SLUM FIRE FIGHTING STRATEGIES FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF KIBERA, NAIROBI COUNTY, KENYA

BY
EKERE NSIKAK EDOBOT
ID NO. 644939

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UNITED STATES INTERNATIONAL UNIVERSITY- AFRICA
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FALL 2015
DECLARATION

I, the undersigned, hereby declare that all information in this thesis is my own original work and that it has not been published or submitted in any organization or institution other than the United States International University- Africa Nairobi, Kenya for academic credit

Signature ___________________ Date ________________

Nsikak Edobot Ekere- 644939

Student

This thesis has been presented for examination with my approval as the appointed supervisor

Signature_____________________ Date ________________

Dan. N. Odaba

Supervisor

Signature_____________________ Date ________________

Dr. Tom Onditi, PhD

Dean, School of Humanities and Social Sciences

Signature_____________________ Date ________________

Amb. Prof. Ruthie C. Rono, PhD

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DEDICATION

I dedicate this work to my beloved parents Mr. and Mrs. Edobot Ekere who have stood with me since I was a child going through nursery school all the way to the university studies until now. They have been an eternal source of inspiration since growing up. I will also like to dedicate this work to the men and women who have giving themselves to serve in slum firefighting in Kibera, Nairobi County, Kenya.
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<td>CBDP</td>
<td>Community Based Disaster Program</td>
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<td>DM</td>
<td>Disaster Management</td>
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<td>DP</td>
<td>Disaster Preparedness</td>
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<td>DRR</td>
<td>Disaster Risk Reduction</td>
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<td>EWS</td>
<td>Early Warning System</td>
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<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
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<td>HAZMATS</td>
<td>Hazardous Materials</td>
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<td>ISDR</td>
<td>International Strategy for Disaster Reduction</td>
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<td>ICRC</td>
<td>International Committee for Red Cross and Red Crescent Societies</td>
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<td>IFRC</td>
<td>International Federation of Red Cross and Red Crescent Societies</td>
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<tr>
<td>KRC</td>
<td>Kenya Red Cross</td>
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<td>KPLC</td>
<td>Kenya Power and Lighting Company</td>
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<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<td>NGOs</td>
<td>Non Governmental Organizations</td>
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<td>NODC</td>
<td>National Disaster Operation Centre</td>
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<td>SJA</td>
<td>St John Ambulance</td>
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<td>NCC</td>
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Definition of Terms

**Disaster:** A serious disruption of the functioning of a community or society involving widespread human, material, economic or environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources. It is a hazard which has adversely affected human life by resulting to injuries.

**Disaster Management:** Encompasses a range of policies and practices developed to prevent, manage and reduce the impact of disaster. It covers the implementation of disaster preparedness, mitigation, emergency response, relief and recovery measures.

**Disaster Recovery:** Continues beyond the disaster period immediately following the onset of a disaster and is divided into relief, restoration/rehabilitation and reconstruction. The purpose is to return all systems, both formal and informal to normal.

**Relief/Rehabilitation/Reconstruction:** Measures undertaken in the aftermath of a disaster to respectively save lives and address immediate humanitarian needs, restore normal activities, physical infrastructure and services.

**Disaster Response:** Includes initial emergency rescue, administering first-aid to the injured, referring the injured to medical facilities, evacuation of homeless to temporary shelters, provision of essential items such as food and water and immediate psychological support to survivors.

**Mitigation:** Are initiatives to eliminate and lessen risks through increasing awareness about risks and emergencies. Mitigation measures are both physical and structural for example using non-combustible building materials, or non-structural in the form of targeted educational programs, compliance and enforcement of safety regulations (Pogosyan, 2000:14 and UN, 2009).

**Hazard:** Potential threat to humans and their welfare. A dangerous phenomenon, substance, human activity or condition that may cause the loss of life, injury or other health impacts, property damage, loss of livelihoods, and services, social and economic disruption or environmental damage.

**Vulnerability:** The characteristics and circumstances of community, system or asset that makes it susceptible to the damaging effects of a hazard. Human vulnerability is the relative lack of capacity of a person or communities to anticipate, cope with, resist and recover from
the impact of a hazard. Structural or physical vulnerability is the extent to which a structure is likely to be damaged or disrupted by a hazard event.

**Risk:** is the combination of probability of the occurrence of a hazard and vulnerability to negative consequences. Risk = Vulnerability x Hazards

**Disaster Risk:** The potential disaster losses in lives, health status, livelihoods, assets and services which could occur at a particular community or society over some specified period.

**Human Capacity:** The qualities and resources an individual or community can use and develop to anticipate, cope with, resist and recover from the impact of hazard. Include material resources such as food and cash.

**Recurrent slum fire disasters:** Are disasters which occur on a regular basis due to interaction between hazards and vulnerabilities. It is an example of technological disaster with a rapid onset.

**Slum:** Is a contagious settlement where inhabitants are characterized as having inadequate housing and basic services.

**Triggering agents:** Emanate from the natural environment or from human activity. Disasters are outcomes of triggering agents.
ABSTRACT

Slum fires impose significant social and economic costs including loss of life, destruction of health, property, dwellings and jobs while the interlinked physical and social vulnerabilities expose the urban poor not to single but multiple risks. Disaster preparedness and mitigation are the main methods of protecting such communities against fire disasters. This study sought to examine fire safety mechanisms and their effect on prevalence of fire disasters in Kenya slums. Nairobi will further absorb another 5 million people in the next two decades who will seek residence in slums and will join the slum population which is already vulnerable and reeling with poverty and continues to lose life, property and livelihood due to fire disasters in slums. The site of the study was Kibera is a division of Nairobi Area, Kenya, and neighbourhood of the city of Nairobi, located 5 kilometres (3.1 mi) from the city centre. Kibera is the largest slum in Nairobi, and the second largest urban slum in Africa. The neighbourhood is divided into a number of villages, including Soweto East, Gatwekera, Kisumu Ndogo, Lindi, Laini Saba, Siranga, Makina and Mashimoni. A part from the low class, the majority of those who live in Kibera slum are poor who lived below the poverty line. Sampling was done for each of the eight villages which were divided into two clusters and from each, three households were selected using simple random sampling was done for each of the eight villages which were selected using simple random sampling and in each, one person chosen by purposive sampling to give a total sample size of forty eight persons. The study revealed that 46.9% of participants have experience ten and more incidents of fire in Kibera slum within a year while 36.7% have witnessed fire disasters. The cause of most fires in Kibera slum is unattended stoves by drunken residents, electric faults, and congested houses made of combustible materials and presence of kerosene. Majority of the respondents did not know of any fire safety mechanism while some had poor knowledge about fire safety mechanisms. Neighbours were the most active group in fighting fire at followed distantly by the fire brigade at a very minimal percentage. The challenges faced by residents when coping with fire are poor infrastructure and lack of safety equipment and little knowledge over handling of inflammable materials. Many of the respondents also felt that community sensitization to fire preventive measures was the best option for sustaining effective fire safety mechanisms while approximately a third of them thought that putting fire safety measures in practice would help, while another group said that the government needed to ensure effectiveness of the fire brigade. Majority of the participants pointed to the need to increase awareness on how to mitigate and deal with fire disaster while others appealed to the government to provide safety facilities. Another group also felt that the need for efficiency and effectiveness of the fire brigade and improving the infrastructure such as roads would be solution to the challenge of fire disasters. Important recommendations for acting against fire incidents include the government increasing capacity in fire safety mechanisms by reducing prevalence of fire disaster s in slums through enhancement of disaster management capability by mainstreaming DM . Provision of effective capability for harmonized and standardized rapid response to disaster by coordinated participation of all stakeholders at all levels is also important. Other strategies are rapid and effective response to disaster, promotion of high compliance in construction against fire outbreaks in the slum.
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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

A disaster is a serious disruption of the functioning of a community or society causing widespread human, material, economic or environmental losses which exceed the capacity of the affected community to cope using its own resources (UNISDR, 2009). According to Myers and Bedford (1980), disasters are social phenomena which stem from the interaction between hazards and vulnerabilities. The Great London Fire of the year 1666 and the Chicago Fire of October, 1871 are among the earliest examples of documented fire disasters which resulted in loss of human property and lives thereby demonstrating how fire disasters have imposed devastating effects since early days.

The number of people at risk of disasters globally has continued to grow by 70-80 million people and Africa has had a notable share of the increase in reported disasters (UN, 2002; ISDR, 2004). Among all technological disasters, fire leads in the number of events, those killed, those affected and the damages incurred. Out of the 76 fire events that have occurred in Africa recently, 1044 persons were killed, 262,652 affected and USD 35,950,000 incurred as damages. The Americas have had 131 fire disasters with 9,727 dead, 78,396 affected and caused damage worth USD 80,558,000. Asia on the other hand has had 280 events of 18,191 dead, 718,785 affected and USD 931, 911,000 in loses. Europe has had 92 events with 2,753 fatalities, 6,202 affected and damages totaling USD 705,000,000 (EM-DAT, 2009).

The statistics above show that fire disasters affect more people in Africa and Asia than in other continents even though damages incurred are relatively low compared to the other areas. This is because in Africa and Asia, most large scale fire disasters occur in slums. Fire disasters regularly occur in slums and since Africa leads with the number of people living in slums, it follows that fire disasters have been seen to be common in these areas (ISDR:2004, Africa Population and Health Research Centre Publication, 2000).

Urbanization is one of the most important demographic shifts worldwide in the past century. It represents a substantial change of how most of the world population has lived for the past century and several thousand of years (Galea and Vlahov, 2005 in Akpan, 2006). It follows that a substantial majority of the word’s population now lives in cities. This has been attributed to the lure of cities offering better employment, education and
healthcare. However, rapid and often unplanned growth is often associated with poverty, environmental degradation and population demands resulting in slum settlements (Moore et al, 2003 in Akpan, 2006). Urbanization is therefore a major factor in the growth of vulnerability, particularly of low income families living within slums (Havlick, 1986 in Wisner et al, 2003).

World population is projected to increase to 9 billion by 2050 versus today’s figure of 6 billion and almost all this growth will be in Africa and Asia with Africa’s population increasing by 1.2 billion. Most of this additional population will projectively live in cities and majority will find their way to slums. Currently, there are 166,208,000 people living in slums in Sub-Saharan Africa compared to the total world population of slum dwellers standing at 923,986,000 persons (UN-Habitat, 2011).

In Kenya during the first republic between 1963 and 1978, the urban population increased by 174% and over a third of the urban population in Nairobi lived in slums. This continued and unabated increase spread into the second republic after 1978 and was marked with brief interruptions in between due to varied government policies aimed at encouraging citizens to live in the rural areas (Macharia, 1992).

