ASSESSMENT OF DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS

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DECLARATION

I hereby declare that this submission is my own work towards my MSc degree in Development Planning and Management and that, to the best of my knowledge, it contains no material published by another person or material which has been accepted in any other University for any degree except where due acknowledgement has been made in the text.

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ABSTRACT

Domestic fires is the highest incidence of fire outbreak in Kumasi (GNFS, 2013). In an attempt to address the alarming rate of fire outbreaks in Ghana, the Fire Precaution (Premises) Regulation (2003) LI 1724 was passed to enable Ghana National Fire Service (GNFS) to carry out inspection of proposed and existing premises, review building plan regarding fire safety and issuance of fire certificate. However, the law is enforced only on public buildings like hotels, schools, commercial buildings etc. to the neglect of private domestic residential buildings. This has led to increasing rate of fire outbreaks in Kumasi Metropolis leading to loss of life and property.

As a result, the study sought to assess the management of domestic fires in Kumasi Metropolis. This was achieved through determination of the level of fire safety knowledge and residents' level of compliance with fire safety regulations; evaluate the roles played by the relevant institutions in the management of domestic fires and examine the problems militating against effective management of domestic fires in the Kumasi Metropolis.

Using four purposively selected fire prone areas in Kumasi, a cross-sectional research design was adopted for the study. Both purposive and systematic sampling techniques were used for the study. Primary data obtained from the field were analysed using quantitative tool like tables, cross tabulation, pie chart as well as qualitative techniques.

The study revealed that compliance with and knowledge on fire safety measures are low. The mean compliance of the house owners in the study communities was approximately two (2) meaning that each house owner is likely to comply with two fire safety measures. Poor house address system leads to inaccurate directions hindering prompt response by fire management institutions to fire emergencies.

It is recommended that, Fire Precaution (Premises) regulation of Ghana, 2003 (LI 1724) on residential buildings should be implemented immediately to compel house owners to integrate issues in physical development.

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FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
GIS	Geographical Information System
GMT	Greenwich Meridian Time
GNFS	Ghana National Fire Service
GovHK	Government of Hong Kong
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame Nkrumah University of Science and Technology
LI	Legislative Instrument
LPG	Liquefied Petroleum Gas
NADMO	National Disaster Management Organisation
NFPA	National Fire Protection Association
UK	United Kingdom
US	United States
USA	United States of America
USFA	United States Fire Administration

CHAPTER ONE

INTRODUCTION

1.1 Background

Buildings as infrastructure along with people's lives need protection against fire outbreaks. Knowledge on the use of installed facilities is essential in tackling fire emergencies; otherwise their installation becomes meaningless (Kachenje et.al., 2010). Lack of such knowledge could hamper escape from fire hazards and thwart attempts to contain fire outbreaks at their preliminary stage (Kachenje et.al., 2010).

Safety from fire is a consideration which seems often taken for granted when looking at new building developments or refurbishments, particularly where housing is concerned. The World Fire Statistics has expressed this problem using the term "the banality of fire". Fire should be, of course, far from banal to any society, due to both its economic and human costs (World Fire Statistics Bulletin, 2012).

Costs due to losses from fire, number in the tens of billions globally, and have been roughly estimated as approximately one per cent of global GDP per annum. For Europe as a whole, the annual toll of fire deaths is measured in many thousands (for 2009, almost 17,000 deaths), with those suffering fire injuries numbered at many times more. Ways of protecting inhabitants from these dangers therefore merit serious attention (World Fire Statistics Bulletin, 2012).

It does not matter where one lives or who one lives, fire knows no boundaries**.** A lightning strike, a carelessly discarded cigarette, an abandoned campfire or a wind-driven backyard fire are just some of the ways fire can turn a rural area or a community into flame. That's why wherever one live and work, it's important to practice fire safety in and around the home, neighbourhood, property and business and reduce the risk. Fire outbreaks that carry the danger of causing disasters have been a concern both in urban and rural areas. In urban areas fire has been occurring in buildings used for various purposes including residential, commercial, educational, office space, as well as other mixed purposes. Fire outbreaks affecting urban and semi-urban areas is a phenomenon which deserves much greater attention than it has been given. Responding to fire requires quick decisions and fast actions in a setting that can be loud, smoky, dark, and hot. Lives and property can be saved by being

prepared before fire strikes (Seattle Fire Department, 2006). Seattle Fire Department, (2006) in its study in United States of America (U.S.A) observed that fires produce large amounts of thick, black smoke that obscures vision, causes nausea and may even lead to unconsciousness or death. The study further stressed that, three out of four people who die in residential fires die from smoke inhalation. While fires are often unpredictable, there are many steps necessary to protect the family, and property in the event of a fire.

Each year more than 2,500 people die and 12,600 are injured in home fires in the United States, with direct property loss due to home fires estimated at $7.3 billion annually. For protection, it is important to understand the basic characteristics of fire. Fire spreads quickly; there is no time to gather valuables or make a phone call. In just two minutes, a fire can become life-threatening. In five minutes, a residence can be engulfed in flames. Heat and smoke from fire can be more dangerous than the flames. Inhaling the super-hot air can sear the lungs. Fire produces poisonous gases that make a person disoriented and drowsy. Instead of being awakened by a fire, an individual may fall into a deeper sleep. Asphyxiation is the leading cause of fire deaths, exceeding burns by a three-to-one ratio (U.S. Consumer Product Safety Commission, 2007).

Fire-related accidents often result in injuries and sometimes death, which can be prevented through fire safety training. The United States of America has one of the highest fire death and injury rates in the worlds. More than 4,000 people die each year in home fires. Every year, there are more than 500,000 residential fires serious enough to be reported to fire departments. More than 90 percent of residential fire deaths and injuries result from fires in one and two family houses and apartments. Property losses exceed 4 billion dollars annually, and the long term emotional damage to victims and their loved ones is incalculable (U.S. Consumer Product Safety Commission, 2007)

Involvement in a fire can be a devastating experience and the consequences can be distressing and fatal (Australian Bureau of Statistics, 2000). Fire Protection Association of Australia, (2004) outlined the importance of fire safety knowledge in the community's role in the prevention and preparedness to deal with fire. It is therefore essential that the community is provided with training to retain an adequate level of fire safety knowledge. It is also important that people retain an adequate level

of knowledge about the importance of maintaining functional fire safety equipment (DiGuiseppi *et al.*, 2002).

The British crime survey, (2003) in their study in England and Wales observed that domestic fires account for 22% of total fires in the year 2002/03. Deaths from fires and burns are the third leading cause of fatal home injury (Runyan, 2004). The United State's mortality rate from fires ranks eighth among the 25 developed countries for which statistics are available (International Association for the Study of Insurance Economics, 2009).

United States Fire Administration, (2013) on its study on fires on Residential Building from 2007 to 2011 came out with the fire statistics in table 1.1

Table 1.1 Fire statistics on residential Buildings

Year	Fires	Deaths	Injuries	Dollar Loss
2007	390,300	2,765	13,525	7,764,600,000
2008	378,200	2,650	13,100	8,380,600,000
2009	356,200	2,480	12,600	7,611,800,000
2010	362,100	2,555	13,275	6,856,700,000
2011	364,500	2,450	13,900	6,651,400,000

Source: United States Fire Administration, (2013)

The majority of structure fires in Alaska occur in the home. In 2006, there were 998 reported residential structure fires. These fires caused an estimated direct loss of $30 million. There were 29 civilian injuries, 20 civilian deaths and 14 fire fighter injuries caused by these fires (Tyler, 2006). The total number of reported residential structure fires went up by 8% from the 910 reported in 2005 (Tyler, 2006).

In Ghana, disaster occurrences especially in the urban cities and towns have been brought on largely by the lack of adherence to building code regulations and the weak enforcement of planning laws by the relevant institutions (Africa Adaptation Programme on Climate Change, 2012). Other precipitating factors include the high proportion of the population living in poor quality and overcrowded housing facilities

within slum settlements with high fire risk; outmoded building codes; building on water-ways and hazardous sites which are at risk from floods, earthquakes etc. and poor infrastructure in terms of drainage and road network which inhibit delivery of emergency relief services. These challenges would be addressed through the implementation of the policy objective of minimizing the impact of, as well as the development of adequate response strategies to disasters" (Africa Adaptation Programme on Climate Change, 2012).

In the Accra and Kumasi Metropolitan areas in Ghana domestic fires accounted for 51% and 79% respectively of all reported fire outbreaks in the Metropolis in 2003 (GNFS, 2004 in Ayarkwa et.al., 2010).

1.2 Problem Statement

In Ghana, damage to home and other property is very alarming due to frequent fire outbreaks. Fire outbreak is potentially the most serious hazard that Ghana faces at the moment (Antwi, 2013). According to statistics available at the Ghana National Fire Service, (2013), a total of 7,670 fire outbreaks occurred between January 2008 and June 2010 leading to 102 deaths, 119 injuries and damages worth GH¢23,964,380. The statistics indicated that Greater Accra Region recorded the highest number of fire outbreaks, with 2002 reported cases. The Ashanti Region followed closely with 1,823 fire incidents. The Brong Ahafo and the Central Region recorded 821 and 732 cases respectively, with the Eastern and Western regions recording 494 and 379 cases of fire outbreaks respectively. The Northern, Upper East and Upper West regions recorded 301, 304 and 379 cases of fire outbreaks respectively. The Volta Region recorded the least cases with 42 outbreaks.

In 2012, Ghana recorded 4,577 fire outbreaks resulting in 295 deaths. The cost of damage was estimated at GH¢10,321,963 (Daily Graphic, Monday June 17, 2013). According to Daily Graphic; Saturday June 15 2013, the Ghana National Fire Service (GNFS) recorded 2,201 fire outbreaks nationwide between January and April 2013. These fire outbreaks claimed 18 lives, injured 19 and caused damage to properties estimated at GH¢16 million. The records further indicated that, 773 of the fires were domestic, 232 vehicular, 204 electrical installations, 175 commercial, 38 institutional, 453 bush fires, while the remaining 249 were from other causes.

During the first week of 2013, the Ashanti Region recorded the highest number of 52 fire outbreaks, with the Volta, Upper East and Upper West regions recording the least, of one each (Ghana Business News; Tuesday January 15 2013).

The statistics indicate that domestic fire is the most frequent occurrence of fire outbreaks in Ghana. Ashanti and Greater Accra regions also recorded the highest number of fire outbreaks. However most of the outbreaks in the Ashanti region occur in Kumasi Metropolis. In 2009 alone Kumasi recorded 420 fire outbreaks and out of this, 205 were domestic fire, 62 were commercial, 63 vehicular, 30 industrial, 16 electrical, six institutional and 26 bush fires (Ghana Web; Friday January 22, 2010). The fires claimed six lives and left 311 with various degrees of injuries.

According to the Ashanti Regional Fire Service Department (2013), more than half of the fire outbreak in Ashanti region occurs in Kumasi Metropolis. According to the report, out of seven hundred and sixty four (764) fire outbreaks recorded in the Ashanti region in 2011, four hundred and seventy (470) representing 62% were recorded in the Kumasi Metropolis. In 2012, nine hundred and seventy (970) fire outbreaks were recorded in the Ashanti region; out of which 527 representing 54% occurred in the Kumasi Metropolis. Nine hundred and eight (908) fires recorded (up to October) 2013 in Ashanti region, five hundred and fourteen (514) representing 57% occurred in Ashanti region.

GNFS Report (2013), revealed that domestic fires is the highest incidence of fire outbreak in Kumasi. In 2011, 185 out of 470 fires recorded in the Kumasi Metropolis were domestic fires. This represents 39% of fire outbreak in the Metropolis. The second highest incidence was commercial fires which recorded 19% of fire outbreaks in the Metropolis. In 2012, 247 domestic fires were recorded out 527 fire outbreaks. This represented 47% of the outbreaks in the Kumasi Metropolis. Commercial fires which recorded second highest incidence recorded 19% of the total outbreak. In 2013, 614 fires had been recorded. Out of this, 258 representing 42% were domestic fires. Commercial fire which recorded the second highest outbreak constituted 22.5% of the total outbreak. According to GNFS-Kumasi Metropolis, areas like Agric Nzima, Patase, Tanoso and New Suame are considered as emerging areas with regards to domestic fire outbreaks. Domestic fires lead to property loss, psychological distress, severe and fatal injuries as well as loss of life.

In an attempt to address the alarming rate of fire outbreaks in Ghana, the Fire Precaution (Premises) Regulation (2003) LI 1724 was passed to enable Ghana National Fire Service (GNFS) to carry out inspection of proposed and existing premises, review building plan regarding fire safety and issuance of fire certificate. However, the law is enforced only on public buildings like hotels, schools, commercial buildings etc. to the neglect of private domestic residential buildings. . These problems have led to high rate of domestic fire outbreaks in Ashanti region in general and Kumasi Metropolis in particular which do not only destroy live and properties worth millions of Ghana cedis but also render many people homeless. However, these outbreaks and their effects could have been minimised if residents had had adequate knowledge and preparation on fire prevention, detection and control in their residential areas. There is therefore the need for this study to investigate domestic fire management in the Kumasi Metropolis.

1.3 Research Questions

1. What is the level of fire safety knowledge of the residents of Kumasi Metropolis?
2. What is the residents' level of compliance with fire safety measures as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003)?
3. What are the roles played by the relevant institutions in the management of domestic fires in Kumasi Metropolis?
4. What problems militate against effective management of domestic fires in Kumasi Metropolis?

1.4 Objectives of the Study

The general objective of the study is to assess domestic fire management in Kumasi Metropolis.

1.5 Specific Objective

1. To determine the level of fire safety knowledge of the residents of Kumasi Metropolis.
2. To determine residents' level of compliance with fire safety measures as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003).

3. To evaluate the roles played by the relevant institutions in the management of domestic fires in Kumasi Metropolis.

4. To examine problems which militate against effective management of domestic fires in the Kumasi Metropolis?

1.6 Significance of the study

The study would enhance peoples knowledge on domestic fire management practices in Kumasi Metropolis. It would also help to determine the level of compliance with fire safety regulations as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003). It would also help home owners to know the fire safety measures that must be incorporated in their building plan. The research document produced from the study would serve as a reference material for students, researchers and policy makers. It would therefore shape the debate in fire management regarding domestic fires. Furthermore, the knowledge on where, when, how and why do fires start is essential to ensure appropriate fire policy and management. The ability to understand and predict the patterns of fire ignitions will help managers and decision makers to improve the effectiveness of fire prevention, detection and control. The study would also come out with fire safety standard which can provide a comprehensive document to form the basis of a structured approach to fire safety management. Furthermore, the study identified the fire safety measures which need immediate attention.

1.7 Scope of the Study:

The geographical scope of the study is the fire prone areas within Kumasi Metropolis (Agric. Nzima, Patase, Tanoso and Old Suame).

Contextual Scope: The contextual scope of the study is management of domestic fire. The study looked at fire safety knowledge in the residential areas, compliance to fire safety regulations, institutional measures to manage domestic fires and challenges confronting effective management of domestic fires.

1.8 Organisation of the study

The study is organised into five chapters. Chapter one looks at the introduction of the study which comprised of the background, the problem statement, research questions, objectives of the study, justification and organization of the study. Chapter Two considers the review of the relevant literature for the study. Chapter Three contains

the study profile and methodology employed in achieving the objectives of the study. This includes description of the study area, type and sources of data, sampling method, method of data collection and methods of data analysis. Chapter Four covers presentation, discussion and analysis of results. Chapter Five provides a summary of the key findings for the study, conclusions drawn from the study and policy recommendations.

CHAPTER TWO

REVIEW OF CONCEPTS ON MANAGEMENT OF DOMESTIC FIRES: STRATEGIES AND CHALLENGES

2.1 Introduction

This chapter reviews literature on existing body of knowledge and recorded work produced by researchers and scholars relevant to the current study. The literature review helps researchers to identify research gaps in order to come out with research problem. It also helps to underpin the research work against existing body of knowledge to come out with their strength and weaknesses. Literature review further provides an opportunity to learn more about a given topic and also to create support or a rationale for engaging in a particular area of proposed research. Literature was reviewed on fire management, causes of fire outbreak, domestic fires, fire prevention, fire control and compliance with fire safety regulations.

2.2 Fire Management

The Wildland Fire Management Terminology produced by the Global Fire Monitoring Centre for the FAO defines Fire Management as including "all activities required for the protection of burnable forest and other vegetation values from fire and the use of fire to meet land management goals and objectives", involving "the strategic integration of such factors as knowledge of fire regimes, probable fire effects, values-at-risk, level of forest protection required, cost of fire-related activities, and prescribed fire technology" (Joaquim et.al., 2010)

Global Fire Initiative viewed fire management as "an approach to addressing the problems and issues posed by both detrimental and beneficial fires", by "evaluating and balancing the relative risks posed by fire with the beneficial or necessary ecological or economical roles that it may play", and by facilitating the implementation of "cost-effective approaches of preventing detrimental fires and maintaining desirable fire regimes", recognizing that "managing beneficial aspects of fires may involve various forms of fire use" (Joaquim et.al., 2010).

Risk management can be considered as the identification, assessment, and prioritization of risks followed by coordinated and economical application of

resources to minimize, monitor, and control the probability and impact of unfortunate events or to maximize the realization of opportunities (Hilakivi, 2010).

Fire safety management is a legal responsibility on having control over premises and to take reasonable measures to prevent the occurrence of a fire and to protect the lives and safety of personnel in the event of a fire. The occupants have to be aware of the significance of the responsibilities and of the appropriate action to take in the event of fire (Chow, 2001).

The main objectives of fire safety management are to ensure that in case of a fire: All the fire safety measures provided will be available; Occupants will be able to use the fire safety measures. Occupants will be assisted to escape to a safe place. Maintenance of active systems such as detectors, sprinklers, extinguishers, hose reels and fire hydrants, Re-verification of system performance and of the integrity of system interfaces at regular intervals, Information and drawings on layout, escape routes and information signs for occupants, Good housekeeping such as proper disposal of rubbish and proper use of heat sources like gas cookers (Chow, 2001).

According to Chow, (2001), on his study on review of fire management in Hong Kong reiterated that, for new buildings, fire safety management should be planned at the design stage of fire safety provisions using the 'engineering approach'. The fire safety objectives should be stated clearly in a fire safety manual as proposed. For existing buildings, the fire safety provisions are recommended to be assessed with a ranking system on the passive building design and active fire protection system by comparing with the new fire codes. Fire safety management programme is then worked out with reference to the inadequacy on those hardware provisions. A fire safety plan should be drafted with clear understanding on the fire safety design philosophy and assumptions made. Control by legislation by a single government department is strongly recommended. A fire safety management program should be divided into 8 elements: Inspections, Education and training, Fire suppression, Emergency service, Evaluation of fire possibility, Fire prevention, Reports and record keeping and Communication.

Fires are recurrent disturbances in landscapes. Ecological effects are therefore shaped by fire regimes, namely the collective effects of fire frequency, intensity, season and type (Gill et al. 2002, Gill and Bradstock 2003). Spatial characteristics are also

important. The fire regime at any location reflects the sequence of individual fires that have occurred there, including the characteristics and timing of each fire. Fire regimes are determined by the human, physical and biological characteristics of the landscape—the chance of ignition, the chance of fire spreading across the landscape, plus weather and fuel characteristics. A spectrum of different fire regimes is possible in most ecosystems, reflecting differences in the number, size and circumstances (e.g. weather) of individual fires. The intervals between fires are an important component of fire regimes that are not necessarily apparent to the naked eye. Historical records of fire are therefore important (e.g. mapping fires using remote sensing) for documenting recurrent patterns of fire (Myers et.al, 2004).

Management can affect fire regimes through alterations to rates of ignition, fuel quantity and spread of fires via prevention and suppression activities. The effects of different management activities and strategies on fire regimes are complex, incompletely known and dependent on local factors. Ignition sources vary—fires may start from lightning, or be deliberately or accidentally lit by people. Once started, the spread of fire depends on slope, fuel moisture, and weather (temperature, humidity, and wind), (Myers et.al, 2004).

Over half of the 175 linked unintentional domestic fire-related injuries resulting in hospitalisation occurred on a weekend. Unintentional domestic fire-related injuries also occurred more commonly in the night and evening, with one fifth of the injuries occurring between midnight and 3 a.m., and one sixth between 9 p.m. and midnight, (Duncanson, 2011).

A key issue in fire safety research is identification of the best processes to increase prevalence of installed and functioning domestic smoke alarms. A well-conducted randomised trial of free smoke alarm distribution in inner London found no difference, at follow-up, between intervention and control groups, in terms of smoke alarm installation, residential fire occurrence, or fire-related injury. A key observation in this study was that very few of the alarms provided had been installed, although recipients were provided with contact details to arrange free installation (DiGuiseppi et al., 2002). Inclusion of trained fire-fighters in the installation teams provided opportunity to maximise the impact of the concurrent fire safety messages, delivered within homes.

