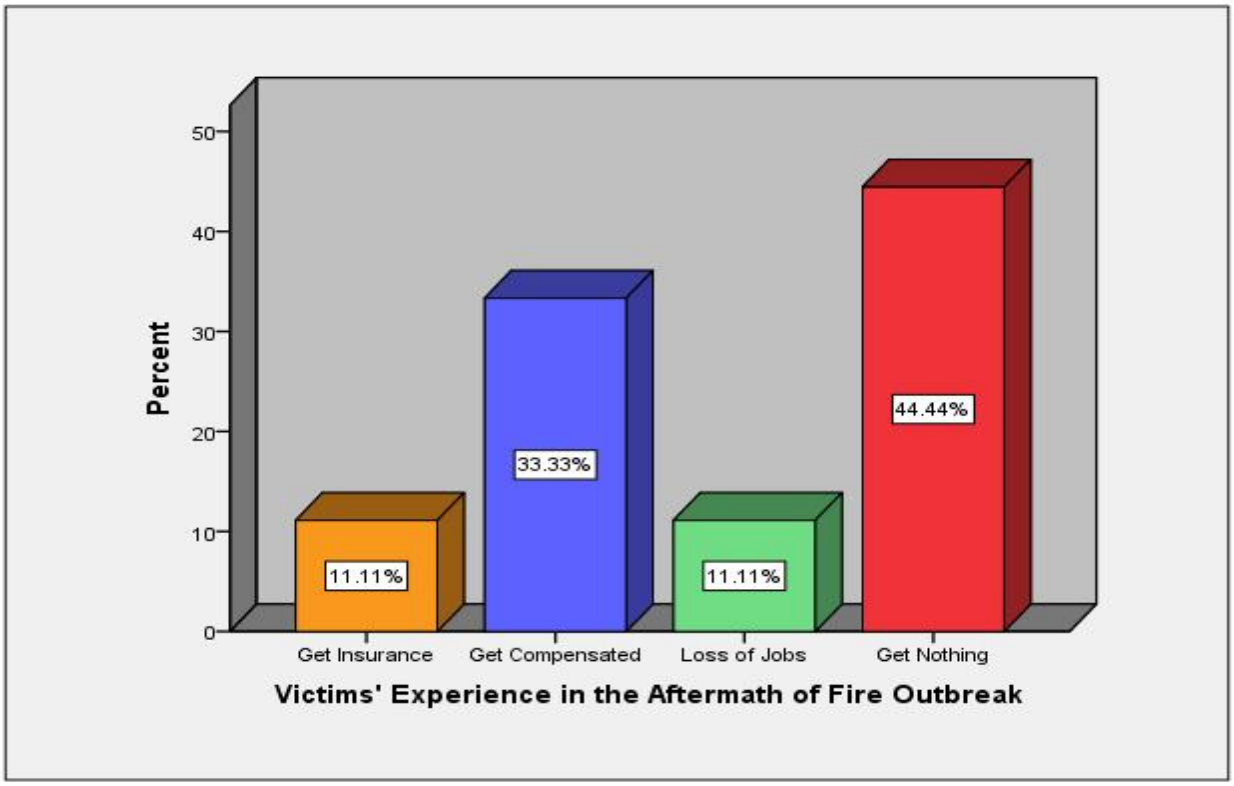

Fig 4.17: Victims' Experience in the Aftermath of a Fire Outbreak
Source: Author's Field Survey, 2022.

From the chart, the majority of respondents at 44.4% affirmed that in the aftermath of a fire outbreak, victims get nothing, 33.3% however noted that in the case

where the fire is caused by an external factor, compensations are sometimes given to the victims. 11.1% of respondents noted that some victims receive their insurance package as a result of insuring their lives or properties with a further 11.1% of respondents affirming that victims usually lose their jobs in the event of a fire outbreak.

It can be concluded from the above that for majority of victims in the study area do not get anything in the event of a fire outbreak.

In terms of the availability of guidelines regulating the operations of the fire service, all respondents affirmed that there are guidelines regulating their operations. According to the supervisor of the 107 AMG Nig. Air Force Fire Service, the fire service act (1963) and the national fire code (2013) regulates the operations of the fire service across the state. Other regulations binding the fire service as affirmed by the supervisor at the NPDC fire service is that, "*the sale of fire alarm or fire extinguisher by unauthorized or road side vendors is prohibited*". The fire service has also been empowered to respond to fire emergencies at all times and to break into any building in the event of a fire outbreak.