According to the Ministry of Planning, National Development and Vision 2030, Kenya’s population rose to 38.6 million towards the end of the year 2009 and is estimated to head towards the 40 million mark in 2010. The population is growing at a rate of 2.7% and is bound to be affected by high poverty rates whereby 57% of Kenyans will live below the poverty line.

The name "Nairobi" (Kenya’s capital city) comes from the Maasai phrase Enkare Nairobi, which translates to "cold water," the Maasai name of the Nairobi River, which in turn lent its name to the city. However, it is popularly known as the "City in the Sun" and is surrounded by several expanding villa suburbs. Nairobi was established in 1899 as a depot for railway supply. By 1922 its population was 9,000 people and by 1950 its population was noted to be of about 80,000 people.

At independence in 1963, Nairobi had a population of 350,000 people. Its current population is estimated at 3,138,369 people spread over 685 square kilometres ((GoK, 2010). Today, Nairobi is the largest city between Cairo and Johannesburg and the economic capital of most of Eastern and Central Africa. The city lies on the Nairobi River, in the south of the nation, and has an elevation of 1795 m above sea-level.
Nairobi is currently one of the most prominent cities in Africa politically and financially. Home to thousands of Kenyan businesses and over 100 major international companies and organizations, including the United Nations Environment Programme (UNEP) and the main coordinating and headquarters for the UN in Africa and Middle East, the United Nations Office in Nairobi (UNON), Nairobi is an established hub for business and culture.

The location of Nairobi and its relatively well-developed infrastructure, including a modern airport and commercial centres has led to very rapid expansion of the city since 1979. The city’s population growth has influenced environmental change over the past century as more land has been opened up for human settlement, industries, roads and other infrastructural development (Fig. 1.2).

A growing number of urban residents are finding shelter in sub-standard housing in informal settlements with severe fire safety and sanitation problems. The slums of Kibera and Mathare may well be Africa’s largest and are also probably the most dangerous with very little or no basic services. Lack of services and infrastructure severely constrains the economic development of the informal sector, particularly in the slums. Similarly, the private sector involvement has not been exploited for sustainable and equitable development of the city, in terms of wealth creation and service delivery. Both the municipal and the private sectors must be coordinated and regulated in an innovative and participatory way if they are to benefit the whole community (UN-Habitat, 2006).

Nairobi’s rapid population growth puts available water resources under serious pressure. Access to clean water in Nairobi is inequitable. For households, income determines both the environmental quality of their surroundings and their consumption of urban services. High-income groups barely more than 10% of the population consume 30% of domestic water, while low-income groups 64% of population consume only 35%. Over 60% of the Nairobi population live in slums and only 22% of slum households have water connections. Slum residents experience water shortages; 75% of them buy water from kiosks at prices far higher than those paid by middle- and high-income households, which typically have direct connections to the city’s network. Many slum dwellers have limited water for bathing and often use polluted river water. Public taps serve a mere 3% of slum households (UN-Habitat, 2006).

Nairobi is a centre of attraction from an international perspective but locally there is a growing level of unpreparedness towards disasters by the city. Three hours hardly pass
before a report on destruction of lives and property by fire is made and the slums are the 
most affected areas with very little done by the authorities to mitigate this disaster.

For years the city has falls victim to minor fires that lead to deaths that with precaution and 
preparedness cannot cause injuries. This has always been the trend in the developing world. 
Kenya hardly sets aside funds that are pointed towards disaster preparedness. The national 
budget assigns less than 1% of its national revenue towards the same and later when shared 
amongst national disasters, fire preparedness is left out.

Population and Housing Census Report (2001) reveals that Nairobi is highly populated with 
a density of 3079 people per square km and an overall population growth of 7% over the 
last two decades. More than half of the city’s population lives in slums which occupy only 
5% of the residential land. Nairobi is divided into nine administrative districts namely 
Kasarani, Embakasi, Lang’ata, Westalnds, kamukunji, Dagoretti, Mkadara, Njitu and 
Starehe. Kibera slum falls within Lang’ata, District on the eastern part of Nairobi.

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Slums are dependent on the local government but hardly receive any assistance in form of 
disaster preparedness or mitigation. Survivors of the fire disaster in slums usually rebuild 
their dwellings using whatever materials they manage to salvage because they are 
homeless and have no where to go.Government agencies designed to assist communities in 
the aftermath of technological disasters like slum fires are poorly equiped, spatially and 
socially distant from the affected communities and are unfamiliar with the needs in terms 
of service provision. They define the effects of disasters in terms of narrowly framed agency 
standards that channels limited government resources to short-term problem management 
and ignored the more complex community needs (Kroll –Smith and Couch: 1990, 

According to the Kibera District Development Plan of 2008 – 2012 prepared by various 
stakeholders and chaired by the District Commissioner, fire was identified as one of the 
impediments of development in the slum. It was noted that frequent fire disaster have had
devastating effects to the residents. Some of the causes of fires identified were the use of inferior building materials, congestion in most dwelling place, illegal connections of electricity, lack of fire points and in accessibility.

1.2 Statement of the problem

Slum fire disasters are consequences of phenomena or events induced by human activities and habitation, and both man-made and technological in their causation (Baird, 1975). According to Smith and Haffman (2002;3-4) in Marray (2009), slum fire disasters result from the entrenched social inequalities, spatial location of vulnerable communities and political neglect. Residents of slums are the urban poor who are exposed to risk and vulnerabilities (Murray, 2009).

Murray (2009) and UN (2003) list the four causes of fire disasters in slums to be the spatial layout of slums in the form of extreme proximity, narrow alleys and high density shelters, stock piles of combustible building materials, inadequate fire prevention measures and inferior fire suppression techniques. Illegal tapping of electrical supply lines, faulty electrical connections, illegal wiring, overturned kerosene stoves and lamps, and unattended cooking fires also lead to fire disasters. In addition, carelessness, negligence, recklessness and inattention by the slum dwellers also magnify the ease of another inadvertent or accidental trigger for another fire disaster. Slum dwellers do not have adequate fire prevention and suppression measures and lack even water to douse the flames while fire departments have continued to perform dismally as a result of lack of proper equipment and funds for repair and maintenance (Marry:2009, UN:2003). Lack of access roads in slums has made it almost impossible for the NCC engines to reach sites of fire disasters within Kibera slum.

Disaster preparedness and mitigation categorize the main methods of protecting communities against fire disasters. Preparedness entails policies and procedures designed to facilitate an effective response to a disaster while response are actions taken immediately, during and after a disaster to protect people and property and to enhance recovery. Mitigation entails actions taken before or after a disaster to reduce impacts on people and property. The use of these methods by slums residents and local authorities ensures disaster risk reduction in slums, while their absence spells doom.

Slum fires impose significant social and economic costs including loss of life, destruction of health, property dwellings and jobs (Twigg, 1999). The media routinely overlooks slum
fires and do not regard them as important because they are common and are not news worthy. Slum dwellers themselves regard such fires as sheer accident or bad luck and therefore fail to seek for assistance in terms of preparedness and mitigation. Thus the underlying structural determinants of unequal vulnerability to disaster are ignored. (Murray, 2009).

According to Murray (2009) the interlinked physical and social vulnerabilities expose the urban poor not to single but multiple risks. The on-going exposure to risk and vulnerability to hazards make the urban poor conduct their daily lives typically under a permanent state of emergency. The fires become part of everyday conditions of existence for the poor slum dwellers that eventually are unable to distinguish between what results from chance or accident and what results from normal state of affairs (Mbembe and Rottman, 1995:339 in Murray, 2009).

Using a case study of Kibera Slums in Nairobi County, this study seeks to bring out the problem posed by slum fires as a threat to sustainable development looking at the causes and nature of the fire disasters, responses and reactions to the fire disasters from the victims and the relevant authorities, the impact of the fire safety mechanisms and how to sustain an effective fire safety mechanism for a steady and sustainable growth and development.

1.3 Research Questions

This study sought to investigate why residents of Kibera slum and Nairobi City Council have failed to learn, adopt and utilize Disaster preparedness, Mitigation and Response methods (or fire safety mechanisms) in order to protect themselves from fire disaster. This study was guided by the following research questions:

i. What is the nature of fire disasters in slums?
ii. Are there any fire safety mechanisms taken by the slum residents and the local authorities against fire disaster in slums?
iii. What are the attitudes of slum residents’ towards these safety mechanisms?
iv. Is there any relationship between fire safety mechanisms and prevalence of fire disasters in slums?
v. How to sustain an effective fire safety mechanism in slums?
1.4 Objectives of the study

The broad objective of the study was to examine fire safety mechanisms and their effect on prevalence of fire disasters in Kenya slums. The specific objectives were:

i) To outline the nature of fire disasters in slums.
ii) To investigate whether there are any fire safety mechanisms taken by the slum residents and the local authorities against fire disasters in slums.
iii) To examine the attitudes of slum residents and local authorities towards the fire safety mechanisms.
iv) To determine the effect of fire safety mechanisms on prevalence of fire disaster in slums.
v) To examine how to sustain an effective fire safety mechanism in slums.

1.5 Significance of the study

A survey of mitigation and preparedness in developing countries in Asia and the Pacific found out that there was minimal planning for natural disasters but almost none for technological disasters (Asia Development Bank, 1991:3). Governments in developing countries give less attention to technological disasters than natural disasters such as floods and earthquakes as compared with minimal studies on human caused disaster such as fire. The reasons for this may be because the latter are difficult to conceptualize as exhibited by the challenge posed by the rapidly changing social and demographic perspectives in fire disasters. During disasters, data must be collected rapidly under highly adverse environmental conditions since critical information such as extent of damage to buildings and details on victim extrication process is perishable and usually irretrievable unless collected early.

Nairobi, the capital city of Kenya will further absorb another 5 million people in the next two decades who are mainly immigrants from the countryside (African population and Health Research Centre Publication, 2002). With this increase in population, more people will seek residence in slum because they are unable to pay even modest rental costs in overcrowded low income estates. This population which is already vulnerable and reeling with poverty continues to lose life, property and livelihood due to fire disaster in slums. Although the slum upgrading program by the government will go a long way in improving the standards of living of these residents, it will take long to reach all slums in Kenya. The achievement of the Millennium Development Goals and the Kenya Government Vision
2030 will probably depend on how well the stakeholders deal with this problem. This study attempted to generate important information that is useful in guiding policy makers in planning and provision of mitigation and preparedness facilities to ameliorate the urban slum fires.

1.6 Scope of the study

The scope of this study included residents of Kibera slum in Nairobi as respondents while local government and government officials such as chiefs and District officers offered important information related to the study. In addition, the regional coordinator of Kenya Red Cross society was also consulted for information.

The study examined fire safety mechanisms and their effects on prevalence of fire disasters in Kenya slums. Emphasis was put on informing slum residents and the local authority on how best they can be able to prevent fire disasters and minimize subsequent losses.