Behaviour and Fire" which seeks to understand how human behaviour and environment interact to result in casualties, and test design and engineering interventions which could mitigate the effects of fire. O'Connor (2005) notes that; to address the fire safety of occupants in a building, it is important to understand and consider the factors that may influence the responses and behaviours of people in threatening fire. Bruck and Ball (2005) investigated factors associated with residents failing to wake to a functioning smoke alarm. They estimated that in the USA 770 persons per annum die in such circumstances. They observed that children and adults aged over 60 years were the population age-groups who most often stayed asleep in the presence of a functioning alarm.

In laboratory settings the investigators observed the pitch and intensity of sound required to wake people of varying ages. Only 57 percent of children aged 6-10 years woke to the standard 3000Hz signal at 89dB usual in domestic smoke alarms. In contrast 94 percent of the children in this age group woke to a lower pitched (500-2580 Hz) alarm, and to their mother's voice or a female actor's voice saying the child's name every 6 seconds (all stimuli at 89dB). With the frequency stable at 3000 Hz, the average auditory arousal threshold for participants was over 100 dB for children aged 5-7 years, and 97 dB for children aged 13-16 years. Adults aged 20-24 years woke at an average threshold of 67.8 dB. These observations are important. However any change to the standard alarm parameters will need to ensure that the current efficacy of alarms for the adult population is not compromised in any way (Lee et.al., 2004).

As the responsible person for premises providing residential care one should be fully aware of the need to manage his/her premises well to ensure the safety and well-being of residents from fire at all times. Residents must be trained to prevent or limit the risk of fire, recognise and neutralise potential fire hazards, and know how to respond to an emergency individually and collectively by actions and communications. Good management of fire safety is essential to ensure that fires are unlikely to occur; that if they do occur they are likely to be controlled or contained quickly, effectively and safely; or that, if a fire does occur and grow, residents are able to ensure that everyone in the premises is able to escape to safety easily and quickly, or remain in safety. One therefore need to have robust and well-kept procedures to avoid fires occurring, to maintain the fire safety systems installed in his premises, to keep escape routes

usable, to keep occupants up to date and well trained, and have emergency plans in place so that everyone knows how to respond to a fire in the premises (Norwich Information Policy Team, 2006).

A fire risk assessment will help one to determine the chances of a fire starting and the dangers from fire that the premises present for the people who use them and other people in the immediate vicinity.

Fire Risk Assessment

Figure 2.1: The five steps of a fire risk assessment

1. **Identify fire hazards:** ▪ Sources of ignition ▪ Sources of fuel ▪ Sources of energy
2. Identify people at risk ▪ People in and around the premises
3. **Evaluate, remove, reduce and protect from risk** ▪ Evaluate the risk of fire occurring ▪ Evaluate the risk to people from fire ▪ Remove or Reduce fire hazards ▪ Remove or reduce the risks to people • Detection and warning • Fire fighting • Escape routes • Lighting • Signs and notices • Maintenance
4. **Record, Plan, inform, instruct and train** ▪ Record significant findings and action taken ▪ Prepare an emergency plan ▪ Inform and instruct the relevant people; co-operate and co-ordinate with others ▪ Provide Training
5. Review ▪ Keep assessment under review ▪ Revise where necessary

Source: Norwich Information Policy Team, (2006).

2.3 Fire management Models

Fire modelling has been a way to reduce the amount of observations necessary for understanding and predicting fire behaviour. Modelling approaches can be reduced to two: empirical and physically-based. Empirical fire behaviour models are established on the basis of a reasonable number of fire observations and predict the rate of spread or flame size of a fire (Sullivan 2009 cited in Joaquim et.al, 2010).

Physically-based models are based on the principles of combustion and they attempt to quantify the basic fire mechanisms. It has only been in the last decade, however, that a full representation of wildfire physics has been able to give predictions of fire spread. The so-called full physical models enable three-dimensional (3D) simulations of fire spread at the scale of a forest stand (<20 ha), but usually on super-computers. These models solve the transport equations of physics over time on a spatial grid, and predict many fire characteristics. Despite the fast development of computer resources, it is not practical – so far and in the near future – to use this new generation of physically-based models to simulate fire at larger scales (10 km2) with resolutions on the order of meters or smaller. The other aspects of these types of model, which limit their applicability is the accessibility of the large amounts of vegetation and atmospheric data that they require. Two-dimensional (2D) fire simulators have been developed in parallel to provide decision-makers with powerful tools capable of predicting and mapping fire behaviour in real conditions. Currently, GIS-based fire simulators can automatically compute fire growth under heterogeneous conditions of terrain, fuels and weather (Sullivan 2009 cited in Joaquim et.al, 2010).

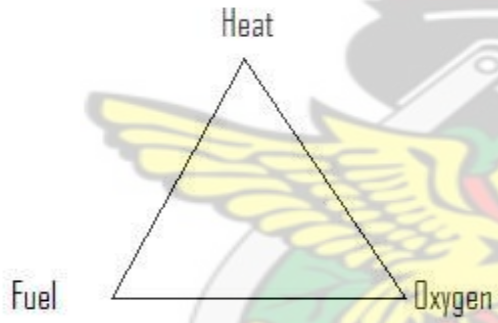
2.4 Causes of Fire Outbreak

In British Columbia, an average 48% of all wildfires are caused by human activity. Wildfire is also a natural phenomenon. Nearly 52% of British Columbia's wildfires are caused by lightning strikes (Fire Smart Manual 2009). Over 90 per cent of fire outbreaks in Nigeria are caused by human negligence, which can be prevented through changing the values, cultures and practices of the people. "Fire outbreak has remained a major disaster not only in Nigeria but the world over. Some of these fire disasters are caused as a result of power surges from electrical wires (Giwa, 2012). In his study in Alaska, U.S. A, Tyler (2006) concluded that the top three leading causes of residential structure fires (excluding unknown which was a reported 28% of all residential structure fires) in 2006 were heating and cooking. For a fire to start, three

things are needed: a source of ignition; fuel; and oxygen. If any one of these is missing, a fire cannot start. Taking measures to avoid the three coming together will therefore reduce the chances of a fire occurring. The remainder of this step will advise on how to identify potential ignition sources, the materials that might fuel a fire and the oxygen supplies that will help it burn (Department for Communities and Local Government 2006).

Naturally fire occurs when all the three elements for combustion are present. Collectively called the fire triangle, fuel, heat and oxygen in their right proportions are essential for any fire to ignite and sustained. Ultimately fire can be prevented or extinguished by removing any one of the elements in the fire triangle (Twumasi, 2013). These three causes of fire is known as the fire triangle. Fig 2.2 shows a fire triangle.

Fig 2.2 Fire Triangle



Source: Adopted from Department for Communities and Local Government, London, (2006)

Department for Communities and Local Government, London, (2006) identified potential ignition sources, the materials that might fuel a fire and the oxygen supplies that will help it burn.

Sources of Ignition

One can identify the potential ignition sources in premises by looking for possible sources of heat which could get hot enough to ignite material found in the premises. These sources could include: smoking materials, e.g. cigarettes, matches and lighters; naked flames, e.g. candles or gas or liquid-fuelled open-flame equipment; electrical, gas or oil-fired heaters (fixed or portable); cooking equipment; faulty or misused

electrical equipment; lighting equipment; equipment owned or used by residents; hot surfaces and obstruction of equipment ventilation,e.g. photocopiers; hot processes, e.g. welding by contractors; arson, deliberate ignition vandalism among others.

Sources of Fuel

Anything that burns is fuel for a fire. One needs to look for the things that will burn reasonably easily and are in enough quantity to provide fuel for a fire or cause it to spread to another fuel source. Some of the most common 'fuels' found in premises providing residential care are: laundry supplies, such as bedding and towels, and medical supplies, such as disposable aprons; toiletries, aerosols; plastics and rubber (e.g. soft play or restraint areas), video tapes, polyurethane foam-filled furniture, foam-filled mats and polystyrene-based display materials; wood or wood-based furniture (permanent and temporary storage); textiles and soft furnishings, such as spare clothes and hanging curtains; private belongings, such as toys; seasonal and religious occasion decorations, such as Christmas decorations; items used in hobbies and crafts; flammable products, such as cleaning and decorating products, petrol, white spirit, methylated spirit, cooking oils, disposable cigarette lighters and photocopier chemicals; flammable gases such as liquefied petroleum gas (LPG); paper products, packaging materials, stationery, advertising material, paper and books; waste products, particularly finely divided items such as shredded paper and wood shavings, off cuts, and dust; and waste storage, refuse containers and skips. One should also consider the construction of the premises, and the materials used to line walls and ceilings, and how these might contribute to the spread of fire. You should check if the internal construction includes large areas of;

• hardboard, chipboard, block-board walls or ceilings;

• synthetic ceiling or wall coverings, such as polystyrene wall or ceiling tiles;

• flooring of polypropylene carpet or carpet tiles; or

• particular fixtures and fittings.

The presence of these materials may pose danger to fire safety management.

Sources of Oxygen

The main source of oxygen for a fire is in the air around us. In an enclosed building this is provided by the ventilation system in use. This generally falls into one of two categories: natural airflow through doors, windows and other openings; or mechanical air conditioning systems and air handling systems. In many buildings there will be a combination of systems, which will be capable of introducing/extracting air to and from the building.

According to Pang and Chow (2011), the top three causes of fire are careless handling or disposal of cigarette ends, matches and candles, food stuff (stove overcooking) and general electrical faults. According to them, over 80% of the fire cases were due to improper action of the occupants. These activities are commonly found in domestic buildings and public housing estates, matching with the fire cases classified according to the premises.

Seattle Fire Department, (2006) in its study in the United States of America observed that, cooking is the leading cause of home fires. In Seattle, cooking causes more fires than any other source. Over a third of all fires in multi-residential buildings started in the kitchen. The majority of these fires began from food left unattended on the stove. The most common materials ignited are grease, oils, and flammable items such as plastic bags and paper products left on or near the stove.

The study further revealed that, heaters are the second leading cause of fires in residential buildings. As would be expected, most heating-related fires occur during the winter months when heaters get turned on and the use of portable heaters and fireplaces increases. Fires caused by furniture, bedding, and other materials placed too close to baseboard heaters and portable heaters are the most common types of heating-related residential fires.

Currently, 95% of the fires in Europe are directly or indirectly caused by human behaviour and activities. Among the fires with known causes, 51% were intentionally caused, 44% started by negligence or accident, and only 5% had natural causes (mainly lightning). Some of the major anthropogenic causes of wildfires in Europe are associated with land management, such as the burning of agricultural and forestry residues, land burning for pasture renovation or the use of machinery. However, there

are many other factors that are also known to cause fires, including arson, accidents with electric power lines and railways or the fire use associated with forest recreation (Joaquim et.al., 2010). Most fires in homes start in the kitchen as a result of people being careless with appliances or being distracted for a moment while cooking. Nearly twenty (20) people a day are killed or injured in kitchen fires (Fire prevention hand book, 2005). One of the causes of fire outbreak is carelessness. This happens when fire is not taken seriously by the person handling it. Some careless behaviour that can cause fire outbreaks include:

- Faulty electrical wiring, this is one of the main causes of fire disasters. Using thin cables for house wiring, in order to save cost can cause heating, which can ignite the insulation and spark off a fire disaster.

- Falling asleep while you are cooking can also cause a fire outbreak, as much as is possible avoid cooking when you are tired
- Leaving rubbish and trees near your house. This is very important during the dry season or summer. Bush fire may mistake your house as part of the bush
- Careless use of candles and other naked flames. Avoid the use of candles for illumination as much as is possible. Use candles only for your religious rituals or romantic dinners and turn them off afterwards
- Irresponsible use of fireworks can also cause fire outbreaks. Fireworks should be aimed only at the skies. Aiming your fireworks to any other direction can cause a fire disaster. The fireworks might hit an inflammable substance and cause an explosion that will initiate a fire disaster
- Pouring kerosene into the kerosene tank of your kerosene lamp while the kerosene lamp is lit. This may cause an explosion that can ignite a fire
- Storage of fuel or other inflammable substance around the house or through the part were naked fire may pass
- Smoking near inflammable substance

Another cause of fire disasters is ignorance. Poor awareness of what fire is and how it can be prevented has led to a lot of fire outbreak. Information about fire, how to prepare for fire disasters and how to prevent fire disasters can be found in many books on fire. Fire requires fuel, oxygen and heat to burn. Elimination of any of these

elements will extinguish any fire no matter how intense it is. A good knowledge of fire will enable you to know the possible fire risk areas in your house. It will also enable you to understand how to prepare for a fire disaster and how to prevent fire disasters. Being ignorant of fire fighting gadgets will make you to ignore gadgets that can save your property during a fire outbreak. Ignorance will also make you to compromise with buying a fire insurance policy (Beatthefire, 2006).

Arson is yet another cause of fire outbreaks. Ones house can be set on fire during a riot, strike or social unrest fire outbreaks due to arson are often beyond ones control. Also, ones political and religious views can make his property a target for arsonist. Accidents do occur sometimes. When all necessary precautions have been taken accidents can still occur. This is often beyond your control. Electrical sparks can occur, lightening and more can cause fire outbreaks. Knowing the causes of fire empowers you to prevent it (Beatthefire, 2006).

Abubakar, (2012) identified the causes of domestic fire as*;* Smoking in bed or beside flammable substances; Re-ignite cigarette not properly extinguished; Faulty wiring and reckless use of electrical appliances; Unattended stove and gases; Children playing with matches; Careless use of candle; Storage of hazardous chemical and other flammable materials around the house; The use of cheap and defective equipments; Pouring kerosene into the kerosene tank of a lamp while the lamp is lit and Falling asleep while cooking. According to U.S. Consumer Product Safety Commission, about 120,000 residential fires still are caused by supplemental heaters. The two most common heat sources in residential structure fires resulted from human acts of intention, error or carelessness (Tyler, 2006).

All the causes of domestic fires identified can be summarised and categorised into three main causes based on how the ignition started. The three categories are, ignorance, accidental and carelessness.

2.5 Fire Safety Precautions

The National Building code of Canada defines fire safety as, an objective to reduce the probability that a person in or adjacent to a building would be exposed to an unacceptable fire hazards as a result of the design and construction of the building (Canadian Wood Council, 2002). Frederick and Ricket, (2001) identified two distinct aspect of fire protection: life safety and property protection.

According to Ayarkwa et.al (2010), The British Standard Institution (1997), stipulates some basic considerations intended to provide safety from fire. According to the report, these are achieved by promoting safe aspects of design, construction, and management in the following areas.

- Planning and protection of escape routes from any area that may be threatened by fire.
- Construction and finishing with suitable fire resistant materials.
- Segregation of high fire risk areas
- Fire waiting systems and where appropriate, system for automatic detection of fire
- Smoke control measures to maintain the effectiveness of escape routes and to assist fire fighters
- The provision of fire fighting equipment

The Fire Precautions Regulations implement the general fire safety provisions of a country. The Regulations provide for minimum fire safety standards in places where people reside.

Fire Protection depends on the functional occupancy activity particularly in domestic and industrial environments. The principle however seeks to consider fire as a potential hazard both internally and externally and to provide applications to deal with the safety and protection of life and property (Africa Adaptation Programme on Climate Change, 2012).

Provisions in building codes ensure certification of safety of buildings against natural disaster by engineer and structural engineer. This includes detailed town planning norms for various amenities, medical facilities, distribution services, police, civil defence and home guards and fire services, Fire safety norms completely revamped through detailed provisions on Fire Prevention, Life Safety and Fire Protection, Substitution of halon based fire/extinguishers and fire fighting system. The regulation must also regulate the fire resistance of all building with regards to construction methods and systems. It must also be prescriptive on material application, material standards and the constructive environment (Africa Adaptation Programme on Climate Change, 2012).

According to the Fire Safety (Buildings) Ordinance Cap. 572, an owner or occupier of a composite or domestic building may be required to provide all or any of the following fire service installations and equipment: automatic sprinkler system; fire hydrant and hose reel system; manual fire alarm system; emergency lighting; and automatic cut-off device for mechanical ventilation (GovHK, 2012). An owner may be required to comply with all or any of the following fire safety construction: means of escape; fire resisting construction; and means of access for fire fighting and rescue (GovHK, 2012).

2.5.1 Protective Measures

Fire safety assessment should identify a specific range of protective measures that are appropriate for the particular type of premises and usage of the premises. The combination of measures will vary with the application but the following is a list of topics that need to be considered: Structural and passive fire protection, Fire detection and warning systems, Means of escape (escape routes), emergency escape lighting, Signs and notices, Fire fighting equipment and facilities, Kitchen fire suppression systems, Sprinkler and other water-based extinguishing systems, Gaseous extinguishing systems, Other fixed fire extinguishing systems, Recording, planning, informing, instructing and training (Fire Industry Association, 2011). Fire Protection to a large extent depends on the functional occupancy activity particularly in domestic and industrial environments. The principle however seeks to consider fire as a potential hazard both internally and externally and to provide applications to deal with the safety and protection of life and property. The major applicable considerations are building envelop, environmental conditions, ventilation, material technology, access and circulation, open space planning (Africa Adaptation Programme on Climate Change, 2012).

Fire Prevention Hand book, (2005) identified the following fire safety precautions for public and residential buildings.

- Fit smoke alarms on each level in your home. Keep them free from dust and test them once a week. Consider buying a 10-year alarm, otherwise change the batteries in your alarm every year
- Make a fire action plan so that everyone in your home knows how to escape if there's a fire.

- Keep the exits from your home clear so that people can escape if there's a fire. Make sure that everyone in your home can easily find the keys for doors and windows.
- Take extra care in the kitchen accidents while cooking account for over half of fires in homes. Never leave young children alone in the kitchen.
- Take extra care when cooking with hot oil. Consider buying a deep-fat fryer which is controlled by a thermostat (if you don't already have one).
- Never leave lit candles in rooms that nobody is in or in rooms where children are on their own. Make sure candles are in secure holders on a surface that doesn't burn and are away from any materials that could burn.
- Make sure cigarettes are stubbed out properly and are disposed of carefully, and never smoke in bed.
- Get into the habit of closing doors at night. If you want to keep a child's bedroom door open, close the doors to the lounge and kitchen. This may well help save their life if there is a fire.
- Don't overload electrical sockets. Remember one plug for one socket.
- Keep matches and lighters where children can't see or reach them.
- Take special care when you're tired or when you've been drinking.
- Don't leave the TV or other electrical appliances on standby as this could cause a fire. Always switch them off and unplug when not in use.

Escape routes/doors and fire fighting facilities are not useful unless users of the buildings know how to use them. A study by Kachenje et. al., (2010) on the Assessment of urban fire risk in the central business district of Dar es Salaam, Tanzania revealed that an average of 66% of the occupants in the buildings surveyed did not know how to operate the various items of fire equipment/facilities available in the buildings.

2.5.2 Signs and Notices

In order for occupants, particularly those who are unfamiliar with the building, to use the building safely, there is normally a need to provide fire exit signs to direct people towards alternative means of escape (Fire Industry Association, 2011). It is therefore important to consider the adequacy of such signage in the fire risk assessment. In the course of the fire risk assessment, there is also a need to consider whether other forms

of fire safety signs and notices are necessary, and whether existing signs are adequate. Examples include:

• Safe condition signs, e.g. indicating the use of escape hardware
• Signs on fire doors indicating the need for doors to be shut, kept locked shut or kept clear as appropriate
• Other mandatory signs such as those indicating the need to keep a fire exit clear
• Fire equipment signs primarily where equipment is hidden from direct view, e.g. fire extinguishers
• No smoking signs
• Fire procedure notices

All signs and notices will need illumination to ensure they are conspicuous and legible. They may be externally illuminated or internally illuminated. Signs or notices of the photo-luminescent type need a period of exposure to light before they become visible in darkness (Fire Industry Association, 2011).

2.5.3 Fire Detection and Alarm Systems

Fire in premises must be detected quickly and a warning given, allowing people to escape safely. Fire can be detected by people and manual fire detection may be all that is required. However an automatic fire detection and alarm system is normally considered necessary in the following buildings/situations: Buildings in which people sleep, covered shopping complexes and large or complex places of assembly, buildings with phased evacuation as a means of automatically operating other fire protection measures such as closing fire doors, the release of electronically locked doors or initiation of smoke control systems (Fire Industry Association, 2011).

Smoke alarms should be installed in each bedroom and there should be at least one on every floor of your home. These devices make noise that is loud enough to wake you in the event that there is smoke or a fire in your house (United State Fire Administration, 2013).