The Source of funding for fire service across the study area is presented in Figure 4.16.

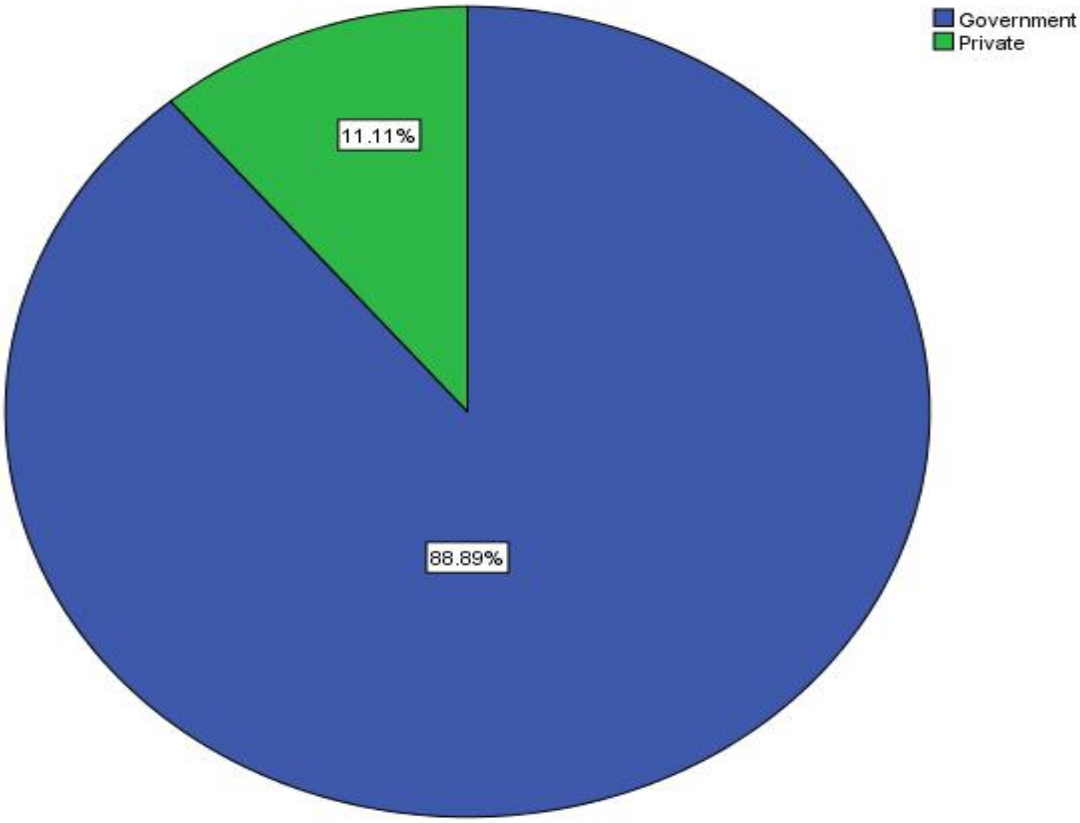

Fig 4.18: Source of Funding for Fire Service
Source: Author's Field Survey, 2022.

As presented in the chart, an overwhelming proportion of respondents at 88.9% affirmed that their fire service departments are funded by the government while the proportion of respondents who affirmed that the funding for their stations come from the private sector is presented as 11.%.

It can thus be concluded that the government is responsible for the funding of majority of fire service departments in the study area. this is the case due to them being owned by the government.

The level of security of the fire service and firemen when they go for operation is presented in Table 4.22.

Table 4.22: Security of Fire Service

	Frequency	Percent
Fair	2	22.2
Not adequate	1	11.1
Well Secured	6	66.7
Total	9	100.0

Source: Author's Field Survey, 2022.

From the table, the majority of respondents at 66.7% are of the opinion that the fire service and firemen are well secured when they go out for a firefighting emergency, with 22.2% stating that the level of security is fair while the proportion of respondents who affirmed that the level of security is not adequate is represented as 11.1%.

It can be inferred from the above that the majority of fire service and firemen are well secured when they respond to a firefighting emergency. There is however need for improvement as there have been attacks on firemen by mobs and aggrieved persons in the event of their late arrival or lack of response to combat a fire outbreak.

Respondents' perception of the presence of fire hydrants across the study area is shown in Figure 4.17 below.