1.7 Limitation of the study

The research will not cover many slums due to time and financial constraints. However Kibera Slum is ideal for the study as a representative sample representing other slums due their homogeneity in housing characteristic and population. Presence of petty offenders like muggers could have also posed a threat to research assistants especially at night. The challenge of inferior road network and alleys was also experienced especially in locating points. Lack of cooperation by some respondents also posed a challenge to the research. These challenges were solved by collecting data during the day and by assuring the respondents that the study is being done for academic purposes only.
CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter consists of review of the relevant literature which is necessary in assisting to understand the subject of the study. The chapter involves discussions done in four parts. It begins by reviewing the theoretical literature then covers the empirical literature to explore the present levels of disaster preparedness employed by stakeholders in slum fire disasters. Under the empirical literature, sources and aspects of slum fire disasters presented by previous researchers are reviewed as well as the theoretical and conceptual framework which are presented here.

2.1 Theoretical Literature

ER (2006) and Langdon (1972:24) define fire as the process of burning which is a chemical reaction in which a substance combines with oxygen in the air at a suitably high temperature and the process is accompanied by the emission of heat, light and sound. Heat, oxygen and fuel or gaseous fuels are the elements essential for a fire to occur and constitute the fire triangle. According to ER (2006), the physical state of a substance determines how well it burns. Gaseous fuels such as LPG (propane and butane) burn more easily because the fuel is already in vapor form and therefore mix easily with oxygen.

This is unlike liquid fuels such as paraffin which must boil off some of the fuel so that it becomes vapor and can mix with oxygen. For a solid to burn, the heat from the fire has to decompose some of the fuel so that it becomes vapor. Timber, rubber, plastics and cotton burn readily but rediness to ignite and burn of solids also depends on the surface area exposed to the air. Therefore, sheets of paper are easily ignited and burn rapidly.

The process of combustion in solids takes place in two stages: first is when the fuel is heated to a temperature which gives a flammable vapor and second is when then the vapor is ignited by a flame or spark. When a flame touches a piece of paper, the paper gives off vapor which quickly catches fire. In liquids, the temperature at which the vapor forms so that it can be ignited is known as the flash point of the liquid. Paraffin has a flash point of 38C (100F). Gases are already vapor hence ignite in one single stage (ER, 2006).

Fire spreads in three ways: convection, radiation and conduction. In convention, heated air moves upwards to from convection currents carrying heat and smoke while in radiation, radiant heat reaches nearer objects which may be heated to ignition point. In conduction,
metals such as steel linking two parts of a building may transfer fire from one side to the other through conduction by transferring heat ((ER, 2006).

2.2 Classes of fire

ER (2006) and Williamson and Buckle (1958:4-6) classify fire into four classes as follows: Class A: Ordinary combustible material or solids such as woods, papers and plastics which form the most common fires in residential buildings. It is extinguished using water solution extinguishers. Class B: Flammable liquids such as petrol / gasoline, oil, paint and some waxes, gases and heavy lubricants which are extinguished by blanketing. Class C: Flammable gases such as butane, LPG gases and acetylene. Class D: Involves combustible metal or metallic alloy elements with combustible metal components. Foam which is a combination of water and foaming agent acts by excluding oxygen while gaseous media includes halogens, nitrogen and carbon dioxide.

Stored at high temperature in liquid foam. It vaporizes on discharge and extinguishes fire on reaching appropriate concentrations. Another media for extinction of fire is dry powdered bicarbonate which is usually non-toxic. Class E: energized electrical equipments such as appliances, switches, panel boxes and power tools. Extinguishers for these fires are rated according to non-conductive properties of the extinguishing agent. Class F: Cooking fats or oils, greases such as animal fats and vegetable fats.

Fire is extinguished through three methods done by taking away any of the three components (fuel, heat or oxygen). Starvation entails removing fuel or the combustible material while suffocation or smothering invloves removing the oxygen for example by using a fire blanket, sand or placing a coating of retardant (a thick soapy substance) on fuel to block it from oxygen. Another method is cooling by dropping water on fire to reduce the temperature. The above methods are classified into fixed installation and portable extinguishers. Fixed installations include dry risers, wet risers (automatic), fire hydrants, smoke detectors and fire alarms. Portable extinguishers include fire blankets and dry sand (especially applied on electrical equipment) and those outlined by the table below. Carbon dioxide, dry power and foam act by removing oxygen.

Slum fires can be prevented through good housekeeping, storing flammable liquids in ventilated areas but away from spark producing sources, using kerosene cookers correctly and observing correct power ratings of electrical outlets.
2.3 Disaster Risk Reduction

UN secretariat through ISDR at the world conference in Kobe Japan in 1995 came up with a document called the Hyogo framework of Action (HFA) which was created to provide a basis for DRR implementation. The document is comprised of five priority areas: ensure that DRR is a national and local priority with strong institutional basis for implementation; identify, assess and monitor disaster risks and enhance early warning; use knowledge, innovation and education to build a culture of safety and resilience at all levels; reduce the underlying risk factors; and strength DP for effective response at all levels (ISDR, 2005).

According to KRCS (2008), DRR are measures designed to protect livelihoods and the assets of communities and individuals from the impact of hazards and reducing their impacts. DRR is addressed by DP, EWS, advocacy, response and mitigation which entails reducing the frequency, scale, intensity and impact of hazards. It is any action taken to minimize the extent of a disaster or potential disaster. Mitigation can take to minimize the extent of a disaster or potential disaster. Mitigation can take place before, during or after a disaster and is mostly used to refer to potential disasters. Advocacy consists of favorably influencing the social, political, economic and environmental issues that contribute to the causes and magnitude of the impact of hazards. Risk reduction aims to minimize the impact of disasters by doing everything possible before a disaster strikes (IFRC, 2007).

DRR is achieved through reduction of vulnerabilities exposed by hazards such as fire since disasters occur when vulnerability and risk converge at a given moment and place (Perrin 1996:342). Vulnerability assessment which involves the identification of slums and such residents who are at risk and planning measures are to be taken to avoid or contain an emergency (FEMA, 1990). Reducing the threats to life, property and environment posed by hazards while simultaneously maximizing benefits is what comprises risk management and includes risk assessment as comprised of three distinct steps namely identification of hazards likely to result in disasters, an estimation of the risks of such events and an evaluation of the social consequences of the derived risks.

In risk perception, an individual responds to a hazard only after a threat is perceived. Individuals aim at satisfactory rather than maximum resolutions and imperfect knowledge forces the decision maker to construct a simpler and more personalized model on which to act (Simon, 1956 in Smith, 1992). Humans make choices from a range of alternatives and
these choices are based on a combination of individual knowledge which determines the perception of hazards (Kates, 1962 in Smith, 1992). According to Whyte and Burton (1982) in Smith (1992), a lay risk-perceiver assumes the consequences of a threat to be greater significance than the probability.

According to Smith (1992), hazard perception is influenced by past experiences, present attitudes, personality and values together with future expectations. Determinate perception occurs in lay people and accepts that hazards exist but seek to place extreme events in some patterns while dissonant perception denies existence of the threat as unlikely to be repeated or to occur. Probability perception accepts that disasters will occur at random but responsibility for dealing with the hazard is transferred to a higher authority like government or even God (Smith, 1992). The public’s perception of risks depends on the mass media rather than on expert opinion, and the tendency in these media is shifting away from information towards entertainment (OECD, 203). This same media routinely overlooks slum fires and does not regard them as important because they are common place and are not news worthy. Slum dwellers themselves regard such fires as sheer accident or bad luck and therefore fail to seek for assistance in terms of preparedness and mitigation. Thus the underlying structural determinants of unequal vulnerability to disaster are ignored (Murray 2009).

2.4 Disaster Preparedness

According to Kent (1991:87), DP entails forecasting and taking precautionary measures prior to an imminent threat when advance warnings are possible. It involves the development and regular testing of warning systems and plans for evacuation through rapid and effective response to minimize potential loss of life and physical damage to property. It also involves training of intervention teams, the population at risk and the establishment of policies. This is achieved through reduction of vulnerabilities exposed by hazards such as fire since disasters occur when vulnerability and risk coverage at a given moment and place (Perrin 1996:342). Efficient organization and effective response is key to disaster preparedness (Scalon, 1980:43). Therefore vulnerability assessment which involves the identification of slums and such residents who are at risk and planning measures are to be taken to avoid or contain an emergency (FEMA 1990).

DP can also be defined as the measures taken to prepare for and reduce the effects of disasters or the means to predict and where possible, to prevent them, mitigate their impact
on vulnerable populations and respond to and effectively cope with their consequences (ER, 2006).

Mitigation entails actions taken before or after a hazard event to reduce impacts on people and property. Mitigation also refers to initiatives to eliminate and lessen risks through increasing awareness about risks and emergencies. Mitigation measures are both physical and structural for example using non-combustible building materials, or non-structural in the form of targeted educational programs, compliance and enforcement of safety regulations (Pogosyan, 2000:14 and UN, 2009). Disaster preparedness is best viewed from a broad perspective and is more appropriately conceived as a goal rather than as a specialized program or stage that immediately precedes disaster response.

Disaster preparedness has three objectives; the first is to increase the effectiveness, efficiency and impact of disaster emergency mechanisms at community and national levels. Under this is the development and regular testing of warning systems and plans for evacuation or other measures to be taken during a disaster alert period to minimize potential loss of life and physical damage. Education and training of officials and the population at risk, the training of first-aid and emergency rescue teams and the establishment of emergency response policies, standards, organizational arrangements and operational plans are to be followed after a disaster.

The second objective of DP is to strengthen community based efforts through national programmes for the community or direct support of the community’s own activity. This includes educating, preparing and supporting local populations and communities in everyday efforts to reduce risks and prepared their own local response mechanisms to address disaster emergency situations. The third objective is to develop activities that are useful for both addressing everyday risks that communities face and for responding to disaster situations through health, first-aid or social welfare programs (ER, 2006). DP is achieved partially through readiness measures that expedite emergency response, rehabilitation and recovery with the end result being rapid, timely and targeted assistance. DP is also achieved partially through community-based approaches activities that build the capacities of people and communities to cope with and minimize the effects of a disaster on their lives.

According to ER (2006) there are eight DP strategies. The first strategy is Hazard, Risk and Vulnerability Assessment to address risks that people face as well as their human
capacities. The assessment should aim to identify characteristics, frequency and potential severity of the hazards a community faces; identify the particular geographical areas and communities that are most susceptible and vulnerable to those hazards; identify the main sectors of a community that would be affected by a hazard and anticipate how they might be affected; and assess the ability of those sectors to withstand and cope with the effects of hazardous phenomena.