Many fire deaths and fire injuries are actually caused by smoke and gases. Victims inhale smoke and poisonous gases that rise ahead of the flames. Survival depends on being warned as early as possible and having an escape plan (U.S. Consumer Product Safety Commission, 2007).

According to the report, at least one smoke detector must be located on every floor of any house. Smoke detectors must be placed near bedrooms, either on the ceiling or 6-12 inches below the ceiling on the wall. Smoke detectors are tested according to manufacturer's instructions on a regular basis (at least once a month) and are kept in working condition at all times. Batteries are replaced according to manufacturer's instructions, at least annually. Batteries are never disconnected. The detector has a distinct warning signal that can be heard whether asleep or awake. Over one-third (37%) home fire deaths occur in homes without smoke alarms (Ahrens, 2011).

According to the Department for Communities and Local Government, (2008), ninety (90) people die each year because the battery in their smoke alarm was flat or missing. The easiest way to protect ones home and family from fire is with a smoke alarm.

Nixon and Diemler, (2012) observed that smoke alarms are an important tool in detecting a fire and keeping ones family safe. A properly installed smoke alarm decreases one and his family member's chance of dying by half.

In his study in Alaska; U. S. A, Tyler, (2006) concluded that, the 20 civilian residential fire deaths occurred in 16 separate fire incidents. Of these 16 residential structures 4 had a smoke alarm present; however, only one of them was in working condition. Nine or 56% did not have a smoke alarm present. In the remaining three residential homes, the smoke alarm presence was reported as undetermined.

2.5.4 Means of Escape

Means of escape are provided to facilitate evacuation in the event of an outbreak of fire. When considering fire management issues, one need to take into account the effects of fire on escape routes; considering how quickly fire could be detected, how quickly it may grow; how it could affect the escape routes; and how quickly people in the building are likely to respond to an alarm. In general, adequate means of escape are provided if people can immediately, or within a short distance of travel, turn their back on any fire and move away from it to a final exit along smoke-free escape routes. It is important to consider how many people will use the escape route and make arrangements for disabled or elderly people. The escape route should be as short as possible and the impact of a blocked escape route must be considered. Of course, precautions should be taken to ensure this does not happen. Emergency lighting and escape route signage should be installed and all employees and occupants must be

informed and trained in how to escape from the building (Fire Industry Association, 2011). There are several critical factors in the assessment of means of escape: Maximum distance occupants must travel to reach a place of relative or ultimate safety such as an exit to a protected stairways or a final exit, Avoidance of long dead ends in which escape is only possible in one direction, Number, distribution and width of story exits and final exits, Means of protecting the escape routes from build up of smoke that might prevent occupants escaping, Ability of occupants to use the escape routes especially arrangements for people with disabilities.

In large or complex buildings, the advice of specialists on the adequacy of means of escape will often be necessary (Fire Industry Association, 2011). Emergency routes and exits should lead as directly as possible to the open air away from the workplace or to a safe area, be adequate for the type of workplace and the people likely to be in it, be able to be quickly and safely used in the event of a power failure.

Department for Communities and Local Government, (2008) reiterated that one must Plan an escape route and make sure everyone knows how to escape. One should make sure exits are kept clear and think of a second route in case the first one is blocked. Few minutes must be taken to practice ones escape plan and review the plan if the layout of the home changes.

According to U.S. Consumer Product Safety Commission, 2007, when one has complied with every item in 'Home Fire Safety Checklist', one still need to have a plan for early warning and escape in case a fire does occur. Many fire deaths and fire injuries are actually caused by smoke and gases. Victims inhale smoke and poisonous gases that rise ahead of the flames. Survival depends on being warned as early as possible and having an escape plan.

Department for Communities and Local Government (2008) , observed that all premises must Plan an escape route and make sure everyone knows how to escape and make sure exits are kept clear. The best route is the normal way in and out of your home. One should think of a second route in case the first one is blocked. Some minutes must be taken to practice the escape plan and review the plan if the layout of the home changes.

2.5.5 Fire Lighting System

According to the Fire precaution regulation of Scotland, (1997), escape routes need to be adequately lit. It further stressed that if the route depends on artificial lighting or if the place is used during the hours of darkness, one may need to consider alternative sources of illumination should the power fail during a fire outbreak. If ones premises is reasonably illuminated by street lighting, that should meet the need. In small workplaces it may be appropriate to provide torches which staff can use if the lighting fails. But it would be necessary to install one or more battery-operated emergency lights which will automatically come on should the mains lighting fail. The use of candles, cigarette lighters or matches as emergency lighting should not be considered.

Emergency lighting operates automatically when the normal lighting fails in order to aid safe escape. The emergency lighting system should be designed to cover escape routes, exits, intersections of corridors, near fire alarm call points, near fire fighting equipment, stairway enclosures and changes in floor level and direction. The primary purpose of emergency lighting (or emergency escape lighting) is to illuminate escape routes but it is also provided to illuminate signs and other safety equipment. The size and type of your premises and the risk to the occupants will determine the complexity of the emergency lighting required. In larger more complex premises a comprehensive system of fixed automatic escape lighting is likely to be needed. This will be particularly true in premises where there are significant numbers of staff or members of the public. If escape routes require artificial illumination, one needs to consider whether emergency lighting is necessary (Fire Industry Association, 2011).

2.5.6 Fire Fighting Equipment and Facilities

Fire safety management may identify the need for fire fighting equipment such as: Portable fire extinguishers, Fire blankets, Fire buckets, Hose reels, Sprinkler systems, Water mist systems, Water spray systems, Gaseous fixed fire extinguishing systems, Foam systems,

Powder systems, Kitchen fire suppression systems, Facilities for use by fire fighters including fire mains, fire fighting lifts and fire fighters switches for high voltage, illuminated signs (Fire Industry Association, 2011).

Portable Fire Extinguishers

Critical parts of UK fire legislation are the general fire precautions or fire safety measures that the responsible person will need to take to comply with the law. Key measures of these general fire precautions can, in part, be met by the adequate provision of portable fire extinguishers, the application of a suitable system of maintenance and effective training in their use. Portable fire extinguishers are able to control or extinguish small fires, preventing them from developing into big ones before Fire & Rescue Service arrive. Portable fire extinguishers are valuable in the early stages of fire because of their portability, immediate availability and easy use by one person People are not expected to deal with a large fire, since extinguishers are essentially first aid fire fighting appliances of a limited capacity. But their ability to help contain the spread of fire may be vital until the Fire and Rescue Service arrive.

The capability to contain and prevent the spread of small fires is an essential tool in meeting general fire precaution measures or fire safety measures required by law. Portable fire extinguishers can reduce the likelihood of the spread of fire on the premises and mitigate the effects of the fire on people, property and the environment. Fire fighting equipment should be simple to use, essentially, a pull-pin, point and squeeze handle operation. This makes them easy for anyone to use. However, the usefulness of portable fire extinguishers depends on people knowing how to use them. All modern extinguishers have clear instructions on them.

Where there are employees some, and preferably all, should be provided with formal training.

Various types of portable fire fighting equipment are available, ranging from the simple fire bucket with water or sand through to water-based extinguishers as well as foam, powder, Carbon dioxide (CO2) and wet chemical extinguishers (Fire Industry Association, 2011).

Fire Code requirements specify the size, number and location of fire extinguishers within ones facility. These requirements help establish a protection level appropriate for the hazard class of the building. One should make sure he or she knows the types, sizes and maintenance requirements of his extinguishers, as well as the basics of extinguisher operation (Seattle Fire Department, 2006). Fire extinguishers shoot out a

jet to help control a fire. They are quick and simple to use, but always read the instructions first (Department for Communities and Local Government, 2008).

Fire Blankets

These are lightweight sheets of fire-resistant material which are used to cover a fire to cut off its oxygen supply or to wrap around a person whose clothes are on fire.

Fire blankets are used to put out a fire or wrap a person whose clothes are on fire. They are best kept in the kitchen. Fire blankets, along with fire extinguishers, are fire safety items that can be useful in case of a fire. These non-flammable blankets are helpful in temperatures up to 900 degrees and are useful in smothering small fires by not allowing any oxygen to the fire. Due to its simplicity, a fire blanket may be more helpful for someone who is inexperienced with fire extinguishers (Fire Prevention Hand book, 2005).

Small fire blankets, often made of fire-treated synthetic materials, are best for home use. Larger fire blankets made of fire retardant wool are often used in industrial situations, although most fire blanket manufacturing is moving to synthetic materials for greater fire safety. Do not throw a fire blanket over a fire. The chances are high that you will miss the fire, but be unable to retrieve the fire blanket, (Department for Communities and Local Government, London, 2006).

Every building should have a fire blanket inside for safety reasons, and everyone in the building should know how to use it. The use of a fire blanket can save the life of a person whose clothes have caught on fire. It can also be used to put out any small fire that cannot be put out with water alone. Here is the technique to use a fire blanket effectively. Put on the fire-resistant gloves, if available. Unfold the fire blanket so that it is completely opened. Hold the fire blanket with your hands wrapped in the top edge of the blanket. This will protect your hands from the heat and flames. Completely cover the flames with the fire blanket by throwing the blanket on top until the fire goes out. Put flames out on a person's clothes by wrapping the fire blanket around the victim. Let the fire blanket cool completely for 30 minutes to 1 hour after the fire is out. Fold it back up for storage. Most fire blankets are designed to be reused, (Department for Communities and Local Government, London, 2006).

Covering a fire with a fire blanket removes the "oxygen" part of the fire triangle and can extinguish a fire. This is the reason why doors and windows must be shut whenever there is fire in a building. The rampant outbreak of fire in the country during the dry and hot seasons especially from November to April is due to the excessive heat (Twumasi, 2013).

2.6 Prevention of Fire Outbreak

Abubakar, (2012) on his article on causes and preventions against fire outbreak in Nigeria identified fire preventive measures as:

- Avoid smoking in bed, and ensure that cigarettes are put in water before disposal so that they will not re-ignite.
- Never leave cooking pots and pans unattended even for a short while.
- Store hazardous materials such as flammable liquids and gases, paints and chemicals in safe places.
- Never leave burning candles unattended, and avoid placing them near air vent, plastic, carpet etc.
- Always put off kerosene lamp before refilling its tank.
- Never forget to turn off and unplug your electrical appliance after use.
- Avoid placing flammable substances near sources of heating like the store, fire place, or furnace.
- Keep matches and other fire-ignited means out of reach of children.
- Ensure that certified electrical engineers are employed to supervise house wiring.
- Avoid cooking when you are tired

Department for Communities and Local Government (2008) identified the following preventive measures to fire outbreak: Close inside doors at night to stop a fire from spreading. Turn off and unplug electrical appliances unless they are designed to be left on – like freezer. Make sure your cooker is turned off. Don't leave the washing machine on. Turn heaters off and put up fireguards. Put candles and cigarettes out properly. Make sure exits are kept clear. Keep door and window keys where everyone can find them.

Nixon and Diemler (2012) identified the following preventive measures against fire outbreak:

- Use caution when using alternative heating sources.
- Check with your local fire department on the legality of using kerosene heaters in your community. Be sure to fill kerosene heaters outside, and be sure they have cooled before filling.
- Give space heaters space. Keep space heaters at least three feet away from combustible materials. Make sure the floor and nearby walls are properly fire rated.
- Use only the type of fuel designated for your heating appliance and follow manufacturer's instructions.
- Store ashes in a metal container outside and away from your residence.
- Do not place ash containers on decks made of wood or composite materials.
- Keep open flames away from walls, furniture, drapery, and combustible items.
- Keep a screen in front of the fireplace.
- Have heating units inspected and cleaned annually by a reputable professional.
- Keep matches and lighters up high, away from children. If possible, keep them in a locked cabinet.
- Never smoke in bed or when drowsy or medicated.
- Provide smokers with deep, sturdy ashtrays.
- Do use cigarette and cigar butts with water before disposal.

GovHK (2012) in its study in HongKong revealed that every occupier has a part to play in taking fire precautions in their own households. These are some of the examples:

- Use ashtray while smoking on a sofa or a chair.
- Allow sufficient space behind your TV and radio set and do not block the ventilation openings.
- Avoid overloading electrical circuits and plugging more than one adapter into the same socket.
- Do not leave your cooking on stove unattended.

- Regularly unplug the refrigerator and get rid of the dust from the motor compressor area.
- Never place the heater too close to curtains, beds, settees or chairs.
- When using essential oil with a vaporizer, keep the room ventilated.

2.7 Domestic Fires in the World

Many people worry about being trapped in a fire in a hotel, school or work place. However, domestic fire continues to account for the vast majority of civilian casualties. The United States Fire Administration, (2008) estimates that in the U. S., residential fires account for 25% of nationwide fire outbreaks. The USFA, (2008) residential fire statistics indicates that residential fires account for 84% of all fire fatalities and 81% of the injuries to civilians in 2008. The same report indicates that between 1999 and 2008, there were an estimated 399,800 fires annually resulting in 2,995 civilian deaths and 14,600 injuries each year. Of the fires that occur in buildings, in the U. S and Canada, about three quarters (3/4) are reported to occur in people's homes. Thousands of people die every year in house fires. Furthermore, tens of thousands of people are injured. Fires are caused by a large variety of things, including children playing with matches and smoking. Because the risk to life, limb and property is so huge, the United States Fire Administration (USFA) holds a fire prevention week every year. The agency also spends a tremendous amount of effort trying to help people learn about and practice fire safety (United State Fire Administration, 2013).

2.8 Domestic Fires in Ghana

Ghana National Fire Service, (2012) stressed the need for insurance firms to formulate policies that would help tackle the problem of domestic fires in the country. It was emphasised that, the highest category of fire outbreaks recorded in the country over the past five years, was domestic fires and that it was therefore imperative to educate the public on the need to take fire safety measures seriously to help address the situation. The service called on building inspectors in the various district assemblies to be proactive and intensify their supervision and monitoring roles to ensure that people use the appropriate materials in their homes to reduce the high number of domestic fires.

The incidence of fire outbreaks in Ghana has significantly increased over the last three years despite the government's concerns and purported interventions. The Ghana National Fire Service, in its recent interaction with the media, described the market fires within the first quarter of 2013 as "not normal", perhaps not in terms of the frequency of occurrence but the pattern (Twumasi, 2013). A high number of domestic and factory fires were recorded in the last quarter of 2012 involving scores of deaths (Twumasi, 2013).

2.9. Domestic Fires in Kumasi

According to the Ashanti Regional Fire Officer (2013), the causes of domestic fires in Kumasi Metropolis are put into three main categories. These are;

i. ignorance eg. Minors playing with matches, candles etc.
ii. accidental eg fire caused by natural factors like lightening
iii. Carelessness eg overloading of electrical circuit, putting candles on Television, engaging amateur electricians in electrical works etc. Kumasi Metropolis records more than half of the half of fire outbreaks recorded in the Ashanti Region.

Out of 764 fire outbreaks recorded in Ashanti region in 2011, 470 (61.5%) was recorded in Kumasi Metropolis. 185 (39%) of fires recorded in Kumasi Metropolis were domestic fires. Fire outbreaks in Kumasi Metropolis increased from 470 in 2011 to 527 in 2012 with domestic fires in the Metropolis increasing from 185 in 2011 to 247 in 2012 (GNFS Report, 2013). Statistics from the GNFS, 2013 indicates that, out of 614 fire outbreaks recorded in the Kumasi Metropolis, in 2013, 258 representing, 42% were domestic fires.

2.10 Compliance with Fire Safety Measures

The main purpose of a fire related portions of code compliance inspection program is to discover and correct conditions that pose threat to life and property, and motivate owners and building managers to prevent future hazards (Hall, Flynn and Grant, 2008pp1). Argueta et.al., (2009) in his study in Australia, indicated that residential accommodations are sometimes non-compliant with fire safety standards. Due to recent fire fatalities in some substandard lodgings, the public has become more aware of these deficiencies and has called for change. Individuals at the Metropolitan Fire and Emergency Services Board (MFB) have taken an active role in assessing the situation and implementing solutions. Argueta et.al.,(2009) further observed that,

about 42.6% of international students in Australia have access to fire extinguishers whilst 20.6% have access to fire blanket. Unfortunately, over 50% did not know how to correctly use this equipment. Furthermore, 18% did not know that the emergency phone number in Australia is 000. On the other hand, 83% of international students did have smoke detectors in their place of residence. Also a large majority, 91%, of the local students had smoke detectors in their place of residence. The same question received an 83% positive response among international students.

Three of every five home fire deaths resulted from fires in homes with no smoke alarms or no working smoke alarms No smoke alarms were present in more than one-third (37%) of the home fire deaths (Ahrens, 2014). The report further stressed that, in telephone surveys done for National Fire Protection Association (NFPA) in 2004, 2008, and 2010, 96% of all households reported having at least one smoke alarm).

A report by the Australian Fire and Emergency Services Authorities Council (AFAC) in 2009, observed that over the period of 1999 to 2006, a smoke alarm was not present in 66.7% of cases where a house fire occurred (Regulation Impact Statement-Australia, 2012 pp11).

About 95% of all fires are found to be extinguishable if the correct fire extinguisher is applied promptly. Fire extinguishers are located throughout Australian workplaces as part of their compliance with Australian Standard AS1851 and the Building Code of Australia (BCA), however the majority of people are fearful of fire extinguishers or do not understand how to operate a fire extinguisher in an emergency (Fire and Safety Australia, 2013).

In its study in Australia, Fire and Safety Australia, 2013, concluded that;

• Fire safety training increases the knowledge and emergency response actions of building occupants when confronted with a fire or emergency situation.

• By conducting annual evacuation exercises (as is a mandatory requirement under AS3745-2010), building occupants will obtain more confidence in following emergency procedures for their workplace and they will better understand what emergency actions to take for themselves and their workplace colleagues.

• By conducting regular fire safety training, building occupants improve their knowledge about the location and operation of site of fire fighting and emergency equipment.

• After attending a basic fire extinguisher training session (where each participant operated a fire extinguisher on a real fire) over 90% of people operated the fire extinguisher correctly on their second attempt and they were 33% more effective in extinguishing the fire (they selected the correct fire extinguisher, they cooled the area after the fire was out and they aimed at the base of the fire).

None of the literature reviewed on compliance with fire safety regulations touched on the mean compliance with by the occupants of buildings. This study would therefore include the mean compliance with fire safety regulations by house owners.

2.11 Concepts of fire Risk Modelling

Risk is defined as the chance of something happening that will have an adverse impact upon objectives. It's measured in terms of consequence and likelihood (Australian Standard,AS/NZS 4360. 1999).

The definition notes three separate components that combine to articulate risk: Likelihood (probability of an event), Consequence (impact of an event), Objective (to enable the consequence to be measured against).

Earlier attempts at modelling risk for fire management have missed one or more of these three components. For example, the earlier versions of "Wildfire Threat Models" did not develop an objective against which a measurable consequence could be assessed. Consequence was termed 'threat' in the earlier models and was a ranking, not a measure.

A model prepared by the Dept. of Natural Resources and Environment incorporated all three components to define risk - likelihood, consequence and objective. However, likelihood and consequence were a single inseparable component. The model is constrained to examine one objective only, the probability of success or not of first attack suppression efforts. Early modelling has not identified the three component aspects of risk within a model. This paper sets out a revised concept of the components of bushfire risk management in a simplified format.