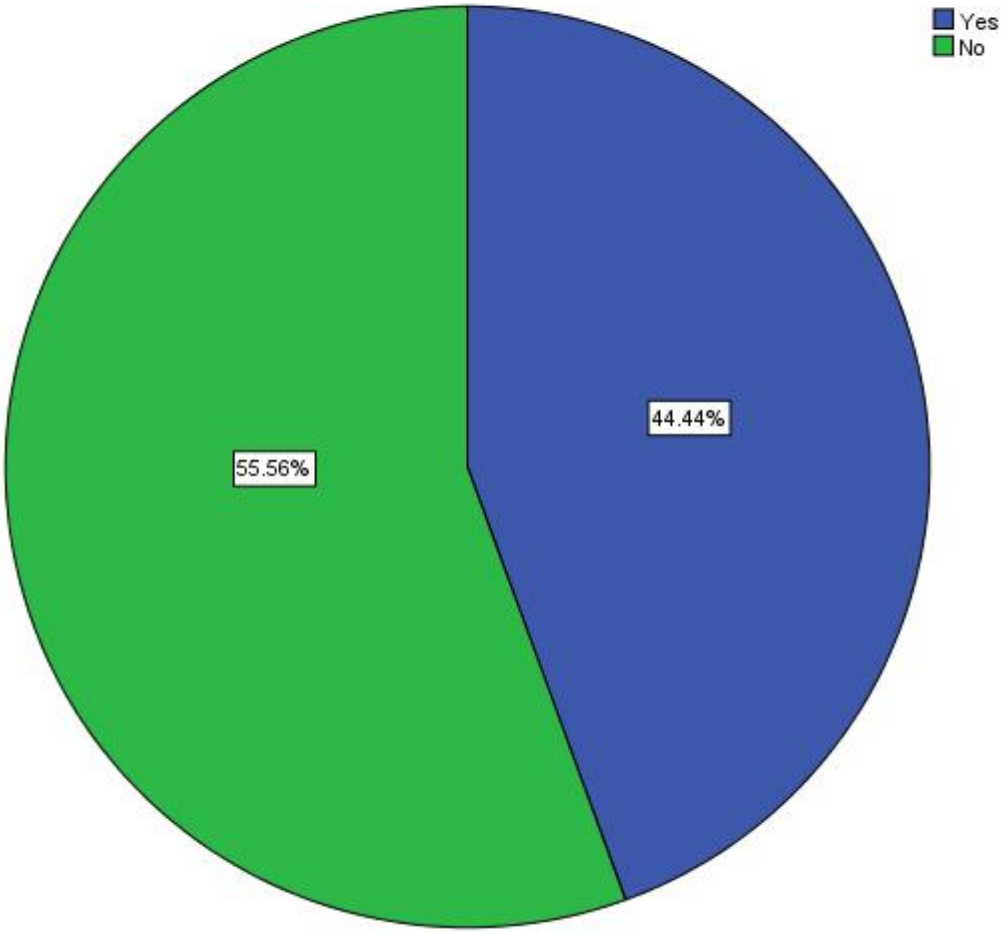

Fig 4.19: Presence of Fire Hydrants across the Study Area
Source: Author's Field Survey, 2022.

From the chart, 44.4% of respondents are of the opinion that there are fire hydrants across the study area while the proportion of respondents who believe in the contrary is represented as 55.6%.

From the above and from observation during the field survey, there are no fire hydrants across the city. It can be concluded thus that there is need for fire hydrants to be

strategically positioned across the city to enable the easy access to water by the fire service during a fire outbreak.

In terms of challenges, it was unanimously affirmed by all respondents that the fire service in Benin City face a lot of challenges and that these challenges hamper their operations and effectiveness. According to the Supervisor of the NPDC fire service and as corroborated by the Supervisor of the 107 AMG Nig. Air Force Fire Service, "*traffic jams are a major challenge for the fire service in a bid to accessing the scene of a fire outbreak*." Due to a lack of freeway for fire trucks, it has become essentially difficult for fire trucks to get to scenes of fire outbreaks in time to combat the fire, especially in the more populated parts of the city. To combat this problem, it was severally suggested by respondents that the government should improve on the road accessibility for fire service trucks to enable them access scenes of fire outbreaks a lot faster.