The second is response mechanisms and strategies which are strengthened by the development of: evacuation procedures and how to disseminate these procedures to the public; training of assessment teams, an assessment process and information priority for an emergency response; measures to activate special installations such as emergency or mobile hospital facilities; procedures for activating distribution systems; preparation for emergency reception centres and shelters; procedures for activating land transport and preparation for storing or making arrangements for rapid acquisition of emergency relief supplies and equipment. Efficient organization and effective response is key to disaster preparedness (Scalon, 1980:43).

Third is preparedness planning whereby a preliminary plan should identify emergency shelters sites, plan and publicize evacuation routes, identify emergency water sources, determine chains of command and communication procedures, train response personnel and educate the public about what to do in case of an emergency. The aim of these measures is to improve the quality, timing and effectiveness of response to a disaster.

Disaster preparedness planning involves identifying organizational resources, determining roles, developing policies and procedures and planning preparedness activities aimed at ensuring timely disaster preparation and effective emergency response. The aim of preparedness planning is to identify assignments and responsibilities specific activities covering organizational and technical issues to ensure that the response systems function successfully in the event of disaster. The ultimate aim of writing a plan is to stimulate ongoing interaction between parties.

The fourth is coordination of efforts and resources among agencies and people involved in emergency response including the effected local population and local community based organizations, government emergency structures, fire brigades, health departments, international agencies and NGOs. Coordination helps avoid duplication and identifies gaps and weaknesses in necessary services during actual emergencies.
The fifth strategy is information management since disaster preparedness and response depend on gathering, analysing and acting on timely and accurate information before (hazard and early warning information), during (disaster needs assessment) and after disasters (progress of post disaster recovery). This will be achieved by developing procedures and mechanisms for obtaining, analysing and responding to early warning information related to hazard detection and forecasting alerts.

Sixth is EWS whose purpose is to detect, forecast where necessary, issue alerts related to impending hazard events. To fulfil a risk reduction function, EWS needs to be supported by information about the actual and potential risks that a hazard poses as well as the measures that people can take to prepare for and mitigate its adverse effects. Early warning system information needs tone communicated in such a way that facilitates decision – making and timely action of response from organizations and vulnerable groups (Maskrey, 1997 in ER, 2006).

When developing EWS, planners must account for the public’s perception of warnings, their experience related to reacting to warnings in the past and general public beliefs and attitudes regarding disasters and public early warnings. Efforts should be made towards raising awareness of the hazards to which a community is exposed and assist local organizations and vulnerable populations with interpreting early warning information and taking appropriate and timely action to minimize loss and damage.

Seventh is resource mobilization whereby stakeholders must develop procedures for mobilizing and acquiring emergency funds, supplies and equipment. Eighth is public education, training for response teams and rehearsals done to promote an informed, alert and self-reliant community capable of playing its full part in support of or in cooperation with government officials and others responsible for disaster management activities. Rehearsals keep plans fresh in areas such as rescue operations, first aid provision and response or needs assessment, coordination meetings and relief transport logistics.

The ninth strategy is CBDP where government disaster organizations, community volunteers, citizens, organizations and business have an active and important role to play before, during and after major emergencies and disasters. CBDP is a process that seeks to develop and implement a locally appropriate and locally owned strategy for DP and risk reduction.
The foregoing is because local populations in disaster-stricken areas are the first to respond to a disaster and are usually involved in search and rescue activities as well as in providing emergency treatment and relief to their families, friends and neighbours. Improving the skills and knowledge of these first responders to disasters is by providing them with education and training in preparedness measures, basic rescue techniques, first aid and emergency treatment.

2.5 Empirical Literature

2.5.1 Nature of fire Disasters in Slums

Slums in Nairobi have a high population density of up to 2300 persons per hectare whereby 50% to 80% of slum households rent from private-sector landlords. Natural growth and rural-urban migration contribute to the growth of the slums while residents earn low incomes from low skill employment and have limited assets (UN-Habitat, 2001). According to UN-Habitat (2001), slums lack basic services such as sanitation, safe water sources, waste collection systems, electricity supply, surfaced roads / footpaths, street lighting and rain water drainage. Slums are also characterized by substandard housing or illegal and inadequate building structures in form of non-permanent building materials. Other features are overcrowding and high density whereby five or more persons share a one-room unit, unhealthy living conditions on hazardous locations and lack of access ways. Poverty and income gaps also fuel social tensions and weaken the social cohesion needed to assess and respond to potential dangers (OECD, 2003).

Slum fires are human induced disasters imposing significant social and economic costs including loss of life, destruction of health, property, dwellings and jobs (Twigg, 1999). Apart from population growth and lack of knowledge about how to effectively resist the effects of disasters, rapid urbanization is also a risk factor. It leads to the concentration of population in cities which expands faster than the capacity for urban authorities to supply housing or basic infrastructure resulting in explosion of informal settlements. Unregulated low-income settlements where land values are lowest often occupy the most hazard-prone locations which are preferred by the poor as a way of reducing everyday risks by gaining greater accessibility to urban services and employment (UNDP, 2004). For low-income communities, risk is tied to a hazardous living environment with limited access to emergency services (IFRC, 1998). Poverty is therefore also the root cause of vulnerability (IFRC, 2000).
The occurrence of fire disasters in slums should be looked at in the wider context of environmental setting and the socio economic circumstances within which fires take place. Just as absence of local government controls to ensure acceptable levels of fire safety is a cause of fire, so is arson which may be used as a weapon by public or private interests to remove these communities in preparation for commercial development (UN, 2003). The root cause of fire disasters in slums is therefore the trenched social inequalities in income, housing and opportunities for advancement coupled with political neglect (Murray, 2009). Residents of slums are the urban poor who are exposed to risk and vulnerability to hazards due to the interlinked physical and social vulnerabilities (Murray, 2009). Sanderson (2000) contends that disasters such as fire hazards in slums perpetuate poverty for those already poor.

The housing structures in slums are built using flammable building materials and are too close to each other. Poor electricity wiring or illegal power connection, use of fuels such as kerosene and inability of fire trucks to access areas under fire contribute to continued devastating fire disasters (Sanderson, 2000). Other causes of fire in slums are poor housekeeping in keeping items carelessly, unattended cookers, gas leaks, fuelling stoves, unattended heaters, minors, overload of electrical outlets, cigarettes, domestic violence and accidents (ER, 2006). Even though slums are dependent on local government, they hardly receive any assistance in the form of disaster prevention, mitigation and recovery (Murray, 2009).

The aftermath of fire disasters in slums is usually marked by individual effects made to return to the pre-disaster situation. Homeless victims are usually unable to call local government or the provincial administration because authorities regard slums as illegal settlements (Murray, 2009). Most fire disaster victims receive assistance in the form of relief and rehabilitation aid from family and relatives (Quarantelli, 1960). In slums such as Kibera, fire disasters are usually followed by victim organization done by activities and politicians some of which may be featured in local television. Few NGOs, politicians and good Samaritans may volunteer to donate blankets, food stuffs or money but such efforts are usually low key due to glaring absence of government assistance (Murray, 2009). Failure by the media to highlight incidents of fire disasters within slums result in general misinformation and under-information thereby causing limited understanding about fire disasters in the slums. This attitude by the media is borne out of the desire to make profit and thereby do away with news that will not attract the public. In the identification and
management of a disaster, communication and information play an important role (Weichsel, Gartner and Bertens, 2000).

Availability of high volumes of information, lack of public dispute between experts about the nature of the risk and a dramatization of the risk will all tend to amplify the perceived risk. Risks are taken more seriously if the impact is likely to have concentrated life-threatening potential and to be immediate and direct rather than cause mortality and be well spread which is delayed and indirect (Smith, 1992). The media plays a role in this when it fails to report cases of fire disasters immediately they occur therefore the public will not contends that the inferior position that slum fire disasters are given by the media ensure that most of these incidents go unreported. The public and official pronouncements frame the devastating effects of slum fires as the unfortunate outcome of circumstances where the unlucky victims happened to be in the wrong place at the wrong time.

2.6 Challenges of Disaster Management in Kenya

Government agencies mandated with the responsibility of informing the public about disaster management are not up to the task and their performance has been dismal (Krol-Smith and Couch:1990, Mott:1974 in Arnoff and Gunter: 1998). This has created a scenario of disaster management failure and resulted in challenges which need to be overcome. The National Policy for Disaster Management in Kenya (2009) outlines several challenges faced by the current disaster management system. The policy, legal and institutional frameworks are inadequate, uncoordinated and not able to give strategic guidelines on DM. They are instead heavily weighted towards emergency response making systematic approach to planned DM inadequate. Secondly, participating institutions face inadequate budgetary allocation and conditional donor support thereby lacking finances, human resources and equipment. Inadequate information and data leads to poor planning, lack of institution memory and lack of improvement towards best practices.

Fourthly, weak linkages on DM capabilities between local communities and national/county levels lead to poor sensitization on DM especially in preparedness and coping mechanisms thereby increasing vulnerability and potential impacts on victims. Other challenges are inadequate integration and coordination among government ministries/departments, Agencies, NGOs, CSOs, the private sector, international development partners and UN Agencies. Initiatives among these parties have been consistent, less planned, less harmonious and majorly reactive in manner. There has also
been inadequate regional and international linkages coupled with poor government and lack of political will.

This policy however recommends inclusion of features for an effective DM system through government playing a leading role in Disaster Risk Reduction. This will be done through enhancement of disaster-awareness and disaster management capability by mainstreaming DRR at all levels of institutional structures for education and training. DRR will be mainstreamed among the general public through sensitization and community based education to attain awareness and functional literacy. The provision of effective capability for harmonized and standardized rapid response to disasters by coordinated participation of all stakeholders at all levels is also important. Creation of institutional and legal framework for autonomous National Disaster Management body that promotes information and lesson sharing among stakeholders and making provision for consideration of issues such as problems related to rural-urban migration/creation of overcrowded slums which are a preparation for disaster are important steps. Similarly, provision for continuous and sustainable reception, processing, storage and management of an effective database for DM will go a long way towards improved DM.

Other recommendations include rapid effective response to disasters, promotion of high compliance with safety regulations against potential risks, hazards and disasters and promote compliance with construction against fire outbreaks. Regular and periodic dedicated emergency drills by government departments and other stakeholders will improve effectiveness in response capability to disasters.

Some of the issues addressed include;

i. Inadequate policy, legal and institutional frameworks
ii. Inadequate finances, human resources and equipment
iii. Inadequate information and data
iv. Weak disaster management capabilities within communities and institutions.
v. Inadequate integration and coordination.

Solutions to the above include;

a. Sensitization, awareness creation and functional literacy to the public.
b. Promote linkages between disaster risk management and sustainable development for reduction of vulnerability to hazards and disasters.

2.3 Theoretical Framework

Sociological theory is making sense of a disturbing situation or a phenomenon to allow us most effectively understand that phenomenon (Francis, 1982). Another writer, Kerlinger (1964) describes a theory as a set of interrelated views of a phenomenon by specifying relations between variables with the purpose of explaining natural phenomena.