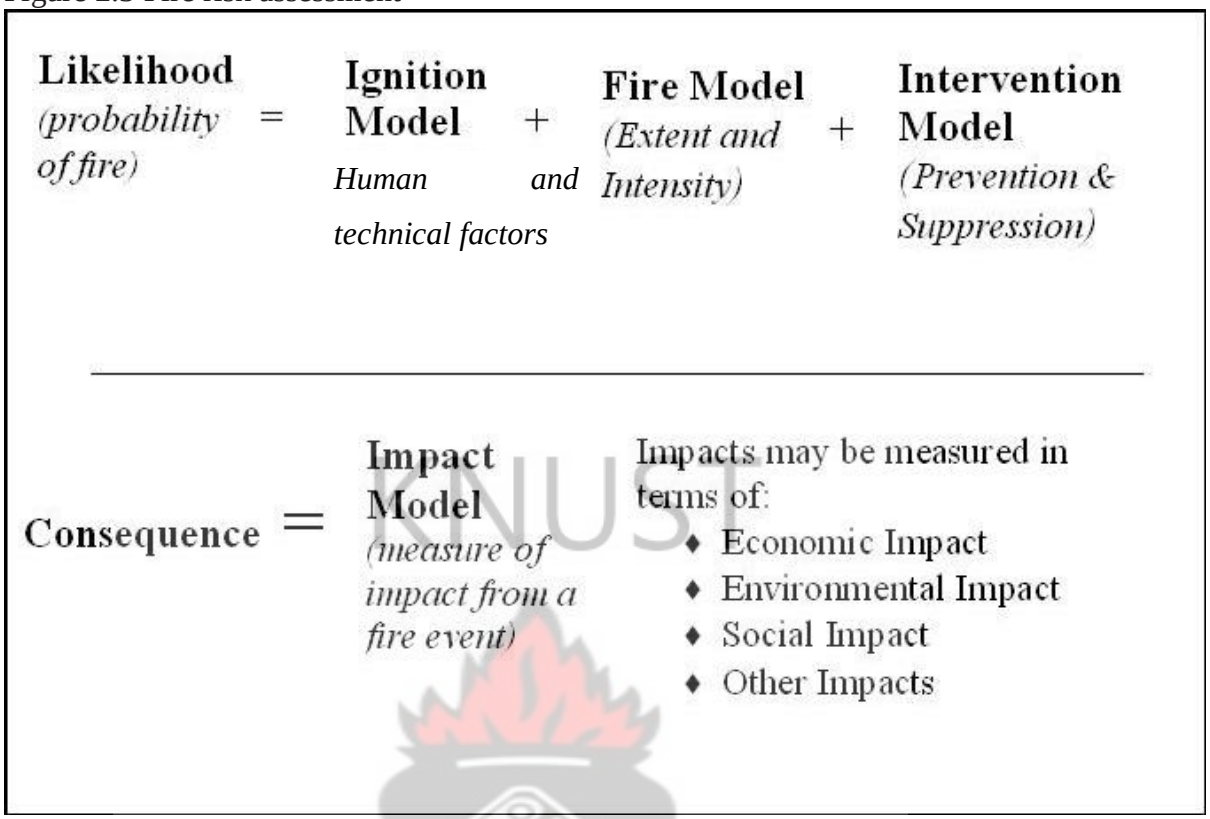
Risk assessment in the context of environmental events such as wildfire is a relatively new process of understanding (Smith. 2001).

Bachmann and Allgower (1998) prepared another conceptual framework for wildfire risk assessment. Their work describes a series of inputs including ignition, fuel, weather conditions and the impacts of fire on natural and human assets, and uses a mathematical matrix methodology to combine the inputs. The methodology is only practical for assets that can be given a quantified or monetary value. The framework is limited to providing a risk number, or series of numbers, as the output. This framework is similar to the previous wildfire threat models in that it gives an output that the manager must then use to filter through various risk mitigation options for them to estimate their best course of action.

A risk assessment is the first step designed to find out what the problems are. In practice, quantitative risk assessment has not been attempted for many environmental hazards but the following is a representation of how this may be conceptualised.

A revised layout for wildfire risk assessment is proposed in Figure 2.3. This layout follows closely with the concept developed by Smith (2001) and is capable of analysing scenarios characterised from the user needs analysis.

Figure 2.3 Fire risk assessment

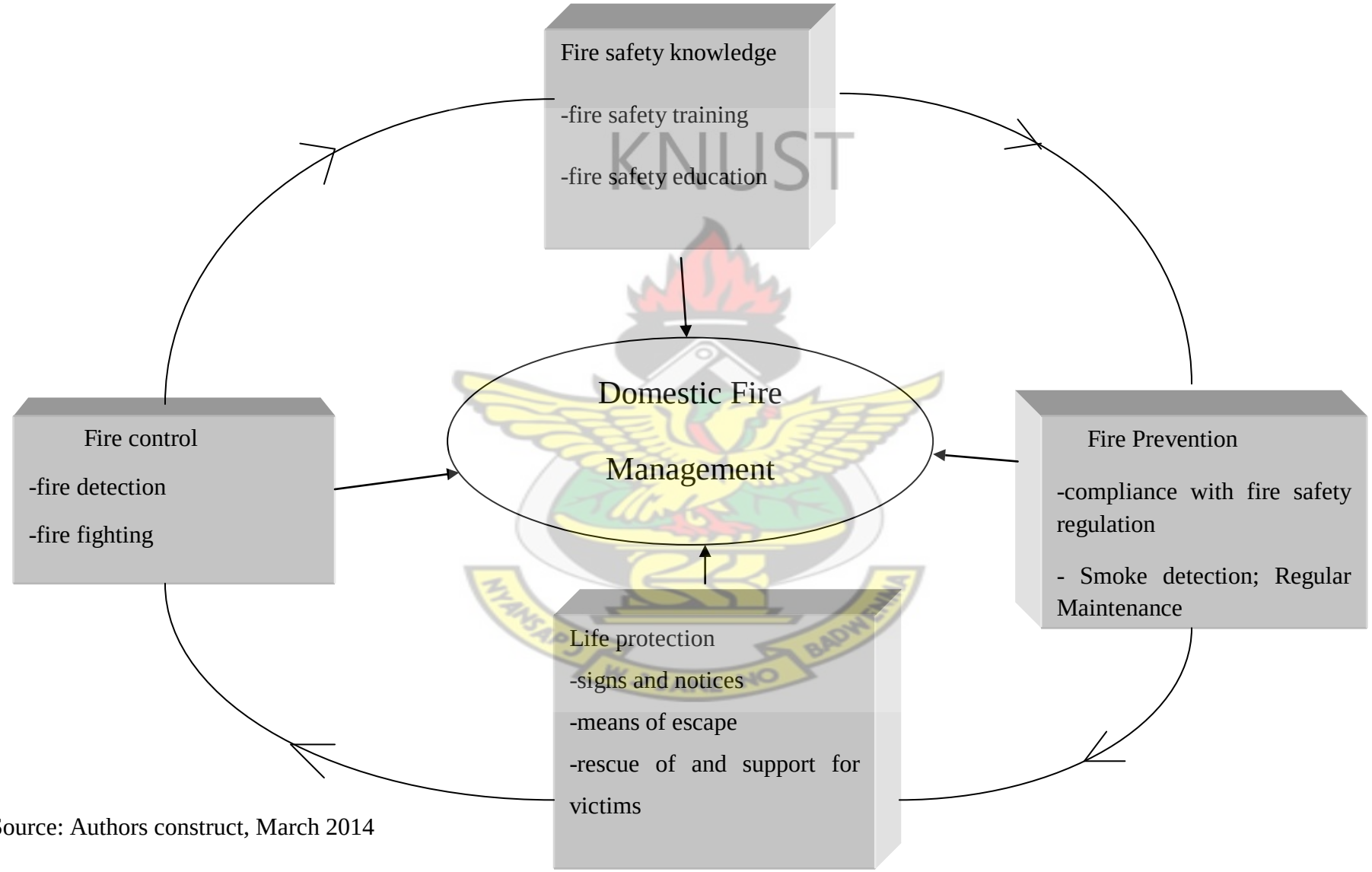


Source: Adopted from Bachmann and Allgower (1998)

2.12. Conceptual Framework

The conceptual framework of the research gives an overview of the issues relating to the subject matter of the research. The concept was developed based on reviewed literature.

Figure 2.4 Conceptual framework of Domestic Fire Management



Source: Authors construct, March 2014

Domestic fire management is a serious concern in Ghana due to the alarming rate of domestic fire outbreaks. As shown in Figure 2.4, Domestic Fire Management can be achieved through fire prevention (compliance with fire safety regulation, Smoke detection; Regular maintenance), fire safety knowledge (fire safety training, fire safety education), fire control (fire detection, fire fighting) and life protection (sign and notices, means of escape, rescue of and support for fire victims). Fire safety knowledge aids fire prevention leading to life protection. Life protection aids fire control thereby enhancing fire safety knowledge with the ultimate aim of improving Domestic Fire Management.

Most of the literature reviewed on the fire management concentrated on fires related to public residential buildings to the neglect of private domestic buildings. This study is intended to fill that gap. Also all the available literature only looked at the fire safety measures necessary to put in place at residential areas, but did very little on the compliance with fire safety regulations by house owners or their representatives. This study would therefore critically look at the compliance of fire safety measures in the residential areas.

CHAPTER THREE

STUDY PROFILE AND RESEARCH METHODOLOGY

3.1. Introduction

This chapter describes the study area as well as looking at the overview of the procedures applied in the study. It looks at the various methods as well as the reasons for adopting such methods in the research. It further describes the process that was used in collecting, analysing and presenting data.

3.2 Study Area

Kumasi is located in the transitional forest zone, about 270km north of the national capital, Accra and covers a total land area of 254 square kilometers (25,415 hectares). It stretches between latitude 6° 35"– 6° 40" North and longitude 1°30" – 1°35" West, and its elevation ranges between 250 and 300 meters above sea level. Kumasi is bounded to the north by Afigya Kwabre District and Kwabre East District, to the east by Ejisu Juaben Municipal and Bosomtwe-Atwima Kwanwoma District, to the west by Atwima Nwabiagya District and to the south by Atwima Kwanwoma District.

The Metropolis falls within the wet sub-equatorial climatic type. The average minimum temperature is about 21.5°C and a maximum average temperature of 30.7°C. The average humidity is about 84.16 per cent at 0900 GMT and 60 per cent at 1500 GMT. The high temperature and the relative humidity support combustion which promotes easy spread of fire when there is an outbreak.

The 2000 Population and Housing Census report revealed that the housing stock in the Metropolis was 67,434, constituting 20.5 percent of the regional housing stock of 328,751. The growth rate of the housing stock of the Metropolis is 2.4 percent. The inhabitants of Kumasi are mostly business-oriented people with the majority of them engaged in buying and selling activities.

Kumasi Metropolis is bedevilled with a number of fire outbreaks. Table 3.1 illustrates statistics of fire outbreaks from 2003 to 2013.

Table: 3.1 Fire outbreaks in Kumasi Metropolis from 2003 to 2013

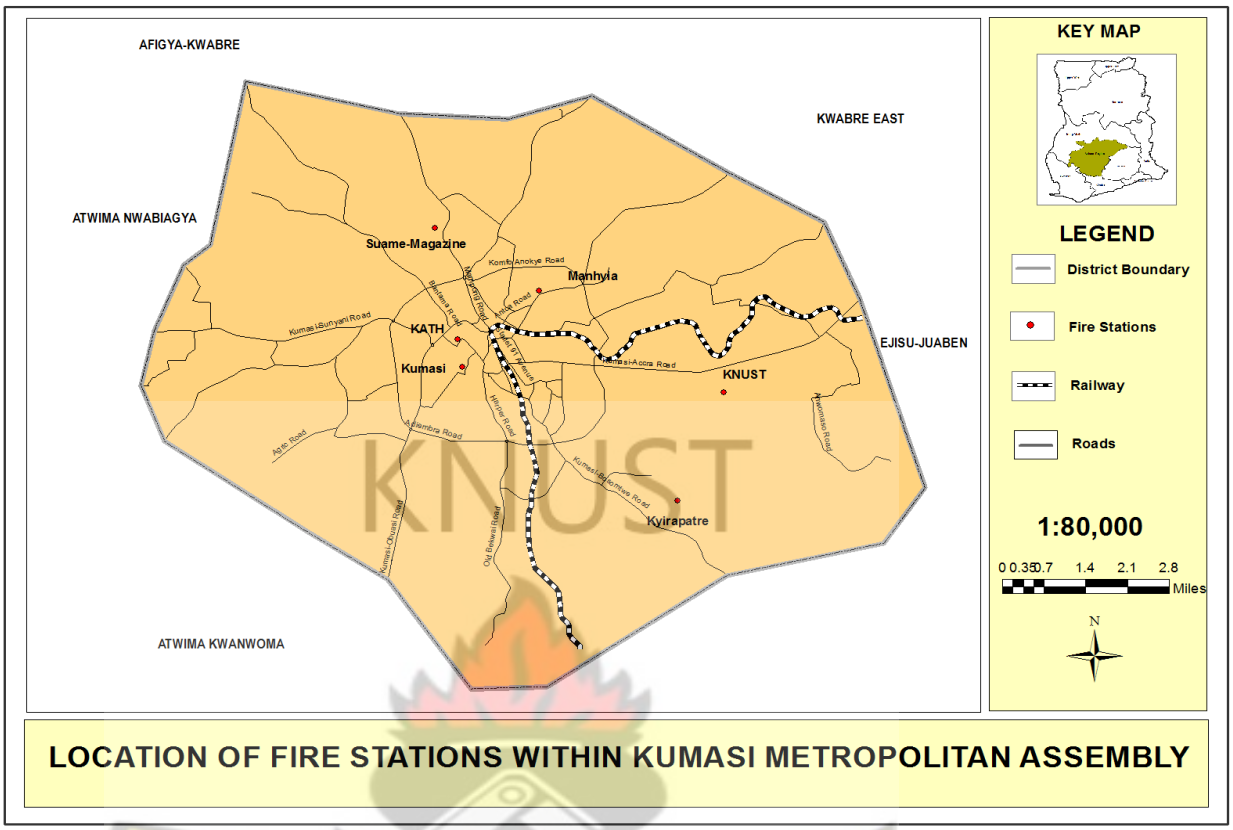
Year	Domestic	Industrial	Vehicular	Insti Tutional	Electri cal	Commerci al	Bush	Others	Total
2003	206(55)	27 (7)	50 (13)	1	18 (5)	40 (11)	19 (5)	14 (4)	375 (100)
2004	203 (60)	32 (9)	36 (11)	1	12 (4)	41 (12)	13 (4)	3 (1)	341 (100)
2005	203 (53)	51 (13)	27 (7)	3 (1)	15 (4)	39 (10)	31 (8)	15 (4)	384 (100)
2006	171 (51)	34 (10)	32 (9)	-	26 (8)	44 (13)	11 (3)	17 (5)	335 (100)
2007	253 (54)	39 (8)	38 (8)	3 (1)	27 (6)	53 (11)	34 (7)	18 (4)	465 (100)
2008	179 (43)	39 (9)	59 (14)	11 (3)	14 (3)	75 (18)	26 (6)	16 (4)	419 (100)
2009	204 (48)	30 (7)	63 (15)	6 (1)	16 (4)	66 (16)	26 (6)	12 (3)	423 (100)
2010	208 (45)	18 (4)	69 (15)	25 (5)	17 (4)	83 (18)	26 (6)	13 (3)	459 (100)
2011	185 (39)	29 (6)	65 (14)	28 (6)	25 (5)	88 (19)	12 (2)	37 (8)	470 (100)
2012	247 (47)	18 (3)	81 (16)	16 (3)	15 (3)	100 (19)	20 (4)	30 (6)	527 (100)
2013	258(42)	17(3)	85(14)	21(3)	22(4)	138(22)	26(4)	47(8)	614(100)

Note: All the figures in parenthesis are in percentages

Source: GNFS Report (2013).

The Metropolis has six fire stations; namely Kumasi station at KMA , Komfo Anokye station, Manhyia station, Magazine station and KNUST station. Each of the fire stations is equipped with a fire Tender. The location of these stations are shown in figure 3.1

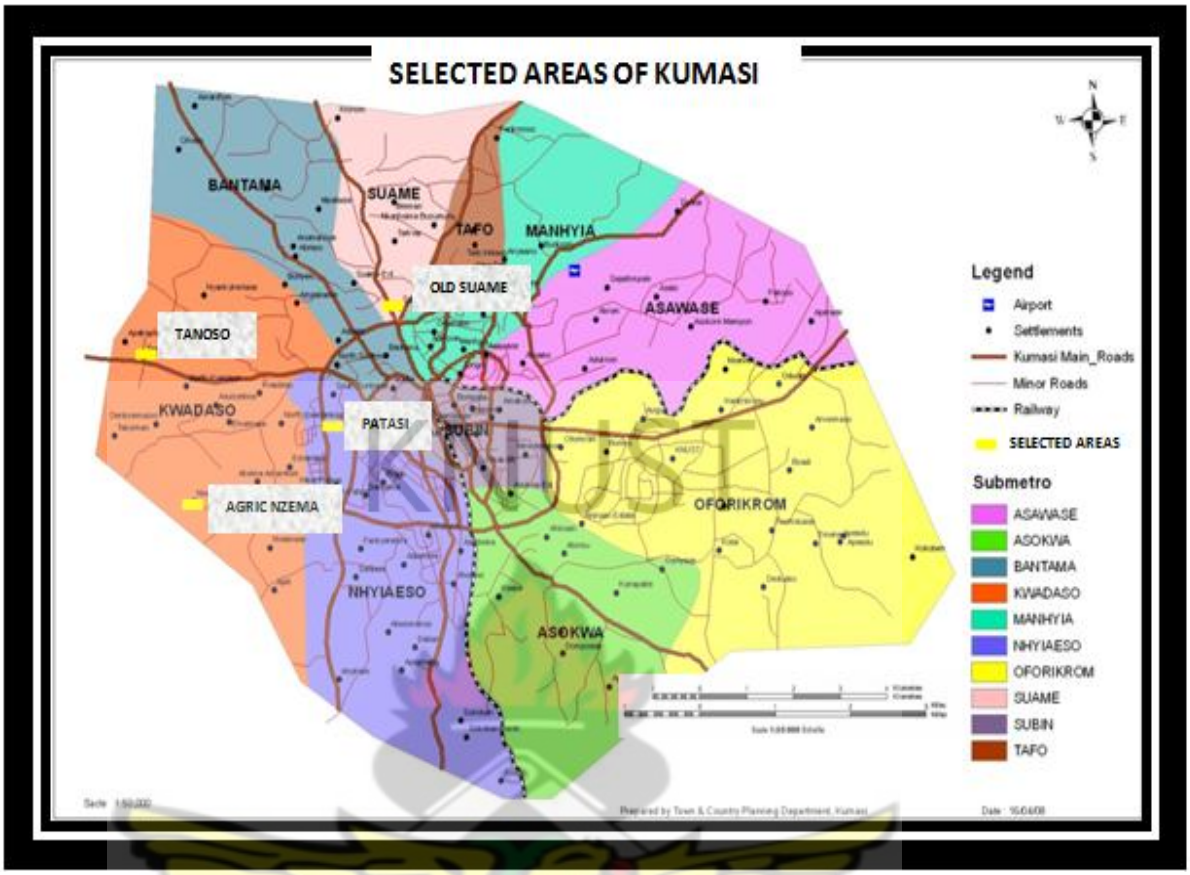
Figure 3.1. Map of Kumasi Metropolis showing location of fire stations



Source: Town and Country Planning Department, (2010)

The Ghana National Fire Service (GNFS) has identified four suburbs in the Kumasi Metropolis as fire prone areas.

Figure 3.2. A map of Kumasi showing the location of the selected study areas



Source: Town and Country Planning Department, (2010)

As shown in figure 3.2, the suburbs were given as, Old Suame, Patase, Nzema, and Tanoso. There is therefore the need to take fire safety measures to protect the built and the natural environment of these suburbs from fire hazards.

3.3 Research Design

The study adopted a Cross-Sectional Design (CSD). This is because; the nature of the subject matter to be addressed requires a natural setting with real life situations. This permitted intelligent statistical inferences to be made on the broader population and allowed generalization of findings to real life situations. Hence, management of domestic fires in the Kumasi Metropolis was critically assessed.

3.4 Population, Sampling Size and Sampling Technique

The population of the study was made up of all houses within the fire prone areas of Kumasi Metropolis. These areas are Agric Nzima, Patase, Tanoso and New Suame. These areas are termed fire prone because Ghana National Fire Service has identified

them as emerging areas with regards to fire outbreaks. It also included all the institutions (GNFS, District Assembly, Ambulance Service and National Disaster Management Organisation (NADMO)) which are major stakeholders in Domestic Fire Management.

Both probability and non-probability sampling methods were used for the study. Purposive sampling was used to identify all the fire prone communities in the Kumasi Metropolis. These communities were identified by the Ghana National Fire Service as Old Suame, Patase, Agric Nzema and Tanoso. They are considered as fire prone due to their emerging trends with regards to domestic fire outbreaks. The sampling frame was then all the houses within the four selected communities. Systematic sampling was further employed to select three hundred and sixty two houses (362) from the selected communities In each house, the house owner or his representative was interviewed. Purposive sampling was again employed to select and interview institutions like Ghana National Fire Service (GNFS), National Disaster management Organisation (NADMO), Ghana Ambulance Service and Kumasi Metropolitan Assembly who are major stakeholders in the management of domestic fires. Purposive sampling was used to identify institutions which have major roles to play with regards to domestic fire management in the Kumasi Metropolis.

3.5 Unit of Analysis

The unit of analysis refers to the object under study. It is the major entity that is analysed in the study. Depending on the research, the unit of analysis could be individuals, groups, organizations, communities, critical incidents and time periods (Oduro-Ofori, 2011, cited in Naku, 2012). In effect, the unit of analysis in any study is therefore the actual empirical units, objects or occurrences which must be observed or measured in order to study a particular phenomenon (Kumekpor, 2002).

The main unit of analysis for this research was the house owners or their representatives. Other units included, the Ghana National Fire Service, Ghana Ambulance service, National Disaster Management Organisation and Kumasi Metropolitan Assembly.