Mob attacks, inadequate funding, lack of modern equipment, lack of manpower, and the unavailability of life insurance for staff of the fire service are other prominent challenges highlighted by respondents. To resolve these challenges, they suggested that the government should provide every staff of the fire service with life insurance. It was also suggested that the fire service should be provided with more security to prevent mob attacks in the event of a fire outbreak. The employment of more staff to increase the staff strength of the fire service was also advocated as well proper funding and the provision of modern equipment and fire hydrants for fire service stations in the study area.

4.3 Nearest Neighbor Analysis

The ratio of the spatial distribution of fire service stations in in Benin Metropolis was calculated using the Nearest Neighbor analysis in the ArcGIS 10.3 environment. Figure 4.18 reveals a Nearest Neighbor ratio of 0.31 which implies a clustered distribution of fire service stations in the study area. This follows that the fire service stations emerged and are spread the way they are as a result of the demand for easy accessibility to fire services in the event of fire hazards in these locations.

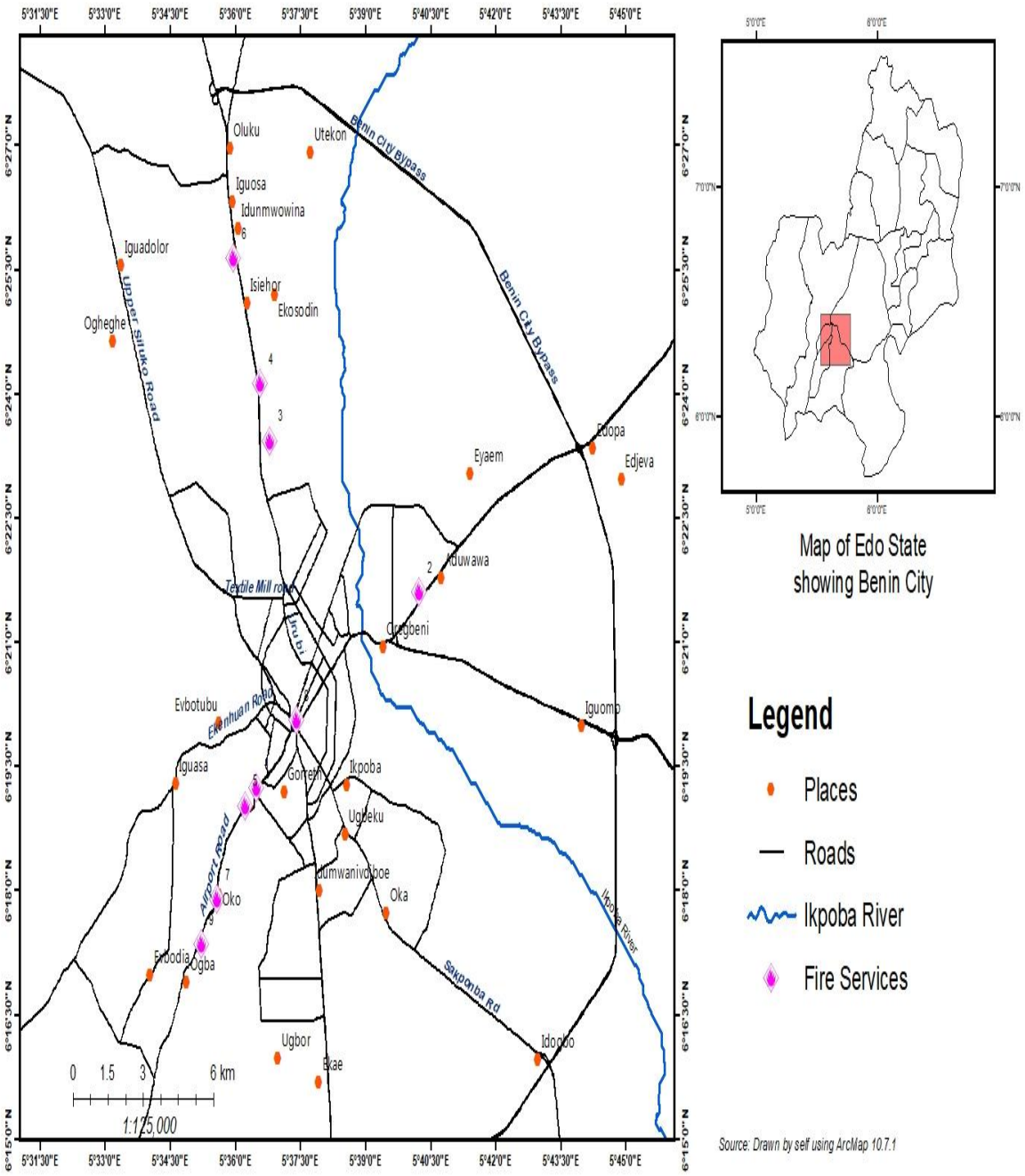

Fig 4.20. Map of Benin City showing the spatial distribution of fire services in Benin City. Source: Google Map reconstructed by Author, 2022.