This study will broadly utilize the structure paradigm which emphasizes on the constraints placed on individual action by boarders and more powerful institutional forces. The paradigm forges a link between disasters, underdevelopment and economic dependency of the third world. The belief is that disasters in the third world arise from the workings of the global economy, from the spread of capitalism and from the marginalization of poor people (Muthi, 1969).

2.4 Systems/Functional Theory

The main proponent of this theory was Talcott Parsons who in 1960 viewed society as a system made up of separate parts called sub-systems whom failure would mean failure of the entire system hence society. This theory explains the relationship between these subsystems of the society to be based on information exchange (Ritzer, 1988). According to Parsons (1979), a system such as a society must fulfil the following roles;

1. Adaptation which entails the ways geared towards restoration of a distorted equilibrium brought about by lack of order.
2. Integration entails facilitation of parts towards a harmonized interrelationship.
3. Goal attainment whereby emphasis is on motivating members to perform their roles such as heeding advice on how to live. The society should therefore aim at attaining its goals.
4. Pattern maintenance whereby the society must ensure that its essential characteristics are maintained.
2.5 Relevance of the theory

Kibera slum is a part of Nairobi County and in extension, the country. Recurrent fire disasters occurring in the slum and the subsequent homeless situation experienced by victims is a concern for the country and therefore needs to be addressed for lasting solutions to be achieved. The theory explains how slum fire victims and local authorities both who exist within the larger Kenyan community seek ways of coping with fire disasters through adoption of fire safety mechanisms through knowledge and physical empowerment. The ultimate adoption of fire safety measures will enable these parties to eventually play their rightful roles in society. Kenya Vision 2030 blue print for development envisages the socio-economic development of the role population which will not be achieved if fire safety measures are not adopted and slum fire disasters continue to occur.

2.6 Critical Theory

According to Holy and Mc Cathy (1994), Critical Theory was developed the Frankfurt School in 1930s and 1940s. The element of criticism arose out of Immanuel Kant’s *The Critique of Pure Reason* which came as a call to reason to undertake a new self-knowledge and thereby critique the society. Agger (1991) gives earlier representatives of the theory as Hockheimer, Marcuse and Adorno while a recent proponent is Jurgen Habermas who was Adorno’s student. Critical Theory as developed by Frankfurt School attempted to explain why the socialist revolution prophesied by Marx in the mid–19th century did not occur as expected and linked economic with cultural and ideological analysis in their explanation.

Critical theory is anti-positivism by going against the positivism adage that one can be perceived by the world without making assumptions about the nature of phenomena under investigation. This means that knowledge can simply reflect the world as rational and necessary hence deflating attempts to change it. Critical theory attempts to develop a mode of consciousness and cognition that breaks the identity of reality and rationality, viewing social facts not as inevitable constraints on human freedom but as pieces of history that can be changed (Agger, 1991)

2.6.1 Relevance of the theory

Slums are inhabited by the vulnerable poor who face many risks such as fires. Frequent occurrence of fire in Kibera slum is a major concern to residents as well as government and other players due to the negative effects it has on the society. Hockheimer (1982:244)
outlines that critical theory seeks human emancipation from circumstances that enslave them which relates well with conditions facing slum dwellers.

Since this study aimed at discovering the fire safety mechanisms adopted by slum residents and local government authorities, critical theory explains well how these parties seek to adopt these safety measures since the theory possesses the characteristics of being explanatory, practical and normative. It explains what is wrong with the current social reality, identifies the actors to change it and provide both clear norms for criticism and achievable practical goals for social transformation (Hockheimer, 1982:2). Fire Disasters motivate the poor residents to organize and seek assistance in the form of training on mitigation and preparedness measures and in seeking recovery aid from the government and NGOs.

Figure 2 shows the role played by the adoption of fire safety mechanism by slum dwellers and local government authority. Application of measures such as D.R.R and DP together with mitigation and response are key towards achieving management of fire disaster in slums and represent empowerment of such communities to protect themselves. Under DP, the elements of information management or advocacy, co-ordination of efforts, EWS, resource mobilization, CDBP and policies are included. Adoption or exclusion of these measures will influence the extent of fire disasters either positively or negatively and will act on indicators such as number of houses destroyed.

The study therefore strove to look into fire safety measures and their effect on the prevalence of fire disasters in slums. It brought forward two hypotheses as follows: -

- How ineffective Fire Safety Measures have led to an increase in slum fire disasters in Kibera slum of Nairobi.
- How Effective Fire Safety Measures have led to a decrease in slum fire disasters in Kibera slum of Nairobi.

2.7 Operationalization of Variables

The Independent Variable was operationalized as follows:

Fire Safety Mechanisms: In this study will refer to preparedness, mitigation and response measures.
Preparedness Measures: In this study will refer to policies and procedures to facilitate an effective response.

Mitigation Measures: In this study will refer to actions taken before or after a disaster to reduce impacts on people and property. Mitigation measures will also refer to incentives. Incentives mean actions taken to discourage a lifestyle of risk and vulnerability to hazards but encourage one characterized through reduction of vulnerabilities exposed by hazards such as fire. They will be indicated by increasing capacity of local government, sensitization and education of slum dwellers and offering rewards to those who perform well.

Response measures refer to actions taken to immediately before, during and after a disaster to protect and enhance recovery. They will be indicated with information by stakeholders and institutional capacity.

Information by Stakeholders in this study will mean knowledge on fire safety measures and will be measured by level of awareness on these fire safety measures.

Institutional Capacity in this study will mean the performance of government, local government and NGOs involved in humanitarian missions such as Kenya Red Cross. The Dependent Variable was operationalized as follows; Extent of Fire Disasters: In this study will refer to the number of incidents of fire disasters taking place within the slum. It will also mean the frequency of occurrence of the fire disasters. The indicators in extent of fire disasters will be the number of lives lost, the cost of property destroyed by the fires and number of houses destroyed. It will also be indicated by number of slum dwellings not conforming to safe construction rules, information by slum dwellers and local government authority.

Slum Dwellings in this study mean the presence or absence of slum dwellings adhering to modes of safe construction and will be measured by number of slum structures.

Number of fire in the study mean the total number of fires recorded to have occurred previously in the slum.
CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter outlines the research design used, the site, and population study, sample size and selection and the method of data analysis which will be applied.

3.1 Research Site

Kibera (Nubian: Forest or Jungle[1]) is a division of Nairobi Area, Kenya, and neighbourhood of the city of Nairobi, located 5 kilometres (3.1 mi) from the city centre. Kibera is the largest slum in Nairobi, and the second largest urban slum in Africa. The 2009 Kenya Population and Housing Census reports Kibera's population as 170,070, contrary to previous estimates of one or two million people. (Muchiri 2010).

The neighbourhood is divided into a number of villages, including Kianda, Soweto East, Gatwekera, Kisumu Ndogo, Lindi, Laini Saba, Siranga, Makina and Mashimoni. Conditions in Kibera are extremely poor, and most of its residents lack access to basic services, including electricity and running water.

Kibera is heavily polluted by human refuse, garbage, soot, dust, and other wastes. The slum is contaminated with human and animal feces, due to the open sewage system and the frequent use of "flying toilets". The lack of sanitation combined with poor nutrition among residents accounts for many illnesses and diseases.

The Uganda Railway Line passes through the centre of the neighbourhood, providing passengers aboard the train a firsthand view of the slum. Kibera has a railway station, but most residents use buses and matatus to reach the city centre. Carjacking, irresponsible driving, and poor traffic law enforcement are chronic issues.

Kibera originated as a settlement in the forests outside Nairobi, when Nubian soldiers returning from service with the King's African Rifles (KAR) were allocated plots in 1904 as a reward for their efforts. Kibera was situated on the KAR military exercise grounds in close proximity to the KAR headquarters along Thika Road. (de Smedt, Johan 2009) The British colonial government of the time allowed the settlement to grow informally, primarily because of the Nubians' status as former servants of the British crown, which put the colonial regime in their debt. Furthermore the Nubians, being "Detribalized Natives", had no claim on land in "Native Reserves". Over time, other tribes moved into the area to rent land from the Nubian landlords.
After Kenya became independent in 1963, a number of forms of housing were made illegal by the government. The new ruling government affected Kibera on the basis of land tenure, rendering it an unauthorized settlement. Despite this, people continued to live there, and by the early 1970s landlords were renting out their property in Kibera to significantly greater numbers of tenants than were permitted by law. The tenants, who are highly impoverished, cannot afford to rent legal housing, finding the rates offered in Kibera to be comparatively affordable. The number of residents in Kibera has increased accordingly despite its unauthorized nature. The average size of a shack in this area is 12ft x 12ft built with mud walls, screened with concrete, a corrugated tin roof, dirt or concrete floor. The cost is about Ksh 700 per Month (£6). These shacks often house up to 8 or more, many sleeping on the floor. By 1974, members of the Kikuyu tribe predominated the population of Kibera, and had gained control over administrative positions, which were kept through political patronage. (Lowder, Stella 1986).

However a shift in Kenyan demographics has taken place since then. The Luo and Luhyia ethnic groups from the western part of Kenya being the primary inhabitants of this area due to rural-urban migration. By the year 1995, Kibera had become a predominantly Luo inhabited slum. Presently, Kibera's residents represent all the major Kenyan ethnic backgrounds, with some areas being specifically dominated by people of one ethno-linguistic group. Many new residents come from rural areas with chronic underdevelopment and overpopulation issues. The multi-ethnic nature of Kibera's populism combined with the tribalism that pervades Kenyan politics has led to Kibera hosting a number of small ethnic conflicts throughout its century-long history. The Kenyan government owns all the land upon which Kibera stands, though it continues to not officially acknowledge the settlement; no basic services, schools, clinics, running water or lavatories are publicly provided, and the services that do exist are privately owned. (De Smedt, Johan undated)

The Kibera slum is purported to be one of the biggest informal urban settlements in the world. Several actors had provided and published over the years growing estimations of the size of its population, most of them stating that it was the largest slum in Africa with the number of people there reaching over 1 million. According to Mike Davis, a well-known expert on urban slums, Kibera had a population of about 800,000 people. (M. Davis, (2006) International Housing Coalition (IHC) talked about more than half a million people living in the Kibera slums. UN-Habitat had released several estimations ranging between 350,000
and 1 million people. These statistics mainly come out of analysis of aerial pictures of the area. IRIN estimated a population density of 2000 residents per hectare (IRIN Humanitarian news and analysis. UNOCHA (2006),

3.2 Socio-Economic Characteristics

The poor who are the majority in Kibera slum live below the poverty line and those in the low class are also found here. Kibera slum residents earn low income and are largely in unskilled employment sectors such as casual labour done in the adjacent Industrial area. Some of them also engage in domestic labour in more affluent neighbourhoods such as Langata, Karen and Woodly while others engage in petty business which generates low income. The population is characterized by high rates of unemployment and generally possess limited assets. This has in turn contributed to high crime rates. Apart from women and children heading most of these household, acts of prostitution, and drug abuse among other crimes is rampant in the slums of Kibera.