3.6 Determination of the Sample Size

According to the 2000 population and housing census by the Ghana Statistical Service, the housing stocks of the selected communities are given in table 3.2. From the KMA Medium Term Development plan (2010), the growth rate of 2.4% for housing stock in Kumasi Metropolis was derived.

The housing stock of the study communities was projected to the current year (2014) using the formula: $Pt=PoE^{(rt)}$

where

Pt = Future housing stock (2014)

Po = Housing stock of the base year (2000 housing stock)

E = Natural Log. (Constant) = 2.718283

r =Housing Stock Growth Rate of KMA (2.4 percent, from KMA Medium Term Development Plan, 2010)

t = Time frame (14 years)

Table 3.2: Housing Stock Projection of the Study Area

STUDY AREAS	**HOUSING STOCK (2000)**	**PROJECTED HOUSING (2014)**
Agric. Nzima	341	477
Patase	721	1009
Old Suame	654	916
Tanoso	975	1365
Total	**2691**	**3767**

Source: Author's Projection, March 2014.

(Note: Figures for the Housing Stock was obtained from 2000 Population and Housing census)

The mathematical method was used to determine the sample size. In order to increase the accuracy of the research results, giving room for a minimal degree of error, the research operated at a 95 percent level of confidence with a margin of error of 5

percent. Using the mathematical sampling method: $n=N/1+N(\alpha)^2$ where n= sample size, N= sampling population and α= margin of error, as indicated.

From table 3.2, the sample size (n) for the study is given by

$n=3767/1+3767(0.05)^2$

$n=3767/1+3767(0.0025)$

$n=3767/10.42$

$n=361.5$

$n\approx362$

A sample size of Three hundred and sixty two (362) houses was obtained from the selected communities. To obtain a representative number of respondents from each study area, the sample was proportionally distributed as shown in Table 3.3.

Table 3.3: Sample Size for the Study Communities

STUDY AREA	SAMPLE SIZE PER POPULATION	TOTAL	SYSTEMATIC SELECTION OF HOUSES
Agric. Nzima	477/ 3767×362	46	362/46=7.8 Approximately, after every 8th house
Patase	1009/ 3767×362	97	362/97=3.7 Approximately, after every 4th house
Old Suame	916/ 3767×362	88	362/88=4.1 Approximately, after every 4th house
Tanoso	1365/ / 3767×362	131	362/131=2.8 Approximately, after every 3rd house
Total		**362**	

Source: Authors computation, March 2014

It was observed during the data collection that, the responses of the respondents were similar and showed a particular pattern. So after collecting approximately 85 percent (307 respondents) of the field data, it was inferred that the remaining data to be collected would significantly, not affect or change the result of the already collected data. As a result only 300 respondents were used for the study instead of the calculated 362 sample size. The actual sample used in the selected communities is shown in Table 3.4

Table 3.4: Actual Sample Used in Selected Study Areas

STUDY AREA	CALCULATED SAMPLE	ACTUAL SAMPLE USED
Agric. Nzima	46	48
Patase	97	82
Old Suame	88	77
Tanoso	131	100
Total	**362**	**307**

Source: Authors computation, March 2014

3.7 Data Collection Instruments and Tools

Data collection instruments are important in determining the quality of the data collected for research. In view of this the instruments used by the researcher must be appropriate for the research in order to come out with good quality results upon which valid and scientific conclusions and inferences can be made.

Primary and secondary sources of data were used in this study. The primary data comprised information that was collected using interviews, direct observations and key informant interviews. Secondary data was obtained from relevant journals, books, internet, statistical bulletin and newspaper reports. interview guides comprising both open and close ended questions as well as direct observations were used for the house to house collection of data in the study area.

Interviews were used because some of the respondents could not read and write. So this instrument made room for flexibility in asking questions so that respondents could understand it better and provide right answers. Direct observations also

accorded the researcher the opportunity to get first hand information on compliance with fire safety measures.

Research assistants were trained to help in the data collection. The researcher together with the trained research assistants asked questions and recorded responses from the respondents. The researcher and his assistants also observed directly to obtain first hand information on issues relating to compliance to fire safety regulations by the respondents. A relaxed and healthy atmosphere was created which enabled the respondents to cooperate, answer questions and seek for clarification about some of the questions asked. The process also permitted the researcher and the research assistants to translate the questions into Asante Twi language for easy comprehension by respondents who did not understand the English Language.

Key informant interviews were used to obtain information from personnel from institutions (Ghana National Fire Service, National Disaster and Management Organisation, District Assembly, Ambulance service, Ghana Police service etc.) which are considered relevant for fire prevention, fire fighting and rescue. This instrument was used to collect in-depth information from officers who were well abreast with issues relating to Domestic Fire Management.

Table 3.5: Summary of Data Required

Objectives	Variable	Data categories	Data sources	Tools used
Objective one: To determine the level of fire safety knowledge of the residents of Kumasi Metropolis	Causes of fire outbreak	➢ Heater ➢ Lightning ➢ electrical wires ➢ Careless use of candles and other naked flames ➢ cooking ➢ reckless use of electrical appliances	House owners or their representatives	Interviews
	Fire Prevention	➢ the use of right electrical wires ➢ adherence to signs and notices ➢ regular maintenance of fire detection system ➢ cautious use of naked flames ➢ avoidance of overloading of electrical circuits ➢ the use of professional electricians	House owners or their representatives	Interviews
	Fire control	➢ the use of Portable Fire Extinguishers ➢ the use of Fire Blankets ➢ the use of Fire buckets ➢ the use of Hose reels ➢ the use of Sprinkler systems ➢ seeking assistance from the Ghana National Fire Service	House owners or their representatives	Interviews
Objective two: To determine residents' level of compliance with fire safety regulations as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003)	Compliance with fire safety measures	➢ Physical accessibility to building ➢ Means of escape ➢ Signs and notices ➢ Smoke detectors ➢ Emergency lighting system ➢ Portable Fire Extinguishers ➢ . Fire Blankets ➢ Fire buckets	House owners or their representatives	Interviews, Direct observations

Objective 3: To evaluate the measures put in place by the relevant institutions to manage domestic fires	Roles played by institutions to manage domestic fires	➢ Fire prevention ➢ Fire control ➢ Fire rescue ➢ Support to fire victims	KMA, NADMO, Ambulance Service, GNFS	Interviews
Objective 4: To examine problems which militate against effective management of domestic fires in the Kumasi Metropolis	Challenges confronting domestic fire management	➢ Lack of funds ➢ Knowledge on the use of fire safety devices ➢ Cost of safety equipment ➢ Frequent power outage ➢ Road network ➢ Physical accessibility to building ➢ Careless use of naked flame ➢ Delays in responding to distress calls by GNFS ➢ Too many fuel kept inside the house	House owners, KMA, NADMO, Ambulance Service, GNFS.	interviews, Direct observation

Source: Author's construct, March 2014

3.8 Training of Research Assistants and Pre-Testing of Questionnaire

Four research assistants were trained to help in the data collection. They were initially taken through the rationale for the study and the main objectives of the study. They were also trained on how to go about the data collection, which areas and how to identify their respondents. The researcher made sure that the research assistants understood the local languages spoken in the study areas and how they could translate the questions in order to get the right responses.

The research assistants were strictly asked to select the 8th, 4th, 4th and 3rd houses at Agric. Nzima, Patase, Old Suame and Tanoso respectively. They were monitored to ensure that it was done accurately. The questionnaire was pre-tested in two study communities, namely Tanoso and Old Suame, to check its reliability and validity. As a result of the pre-testing, some questions in the questionnaire were rephrased to capture the needed information whilst other questions had to be totally taken off from the questionnaire. It also enabled the researcher to appreciate some of the problems that were most likely to be encountered during the actual data collection.

3.9 Data Analysis

Data collected from a cross-section of respondents was analysed using statistical tools, such as, frequency distribution, means, proportions, charts etc.

Pie charts and frequency tables were used to analyse the data on demographic characteristics of the respondents and assess the level of fire safety knowledge of the residents of Kumasi Metropolis. The level of compliance with fire safety regulation in the residential areas was analysed using frequency tables, cross tabulation and mean. Institutional measures to manage domestic fires was analysed qualitatively. Proportions and qualitative analyses were further used to analyse constraints militating against management of fire outbreaks in the Kumasi Metropolis.

3.10 Ethical consideration

The study included certain ethical issues to improve the validity of the findings. For instance the identity of the researcher was made known to all the communities visited. The research topic was well explained to the house owners or their representatives as well as the institutions visited. Confidentiality and privacy were observed during the research process and name of respondents were never asked. The assemblymen and

other opinion leaders within the selected communities were contacted to seek their permission before the data collection. Aside these community leaders, each suburb visited were informed about the study before it commenced.

CHAPTER FOUR

ANALYSIS ON DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS

4.1. Introduction

This chapter deals with the presentation and discussion of results of the study. It comprises socio-economic and demographic characteristics of respondents of the study, the level of fire safety knowledge of the residents of Kumasi Metropolis, the level of compliance with fire safety regulations by house owners as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003). In addition, the institutional measures put in place to manage domestic fires and factors militating against effective management of domestic fires in Kumasi Metropolis were discussed.

4.2. Socio-economic and Demographic Characteristics of Respondents

The demographic and socio economic data of the respondents is critical because it helps o ne to know about the characteristics of the respondents who took part in the study as they provide some basic and personal information about themselves. It also helps to explain the relationship between socio-economic and demographic characteristics and the level of compliance.

4.2.1. Effects of Socio-economic and Demographic Characteristics of Respondents on level of compliance

Socio-economic and Demographic characteristic like age, sex, level of education and income levels is critical to the management of domestic fires. As indicated in Table 4.1, it was established that house owners or their representatives below 30 years of age had the lowest number of respondents complying with more than two fire safety measures. However, house owners between 30 to 40 years had the highest respondents (17.1%) complying with more than two fire safety measures. This indicates that, house owners at their middle ages are more concern with fire safety issues than their counterparts in the other age groups. With regards to sex of respondents, it was observed that, both sexes had about 16% of respondents complying with more than two fire safety regulations (see table 4.1). This confirms that sex is not a major determinant of compliance with fire safety regulation within the study area.

The study further found out that, respondents with higher educational qualification thus Senior High School and above comply more with fire safety measures than their counterparts below Senior High School level. As shown in Table 4.1, 44.7% of respondents with educational qualification above the Basic level complied with more than two fire safety regulations whilst 21.4% of respondents with qualification below Senior High School complied with more than two fire safety measures. This may be due to the fact that as a person attains higher education, he/she is able to understand issues concerning fire safety better thereby putting more measures in place to mitigate its occurrences. Satyen *et al.,* (2003) found that an increased level of fire safety knowledge enables individuals to be more cautious about unsafe behaviours and more aware of the importance of the use of fire blankets and fire extinguishers.

Moreover the study established that income levels influence compliance with fire safety measures. As found in Table 4.1, 10.6% of respondents below the income level of GH₵200 per month complied with more than two fire safety measures. Respondents within the income range of GH₵201 and of GH₵1000 had 13.2% complying with more than two fire safety measures. However, 91.6% of respondents with monthly income more than GH₵1000 complied with more than two fire safety measures. This signifies that as income of the respondent increases they become more capable to comply with fire safety measures. This is so because, respondents in the higher income categories are more likely to be able to afford the cost involved in adopting fire safety measures.

Table 4.1 Effects Socio-economic and Demographic characteristics of Respondents on level of compliance

	Level of Compliances													
Age of responder	0		1		2		3		4		5		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Below 30years	0	0	4	22.2	12	66.7	2	11.1	0	0	0	0	18	100
30-40years	4	11.4	12	34.3	13	37.1	4	11.4	2	5.7	0	0	35	100
41-50years	7	8.0	23	26.1	44	50.0	10	11.4	4	4.5	0	0	88	100
51-60years	5	4.7	40	37.7	45	42.5	10	9.4	5	4.7	1	0.9	106	100
Above 60years	6	10.0	15	25.0	29	48.3	8	13.3	2	3.3	0	0	60	100
Total	**22**	**7.2**	**94**	**30.6**	**143**	**46.6**	**34**	**11.1**	**13**	**4.2**	**1**	**0.3**	**307**	**100**
	Level of Compliance													
Sex of respondents	0		1		2		3		4		5		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Male	13	6.7	70	36.3	80	41.5	22	11.4	7	3.6	1	0.5	193	100
Female	9	7.9	24	21.1	63	55.3	12	10.5	6	5.3	0	0	114	100
Total	**22**	**7.2**	**94**	**30.6**	**143**	**46.6**	**34**	**11.1**	**13**	**4.2**	**1**	**0.3**	**307**	**100**
	Level of Compliance													
Educational level of responder	0		1		2		3		4		5		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
No formal education	2	3.4	21	36.2	28	48.3	5	8.6	2	3.4	0	0	58	100
Basic	8	9.4	26	30.6	43	50.6	7	8.2	1	1.2	0	0	85	100
Secondary	11	10.1	36	33.0	45	41.3	16	14.7	1	0.9	0	0	109	100
Tertiary	1	1.8	11	20	27	49.1	6	10.9	9	16.4	1	1.8	55	100
Total	**22**	**7.2**	**94**	**30.6**	**143**	**46.6**	**34**	**11.1**	**13**	**4.2**	**1**	**0.3**	**307**	**100**
	Level of Compliance													
Income range of respondents	0		1		2		3		4		5		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Below GH₵ 200	8	10.7	23	30.7	36	48.0	4	5.3	4	5.3	0	0	75	100
GH₵ 201-1000	14	6.4	71	32.3	106	48.2	27	12.3	2	0.9	0	0	220	100
Above GH₵ 1000	0	0	0	0	1	8.3	3	25.0	7	58.3	1	8.3	12	100
Total	**22**	**7.2**	**94**	**30.6**	**143**	**46.6**	**34**	**11.1**	**13**	**4.2**	**1**	**0.3**	**307**	**100**

Source: Author's Field Survey, March 2014

4.3 Fire Safety Knowledge by House owners or their Representatives within Kumasi Metropolis

Fire-related accidents often result in injuries and sometimes death, which can be prevented through fire safety training. To estimate the extent to which fire safety training should be provided, it is essential to assess the current level of fire safety knowledge within the general community (The Australian Journal of Emergency Management, 2006)

4.3.1 Awareness of fire safety Measures in the Kumasi Metropolis

Table 4.2. sought to find out whether house owners were aware of any form of fire safety measures. Two hundred and ninety eight (298) out of three hundred and seven (307) representing 97.1% were aware of some form of fire safety measures as indicated in table 4.2. Only nine representing 2.9 were not aware of any form of fire safety measure. This indicates that majority of the house owners within the study community have some form of knowledge on fire safety measures. Some fire safety knowledge mentioned by respondents were on causes of fire outbreak, prevention and control of fire outbreak as well as fire rescue. However, the level of their awareness seemed to be low since respondents could not well explain how those safety measures could be achieved. This reflected on the low compliance with fire safety measures such as sign and notices, fire extinguishers, fire buckets, fire blankets, emergency lighting system and smoke detectors.

Table 4.2 Awareness of fire safety Measures in the Kumasi Metropolis

Awareness	**Frequency**	**Percentage**
Yes	298	97.1
No	9	2.9
Total	**307**	**100**

Source: Author's Field Survey, March 2014

4.3.2 Aspect of fire safety Awareness

Table 4.3. represents the aspect of fire safety knowledge house owners are aware of. As indicated in the table, letters A, B, C, D were used to represent the aspect of fire safety knowledge. Letters A, B, C and D were used to represent the knowledge on causes of fire outbreak, fire prevention, fire control and fire rescue respectively. As shown in Table 4.3. thirteen (4.3%) house owners or their representatives were aware of only one aspect of fire safety measures. Seven respondents representing 2.3% were

aware on only causes of fire outbreak. This indicates that these respondents are handicap on fire prevention, control and rescue. This puts them at a higher risk in terms of fire outbreak as indicated by Norwich Information Policy Team, (2006) that a fire risk assessment will help one to determine the chances of a fire starting and the dangers from fire that the premises present for the people who use them and other people in the immediate vicinity. Forty six (46) respondents representing 15.4% were aware of both causes and prevention of fire outbreak. Majority of the respondents (50.8) were aware of causes of fire, fire prevention and fire control whilst 29.1% were aware of all the three afore mentioned fire safety measures in addition to fire rescue. This shows that about 79.9 of the respondents were aware of at least three fire safety measures. This signifies that awareness of respondents on fire safety measures is high. Notwithstanding the considerable high awareness on fire safety measures, it could not be translated into the respondent's knowledge on how to ensure those safety measures. More than 80% of respondents did not have any knowledge on smoke detectors, sign and notices, fire blankets, fire buckets and emergency lighting system. This confirms the assertion by Argueta et.al.,(2009) that, over 50% of international students in Australia did not know how to correctly use available fire safety equipment.

Table 4.3. Aspect of fire safety Awareness

Safety measure	**Frequency**	**Percentage**
A	7	2.3
B	5	1.7
C	1	0.3
D	1	0.3
A and B	46	15.4
A, B and C	152	50.8
A, B, C and D	87	29.1
A, C and D	0	0
Total	299	100
Non-response	8	2.6
Total	**307**	**100**

A=Causes of fire outbreak B=Fire Prevention C=Fire control D=Fire rescue

Source: Author's Field Survey, March 2014

4.3.3 Sources of Awareness on Fire Safety Measures

As shown in table 4.4, Majority of the respondents (72.9%) had their sources of fire safety awareness from the mass media and public education by GNFS and NADMO. This means that the mass media, GNFS and NADMO are making a lot of efforts to

create awareness on fire safety in the Kumasi Metropolis. About 9.8% of the respondents got the source of their awareness from the mass media, public education and school curriculum. Only one person had his source from other sources such as friends and relatives.

Table 4.4 Sources of awareness on fire safety Measures

	Name of community									
Sources	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
1	15	36.6	9	11.4	3	4.0	13	13	40	13.6
2	0	0	1	1.3	4	5.3	0	0	5	1.7
3	1	2.4	0	0	0	0	0	0	1	0.3
4	0	0	1	1.3	0	0	0	0	1	0.3
1 and 2	15	36.6	66	83.5	63	84	71	71	215	72.9
1 and 3	3	7.3	1	1.3	0	0	0	0	4	1.4
1, 2 and 3	7	17.1	1	1.3	5	6.7	16	16	29	9.8
Total	41	100	79	100	75	100	100	100	295	100
No response	7	14.6	3	3.7	2	2.6	0	0	12	3.9
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

1=Mass media, 2=Public education by GNFS and NADMO, 3=School curricula, 4= Others

Source: Author's Field Survey, March 2014

4.3.4 Training on Fire Safety Measures

Data from 158 participants aged between 18 and 80 years showed that fire safety training increases the level of fire safety knowledge and the accuracy of response to a fire (The Australian Journal of Emergency Management, 2006). If individuals are provided with adequate fire safety training, they have a better chance of recognising important fire cues sooner and responding appropriately to avoid the risk (Proulx, 2001 cited in The Australian Journal of Emergency Management, 2006).

Out of the 307 house owners or their representatives selected for the study, only thirty six representing 11.7% had had some form of fire safety training. Majority of the house owners (271) representing 88.3% had not received any form of fire safety training before as given by table 4.5. Kachenje, et.al., (2010) in their study in Dar es Sallam, Tanzania observed that lack of training for fire-emergency preparedness was a factor blamed by most of the respondents for their inability to use the various means and equipment, as well as limited knowledge related to fire and rescue.

This situation may increase the risk of fire out breaks in the Kumasi Metropolis since there is a positive relationship between fire safety training and fire safety precautions. The Australian Journal of Emergency Management, (2006) observed that exposure to fire safety training would enable individuals to accurately evaluate a fire situation and choose an appropriate course of action. The effectiveness of fire safety training is also evident through a dramatic decline in deaths occurring from fires in US homes as a result of increased public safety education and more wide spread use of smoke alarms (National Fire Protection Association, 2000, 2002).

The table further shows that in terms of distribution according to communities, 12.5% of house owners in Agric Nzima had had training on fire safety measures. Patasi recorded 9.8% of house owners being trained in the fire safety measures whilst Old Suame had 15.6% with Tanoso recording 10%. This specifies that, a larger proportion of house owners in Suame had received fire safety training than the other three communities with Patasi having the least proportion of trainees. This indicates that, residents of old Suame are expected to be more conscious about fire safety measures than the other study communities.