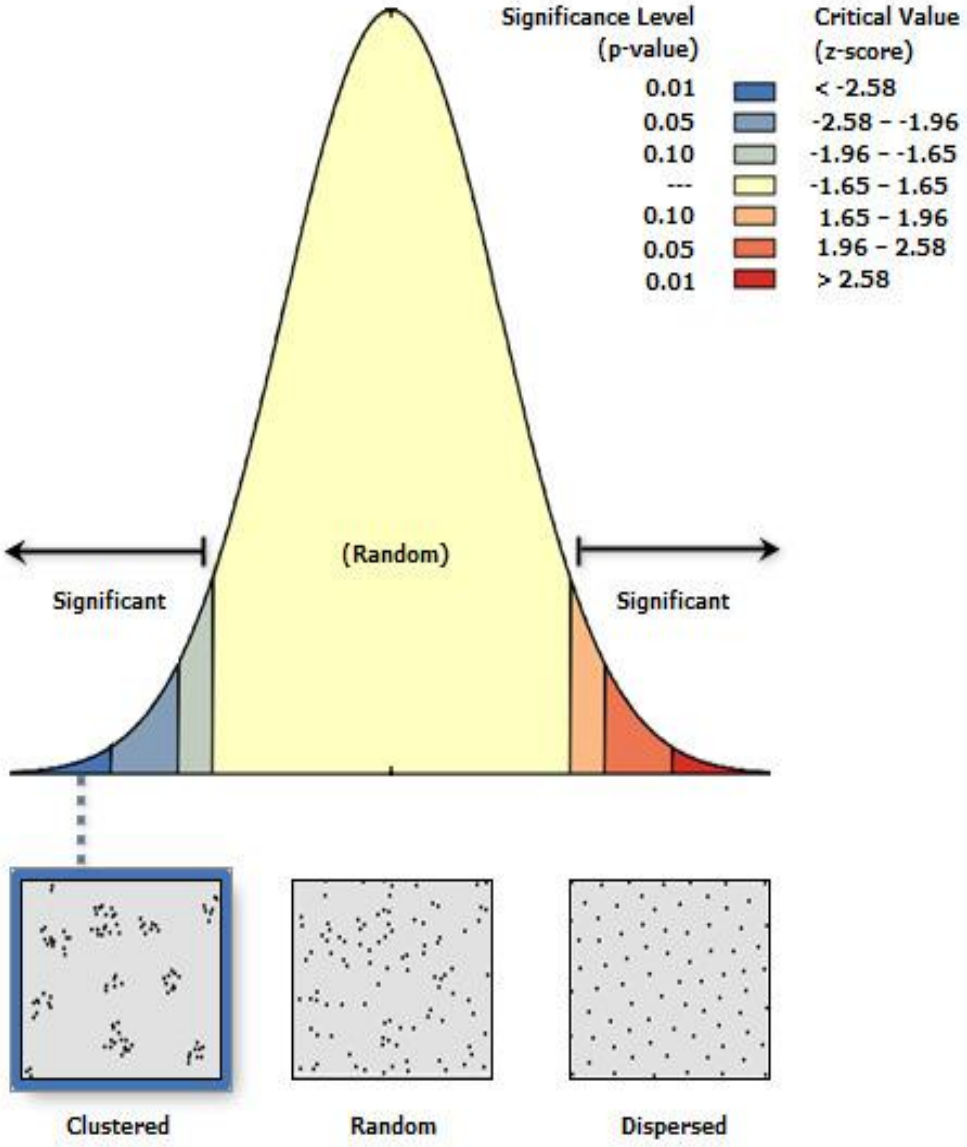

Fig 4.21: Nearest Neighbor Coefficient
Source: Field Survey, 2022

Table 4.23: Average Nearest Neighbor Summary

Observed Mean Distance:	1804.7691 Meters
Expected Mean Distance:	5749.3961 Meters
Nearest Neighbor Ratio:	0.313906
z-score:	-3.937639
p-value:	0.000082

Source: Field Survey, 2022

Table 4.24: Dataset Information

Input Feature Class:	Fire Services
Distance Method:	EUCLIDEAN
Study Area:	1190000000.000000
Selection Set:	False

Source: Field Survey, 2022

4.4 Hypothesis Testing

This section deals with the testing of the stated hypothesis. The hypothesis in its null form is presented below and tested using the nearest neighbor spatial analysis technique.