The slum lacks basic services such as sanitation, safe water sources, electrical supply and surfaced roads while illegal power connections and use of fuel such as kerosene is rampant. Those structures with electrical supply usually have poor wiring while the households are characterized by congestion, low levels of literacy and poor living conditions which result in poor housekeeping.

3.3 Research Design

A research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems (Kerlinger, 1986:279 in Kumar, 2005). It is also a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately and economically. It comprises operationalizing variables so that they can be measured, selecting a sample, collecting data and analysing results. (Thyer, 1993:94 in Kumar, 2005).

The study used both qualitative and quantitative data. In the Qualitative approach, it is concerned with the subjective assessment of the respondent’s attitudes, opinions and behaviour (Kothari, 2004) describing it as it is seen and experienced by those involved (Patrick and Steve 2005). Quantitative method because of its relative precision and lack of ambiguity (Nigel 2009) was used to infer from the population of Kibera slum on the fire safety mechanisms put in place at both personal and institution level from a given sample
and hence used survey design. This is a distinguished intensive description and analysis of meaning of the subject to facilitates in-depth understanding of the situation. The primary data was collected from heads of households while additional information was sought from the area Chief, District Officer, an NCC fire brigade expert and the Kenya Red Cross regional coordinator. Secondary data has also been analysed to inform the study.

3.4 Units of Analysis and Observation

According to Singleton et al (1988) the unit of analysis is that which the researcher wishes to study, understand or explain. The unit of analysis for this study was fire safety mechanisms and their impact on reduction of fire disasters. The unit of observation is collected (Singleton et al, 1988). These are the people who directly or indirectly experience fire disasters in Kibera slum. The units of observation in this study were the heads of households identified as bread winners in the family regardless of sex or age.

3.5 Sampling Design

A sample is a small group of individuals obtained from an entire group or accessible population having a common observable characteristic (Mugenda and Mugenda, 1999). Sampling is therefore a process of making of making statistical inference from samples of populations. That is, we wish to use known facts (response from the sample) to understand selecting a sample from a population to become the basis for predicting the prevalence of an unknown facts (responses of the population) (King et al, 1994 as in Nigel 2005)

Kibera slum was purposively selected on the basis of its suitability as an informal settlement affected by fire and for its resemblance to other slums in Kenya in terms of population and social – economic considerations. Its proximity to the Nairobi Industrial area also qualifies it as a slum of interest. Kibera slum is divided into eight villages. Each of the eight selected villages was divided into two clusters considering their physical location in the villages. From each of the clusters three households were selected using simple random sampling and in each one person was chosen by purposive sampling given that he or she satisfies the criteria of the main bread winner and decision maker in the household. This made a total sample size of forty eight persons to which questionnaires were administered.

To enrich the information received from the forty eight respondents, four key informants were selected purposively as follows:, area Chief, District Officer, the regional coordinator of the Kenya Red Cross and a fire expert from the NCC fire brigade.
3.6 Methods of Data Collection

This study was both quantitative and qualitative whereby quantitative data was collected by use of a structured questionnaire containing open and closed ended questions for full explanations. The questionnaires were administered on the forty eight household’s heads and to two focus groups by research assistants who recorded the responses immediately they were made. Apart from the questionnaire above, qualitative data was collected by the use of an Interview Schedule administered through informal in-depth interviews on the four key informants. Observation checklist was used to observe the lifestyles and dwelling units of respondents while document analysis of policy papers, strategic planned official research documents was done to collect basic data on the data on the research questions.

3.7 Data Analysis

The collected data inform of the completed questionnaires and interview schedules underwent editing to detect and correct errors and omissions. It was then put in categories or classes through coding or classification according to the study’s objectives then tabulated and counted.

Descriptive statistics was used to analyse quantitative data which was then presented in graphical and tabular form. The researcher analysed the data using Microsoft Excel and SPSS computer packages after which statistical inferences were drawn to form the basis of the study findings through computation of percentages and distribution tables.
CHAPTER FOUR

4.0 DATA ANALYSIS, INTERPRETATION AND SUMMARY OF FINDINGS

The main purpose of this study was to examine fire safety mechanisms and their effect on prevalence of fire disasters in Kenya slums. The sample for the study included 48 respondents each selected from the three households of the two clusters from the eight villages of Kibera slum. This chapter reports on the results of analysis of data and its presentation covering the respondents’ background information, the nature of fire disasters in slums and an assessment of fire safety mechanisms taken by the slum residents and the local authorities against fire disasters in slums. The chapter also looked into attitudes of slum residents and local authorities towards the fire safety mechanisms, the effect of fire safety mechanisms on prevalence of fire disasters in slums and the modalities to sustain an effective fire safety mechanism in slums. The findings of the study are presented using frequency distributions presented in tabular form.

4.1 Background Information

This section presents the background information for the respondents detailing the villages they came from and their demographic data.

4.2 Distribution of Respondents

All the eight villages of Kibera slum were covered in the study and an equal number of respondents from each of the eight villages participated in Kibera, Soweto East, Gatwekera, Kisumu Ndogo, Lindi, Laini Saba, Siranga, Makina and Mashimoni villages. This implies that this study was inclusive and a good representation of the entire population of Kibera slum.

4.3 Gender of Respondents

Out of all participants of this study, 57 % were male and 43 % female. This difference is attributed to the high numbers of male heads of households as compared to females. The difference is however marginal to affect gender representation which was therefore accurately observed as shown below.

4.4 Age of Respondents

Figure 5 shows that 53 % of the respondents were above age of forty, 37 % fell between ages 31-40, 9 % were between ages 21-30 while only 2 % of the respondents were below
20 years. It can be deduced therefore that the respondents were mature and had enough experience to participate in the study.

4.5 Marital Status of the Respondents

Figure 6 below shows that 77 % of the respondents are married, 13 % were single, 8 % widowed and 2 % were separated. This is a good representation of a typical normal society.

4.6 Education Level of Respondents

This figure below reveals that 49 % went to primary school, 36.7 % were secondary graduates while 8.2 % were college graduates. The figure also reveals that 6.1 % of the respondents have no education at all. From the above, it can be seen that slum residents have relatively low level of education and this dictates the level of knowledge that majority of the residents may have with regard to fire safety mechanisms and effective response. The level of education also informs the measures that slum residents are likely to take in situations of fire disasters.

4.7 Occupation of the Respondents

Figure 8 below shows that 51 % of the participants in this study depend on small scale businesses as means of livelihood, 16.3 % are employed as casual workers, and 12.2 % each are employed in other sectors while another 12.2 % are unemployed. The above results reveal that majority of the respondents are involved in economic activities associated with low incomes.

4.8 Duration of Stay

When asked about the duration of residence in Kibera, 81 % of respondents indicated that they had lived in Kibera slum for over six years, 6 % have resided there for between four to five years, and 9 % between two to three years and only 4 % have stayed for one year and below. This implies that most respondents have information about the slum and can be relied on in terms of revealing details of past fire disasters in Kibera.

4.9 Terms of House Possession

Here, 62 % of the respondents live in. Respondents who have full ownership of houses are likely to exercise care and caution as far as fire safety mechanisms are concerned. However, they are a minority and may not affect overall efforts to apply fire safety mechanisms within the slum.
4.10 Type of Fuel

Paraffin, charcoal, firewood and gas are the only fuels used within the slum. However the use of paraffin was higher at 58.3%, charcoal was 33.3% while firewood and liquid gas were used very scarcely by 4.2% of the participants. Liquid gas is being used by a few people despite being safer to handle than the rest of the fuels. Paraffin especially, poses a higher risk to these houses as negligence in handling the fuel may cause fire.

4.11 Understanding the Nature of Fire Disasters in Slums

The nature of fires in the slum entails frequency of the fire incidents, the materials used to construct the house and the causes of fire disasters in the slum.

4.12 Frequency of fire incidents

The results in the table below show that 46.9% of participants have experienced ten and more incidents of fire in Kibera slum within a year, 36.7% have witnessed between one to five while 16.3% have experienced fire between six to ten times within same year. This shows that the frequency of fire incidents in the slum is high since majority of respondents have witnessed many fire incidents. Similarly, those residents who have lived in Kibera for the shortest duration of less than a year also reported to have witnessed a number of five incidents. The above results are supported by the findings that not less than four fire incidents occur and are reported to the area chief every month.

4.13 Causes of Fire Disasters

The results in Table 3 below show that 44.7% of the respondents consider the cause of most fires in Kibera slum to be unattended stoves, by drunken residents and 17% put the blame on electric faults emanating from illegal tapping of electricity. The already congested houses coupled with presence of kerosene act in unison to make the risk of fire even greater in the slum. Despite indications that electrical faults cause a larger number of fires, many respondents chose to downplay the role of tapped electricity probably due to fear of victimization or arrest since most connections are illegal.

Another 6:4% of the respondents attribute the cause to poor housekeeping while 4.3% relative it to arson. Having many children in such a small area comes with challenges as the same living space is used for play thereby creating more risk of fire outbreaks. On average, each room is occupied by a family of four persons. Recklessness and carelessness in handling stoves therefore contributes in a large measure towards causing fire in the slum.
Similarly, the land on which the slum stands is often a subject of rivalry as different parties try to take possession through arson. NCC fire engines are sometimes stoned by rowdy youth hired to ensure complete destruction of the structures and make room for new owners. Finally, 27.7% indicated that they did not know the cause of fires in the slum. This large number can be explained by the low literacy levels and suspicions that the residents had in divulging information. Most of these unknown cases may be attributed to illegal tapping of electricity.

4.14 Housing Characteristics

Majority of the respondents (95.9%) reported that the most used material for building both wall and roofs in the slum was iron sheets while a minimal number represented by 4.1% lived in houses with walls made from timber. Similarly, houses with walls made from carton and those made from plastic sheets were also represented by 2% each. As regards to the material used to make the floor, 54.2% of the houses had floors made of cement, 37.5% from mud infill, 3% from wood poles and 4.2% from carton pieces.

These results indicate that most of the houses in the slum have walls and roofs made from iron sheets and also have cemented floors. Iron sheets are Combustible, readily burn and transmit fire to adjacent houses quickly given the close proximity of houses in the slum. It is therefore difficult to put out such fires given the combustible materials and close proximity of the houses.

4.15 Fire Safety Mechanisms in the Slum

Fire safety mechanisms are the measures put in place to prepare for, mitigate and respond effectively against frequent fire disasters in the slum. Knowledge and application of these mechanisms by residents play a big role in determining the extent of risk posed by fire disasters just as the mode of immediate response to these disasters.