Table 4.5.Training on fire safety Measures

Training on fire safety measures	**Name of community**									
	Agric Nzema		Patasi		Old Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	**%**
Trained	6	12.5	8	9.8	12	15.6	10	10	36	**11.7**
Not trained	42	87.5	74	90.2	65	84.4	90	90	271	**88.3**
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

4.3.5 Houses affected by Fire Outbreaks in Kumasi

About half of the fire outbreak in Ashanti region occurs in Kumasi Metropolis. Out of seven hundred and sixty four (764) fire outbreaks recorded in the Ashanti region in 2011, four hundred and seventy (470) representing 62% were recorded in the Kumasi Metropolis (Ashanti Regional Fire Service Department, 2013). As indicated in table 4.6, the study revealed that, out of the 307 houses selected for the study, twenty houses (20) representing 6.5% had experienced some form of fire outbreak before. Tanoso recorded the highest percentage of fire outbreak of 10% out of the houses

selected from the community for the study. Patasi recorded the lowest percentage of outbreak of 3.9%. This deviate from the preposition that house owners with fire safety training are likely to be more conscious about fire safety measures since Patasi recorded the lowest percentage in terms of fire safety training and also recorded the lowest number of incidence. This may be due to the fact that more respondents from Patasi had had some form of formal education as compared with the other suburbs.

Table 4.6 Houses affected by Fire Outbreaks in Kumasi

	Name of community									
	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Affected	5	10.4	2	2.4	3	3.9	10	10	20	6.5
Not affected	43	89.6	80	97.6	74	96.1	90	90	287	93.5
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

4.3.6 Causes of fire outbreak in the Kumasi Metropolis

House owners who have experienced fire outbreak before were asked what caused the fire outbreaks. The causes of the outbreaks were given as Heaters, Faulty electrical wires, candles and other naked flames, carelessness when cooking and power fluctuations. From table 4.7, 30% of domestic fires identified during the field work were caused by power fluctuations. Faulty electrical wires caused 25% of the outbreaks. Heaters, Candles and other naked flames, carelessness during cooking accounted for 20%, 20% and 5% respectively of fire outbreaks recorded. This indicates that more than 50% of fire outbreaks in Kumasi Metropolis is caused by issues related to electricity. This is consistent with the findings by Giwa, (2012*)* on his study on fire prevention and outbreak which revealed that, most fire disasters are caused as a result of power surges from electrical wires. The findings is however in contrast with that of Tyler (2006) in his study in Alaska, U.S.A; which concluded that the top two leading causes of residential fires were heating and cooking.

Table 4.7 Causes of fire outbreak in the Kumasi Metropolis

	Name of community									
Causes of fire outbreak	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Heater	0	0	2	100	1	33.3	1	10	4	20
Faulty Electrical wires	2	40	0	0	2	66.7	1	10	5	25
Candles and other naked flames	2	40	0	0	0	0	2	20	4	20
Cooking	0	0	0	0	0	0	1	10	1	5
Power fluctuations	1	20	0	0	0	0	5	50	6	30
Total	**5**	**100**	**2**	**100**	**3**	**100**	**10**	**100**	**20**	**100**

Source: Author's Field Survey, March 2014

4.3.7 People's Reaction to Fire Outbreaks

The behaviour of people needs to be modified to prevent and help them prepare to deal with a fire. It is clear that fire emergencies are stressful events as they initiate suddenly, are intense, and require an immediate response (Driskell and Salas, 1996 in The Australian Journal of Emergency Management, 2006). Investigations of people's response to a fire have revealed that people determine whether to fight or flee from the fire based on their perception of the emergency (Canter, 1985 in The Australian Journal of Emergency Management, 2006).

Respondents who had experienced fire outbreak before were asked about their immediate reaction during the fire outbreak. From table 4.8, majority of the respondents (85%) just ran away either through the escape route or any identified safe route. Ten percent (10%) of the victims creamed for assistance whilst 5% attempted to control the fire. A similar result was recorded when the respondents who had not experienced any fire outbreak were asked about their immediate reaction in case of fire outbreak. As indicated in the Table 4.9, 84% of the respondents reiterated that in case of any fire outbreak they would quickly run away for safety through identified safe places or the escape routes. Only 8.7% responded that, they would make an attempt to control the fire based on its severity, whilst 7.3% responded that they would scream for assistance in case of outbreak.

According to the "naturalistic decision making" theory, during a threat situation such as fire, people do not make decisions but instead choose the first course of action that seems to be appropriate given the seriousness of the situation. Therefore an

individual's decision is dependent upon how well the individual interprets the information present in the environment (Driskell & Salas, 1996 cited in The Australian Journal of Emergency Management, 2006).

Table 4.8. Reaction of fire victims during outbreak

	Name of community									
Reaction to fire	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Looked for escape route and run away	1	20	2	100	1	33.3	7	70	11	55
Identified safe place for escape	3	60	0	0	2	66.7	1	10	6	30
Attempted to control the fire	0	0	0	0	0	0	1	10	1	5
Screamed for assistance	1	20	0	0	0	0	1	10	2	10
Total	**5**	**100**	**2**	**100**	**3**	**100**	**10**	**100**	**20**	**100**

Source: Author's Field Survey, March 2014

Table 4.9. Reaction of respondents in case of fire outbreak among non-fire victims

	Name of community									
Reaction to fire	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Looked for escape route and run away	20	46.5	48	60	42	56.8	61	67.8	171	59.6
Identified safe place for escape	14	32.6	22	27.5	20	27.0	14	15.6	70	24.4
Attempted to control the fire	1	2.3	8	10	10	13.5	6	6.7	25	8.7
Screamed for assistance	8	18.6	2	2.5	2	2.7	9	10	21	7.3
Total	**43**	**100**	**80**	**100**	**74**	**100**	**90**	**100**	**287**	**100**

Source: Author's Field Survey, March 2014

4.3.8 Knowledge on the function of fire safety Measures

One can reduce the chance of injury if he/she knows what to do if there is a fire. They need appropriate information to help them manage fire effectively.

According to Fire precaution regulation of Scotland (1997), all people in premises should be aware of the risk of fire. They also need to know the action to be taken in case of fire, including:

- How to warn others of the fire including the operation of the fire-warning apparatus provided
- The location and use of escape routes
- The use of the fire equipment provided
- How to summon the fire service

Adequate level of fire safety knowledge and preparedness is essential to reduce the time delay to start evacuation (Proulx, 2001 cited in The Australian Journal of Emergency Management, 2006).

Knowledge on the use of Physical accessibility

The knowledge of respondents on the functions of some fire safety measures was sought for. The knowledge on function of physical accessibility among the people is very high. Three hundred and forty six respondents constituting 80.1% had knowledge on the use of physical accessibility to building. However, as shown in tables 4.10, sixty one (61) respondents representing 19.9% did not know the use of physical accessibility to building. The high knowledge on the essence of physical accessibility reflected in the high compliance of that safety measure. In terms of communities, knowledge by residents of Agric Nzima is high than the other communities with 97.9% having knowledge. The respondents of Tanoso had the least knowledge on physical accessibility (64%).

The safety measures that were identified were; physical accessibility to premises, Availability of means of escape, signs and notices, smoke detectors, emergency lighting system, fire blankets, fire buckets and fire extinguishers.

Table 4.10. Knowledge on the use of Fire Safety Measures

	Name of community									
Physical accessibility	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	47	97.9	65	79.3	70	90.9	64	64	246	80.1
No	1	2.1	17	20.7	7	9.1	36	36	61	19.9
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

	Name of community									
Means of escape	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	43	89.6	70	85.4	72	93.5	84	84	269	87.6
No	5	10.4	12	14.6	5	6.5	16	16	38	12.4
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

	Name of community									
Signs and notices	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	10	20.8	17	20.7	19	24.7	8	8	54	17.6
No	38	79.2	65	79.3	58	75.3	92	92	253	82.4
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

	Name of community									
Smoke detectors	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	7	14.6	9	11	17	22.1	9	9	42	13.7
No	41	85.4	73	89	60	77.9	91	91	265	86.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

	Name of community									
Emergency lighting system	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	3	6.3	4	4.9	4	5.2	6	6	17	5.5
No	45	93.8	78	95.1	73	94.8	94	94	290	94.5
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

	Name of community									
Fire blankets	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	9	18.8	14	17.1	13	16.9	14	14	50	16.3
No	39	81.3	68	82.9	64	83.1	86	86	257	83.7
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

Knowledge on the use of Means of Escape

Adequate means of escape are provided to enable people immediately, or within a short distance of travel, turn their back on any fire and move away from it to a final exit along smoke-free escape routes (Fire Industry Association, 2011). Means of escape is therefore a very important measure in managing domestic fires. The knowledge of the people on the function(s) on the means of escape was ascertained. The study revealed that, people's knowledge on the use of the means of escape was very high. As shown in the table 4.10, two hundred and sixty nine (269) out of three hundred and seven (307) of the respondents representing 87.6% had knowledge on the use of the means of escape. More than 80% of respondents from each selected community were conversant with the use of means of escape. This results is higher than the findings from Kachenje, et.al (2010) on their study on assessment of urban risk in the Central Business District of Dar es Salaam, Tanzania, which observed that 40.8% of all the respondents appeared to lack awareness of the existence of emergency exits in the buildings they use This might have accounted for why majority of the people decides to run away whenever there are any fire emergencies. This might have also accounted for the low number of injuries and deaths resulting from fire outbreaks in the Kumasi Metropolis. This is supported by the information from GNFS (2013) that, out of 614 fire outbreaks recorded in the Metropolis in 2013, four injuries and two deaths were recorded.

Knowledge on the use of Signs and Notices

In order for occupants, particularly those who are unfamiliar with the building, to use the building safely, there is normally a need to provide fire exit signs to direct people towards alternative means of escape (Fire Industry Association, 2011). Exit signs on doors or indicating exit routes should be provided where they will help people to find a safe escape route. Signs on exit routes should have directional arrows, "up" for straight on and "left, right or down" according to the route to be taken (Fire precaution regulation of Scotland, 1997). An "Exit", "Fire exit" or "Emergency exit" sign should be positioned over every final exit from the building and, where appropriate, any gate or final exit from the premises. Where the sign over the final exit is not visible, additional signs should be provided with appropriate direction arrows leading to the final exit (Fire Industry Association, 2011).

House owners' knowledge on the use of signs and notices within Kumasi Metropolis is very low. As pointed out in table 4.10, only 54 out of 307 respondents representing 17.6% had knowledge on signs and notices. Old Suame recorded the highest percentage (24.7%) on knowledge of sign and notices with Tanoso recording the lowest percentage of 8%. Lack of knowledge on the use of this safety device reflected in corresponding low compliance of the measure.

Knowledge on the use of Smoke Detectors

Smoke alarms should be installed in each bedroom and there should be at least one on every floor of one's home. These devices make noise that is loud enough to wake you in the event that there is smoke or a fire in your house (United State Fire Administration, 2013). Nixon and Diemler (2012) observed that smoke alarms are an important tool in detecting a fire and keeping one's family safe.

From table 4.10, majority of the respondents (86.3%) had no knowledge on the use of smoke detectors. Only 13.7% had knowledge on the use of smoke detectors. This put the people in the Metropolis at a higher risk since even; if the device is available the many people do not know its use to respond to them promptly. This situation might have accounted for the high incidence of fire outbreaks in the Kumasi Metropolis. Tanoso recorded the lowest percentage of the residents' knowledge on smoke detectors with only 9% of the respondents having knowledge on the use of the device. This is a true reflection of the fact that Tanoso had the highest number of fire outbreaks among the four communities.

Knowledge on the use of Emergency Lighting System

According to the Fire precaution regulation of Scotland (1997), escape routes need to be adequately lit. It further stressed that if the route depends on artificial lighting or if the place is used during the hours of darkness, one may need to consider alternative sources of illumination should the power fail during a fire outbreak. Knowledge of people on the use of emergency lighting system is very low among house owners in the Kumasi Metropolis. As shown in the table 4.10, out of 307 house owners interviewed, only seventeen (17) representing 5.5% had knowledge on the functions of the emergency lighting system. This situation increases the fire risk within the Metropolis as people would find it difficult to find a safe route in darkness in times of

fire emergencies. The table further shows that 6.3% of the respondents from Agric Nzima affirmed that they had knowledge on the use of emergency lighting system. Respondents from Tanoso recorded the second highest knowledge (6%) on the use of the device with Suame and Patasi recording 5.2% and 4.9% respectively. The lower number of respondents with knowledge on the use of emergency lighting system reflected in its compliance as only 2 out 307 house owners or their representative complied with the safety measure.

Knowledge on the use of Fire Blankets

When the knowledge of house owners on the use of fire blanket was investigated, 16.3% of the respondents provided answers which affirmed their knowledge on the use of the fire safety device. This means that about 84% of house owners did not have any knowledge on the use of fire blanket. This figure is higher than the findings from Argueta.et.al., (2009) on his study on compliance with fire blanket in Australia that, about 50% of international students did not know how to use the device correctly. Comparatively, 18.8% of respondents from Agric Nzima affirmed that they had knowledge on the function of fire blankets (See Table 4.10); whilst respondents from Patasi, Suame and Tanoso recorded 17.1%, 16.9 and 16.3% respectively. This specifies that, the knowledge on the use of fire blankets is consirably low among the house owners of Kumasi Metropolis. This situation reflected in the compliance of the safety device as Agric. Nzema recorded the highest percentage of compliance of 20.8%. This signifies that house owners from Agric. Nzema can more easily use fire blankets in times of fire emergencies than their counterparts from the other three communities.

Knowledge on the use of Fire Buckets

Fire buckets is one of the devices used in the management of domestic fires. When the knowledge of respondents on the use of fire buckets was elicited, it was revealed that only 13.4% of the respondents provided responses to affirm their knowledge (See table 4.11). This means that in case of any fire outbreak, it would be difficult for the occupants in the building to use fire buckets to control the fire at the initial stage. The fire therefore can easily escalate and get out of hands. In terms of distribution according to communities, Agric Nzima, Patasi, Suame and Tanoso recorded 12.5%, 20.7%, 15.6% and 9% respectively.

Knowledge on the use of Fire Extinguishers

The usefulness of portable fire extinguishers depends on people knowing how to use them. Fire Code requirements specify the size, number and location of fire extinguishers within ones facility. These requirements help establish a protection level appropriate for the hazard class of the building. One should make sure he or she knows the types, sizes and maintenance requirements of his extinguishers, as well as the basics of extinguisher operation (Seattle Fire Department). As indicated in table 4.11, less than half (43.3%) of the respondents had knowledge on the use of fire extinguishers whilst 56.7% had no knowledge. This implies that in an event of fire outbreak, many people would not be able to use fire extinguisher to control the fire. This puts the people at a higher risk against fire.

Table 4.11 Knowledge on the Function of Fire safety Measures

	Name of community									
Fire Buckets	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	6	12.5	17	20.7	12	15.6	6	9	41	13.4
No	42	87.5	65	79.3	65	84.4	94	94	266	86.6
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Fire extinguisher	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Yes	16	33.3	46	56.1	38	49.4	33	33	133	43.3
No	32	66.7	36	43.9	39	50.6	67	67	174	56.7
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

4.3.9 Knowledge on Contacts of Fire Management Institutions

Awareness of contacts of fire management institutions is very important in fire management. In times of fire outbreaks, the occupants of a building should be able to call fire management institutions like the fire service, National Disaster and management organisations as well as the Ambulance service for control, rescue and other assistants.

The knowledge on contacts of contacts of the fire management institutions within the Metropolis is very low. As indicated in table 4.12, 87.6% of respondents are not

aware of the contact numbers of the Ghana National Fire Service (GNFS). This means that in case of fire outbreaks, about 88% of house owners cannot reach for any assistance. With regards to Ambulance service 94.1% of respondents did not know the contacts of the Ghana Ambulance Service whilst 98.4 did not know the contacts of the National Disaster Management Organisation. This might have accounted for the reason why most fire outbreaks in the Metropolis get out of hands before fire service is contacted. This situation increases the risk of fire outbreak in the Metropolis.

Table 4.12. Knowledge on Contacts of Fire Management Institutions

Name of institution/ Awareness of contact of institutions	Yes	%	No	%	**Total**	**%**
Fire Service	48	15.6	269	87.6	**307**	**100**
Ambulance service	18	5.9%	289	94.1	**307**	**100**
NADMO	5	1.6	302	98.4	**307**	**100**

Source: Author's Field Survey, March 2014

4.4 Compliance with Fire Safety Regulations

After ascertaining the level of knowledge of fire safety measures among House owners of Kumasi Metropolis, the level of compliance with the safety measures was investigated. This was aimed at finding out how respondents comply with the various fire safety measures. The fire safety measures considered for the compliance includes; physical accessibility,

4.4.1 Compliance with Physical Accessibility

As indicated in table 4.13, compliance with physical accessibility to houses is very high. Out of 307 respondents, 245 representing 79.8% had their houses accessible to vehicles with 20.2% not having access of vehicles to the building. This figure is higher than the findings from Yemofio (2013 pp.86) in his study on informal settlements in Kumasi, observed that only 48 percent of the total respondents had their homes being accessible by road. This situation implies that, in times of fire outbreak fire tenders and other fire fighting equipment as well as ambulances would be able to get access to most of the building to control the fire and rescue victims. The study also pointed out that, 90.2% of the respondents of Patasi had physical access to their building. With respect to Agric Nzema, 89.6% of the respondents had physical access

to their building whilst Suame and Tanoso had 87% and 61% respectively of respondents having physical access to the building.

4.4.2 Compliance with Means of Escape

Means of escape are provided to facilitate evacuation in the event of an outbreak of fire. Compliance with means of escape in the survey communities turned to be high as shown in table 4.13. The study revealed that 71.1% of the respondents comply with means of escape. This means that in an event of fire outbreak, 71.1% of the houses had routes where victims can use to escape. A considerable number of the respondents (28.3%) did not have means of escape to their houses. This puts the life of the occupants in danger since occupants are likely to be trapped in the house in an event of fire outbreak. Fire rescue teams would also find it difficult to rescue the people due to the absence of the escape route. A comparative analysis of the four communities revealed that, houses with means of escape was highest at Tanoso with 81% of houses complying with the safety measure, with Suame having the least percentage of compliance (61%). Tanoso having the highest level of compliance might have accounted for low casualties to injuries and loss of life despite the high incidence of fire outbreak.

Table 4.13 Compliance with Fire safety regulations

	Name of community									
Physical accessibility to vehicles	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Accessible	43	89.6	74	90.2	67	87.0	61	61	245	79.8
Not accessible	5	10.4	8	9.8	10	13.0	39	39	62	20.2
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Means of escape	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	38	79.2	54	65.9	47	61.0	81	81	220	71.7
Do not comply	10	20.8	28	34.1	30	39.0	19	19	87	28.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Signs and Notices	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	2	4.2	0	0	1	1.3	2	2	5	1.6
Do not comply	46	95.8	82	100	76	98.7	98	98	302	98.4
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Smoke detectors	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	1	2.1	2	2.4	0	0	2	2	5	1.6
Do not comply	47	97.9	80	97.6	77	100	98	98	302	98.4
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Emergency lighting System	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	0	0	0	0	1	1.3	1	1	2	0.7
Do not comply	48	100	82	100	76	98.7	99	99	305	99.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Fire extinguisher	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	3	6.3	7	8.5	2	2.6	9	9	21	6.8
Do not comply	45	93.8	75	91.5	75	97.4	91	91	286	93.1
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

4.4.3 Compliance with Signs and Notices

Signs and notices provide directions to escape routes and other exits. It also gives directions with respect of locations to some fire safety equipments. Compliance to signs and notices turned to be very low among the study communities as indicated in table 4.13. Out of 307 respondents selected for the study only 5 representing 1.6% were complying with signs and notices. About 98% of the respondents were not complying with signs and notices. This implies that occupants especially strangers would be very much at risk in event of fire outbreaks, since there are no directions to safe routes in many houses. None of the respondents in Patasi complied with the safety measure. Agric Nzema had the highest compliance with 4.2% of the respondents complying with the safety measure. None of the respondents in Agric Nzima and Patasi complied with the use of emergency lighting system.

4.4.4 Compliance with Smoke Detectors

Many fire deaths and fire injuries are actually caused by smoke and gases. Victims inhale smoke and poisonous gases that rise ahead of the flames. Survival depends on being warned as early as possible (U.S. Consumer Product Safety Commission, 2007).

The provision of an appropriate fire detection and alarm system is an essential element of the fire safety measures in homes. It provides early warning of the occurrence of fire and thereby facilitates the activation of appropriate emergency procedures, including evacuation. Early detection also improves the chances of restricting the growth and spread of fire within the building by the use of first-aid fire fighting equipment, where safe to do so, and by early call-out of the fire services (Industrial Research and Standards,1995).