H_o: The spatial distribution of fire services across space in Benin metropolis is random.

From Figure 4.18, the significant level of the distribution being clustered is (0.01, -0.10) or less than −2.58, while for random it is equal to 1, whereas for a dispersed distribution, it is greater than 2.58. From the nearest neighbor analysis in Figure 4.18, the

nearest neighbor index gave a nearest neighbor Ratio of 0.313906 (less than 1) and a z-score value of -3.937639. This signifies that there is a less than 1% likelihood that this clustered pattern of fire service stations could be the result of random chance and according to the assumption of the nearest neighbor analysis, anything less than one (1) signifies that the spatial distribution of the phenomena under study is clustered.

From the nearest neighbor summary in Figure 4.18, the observed mean distance between fire service stations in Benin Metropolis is 1804.7691 meters, while the expected mean distance is 5749.3961 meters. This signifies that fire service stations in Benin Metropolis are not in close proximity with one another. From this study, given that the nearest neighbor ratio is 0.313906, the distribution pattern of fire service stations in Benin Metropolis is affirmed to be clustered. Following from the above analysis, the null hypothesis which states that the spatial distribution of fire services across space in Benin metropolis is random is rejected and the alternate which states that spatial distribution of fire services across space in Benin metropolis is clustered is accepted.

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This chapter is the findings, recommendations and conclusion of the study.

5.2 Summary of Findings

This study investigated the spatial area distribution and utilization of fire services in Benin City. Various concerns as to the exact positioning of fire services in Edo State, precisely Benin metropolis were properly considered. The utilization of fire services in the study area was also examined. The study also attempted to examine the causes and possible prevention of fire outbreaks alongside the challenges faced by fire services in Benin Metropolis.

Fire has from time immemorial, served as a tool to assist man carry out activities effectively. It is because of fire man is able to cook, get warmth and every other function too numerous to mention. But fire, when not controlled can be a weapon of mass destruction. This is the case of Benin City, where according to this study, fire services are close to residents; and people, especially market men and women who are ignorant and are not properly orientated give space for fire outbreaks, which in turn leads to deaths of human beings and loss of properties.

One of the disasters discussed in this study was that recorded on the 23rd of October 2019 in the Vanguard Newspaper when a popular Santana market along Sapele road was burnt to the ground leaving scraps from properties of inestimable value.

Another event of fire outbreak in Benin City was that published on the 14th of March, 2022 when a building at Plymouth road was razed by fire and properties worth millions was destroyed. These are more are the wrecks that can be caused when fires are left unattended to. From findings of the study, there are only nine (9) fire services in the whole of Benin city, with just five (5) fire service stations in Oredo Local Government Area, one at Ikpoba-okha Local Government, two (2) at Egor Local Government Area and one at Ovia North East Local Government. But seven of these fire stations are serving private functions like covering of office locations and environs, among others.

The map of Benin City shows that Ovia North East is one of the biggest local governments in Edo State and the biggest in Benin metropolis. However, it was found that there was only one fire service station. This implies a gross under service of the entire region in terms of coverage and accessibility of fire service. Although, this study pointed that the level of fire services operations and their response to fire outbreaks is quite okay. However, retrospectively looking at their operations and the level of fire outbreaks in Benin metropolis as elaborated in the statement of the problem, it can be affirmed that fire service are not fully operational in the study area.

Now, can we say the Federal Fire Service Station and the Edo State Fire Service Station are working effectively and are proportional to the population size? There is still a lot the fire services need to do, there seems to be wide gap that should be filled for the people to have easy access to fire services in the State. Fire Services employed for private companies and organizations shouldn't be made for public use. The Federal Government

has work to do, as well as the State Government, in order to reduce the spate of fire outbreaks in Benin City, and Edo State as a whole.

5.3 Conclusion

This study has shown that the Fire Fighting Services in Benin City has achieved some success in combating fire outbreaks. But there is the need for more action so that the impact of the Fire Services would be felt. The effectiveness of the fire services should not only be felt when there is a casualty, they should be active in organizing campaign against fire disasters, orientation programs, seminars and also providing safety kits like fire extinguishers and other materials for residents. If full force is not geared towards achieving this, then there is every tendency for more fire incidents to occur in Benin City and its environs.