4.16 Knowledge of Fire Safety Mechanisms

According to Table 5 below, a majority of the respondents to the magnitude of 60.5% indicated that they did not know of any fire safety mechanism while 28.9% recognized the importance of access roads in allowing help from outside during fire disasters in the slum. A further 7.9% gave importance to standby fire engines while only 2.6% indicated to know something about fire points. The large number of residents who lack knowledge about fire safety mechanisms can be explained by low education levels and inferior economic activities which do not enable one to gain such knowledge. The small number
that understood the importance of standby engines and fire points is attributed to those residents with higher levels of education and those who work in external settings like industrial area and the city which expose them to these ideas. The above results account for the recurrent and devastating fire disasters in the slum.

Both the provincial administration and local authority enter into the scene only after fire incidents have occurred thus not contributing much towards the knowledge of residents about these mechanisms. Their presence is only felt in sporadic distribution of food and other material assistance in the aftermath of a fire incident.

4.17 Application of Fire Safety Measures

The results from Table 6 below show that 21.3% each of the respondents that were interviewed applied the following household safety measures: to carefully handle inflammable materials, keep the kids away from cooking and lighting fires, and ensure safe use of kerosene stoves. A further 17% observed all the above measures, 12.8% practiced good housekeeping, 4.3% gained information about fire fighting while only 2.1% knew the emergency telephone numbers to call in cases of outbreak of fire. The high numbers of those who apply measures related to the household can be attributed to common experiences regarding congested houses and the use of kerosene to common experiences regarding congested houses and the use of kerosene as important risk factors. Lack of interest by the central and local governments has also contributed to the low numbers of those who have information about fire fighting and those who have emergency telephone numbers.

4.18 Response during Fire Breakout

The results in Table 7 show that 45.8% of the respondents prefer should to alert other people or raise alarm and 20.8% will vacate and evacuate people from the fire place. Only 2.1% of the respondents would switch off electricity gadgets while 12.5% would decide to call fire fighting experts. Shouting and calling for help is the most favoured response because it is the easiest and most natural thing to do in case of a fire incident. The other responses follow in the same order and can all be attributed to previous experience of fire incidents which has taught residents to save lives then property in that priority. Fatalities rates are high at night since all but a few residents are usually sleeping indoors at this time.

The use of water to extinguish fire is also an obvious response even though water is scarce and therefore most residents destroy adjacent houses where the fire emanates in order to
create a buffer zone so as to prevent the fire from spreading. Most residents do not have emergency telephone numbers for the fire brigade and others who may have them see it as a waste of time since the engines arrive late after an outbreak of fire and may not reach the fire due to lack of accessible roads. Due to the fact that most electrical sources are illegally connected,

Residents are not able to switch of the source of power directly and this may contribute to the spread of fire. Attitude of slum residents and local authorities towards fire disasters and fire safety mechanisms comprise of knowledge about fire safety mechanisms, level of importance attached to fire safety mechanisms and whether the fire safety measures are effective in dealing with incidents of fire in the slum.

4.19 Knowledge about Fire Safety Mechanisms

Here, 29.8% of the participants have very poor knowledge about fire safety mechanisms while 27.7% have poor knowledge. On the other hand, 34.0% of the respondents have good knowledge of the fire safety mechanisms while only 4% rate themselves to have excellent knowledge. Cumulatively, majority of the residents have inferior knowledge about fire safety as compared to those who are relatively knowledgeable about fire safety mechanisms. The combined factors of low literacy levels and limited capacity by both local and central government contribute towards this state of affairs. The barazas held by the chief do not help much since they are characterized by very low attendance.

4.20 Level of Importance attached of Fire Safety Mechanisms

About 45.7% of the respondents have a very low regard for fire safety mechanisms while 26% have a low regard for fire safety mechanisms. Only 15.2% have a high regard for fire safety measures while 13% have a very high regard for the measures. Cumulatively, majority of the residents do not regard fire safety measures as important and this can be attributed to the large numbers of those who occupy rental houses hence perceiving low risk property loss. The same can also be attributed to low education and awareness levels on the importance of fire safety mechanisms.

4.21 Effectiveness of Fire Safety mechanisms

63.8% of the respondents agree that the suggested fire safety measures in Table 5 are effective in dealing with fire calamities while 36.2% oppose the effectiveness of the same. Since there are no other fire safety measures that can be introduced given poor accessibility and low literacy levels about the measures in slums, residents do not have a choice but to
stick to what has been tried and tested over time. The responses show that in the context of life in the slum, the measures are effective only if they are strictly adhered to by all residents.

**Relationship between Fire Safety Mechanisms and Prevalence of Fire Disasters in the Slum**

The relationship between fire safety mechanisms and prevalence of fire disasters in the slum can best be understood by examining the methods of extinguishing fire, participants in fire fighting, challenges when coping with fire and the effects of fire incidents to the residents.

**Methods of Extinguishing Fire:** The use of bucket and water by the community has been the main mode of response to fire disasters with a percentage of 59.6 followed by destruction of the nearest houses at 27.7%. Only 10.6% and 2.1% of the respondents prefer to call in the fire brigade and local authority respectively. The first two modes take place more often due to convenience and because most parts of the slum are inaccessible to the fire engines. Most residents do not also have emergency numbers to call the fire brigade or the local authority respectively. The first two modes take place more often due to convenience and because most parts of the slum are inaccessible to the fire engines. Most residents do not also have emergency numbers to call the fire brigade or the local authority respectively. These popular modes reflected by these findings explain why fire disasters remain prevalent in the slums since the use of buckets of water for example, is relatively slow compared to the intervention of the fire brigade. The destruction of adjacent houses to prevent the spread of fire also causes unnecessary destruction of more property.

**Participants in Fire Fighting:** Neighbours’ took the leading position at 72.9% of the respondents to be involves in fighting fire in the slum while only 16.7% identified the fire brigade’s intervention in fire fighting in the slum. Also, 2.1% said that the local authority participates while 6.3% confirmed that all the above participants acted in fire fighting. Neighbours are readily available whenever a fire incident occurs and are also driven by a common goal of preventing the fire from spreading to their own houses.

Apart from being called late, prompt action by the fire brigade is hindered by lack of access to the slum, a long response time due to traffic jams, stoning of the engines by residents, lack of points for refilling water, the danger of being physically assaulted especially at night and the risk of falling into pit latrines while fighting the fires. Other reasons are poor coordination with the local and central governments, lack of support from politicians and insufficient fire fighting equipment as a result of limited funding.
Challenges of coping with fire: Slum residents face a number of challenges when coping with fire notably poor infrastructure and lack of safety equipment as represented by 25.5% of the respondents. The second challenge is little knowledge over handling of inflammable materials at 23.4% and the third is late arrival of failure of intervention by the fire brigade. Other challenges include lack of enough water to put out fire manually at 8.5%, theft during fire disasters, high costs charged by the city council and fire brigade and fatigue is manual extinguishing all at 6.4%. Illegal connection of electricity is another challenge faced by 4.3% of the residents in coping with fire.

The County administration is responsible for creating access roads within the slum since it does allocation and division of land on which the slum stands but this role is not adequately performed. Both the local government and Nairobi Metropolitan ministries fund the fire brigade but the allocation is inadequate to purchase equipment has a short lifespan and need frequent replenishment. The major problem of low literacy levels and little exposure to safety information has resulted in poor handling of flammable materials especially kerosene thereby increasing the risk of fire outbreaks in the slum.

State-owned fire-fighting resources in Nairobi include those managed by the City Council as well as those operated by the military. The City Council manages three fire stations. The main station is located within the often heavily congested Central Business District along Tom Mboya Street. The two other substations are situated along Ruaraka and Enterprise Road. These three fire stations serve the entire populace of Nairobi (totalling about 4 million on a total land area of 696 km²). The military also has a company-sized fire-fighting unit in Nairobi. This unit is equipped with only basic fire-fighting equipment. In addition, the Kenya Airport Authority is also capable of despatching fire engines and fire fighters to complement fire fighting operations within the city centre (as they have done so during the January 2009 Nakumatt fire).

Staffing. The state of readiness of the City Council’s Fire Brigade is a source of concern as well as critique for many Kenyans. The Department currently has only 96 trained fire fighters across its 3 fire stations with an additional 50 untrained volunteers to supplement the main force. According to the Vice-Chairman of the Kenya Local Government Workers’ Union, the Fire Department has not been hiring since 1987 and the Department is supposed to staff up to 500 employees.
Competency: Competency of the small pool of available fire fighters, their fitness and competency levels remain questionable. With no centralised training institution to formulate, endorse and enforce a stringent training regime for would-be fire fighters, it is difficult for individual fire stations to maintain comparable standards of knowledge, equipment proficiency and fitness amongst its rookie and serving fire fighters. The ability to effectively combat a fire incident is less than desirable. It appears like the strategy is to take a defensive mode and let property burn down to ashes as shown in the picture of an incident site above.

Readiness: Equipment and vehicle readiness of the City Council Fire Brigade remains a sore point for many Kenyans. Quoting a news report on the Daily Nation, the journalist who called the emergency hotline was given this reply by an anonymous operator when he requested for a fire engine’s assistance, “No vehicle here. Even if you shout, it won’t help. Tell them to put out the fire the rains will help them.”

Station morale: A visit to the Tom Mboya Fire Station revealed that the Fire Department has been running without any serviceable fire engines for nearly a month. The fire station’s nerve centre, which also houses the various fire alarm panels, also appears to be in urgent need of maintenance. Thus, fire fighters were helpless, poorly equipped, inadequately trained and left alone, with low morale. The drive to undertake extra-ordinary risks in their life-saving missions had gradually reduced to doing perfunctory routine duties in the fire station.

Urban search and rescue: In the area of urban search and rescue (USAR), a battalion-sized Disaster Response Unit within the Armed Forces is on standby to respond to collapsed buildings or structure incidents. The Fire Brigade remains highly dependent on overseas USAR teams for assistance during an actual incident as the local team lacks the expertise, training and equipment in handling such operations. Private sector capacities have also yet to develop any substantial capabilities in responding to USAR incidents. Red Cross has included the development of this capability in their future plans.

Originally, Nairobi city had several points designated as fire stations located at Dandora, Caltex Outering road, Uhuru Market, Westlands where Safaricom now stands, Gigiri and pipeline in Embakasi. This was done with the knowledge that the city would expand and would expand and would therefore need more fire stations. These locations have to date been converted into private use rendering the city’s only fire station hugely overwhelmed.
and at long distances from scenes of fire. Subsequently the response time whenever a fire occurs in the slum has been long due to traffic jams and late information from lack of emergency numbers.