The survey revealed that, peoples' compliance with the use of smoke detectors can be said to be very low. Out of 307 respondents selected for the study, only 5 representing 1.6% (see table 4.13). This put life and property in danger since early warning cannot be given in an event of fire outbreak. This may be a great contributory factor to the high incidence of fire outbreak in the Kumasi Metropolis since occupants do not receive early warning to deal with the fire at the initial stage. So, by the time they realised, the fire might have got out of hands. This is supported by the findings of Ahrens, (2011), that over one-third (37%) home fire deaths occur in homes without

smoke alarms. According to the Department for Communities and Local Government (2008), ninety (90) people die each year because the battery in their smoke alarm was flat or missing. Argueta et.al.,(2009) in his study in Australia observed that, about 16.7% of international students in Australia did not have a smoke alarm in their residence. None of the respondents in Old Suame complied with smoke detectors whilst 2.4% of the respondents from Patasi comply with the safety measure. Respondents from Agric Nzema had 2.1% complying whilst Tanoso had 2% of the people complying. This means that the use of smoke detectors is popular among the residence of Patasi than the other three communities. This is a reflection of the fact that when respondents were asked whether they had experienced fire outbreak before, on 2 out of 82 respondents from Patasi answered in affirmative way. This figure was the lowest among the communities.

4.4.5 Compliance with Emergency Lighting System

In the event of failure of the electrical supply to the normal lighting, emergency lighting is necessary in a home to provide sufficient lighting to:

- indicate clearly the escape routes within the building and along external escape routes where necessary;

- provide illumination along escape routes to allow safe movement towards and through exits;

- ensure that fire alarm call points and fire fighting equipment provided along escape routes can be readily located;

- assist fire and emergency services in rescue, evacuation and fire fighting operations (Industrial Research and Standards (Fire Safety), 1995).

The use of emergency lighting system is almost non-existent in the study area. The survey revealed that, out of the 307 respondents selected for the study 305 representing 99.3% were not complying with emergency lighting system. Only two (2) respondents representing 0.7% had complied with the fire safety measure (see table 4.13). This means that in times of fire emergencies in the dark, many injuries and death would occur as a result of lack of alternative source of light. Evacuation or rescue of victims would be very difficult under such circumstances. None of the respondents from Agric Nzima and Patasi complied with the use of emergency

lighting system. One respondent each from Suame and Tanoso complied with emergency lighting system.

4.4.6 Compliance with Fire Extinguishers

Portable fire extinguishers are valuable in the early stages of fire because of their portability, immediate availability and easy use by a person (Fire Industry Association, 2011).

The research survey revealed that, only few house owners within the study area comply with portable fire extinguisher. As shown in table 4.13, only 21 out of 307 respondents representing had access to portable fire extinguishers. This means that the use of portable fire extinguishers among the study communities was very low. Also most of the fire extinguishers identified during the survey were not functional. Out of the 21 fire extinguishers identified during the survey only 6 were functional. The others were available just to meet the requirement. This signifies that in reality only 2% of the respondents were complying with the use of fire extinguishers. This indicates that any small fire can easily escalate since there would be no fire extinguisher to control the fire at the initial stage. This might have accounted for the high rate of fire outbreak in the Metropolis. This is consistent with the assertion by Fire Industry Association, (2011) that portable fire extinguishers can reduce the likelihood of the spread of fire on the premises and mitigate the effects of the fire on people, property and the environment. Respondents from Tanoso had the highest compliance of 9%. The lowest compliance was recorded by the respondents from Old Suame with 2.6% complying with the safety regulations. This specifies that more house owners in Tanoso can readily control small fires than their counterparts from Old Suame. Argueta et.al.,(2009) observed that about 57% of international students in Australia, did not have access to fire extinguishers.

4.4.7 Compliance with Fire Blankets

Covering a fire with a fire blanket removes the "oxygen" part of the fire triangle and can extinguish a fire (Twumasi, 2013). Considerable number of respondents (12.7%) responded affirmative to the use of fire blanket (see table 4.14). A larger proportion of the respondents representing 87.3% do not comply with the use of fire blankets. Most of the people who complied with the use of fire blankets did not have the actual blanket but they improvised with jute sacks. In spite of the possibility of

improvisation, the use of fire blanket the Kumasi Metropolis is still low. This situation increases the risk of fire hazards as small fires which could have been controlled with fire blankets is likely to get out of hands in the absence of the facility. This finding is similar to that of Argueta et.al., (2009) that about 80% of international students in Australia did not have access to fire blanket.

4.4.8 Compliance with Fire Buckets

Almost all the respondents in the study communities were not complying with the use of fire buckets. As indicated in table 4.14, Only 2 out of 307 respondents representing 0.7% responded in affirmative to the compliance with fire buckets. This indicates that in an event of fire outbreak, there would be no fire bucket to aid in the control of the outbreak. None of the respondents from Agric Nzima and Tanoso were complying with the use of fire buckets whilst one respondent each from Patasi and Suame complied with the safety measure.

Table 4.14 Compliance with Fire Safety Regulations

	Name of community									
Fire blanket	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	10	20.8	6	7.3	5	6.5	18	18	39	12.7
Do not comply	38	79.1	76	92.7	72	93.5	82	82	268	87.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**
	Name of community									
Fire bucket	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
Comply	0	0	1	1.2	1	1.3	0	0	2	0.7
Do not comply	48	100	81	98.8	76	98.7	100	100	305	99.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

4.4.9 Total Compliance to Safety Regulations by Communities

After assessing the level of compliance with the various fire safety regulations, the number of safety measures complied with by the respondents was also ascertained. The highest number of compliance by a respondent was five. As shown in Table 4.15, only one (1) out of 307 respondents representing 0.3% complied with five safety measures. Also only 2.9% complied with four safety regulations whilst 11.1%

complied with three fire safety regulations. A considerable greater number of respondents representing 47.2% had two compliance; with 33.2% complying with only one measure. Sixteen (16) out of 307 respondents representing 5.2% had zero compliance. This means that 5.2% of the respondents were not complying with any of the fire safety regulations. This means that any fire outbreak involving any of these houses would be very devastating.

Table 4.15 Total compliance of communities

	Name of community									
Total compliance	Agric Nzema		Patasi		Suame		Tanoso		Total	
	No	%	No	%	No	%	No	%	No	%
0	2	4.2	2	2.4	9	9	3	3	16	5.2
1	5	10.4	29	35.4	24	11.7	44	44	102	33.2
2	31	64.6	41	50	38	49.4	35	35	145	47.2
3	9	18.8	7	8.5	4	5.2	14	14	34	11.1
4	1	2.1	2	2.4	2	2.6	4	4	9	2.9
5	0	0	1	1.2	0	0	0	0	1	0.3
Total	**48**	**100**	**82**	**100**	**77**	**100**	**100**	**100**	**307**	**100**

Source: Author's Field Survey, March 2014

After assessing the total compliance among the respondents, the mean compliance was calculated. As indicated in the table 4.16, the mean compliance among the study communities is 1.7. This means that any house within the study area is likely to comply with approximately 2 fire safety regulations. This is an indication that the level of compliance to fire regulation among house owners in the Kumasi Metropolis can be said to be low. The low level of compliance among the respondents may be as a result of inadequate knowledge on the use of most of the fire safety measures.

Table 4.16. Mean Compliance

	Number of observation	Minimum	Maximum	Mean	Std Deviation
Compliance	307	0	5	1.7	0.857

Source: Author's Field Survey, March 2014

4.5. Institutional Measures to Manage Domestic Fires in Kumasi Metropolis

Management of fire outbreaks being it domestic or other forms requires collective efforts from all stakeholders. Management of domestic fires therefore does not only involve the effort of the house owners and other occupants but also the effort of some institutions which matter in the management of fires. Among these institutions are;

Ghana National Fire service, Kumasi Metropolitan Assembly, National Disaster Management Organisation and Ghana Ambulance Service. These institutions play major roles in fire management in the areas of prevention, control, rescue and assisting victims of fire outbreaks.

4.5.1. Role of the Ghana National Fire Service in Domestic Fire Management in the Kumasi Metropolis.

Kumasi Metropolis has six fire stations including the regional headquarters at Chirapatre. The other substations are located in Komfo Anokye, Manhyia, Suame Magazine, Kwame Nkrumah University of Science and Technology (KNUST) and Kumasi Metropolitan Assembly (KMA). The Ghana National Fire Service has three safety divisions; these are inspectorate, certification and education divisions. The inspectorate division is responsible for inspecting buildings to make sure that they comply with fire safety regulations. The certification division is also responsible for issuing certificates for buildings which have satisfied the fire safety regulations. The education division is responsible for creating awareness on fire safety issues.

To create awareness and educate the citizens in Kumasi Metropolis on fire management, the education division of the Ghana National Fire Service in Kumasi Metropolis has adopted a strategy of visiting churches and mosques to educate the congregation on fire prevention, fire control and fire rescue at the time of worship. According to the Ghana National Fire Service, this strategy was adopted due to the fact that, all attempts to organise public forum in the various communities failed due to unwillingness of the citizens to attend. The unit also provides an advisory role to house owners on issues of fire safety in Kumasi Metropolis.

In the area of fire control, each of the six fire stations in the Kumasi Metropolis has a fire tender to deal with fire outbreaks. The regional fire station at Chirapatre in Kumasi has one 125 feet Turn Table ladder to deal with fire outbreaks involving high rise buildings in the region. This signifies that, the Ghana National Fire Service is fully prepared to deal with any form of fire outbreaks in the Kumasi Metropolis.

4.5.2. Role of the National Disaster Management Organisation (NADMO) in Domestic Fire Management in the Kumasi Metropolis

National Disaster Management Organisation (NADMO) is one of the key stakeholders in the management of domestic fires in Ghana. In line with this, the

NADMO office in Kumasi Metropolis plays a complementary role in fire management in the Metropolis.

According to the Kumasi Metropolitan coordinator of NADMO, the office assists GNFS to embark on rescue mission during fire outbreaks. There is therefore collaboration between the NADMO and GNFS in rescuing victims during fire outbreaks. Also in collaboration with the GNFS, NADMO investigates into causes of fire and assesses the cost of damage during fire outbreaks. This helps to come out with causes of fire out break so that the right preventive measures can be adopted. It also helps to come out with the actual cost associated with the damage caused by the fire outbreaks. NADMO also provides relieve services in a form of clothing, food and temporal shelter for fire victims within Kumasi Metropolis.

In an attempt to reduce domestic fire outbreaks and other disasters in Kumasi Metropolis, NADMO has formed disaster volunteers in various communities to provide an advisory role to house owners on preventive measures to the various forms of disasters including domestic fires in the Metropolis. However, none these volunteer groups existed in any of the study communities during the time of the visit of the researcher.

4.5.3. Role of the Kumasi Metropolitan Assembly in Domestic Fire Management in the Kumasi Metropolis

Kumasi Metropolitan Assembly plays a very key role in management of fire outbreaks in Kumasi Metropolis. Kumasi Metropolitan Assembly enforces safety regulations and health standards in housing provision. Also the Assembly assists the Ghana National Fire Service in maintenance of fire equipment to put them in good shape to enable GNFS to respond promptly to fire emergencies in the Metropolis. The assembly further provide fuel and financial assistance to GNFS to ensure effective execution of their functions.

Furthermore, the assembly see to it that, fire safety issues like physical accessibility, availability of escape routes, the use of the right construction materials among others are incorporated into building designs and plans as enshrined in the Ghana Building Code before building permits are issued. Kumasi Metropolitan Assembly is making sure that all unauthorised structures within the Metropolis are removed to pave way for free flow of traffic so that in times of fire outbreaks, GNFS can easily get access

of the building under fire. The Assembly is once again in the process of implementing its street naming system so that right and exact directions can be given in times of fire emergencies.

4.5.4. Role of the Ambulance service in domestic fire management in the Kumasi Metropolis

Ambulance service is considered as one of the major stakeholders in fire management in the Kumasi Metropolis. Ambulance service provides first aid to fire victims who have suffered from fire outbreaks. The service has trained personnel who are capable of providing any form of first aid to disaster victims including fire. The service also conveys fire victims who are under critical condition during fire outbreaks to the hospitals. The service works twenty four (24) hours daily to offer services to patients and disaster victims within the Metropolis.

4.6 Problems militating against effective management of domestic fires in the Kumasi Metropolis

Various stakeholders such as house owners, Ghana National fire Service, Kumasi Metropolitan Assembly, National Disaster Management Organisation (NADMO) and Ghana Ambulance service play major roles in the management of domestic fires in the Kumasi Metropolis. In spite of the roles play by these stakeholders, there are a number of challenges which hinder smooth management of domestic fires by each of the above mentioned stakeholders.

4.6.1. Problems faced by house owners in the management of domestic fires in Kumasi Metropolis.

House owners and other occupants have the greatest role to play when it comes to domestic fire management. If the house owners as well as other occupants are equipped with knowledge and other fire management facilities, the incidence of fire outbreaks in residential areas in the Kumasi metropolis would go down to its minimum level. However house owners within the Metropolis are faced with a lot of problems making it difficult for them to play the needed role in domestic fire management within the Metropolis. As shown in the table 4.6.1, some of the problems identified during the field survey were lack of funds to procure fire safety equipment, inadequate knowledge on the use of fire safety devices, delays in responding to distress calls by the fire service and other fire management institutions, high cost of

safety equipment, frequent power outage, erection of unauthorised structures, indiscipline among occupants on the use of naked flames and too many fuel kept inside the house.

The problems are shown on a likert scale ranging from 1 to 5 representing very low to very high depending on the magnitude. As shown on table 4.6.1, with respect to lack of funds to procure fire safety equipment, 2.9% score it 1 representing very low whilst a greater number of them (40.1%) scoring 3 to indicate that the problem is normal. About 37% said the magnitude of the problem is high scoring 4 for it with 16.0% scoring 5 to signify that, the problem is very serious. The weighted rank for the problem is 4, specifying that the magnitude of the problem is high. This means that, house owners do not have adequate funds to enable them to meet the necessary requirement for effective management of domestic fires. Small fires can therefore easily get out of hands and cause major destruction to life and property. The statistics for the other problems are shown in table 4.17.

Table 4.17 Problems faced by house owners in the management of domestic fires

Variable	Responses (Percentage)					
	Very low (1)	Low (2)	Normal (3)	High (4)	Very high (5)	Weighted average
Lack of funds to procure fire safety devices	2.9	3.9	40.1	37.1	16.0	4
Inadequate knowledge on the use of fire safety devices	1.7	4	24.1	49.2	20.5	4
Delays in responding to distress calls by the Fire Service and other relevant institutions	8.1	19.9	17.3	37.1	17.6	3
High cost of fire safety equipment	6.2	28.0	32.9	21.5	11.4	3
Frequent power outage	3.6	16.0	18.2	26.4	35.8	4
Irregular water supply by Ghana water company	8.8	28.0	26.7	10.4	26.1	3
Erection of unauthorised structures	10.5	31.3	21.2	21.2	16.0	3
Indiscipline among occupants on the use of naked flame	17.2	32.2	28.3	17.3	4.9	3
Too many fuel kept inside the house	20.2	25.1	33.9	15.6	5.2	3

Source: Authors Field Survey, March 2014

4.6.2. Problems faced by the Ghana National Fire Service in the management of domestic fires in Kumasi Metropolis

In spite of the enormous roles played by the Ghana National Fire Service in the management of domestic fires, the service is bedevilled with a number of problems which do not ensure effective utilisation of its functions. Among these problems are as follows:

Traffic jam: Traffic jam was one of the issues identified as a problem militating against effective fire management in Kumasi Metropolis. According to the regional fire officer, due to increasing rate of car ownership and indiscipline among drivers and other road users has increased the volume of traffic jam within the Metropolis. Most drivers also turn deaf ears to sirens of fire tenders which sometimes create accident to fire equipment. These situations hinder prompt response by the officers of the GNFS to fire emergencies. Due to this, before they get to the scene, the fire might have got out of hands thereby causing major destructions to lives and property.

Problem of location or improper street naming: One problem which was identified from GNFS in domestic fire management is how to locate the exact facility or area where fire outbreak has occurred. This problem is due to poor directions given by the general public as a result of improper street naming within the municipality as well as poor house address system. GNFS officers therefore waste a lot of time moving round to locate where fire outbreak has occurred. So the situation might have got out of hand by the time the location is found.

False alarms: False alarm is increasingly becoming one of the major problems faced by the GNFS in the management of domestic fires. These false alarms are calls made by some people to deceive the officers of the GNFS. According to the GNFS, in 2010 seventeen (17) false alarms were recorded in the Kumasi Metropolis. In 2011 the number of false alarms was thirty seven (37). There was a reduction in the number of false alarms from 37 in 2011 to 26 in 2012 which further reduced to 12 in 2013. Notwithstanding the continues reduction of false alarm in the Municipality, it is still a source of worry to the GNFS since it becomes difficult for the service to differentiate between true calls and false calls. This affects the ability of the officers of the service to respond promptly to fire emergencies.

Poor road network and physical accessibility: The road network leading to some residential areas in Kumasi Metropolis is very poor making it difficult for fire management officials to get physical access to those areas in times of fire emergencies. The house to house survey conducted by the researcher further confirmed that, some of the areas within the study area have no physical access to their building. The study revealed that, 20.2% of the houses selected for the study were not accessible to vehicles. This means that in times of fire emergencies, fire tenders, ambulance and other rescue equipment cannot reach the accident scenes putting life and property in danger.

Destruction of fire hydrants within the Municipality: According to the GNFS, destruction of fire hydrants is very rampant in the Kumasi Metropolis. These fire hydrants are being destroyed through private development, construction of roads, activities of utility providers among others. Information available to Ghana National Fire Service, 2013 revealed that, only three Fire Hydrants are operational in the Kumasi Metropolis. These fire hydrants serve as a source of water to the fire service in its operations. Continues destruction of fire hydrants means cutting off the supply of water to the GNFS in the metropolis. The service therefore finds it difficult to get access to water to control fire outbreaks.

Poor attitude of residents towards fire officers: Another major problem inhibiting against effective management of domestic fires is the attitude of the public towards fire officers. In most instances, fire officers are assaulted for reporting late to fire scenes without taking into consideration the volume of traffic congestion in the Metropolis. In 2013, fire officers were harassed for responding late to distress calls to fire emergencies. A similar incident happened at Breman in the Kumasi Metropolis in early 2014. These issues put the lives of the fire officers in danger thereby inhibiting effective utilisation of their functions.

Inadequate turn table ladder to deal with fires involving high rise buildings: Another problem identified during an interview with the GNFS is inadequate Turn Table Ladder to deal with high rising buildings within the Metropolis. There is only one 125 feet Turn Table ladder serving the entire Ashanti region to deal with fires involving high rise buildings. This indicates that in a case of simultaneous fire outbreaks involving two or more high rising building, the Ghana National Fire service would be

in the position of attending to only one of them. This situation puts life and property at a higher risk within the municipality.

4.6.3. Problems faced by National Disaster Management Organisation (NADMO) in the management of domestic fires in Kumasi Metropolis

According to the Metro coordinator of NADMO, the major problem facing the organisation in its operations is the delay in the release of relief items by the government. The organisation together with other functions, provide relief items for disaster victims including fire. The organisation therefore relies on government for relief items such as food, clothing, shelter (tents) among others. However, supply of these relief items by the government is not regular. The items are therefore not available at the time they are needed to provide relief services to the victims. This creates a lot of problems for the organisation since it is not able to deliver its functions when they are needed most. At the time of the survey, the Kumasi Metropolitan office of NADMO did not have a single relief item in its custody. So, in case there is any disaster, the organisation would not be in a position to provide any relief items to the victims.

The organisation does not also receive adequate funds to undertake its operations. This hinders effective disaster management within the Metropolis.

4.6.4. Problems faced by Kumasi Metropolitan Assembly in the management of domestic fires in Kumasi Metropolis.

Notwithstanding the role played by KMA in management of domestic fires, the Assembly is faced with a number of challenges. Among these challenges are as follows :

One of the problems identified by the Kumasi Metropolitan Assembly was slums and informal settlements within the Metropolis. According to the assembly, there are a lot of slums and informal settlements within the Metropolis. These informal settlements lead to encroachment of roads which make it difficult for fire management vans to get access to some areas in the Metropolis in times of emergency. According to Amoako and Cobbinah, (2011, pp. 158) the Department of Urban Road of Kumasi emphasised on the difficulty to construct access roads in these communities due to the haphazard and unauthorised development. This is confirmed by Yemofio, (2013) that in Sisaakyi

for instance, ―all the proposed access roads have been encroached upon leaving only two, which are un-tarred and dusty with numerous potholes.

The assembly also mentioned inadequate funds and vehicles for monitoring as one of the problems confronting the assembly. According to the assembly it does not have enough funds and vehicles for the various units within the assembly to monitor development of settlements and erection of other structures within the Metropolis.