5.4 Recommendations

For effective distribution and utilization of fire services in Benin City, some recommendations would be made which is targeted in enhancing the access to fire services and how they should be positioned for effectiveness of service in the area of operations. These recommendations are as follows;

1. **The need for more fire fighters:** This is very crucial. The firefighting workforce should be multiplied. From this study, findings revealed that no fire station from the nine (9) reported that they had up to fifty (50) firemen, except for the Federal Fire Service Station which recorded over fifty (50) men, but not up to one hundred (100) fire fighters.

2. **The need for sub-fire stations:** There is the utmost need for sub –fire stations to be positioned at strategic locations within the area of its operation. For example, the Federal Fire Service Station should have sub-stations in every local government areas of Edo State, then sub-stations should be created on Ward basis or by joining two or more Wards together. If the Federal Fire Service Station is playing that role, the Edo State Fire Service can provide trucks as support to the Federal Fire Service Station and Sub-station and men from Edo State should be inducted into the Firefighting team as they know the whereabouts and happenings around the State and its borders.
3. **The need for orientation for business people, traders and shop owners:** The rise of fires in market places is already becoming a scare. We hardly hear of fire outbreaks in homes, what we hear now is this market was caught up in flames, that market was caught up in an inferno. Therefore, there is the need for proper orientation and safety guidelines for business owners and market people.
4. **The need for provision of fire safety kits:** The Federal Government and State Government should make budgets for the supply of safety kits for residents and shop owners in the State, especially the provision of fire extinguishers and safety jackets, among others.

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APPENDIX A

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

FACULTY OF SOCIAL SCIENCES

UNIVERSITY OF BENIN, BENIN CITY

I am a final year student of the above-named Department. Kindly assist by providing answers to the questions below. The purpose of this questionnaire is to get first hand data for my research work titled **"Spatial distribution and utilization of fire services in Benin City"**. Please be rest assured that your responses will be treated with utmost confidentiality. Please tick √ where appropriate in the boxes or fill in the blank spaces. Thank you.

SECTION A

SOCIO-DEMOGRAPHIC DATA

1. Local Government Area _____

2. Name of fire service _____

3. Year of establishment _____

4. What is your status in this establishment? _____

5. What is your gender? Male ( ) Female ( )

6. What is your age? 18-28 ( ) 29-38 ( ) 39-48 ( ) 48-58 ( ) 59 and above ( )

7. What is your level of education? None ( ) Primary ( ) Secondary ( ) Graduate ( ) Post-graduate ( ) others please specify _____

8. How long have you been working in this fire service? Less than 5 years ( ) 5-10 years ( ) 11-15 years ( ) 16-20 years ( ) 20 years and above ( )

B. General Information

9. Who owns the fire service? Private ( ) Public ( )

10. How many workers are in this fire service?

_____

11. Are you pleased with where it is located? Yes ( ) No ( )

12. Is the fire service accessible? Yes ( ) No ( )

13. Do the workers have shifts in the fire service? Yes ( ) No ( )

14. What area does this fire service cover? _____

15. Is the fire service allowed to answer to calls outside their jurisdiction or state? Yes ( ) No ( )

16. How many firefighter service engines does this fire service have? One ( ) Two ( ) Three ( ) Four ( ) Five ( ) others specify _____

17. How often is fire outbreak in Benin City? Very often ( ) Often ( ) Rarely ( )
18. Which of the following equipments does this fire service have? Fire trucks ( ) Fire hose ( ) Fire hydrant ( ) Fire extinguisher ( ) Smoke detector ( ) Firefighter's helmet ( ) Fire sprinkler system ( ) Gloves ( ) Fire blankets ( ) First aid Kit ( ) others specify _____

19. Does the fire service have an emergency number? Yes ( ) No ( )

20. What is the emergency number? _____

21. Which of these cause fire outbreak the most? You can choose more than one. Lightning ( ) Holiday fireworks ( ) Smoking ( ) Chemicals and gasses ( ) Candles ( ) Appliances and equipment ( ) Children ( ) Electrical systems and devices ( ) others specify _____