Within the slum, perennial shortage of water due to lack of piped water has been as a result of an ineffective central government, an unconcerned local government and uncooperative politicians. Theft of property during fire incidents is common due to high poverty levels and residents would remain to guard their salvaged property instead of rendering assistance in fighting the fire. Together with fatigue in manual extinction of fire, the above will cause a greater impact of the fire disaster on the slum residents. Even though a small section of respondents considered illegal connection of electricity as challenge they faced, the ready explanation to this is their apprehension about arrest. Official information however point to illegal connection of electricity as a major cause of fire in the slum.

**Effects of Fire Incidents on Respondents:** Majority of the respondents covering 54.3 % identified loss of property as the leading effect they suffer as a result of fire incidents while another 23.9 % pointed to destruction of houses. This is explained by the high number of residents who occupy rented houses and thus complain about their lost property. The lesser numbers who own the houses suffer double tragedy in the event of a fire since they lose both their property and the constructed houses. The houses and property are easily destroyed due to combustible materials used to erect the houses and the inferior fire fighting methods adopted by residents.

Fewer respondents reported to have incurred liabilities in other ways. For example, 10.9 % of the respondents reported to have lost a relative, 6.5 % had relatives who had been injured while 4.3 % were personally injured in fire disasters. The deaths can be attributed to fire incidents occurring at night, drunken residents being caught unawares and child victims left unattended and therefore cannot make their own escape during an outbreak fire. Injuries are also sustained during fire fighting especially when destroying other houses in order to create a buffer zone to control the spread of fire.

**Sustaining Effective Fire Safety Measures in the Slums:**
Respondents identified several ways in which effective fire safety measures could be sustained for a long time and also provided solutions for the fire problems in the slum.
How Effective Fire Safety Mechanisms can be sustained for a long time: Many of the respondents (12 or 37.5 %) felt that community sensitization to fire preventive measures was the best option for sustaining effective fire safety mechanisms. Another 34.4 % of the respondents opted for putting the fire safety measures in practice while another 18.8 % said that the government needed to ensure effectiveness of the fire brigade. Only 9.4 % identified spacing of houses within the congested Kibera slums as a possible mechanism towards long term sustenance.

Due to low literacy levels and general ignorance about fire safety issues, sensitization is the best option for sustaining effective fire safety mechanisms and is principally done through training. However, training on its own is not sufficient to ensure sustenance of effective fire safety mechanisms and this call for practice. It is only through practice that residents can learn and internalize the ideas imparted to them during training. The respondents identified the ineffectiveness of the fire brigade due to slow response and lack of equipment which is brought about by inadequate funding. Since funding the local government to the fire brigade through the NCC genral fund has been found to be insufficient, direct government finding through the treasury is a better option. The small number who advised on spacing of houses is attributed to the awareness by residents about the limited area is on high demand for construction hence their acceptance of overcrowding.

Solutions for fire problems in the slum: Majority of the participants at 28.3 % pointed to the increase awareness on how to mitigate and deal with fire disasters while 17.4 % appealed to the government to provide safety facilities. Participants rated equally the need for efficiency and effectiveness of the response points within the slums as roads at 15.2 % each. Erection of fire response points within slums was chosen by 8.7 % of the participants, increasing water access points (water chambers) within Kibera by 6.5 % and making fire emergency contacts known to the residents by 4.3% of the people. Only 2.2 % each opted for creation for employment for youth and to conduct prayers to God.

It is important to note that the principle solution for fire in the slum is to increase awareness on how to mitigate and deal with fire since knowledge empowers and builds capacity of the residents. It also touches the residents directly and enables them to act in an informed manner thereby reducing the risks associated with fires in the slums. The provision of equipment by the government to both residents and the fire brigade enables both parties to effectively participate in fire fighting while improving infrastructure opens up the slum to motorized emergency teams like fire brigade, ambulance and the police.
Fire response points equipped with booster pumps with fighting pipes can greatly augment the role played by the brigade if residents are trained in their use. Similarly, increasing water access points within the slum can give residents of the slum the much needed arsenal of fighting fire while providing emergency numbers will equip and enable them to call the fire brigade promptly.

**Summary of Findings:** The findings were made in light of objectives of the study and discovered that the frequency of fire incidents in the slum is high since majority of respondents have witnessed many fire incidents and that majority of the respondents consider the cause of most fires in Kibera slum to be unattended stove by drunken residents while a small number blame it on electric faults emanating from illegal tapping of electricity. The already congested houses coupled with presence of kerosene act in unison to make the risk of fire even greater in the slum. It was also discovered that an overwhelming number of houses consisted of walls and roofs made of iron sheets while the floors were cemented. Iron sheets are combustible, readily burn and transmit fire to adjacent houses quickly given the close proximity of houses in the slum.

A majority of the respondents did not know of any fire safety mechanisms, a sizeable group recognized the importance of access roads while a few knew about standby fire engines and fire points. The large number of residents who lack knowledge about fire mechanisms is explained by low education levels, inferior economic activities, lacking exposure and absence of public awareness programs by authorities. Similarly there were high numbers for those who apply fire measures related to the household as explained by common experiences regarding congested houses and the use of kerosene as the identified risk factors. The most favored response during breakout of fire was shouting and calling for help since it is the easiest and most natural thing to do in case of a fire incident. The other responses can all be attributed to previous experience which has taught residents to save lives then property in that priority.

Majority of the residents have inferior knowledge about fire safety as compared to those who are relatively knowledgeable about fire mechanisms. The combined factors of low literacy levels and limited efforts by both local and central government explain this state of affairs. Similarly, majority of the respondents do not regard fire as safety measures as important as explained by the large numbers of those occupying rental houses who apart from having low education and awareness levels also perceive low risk of property loss. On effectiveness of fire safety measures as effective in dealing with fire. The residents do not have a choice but to stick to what has been tried and tested over time since there are no
other fire safety measures that can be introduced given poor accessibility and low literacy levels about the measures in slums.

The use of bucket and water by the community is the main mode of response to fire disasters followed by destruction of the nearest houses while a few respondents managed to call in the brigade and local authority. The former method is commonly used due to convenience and because most parts of the slum are inaccessible to the fire engines. Most residents do not also have emergency numbers to call the fire brigade or the local authority. Neighbours are the group considered most active in fighting fire while the fire brigade assisted minimally only in accessible areas. This is attributed to neighbours being readily available and being driven by a common goal of preventing the fire from spreading to their own houses.

The two strongest challenges faced by most residents when coping with fire were poor infrastructure and lack of safety and little or lack of knowledge on handling inflammable materials. Illegal connection of electricity is a challenge faced by a few residents when coping with fire. The leading effect suffered by a majority of the respondents as a result of fire incidents is loss property and destruction of houses. The cause of this boarders on ownership of houses while the houses and the inferior fire fighting methods adopted by residents.

Community sensitization to fire preventive measures is the best option for many of the respondents in sustaining effective fire safety mechanisms followed by putting the fire brigade and the spacing of houses within the congested Kibera slums as a possible mechanism towards long term sustenance are other options. The principle solution for fire problems in the slum is to increase awareness on how to mitigate and deal with fire and provision of equipment by the government to both residents and the fire brigade and improving infrastructure to open up the slum to motorized emergency teams. The government should consider providing subsidized electrification to deter illegal connections.

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATIONS
This section provided for findings, made recommendations, conclusions and areas that needed further research. These items were based on the information from the background information, literature review, research methods, data analysis and interpretation which preceded this chapter. The recommendations focused on the thematic areas of study which are; nature of fire disasters in slums, fire safety mechanisms undertaken, attitudes towards the fire safety mechanisms, effect of fire safety mechanisms on prevalence of fire disasters and sustenance of an effective fire safety mechanism in slums.

5.1 Conclusion

From the findings, conclusions can be drawn that the cause of most fires in Kibera slum is unattended stoves, illegal tapping of electricity, combustible construction materials and negligible knowledge of fire fighting mechanisms. Fire safety mechanisms form the foundation of successful mitigation against prevalence of fire disasters in slums. The application of relevant fire safety mechanisms must directly affect the prevalence of fire disasters in slums. It can therefore be concluded that respondents in the study neither possess nor utilize effective fire safety mechanisms.

The above can also be said for both local and central governments to intervene to ensure effectiveness of the fire brigade and the spacing of houses within the congested Kibera slums as a possible mechanism towards long term sustenance are other options. The principle solution for fire problems in the slum is to increase awareness on how to mitigate and deal with fire followed by Province of equipment by the government to both residents and the fire brigade and improving infrastructure to open up the slum to motorized emergency teams.

5.2 Recommendations

**Policy Recommendations:** For any meaningful achievements in increasing capacity in fire safety mechanisms and therefore reducing prevalence of fire disasters in slums;

The government needs to play a leading role in DRR. This will be done through enhancement of disaster-awareness and disaster management capability by mainstreaming DM at all levels of institutional structures for education and training. DM will be mainstreamed among the slum residents through sensitization and community based education to attain awareness and function literacy. Chief barazas can be used more effectively in addition to school curricula to disseminate information about fire safety measures.
Provision of effective capability for harmonized and standardized rapid response to disasters by coordinated participation of all stakeholders at all levels is also important. This will include the local and central governments, civil society and donors working in unison to attain a disasters free situation in the slum. Training of local volunteers will increase the number of skilled personnel at the community level while sufficient funding will ensure that these activities are effective. The fire brigade should be funded from treasury instead of NCC general fund which is constrained so that agencies of adequate finances, human resources and equipment.

The creation of institutional and legal framework for an autonomous DM body that promotes information and lesson sharing among takeholders and making provision for consideration of issues such as problems related to rural-urban migration and creation of overcrowned slums which are a preparation for disaster is also important. NODC will therefore need to do more than just disaster response and egage itself in DP while the provision for continous and sustainable reception, processing, storage and management of an effective database for DM will go along way towards improved DM.

In addition, rapid effective response to disaster, promotion of high compliance with safety regulations against potential risks, hazards and disasters and promotion of compliance with construction against fire outbreaks in the slum are critical steps to be taken in ensuring that fire incidents are reduced. The local and central governments need to ensure adequate spacing and use of non-combustible materials in construction of houses and create designated points with fire fighting equipment within the slum. These authorities also need to vigorously fight against the brewing and sell of illicit liquor within the slum while KPLC should conduct regular inspection of their lines to guard against illegal connections.

Regular and periodic dedicated emergency drills by government departments such as the fire brigade, police and other stakeholders like KRC AND SJA will improve effectiveness in response capability to disasters. The end result will be adequate integration and coordination while the overall goal to be achieved will be the promotion of mainstreaming in DM to attain disaster awareness and coordination.

5.3 Recommendations for Further Research

This study focused on the examination of fire safety mechanisms and their effect on prevalence of fire disasters in Kibera slum. It was noted that this matter has not been given due attention by the central government and other stakeholders. Further studies are
therefore recommended in other slums in Kenya to get a true picture of the problem and to promote mitigation as an economical and efficient strategy.
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