4.6.5. Problems faced by Ghana Ambulance Services in the management of domestic fires in Kumasi Metropolis

One of the problems raised by the Ghana Ambulance Service was failure to adhere to emergency sirens by the other road users. According to the service, the other road users fail to give way to the vehicles of the service during emergencies. This situation causes delays in responding to emergency calls and accidents which put the lives of people in danger.

The Traffic situation in Kumasi Metropolis sometimes becomes so congested that it becomes very difficult for the service to respond promptly to emergencies. This leads to a situation whereby the service sometimes gets to a scene at a time when the conditions of victims are deteriorated.

Interference by the public was also mentioned as one of the problems faced by the Ghana Ambulance service. According to the service sometimes during emergencies, the crowd within the accident scene becomes so large that it interferes with the activities of the service. Some people even sometimes do not allow the service to go about their activities. This situation does not promote effective discharge of duties by the staff of the service.

CHAPER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

The survey data obtained on the management of domestic fires in the Kumasi Metropolis was presented and analysed in the previous section (Chapter Four). This chapter, which happens to be the final chapter of the study, concludes by providing a summary of the major findings made from the previous chapter. This chapter also contains possible areas for further research.

5.1 Summary of Findings

The findings of the study are summarised according to the set objectives of the study. The study set out to achieve the following objectives

1. To determine the level of fire safety knowledge of the residents of Kumasi Metropolis.
2. To determine residents' level of compliance with fire safety measures as enshrined in the Fire Precaution (Premises) regulation of Ghana (2003).
3. To evaluate the roles played by the relevant institutions to manage domestic fires?
4. To examine problems which militate against effective management of domestic fires in the Kumasi Metropolis.

The findings were presented in four sections based on the objectives of the study.

5.1.1 The Level of Fire Safety Knowledge of the Residents of Kumasi Metropolis

The findings revealed that a greater number (97.1%) of house owners within Kumasi Metropolis had some level of awareness on causes, prevention. control and rescue of fire.

Most of the house owners (88.3%) had never received any training on fire safety measures leading to inadequate knowledge on the use of most of the fire safety measures.

About 6.5% of the houses selected for the study had experienced fire outbreaks before. The causes of these outbreaks were identified as heaters, faulty electrical

wires, candles and other naked flames, cooking and power fluctuations. With respect to the reaction of people during the fire outbreak, majority of the respondents (85%) just ran away either through the escape route or any identified safe route. Ten percent (10%) of the victims screamed for assistance whilst 5% attempted to control the fire. A similar results were recorded when the respondents who had not experienced any fire outbreak were asked about their immediate reaction in case of fire outbreak.

Considering the knowledge of house owners with regards to the use of the various fire safety measures, the study revealed that the level of knowledge on the use of physical accessibility and means of escape were considerably high. About 80% and 88% of the house owner had knowledge on the use of physical accessibility and means of escape respectively. However, only smaller proportion of respondents had knowledge on the use of sign and notices, smoke detectors, emergency lighting system, fire blankets and fire buckets. Only 17.6% of the respondents had knowledge on the use of signs and notices whilst 13.5%, 5.5%, 16.3% and 13.4% had knowledge on the use of smoke detectors, emergency lighting system, fire blankets and fire buckets respectively. With regard to the knowledge on the use of fire extinguishers, a considerable number (43.3%) of house owners had knowledge on the use of the safety measure.

Majority of the house owners in the selected communities did not know the contact numbers of the fire management institutions. The study revealed that 87.6%, 94.1% and 98.4% of the house owners did not know the contacts of Ghana National Fire Service, Ghana Ambulance Service and National Disaster Management Organisation respectively.

5.1.2 The Level of Compliance with Fire Safety Regulations as Enshrined in the Fire Precaution (Premises) Regulation of Ghana (2003).

The study revealed that, with the exception of physical accessibility and means of escape, the level of compliance with fire safety regulations by the house owners in the study communities were identified to be very low. About 80% of the house owners had their houses being accessible to vehicles whilst 71.7% complied with means of escape. The level of compliance with these two safety regulations is high because these requirements must be satisfied during the design stage of the building before building permits are issued. On the other hand the level of compliance with sign and notices, smoke detectors, emergency lighting system, fire extinguishers, fire blankets

and fire buckets were identified to be very low. Only 1.6% of house owners comply with signs and notices and smoke detectors. The use of emergency lighting system and fire buckets were found to be the safety regulations with the least number of compliance with 0.7% complying with each of them. Fire blankets and fire extinguishers had a compliance level of 12.7% and 6.8% respectively. Many people who use fire blankets did not use the actual blanket but improvised with jute sacks. The low level of most of the fire safety regulations are as results of inadequate knowledge on the use of the regulations resulting from lack of training on fire safety regulations.

With respect to total compliance, the highest number of compliance by house owners was five (0.3%). About 5% had zero compliance meaning that they did not comply with any of the safety regulations. The mean compliance of the people was approximately two (2) indicating that every house owner is likely to comply with two fire safety regulations.

5.1.3 Roles played by the Relevant Institutions in the Management of Domestic Fires in Kumasi Metropolis

The Role of the Ghana National Fire Service

The Ghana national fire service has six fire stations to deal with fire outbreaks within the Metropolis. These stations are located at Chirapatre, Komfo Anokye, Manhyia, Suame Magazine, Kwame Nkrumah University of Science and Technology (KNUST) and Kumasi Metropolitan Assembly (KMA).

The Ghana National Fire Service has three safety divisions; namely inspectorate, certification and education divisions. The inspectorate division is responsible for inspecting buildings to make sure that they comply with fire safety regulations. The certification division is also responsible for issuing certificates for buildings which have satisfied the fire safety requirements and the education division is responsible for creating awareness on fire safety.

Ghana National Fire Service in Kumasi Metropolis has adopted a strategy of visiting churches and mosques to educate the congregation on issues relating to fire prevention, fire control and fire rescue at the time of worship. The regional fire station

at Chirapatre in Kumasi has one 125 feet Turn Table ladder to deal with fire outbreaks involving high rise buildings in the region

The Role of NADMO

The office collaborates with GNFS to embark on rescue mission and during fire outbreaks and also investigates into the causes of the outbreak NADMO also provides relieve services in a form of clothing, food and temporal shelter for fire victims within Kumasi Metropolis. The organisation also forms and trains disaster volunteers in various communities to provide an advisory role to house owners on preventive measures to the various forms of disasters including domestic fires in the Metropolis. However, none of these volunteer groups existed in any of the study communities during the time of the visit of the researcher.

The Role of KMA

The assembly see to it that, fire safety issues like physical accessibility, availability of escape routes, the use of the right construction materials among others are incorporated into building designs and plans as enshrined in the Ghana Building Code before building permits are issued. The Assembly also assists the Ghana National Fire Service in maintenance of fire equipment as well as provision of fuel to assist GNFS to respond promptly to fire emergencies in the Metropolis. The Assembly is once again in the process of implementing its street naming system so that right and exact directions can be given in times of fire emergencies.

The Role of the Ambulance Service

The Ambulance service provides first aid to fire victims. The service also provides first aid to disaster victims including fire. The service also conveys fire victims who are under critical condition during fire outbreaks to the hospital.

5.1.4 Problems which Militate Against Effective Management of Domestic Fires in the Kumasi Metropolis

Problems faced by House owners in the Management of Domestic Fires in Kumasi Metropolis.

Some of the problems identified during the field survey were lack of funds to procure fire safety equipment, inadequate knowledge on the use of fire safety devices, delays

in responding to distress calls by the Ghana National Fire Service and other fire management institutions, high cost of fire safety equipment like portable fire extinguishers, frequent power outage, erection of unauthorised structures, indiscipline among occupants on the use naked flames and too many fuel kept inside the house.

Problems of the Ghana National Fire Service

The study revealed that, the major problems faced by the Ghana National Fire Service are traffic congestions due to increasing rate of car ownership indiscipline among drivers, failing to give way to Fire Tenders and other fire equipment by other road users during emergencies. Also due to improper street naming and house address system, the service finds it difficult in locating the exact places where fire outbreaks have occurred. Another major problem identified by the service is false alarm makes it difficult for the service to respond promptly to distress call. The number of false alarms identified during 2012 was twenty six. Poor road network physical accessibility to houses was further identified as some of the problems. Another major problem which was identified was that, the entire Ashanti region had only one 125 feet turn table ladder to deal with high rise buildings. So in case of fire outbreak involving more than one high rise building at a time, the service can attend to only one. In addition some of the public sometimes assault fire officers for arriving late at an accident scene.

Problems of NADMO

The study found out that one of the major problem faced by NADMO was delay and irregular release of relief items by the government. The organisation does not also receive adequate funding to undertake its operations. This hinders effective disaster management within the Metropolis.

Problems of KMA

One of the problems identified by the Kumasi Metropolitan Assembly was development of slums and informal settlements within the Metropolis. These informal settlements lead to encroachment of roads making it difficult for fire management vans to get access to some areas in the Metropolis in times of emergency

The study also revealed inadequate funds and vehicles for monitoring as one of the problems confronting the assembly.

Problems faced by Ambulance Service

The study revealed non-adhere to emergency sirens by the road users as one of the major problems faced by the Ambulance service. This situation causes delays in responding to emergency calls and accidents putting the lives of people in danger. The Traffic situation in the Municipality sometimes becomes so congested that it becomes very difficult for the service to respond promptly to emergencies.

Interference on the activities of the Service by the public was also revealed as one of the problems faced by the Ambulance service. The crowd within the accident scene becomes so large that it interferes with the activities of the service.

5.2 Recommendations

In view of the above findings and taking into consideration the fact that there is the need to be a holistic approach towards management of domestic fires in the Kumasi Metropolis and the country at large, the following recommendations are made.

- There is the need for the Government to develop a comprehensive policy on physical development to fully integrate the issues of fire safety.
- The planning department of the Kumasi Metropolitan Assembly should enforce their development controls to make sure that all houses are physically accessible to vehicles before building permits are issued. Efforts should also be made to create vehicular access in already congested areas especially the core areas of the various communities.
- The education unit of the Ghana National Fire Service should intensify their education and organise fire drills for the general public on the use of some basic fire safety measures like portable fire extinguishers, means of escape, fire blankets among others. The city may be divided into a number of sectors and educate the people on quarterly basis.
- There should be immediate enforcement of Fire Precaution (Premises) regulation of Ghana, 2003 (LI 1724) on residential buildings. This could be done by issuing fire certificate which certifies that each essential basic fire

safety measure has been inspected, tested and verified that the measures are capable of performing the functions specified on the Fire Safety regulation.

- The street naming system by the government should be sped up to provide accurate directions to accident scenes to ensure prompt responses to fire emergencies by the NADMO, GNFS and Ghana Ambulance service.

- The central government should try as much as possible to ensure timely release of funds to NADMO to empower them to deliver their functions effectively.

- The various Unit Committees must form fire brigades in their electoral areas so that they can provide immediate interventions in these communities in times of fire outbreaks.

5.3 Conclusion

The ultimate goal of the study was to assess domestic fire management in Kumasi Metropolis. This was against the background that domestic fire outbreak in the Metropolis had reached astronomical heights which consequently leads to loss of life and property.

The study revealed that, house owners or their representatives are under prepared for fire emergencies since knowledge on and compliance with most fire safety measures are low. There is therefore the need to intensify education on fire safety and also resource Fire Management institutions to empower them to deliver their functions effectively to reduce fire outbreaks to its barest minimum.

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APPENDICES

APPENDIX 1: Household Questionnaires

QUESTIONNAIRE: 2013 / 2014 ACADEMIC YEAR

HOUSEHOLD QUESTIONNAIRE

PROJECT TITLE:

ASSESSMENT OF DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS

I am an MSc. planning Student of K. N. U. S. T. and I am conducting a research into the above named topic. I would be very grateful if you could spare me some few minutes to answer the questions below. The confidentiality of your responses is assured.

Questionnaire No ……Date of Interview…… Locality/Suburb …… Name of Enumerator ……..Tel. No. of Respondent ……

Demographic Characteristics of Respondents

1. Status of respondent [ ]

a=house owner [ ]

b=spouse of the house owner [ ]

c=son/daughter of house owner [ ]

d=care taker [ ]

e=others (specified) .....

2(a) Age of respondents.....

2(b) Age range of house owner/ caretaker

a. Below 30 years [ ]

b. 30 - 40 years [ ]

c. 41 – 50 years [ ]

d. 51 – 60 years [ ]

e. Above 60 years [ ]

3. Sex of Respondent: 1 = Male [ ] 2 = Female [ ]

4. Level of Education of Respondent:

a=No formal [ ]

b= Basic [ ]

c = Secondary / S.H.S [ ]

d= Tertiary (Univ./Poly/Post-Sec.) [ ]

e= Others (Specify)……

5(a). What is your monthly income? ……..

5(b) Income range

a = Less than GH¢200.00 [ ]

b = GH¢200.00 – 300.00 [ ]

c = GH¢301.00 – 400.00 [ ]

d = GH¢401.00- 500.00 [ ]

e= GH¢ 501.00 – 600.00 [ ]

f= GH¢ 601.00 -700.00 [ ]

g= GH¢ 701.00 -800.00 [ ]

h= GH¢ 801.00 -900.00 [ ]

i= GH¢ 901.00 -1000.00 [ ]

j= Above GH¢ 1000

6. What is the type of your building?

a=Single storey [ ]

b=Two storey [ ]

c=Three storey [ ]

d=four storey [ ]

e=five storey [ ]

f=above five storey [ ]

6. Has the electrical wires been changed since the building was put up?

1=Yes [ ] 2=No [ ]

7. If question 10 is yes, how many years now were they changed? ……

Fire safety knowledge

1. Have you heard anything on fire safety before?

1=Yes [ ] 2=No [ ]

2. If answer to question one is yes, what aspect of fire safety do you know?

a=causes of fire outbreak [ ]

b=fire prevention [ ]

c=fire control [ ]

d=fire rescue [ ]

e=others (specify)

……..

3. How did you become aware of the fire safety issues?

a=through the mass Media [ ]

b=public education by GNFS [ ]

c=through school curricula [ ]

d=others (specify) .....

4. Have you had any training on fire safety measures?

1=Yes [ ] 2=No [ ]

5. If yes how many years now?

a=less than one year [ ]

b=one to three years [ ]

c=four to six years [ ]

d=above six years [ ]

6. Have you experienced any form of fire outbreak before? 1=Yes [ ] 2=No [ ]

7. If the answer to question 6 is yes, what caused the outbreak?

a=Heater [ ]

b= lightning [ ]

c= electrical wires [ ]

d= Careless use of candles and other naked flames [ ]

e=cooking [ ]

f= reckless use of electrical appliances [ ]

g= others (specify) ……

……

8. Apart from what caused the fire, what other causes of fire outbreak do you know?

a=Heater [ ]

b= lightning [ ]

c= electrical wires [ ]

d= Careless use of candles and other naked flames [ ]

e=cooking [ ]

f= reckless use of electrical appliances [ ]

g= others (specify) ……

……

9. What was your immediate reaction during the outbreak?

a=I looked for the escape route and ran away [ ]

b=I looked for the direction of the fire and identified a safe place for escape [ ]

c=I looked for fire fighting equipment to control the fire [ ]

d=Assisted by neighbours or fire management institutions to escape [ ]

e=others, specify ……

10. If you have not experienced fire outbreak before, do you have any knowledge on what causes domestic fires? 1= Yes [ ] 2=No [ ]

11. If question 10 is yes, what are they?

a=Heater [ ]

b= lightning [ ]

c= electrical wires [ ]

d= Careless use of candles and other naked flames [ ]

e=cooking [ ]

f= reckless use of electrical appliances [ ]

g= others (specify) ……

……

12. Do you know anything about fire prevention 1=Yes [ ] 2=No [ ]

13. If answer to question 12 is yes, which of the fire preventive measures are you aware of?

a= the use of right electrical wires [ ]

b= adherence to signs and notices [ ]

c= regular maintenance of fire detection system [ ]

d= cautious use of naked flames [ ]

e=avoidance of overloading of electrical circuits [ ]

f=the use of professional electricians [ ]

g=being cautious when cooking [ ]

Others (specify).....

.....

.....

14. Do you have any knowledge on fire control? 1=Yes [ ] 2=No [ ]

15. If the answer to question 14 is yes, what control measures are you aware of?

i=the use of Portable Fire Extinguishers [ ]

ii=the use of Fire Blankets [ ]

iii=the use of Fire buckets [ ]

iv= the use of Hose reels [ ]

v=the use of Sprinkler systems [ ]

vi=seeking assistance from the Ghana National Fire Service [ ]

vii=others (specify).....

16. What would be your immediate reaction in an event of fire outbreak in your premises?

a=I would look for the escape route and ran away [ ]

b=I would look for the direction of the fire and identified a safe place for escape [ ]

c=I would look for firefighting equipment to control the fire [ ]

d=I would wait for an assistance from neighbours or fire management institutions for evacuation [ ]

e=others, specify ……

17. Awareness of contacts of fire management institutions

Name of institution/awareness of contact of institutions	Yes	No
Fire Service		
Ambulance service		
NADMO		

Knowledge on the use of Fire Safety Measures

Name of safety measure	**Knowledge on the use of safety device**	
	Yes	**No**
18. Physical accessibility to building		
19. Means of escape		
20. Signs and notices		
21. Smoke detectors		
22. Emergency lightning system		
23. Portable Fire Extinguishers		
24. Fire Blankets		
25. Fire buckets		
26. Others (specify)		

Compliance with Fire Safety Measures

Name of safety measure	**Yes**	**No**
1. Physical accessibility to building		
2. Means of escape		
3. Signs and notices		
4. Smoke detectors		
5. Emergency lightning system		
6. Portable Fire Extinguishers		

7. Fire Blankets		
8. Fire buckets		
9. Others (specify)		
Total compliance		

10. What measures have you put in place to improve domestic fires management?

a=insurance policy against fire [ ]

b=availability of fire control equipment to deal with fire outbreak [ ]

c=regular maintenance to prevent outbreak of fire [ ]

d=careful use of fire and fuel to prevent fire outbreaks [ ]

e=availability of routes to ensure safe escape [ ]

Problems faced by House owners in Domestic Fire Management

Variable	Response options	Code
a=lack of funds to procure fire safety equipment	1= very low	
b=Inadequate knowledge on the use of fire safety devices	2= low	
c=poor municipal lay out	3= Normal	
d=delays in responding to distress calls by the fire service and other relevant institutions	4= high	
e=High cost of fire safety equipment	5= very high	
f=inadequate equipment for fire service		
g=illregular water supply by Ghana Water company		
h=Frequent power outages		
i=erection of unauthorised structures		
j=indiscipline among occupants on the use on the use of naked flame		
k=too many fuel kept inside the house		
l=Poor road network		
m=others (specify)		

Appendix 2: Questionnaire to the Ghana National Fire Service

QUESTIONNAIRE: 2013 / 2014 ACADEMIC YEAR

QUESTIONNAIRE TO THE GHANA NATIONAL FIRE SERVICE

PROJECT TITLE:

ASSESSMENT OF DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS

1. What are the major causes of domestic fire outbreaks in the Kumasi Metropolis?

.....

.

2. Could you provide me with the statistics of domestic fires from 2003 to 2013?

3. What measures has GNFS put in place to manage domestic fires in Kumasi Metropolis?

.....

.....

4. What are some of the problems faced by the service in its attempt to manage domestic fires? .....

.....

Appendix 3: Questionnaire to the National Disaster Management Organisation

QUESTIONNAIRE: 2013 / 2014 ACADEMIC YEAR

QUESTIONNAIRE TO THE NATIONAL DISASTER MANAGEMENT ORGANISATION (NADMO)

PROJECT TITLE:

ASSESSMENT OF DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS

1. What role is NADMO playing to manage domestic fires in Kumasi Metropolis?

.....

2. How many fire victims have been assisted by NADMO since 2010?

.....

3. What form of assistance have you been offering to victims of domestic fires?

.....

4. What challenges is the NADMO facing in its effort to complement the effort of GNFS to manage the domestic fires in Kumasi?

.....

Appendix 4: Questionnaire to the Ghana Ambulance Service

QUESTIONNAIRE: 2013 / 2014 ACADEMIC YEAR

QUESTIONNAIRE TO THE GHANA AMBULANCE SERVICE

PROJECT TITLE:

ASSESSMENT OF DOMESTIC FIRE MANAGEMENT IN KUMASI METROPOLIS (K MA)

1. What role is KMA playing in domestic fire management in Kumasi metropolis? (prevention, detection and control)

.....

2. What has the assembly achieved in its quest to manage domestic fire?

.....

3. What measures has the service put in place to ensure effective domestic fire management in the Kumasi Metropolis.

.....

4. What problem(s) is the Assembly facing in its efforts to complement the efforts of GNFS to manage domestic fires in Kumasi Metropolis?

.....