22. How many lives are lost to fire annually? _____

23. How much properties are lost to fire annually? _____

24. What are the possible measures taken to prevent fire outbreak?
_____

25. In the aftermath of fire outbreak, what happens to the victims? Get Insurance ( ) Get compensated ( ) Loss of Jobs ( ) Get nothing ( ) others specify _____

26. Is there any guideline regulating the fire service? Yes ( ) No ( )

27. If yes, what are the provisions of the guidelines?
_____

28. What is the source of funding in the fire service? Government ( ) Private ( ) Non-governmental organization ( ) others specify _____

29. How is the security of the fire service? _____

30. Are there fire hydrants available in different areas of Benin City for easy access in putting off fire in cases of fire outbreak? Yes ( ) No ( )

31. Does the fire service face challenges? Yes ( ) No ( )

32. If so, what are the challenges faced by the fire services?

_____

33. What do you suggest as solutions to solving the challenges?

_____

APPENDIX B

DEPATRMENT OF GEOGRAPHY AND REGIONAL PLANNING

FACULTY OF SOCIAL SCIENCES

UNIVERSITY OF BENIN, BENIN CITY

I am a final year student of the above-named Department. Kindly assist by providing answers to the questions below. The purpose of this questionnaire is to get first hand data for my research work titled **"Spatial distribution and utilization of fire services in Benin City"**. Please be rest assured that your responses will be treated with utmost confidentiality. Please tick √ where appropriate in the boxes or fill in the blank spaces. Thank you.

Local Government Area: _____

Name of neighborhood: _____

SECTION A

SOCIO-DEMOGRAPHIC DATA

1. What is your gender? Male ( ) Female ( )

2. What is your level of education? None ( ) Primary ( ) Secondary ( ) Graduate ( ) Post-graduate ( ) others please specify _____

3. What is your Religion? _____

4. What is your income level? Less than 30,000 ( ) 30,000-60,000 ( ) 60,000-90,000 ( ) 90,000-120,000 ( ) 120,000-150,000 ( ) 150,000-180,000 ( ) 180,000-210,000 ( )

SECTION B

General information

5. Are you familiar with any fire service? Yes ( ) No ( )

6. How long have you lived in this neighborhood? Less than 5 years ( ) 6-10 years ( ) 11-15 years ( ) 15-20 years ( ) 20 years and above ( )

7. Has there been fire outbreak in this neighborhood? Yes ( ) No ( )

8. If yes, how many times has there been fire outbreak in the last one year?

_____

9. Do you know the fire service emergency number? Yes ( ) No ( )

10. If yes, what is the emergency number? _____

11. Have you ever called the emergency number during fire outbreaks? Yes ( ) No ( )

12. What is the distance from your house to the nearest fire service station?

_____

13. What are the common causes of fire? Lightning ( ) Holiday fireworks ( ) Smoking ( ) Chemicals and gasses ( ) Candles ( ) Appliances and equipment ( ) Children ( ) Electrical systems and devices ( ) others specify _____

14. Was there loss of lives and properties during the fire outbreak? Yes ( ) No ( )

15. What are the possible measures taken to prevent fire outbreak?

_____

16. What is the response time of the fire service to fire outbreaks? Less than 10 minutes ( ) 10 – 19 minutes ( ) 20 -29 minutes ( ) 30 -39 minutes ( ) 40 minutes and above ( ) they didn't respond ( )

17. How successful were the fire service in putting out the fire? Unsuccessful ( ) fairly successful ( ) successful ( )

18. How was the last fire put out? By the fire service ( ) by neighbors or combination of people to put out the fire ( ) others specify _____

19. Which of the following fire safety equipment/apparatus are available in your residence? Fire alarm ( ) Fire hose and cable ( ) Fire hydrant ( ) Fire extinguisher ( ) Smoke detector ( ) Firefighter's helmet ( ) Fire sprinkler system ( ) Gloves ( ) Fire blankets ( ) First aid Kit ( ) others specify

_____

20. Have you been trained on how to respond to fire outbreaks? Yes ( ) No ( )

21. What do you think about calling the fire service during fire outbreaks in the homes? Very satisfactory ( ) fairly satisfactory ( ) Not satisfactory ( ) Very poor ( )

22. In the aftermath of the fire outbreak, what happens? Insurance pays ( ) victim gets compensation ( ) Loss of Jobs ( ) Get nothing ( ) others specify

_____

23. What do you think are the challenges faced by fire services in Benin City?

_____

24. What should be done to improve the operations of the fire service in Benin City?

_____