EVALUATION OF FIRE DISASTER PREPAREDNESS AT KIAMBU COUNTY FIRE AND RESCUE SERVICES

BY

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DECLARATION

I declare that this thesis is my original work and has not been submitted to any other university or institution for the award of any degree. Any references to works by others have been duly acknowledged. No part of this thesis may be reproduced without the explicit permission of the author and/or Moi University.

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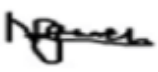

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DEDICATION

I dedicate this thesis to my late father, **Dr. Joseph Kihonge**, whose unwavering support and encouragement shaped my academic aspirations. His belief in the value of education and his tireless efforts to see me excel continue to inspire my journey. May his soul rest in eternal peace.

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ABSTRACT

Background: Fire disaster preparedness remains a critical public safety concern in Kenya, with many counties exhibiting inadequate capacity to prevent, respond to, and mitigate fire-related emergencies. In Kiambu County, fire response systems are often reactive rather than preventive, constrained by insufficient staffing, limited training opportunities, inadequate firefighting equipment, and weak enforcement of safety regulations. These gaps significantly undermine operational effectiveness, heighten vulnerability to fire risks, and compromise the safety of communities, infrastructure, and economic assets. A systematic assessment of fire preparedness is therefore essential to inform evidence-based improvements and strengthen institutional capacity.

Specific Objectives: The study sought to: (i) assess the staffing levels and training among fire personnel in Kiambu County; (ii) evaluate the availability, functionality, and adequacy of firefighting equipment and infrastructure; and (iii) examine awareness and enforcement of fire safety policies within the county fire service.

Methods: The study adopted a concurrent mixed-methods design integrating quantitative and qualitative approaches. The target population comprised fire service personnel across five stations Kiambu, Thika, Ruiru, Kikuyu, and Limuru. A sample of 109 participants was selected through stratified random sampling, while key informants, including station commanders and county disaster management officers, were purposively sampled. Data were collected using structured questionnaires, observation checklists, and key informant interview guides. Quantitative data were analysed using descriptive statistics (frequencies, percentages) and inferential analysis (chi-square tests), whereas qualitative data were subjected to thematic analysis.

Findings: The socio-demographic profile showed that 78.4% of respondents were male and 21.6% female, with most (around 68%) aged between 25–45 years. Although a majority had technical or vocational education, only 42% had formal firefighting certification. *Objective 1:* Staffing levels were critically low, with only about one-third of stations meeting minimum staffing requirements recommended under NFPA 1710. Approximately 70% of respondents reported inconsistent or insufficient training. *Objective 2:* Significant equipment gaps were observed; 60% noted recurring breakdowns of fire engines, 55% cited unreliable water sources and poorly functioning hydrants, and only 25% of stations possessed fully functional PPEs. *Objective 3:* Awareness and enforcement of fire safety policies were limited, with 72% of personnel unfamiliar with existing county fire safety guidelines.

Conclusion: The study concludes that Kiambu County Fire and Rescue Services face substantial preparedness challenges driven by inadequate staffing, insufficient and irregular training, limited and poorly maintained equipment, and weak dissemination and enforcement of fire safety policies. These systemic constraints significantly hinder the county's ability to respond effectively to fire emergencies.

Recommendations: The study recommends urgent recruitment of additional personnel and institutionalization of continuous, certified training programs; increased investment in modern firefighting equipment and maintenance systems; and enhanced enforcement of fire safety policies through regular inspections, stakeholder awareness campaigns, and strengthened inter-agency coordination mechanisms.

OPERATIONAL DEFINITIONS OF TERMS

Kiambu County Government Capacities: The combination of resources, policies, and skills that Kiambu County possesses to enhance fire disaster preparedness and response. This includes financial, managerial, technical, infrastructure, human resource, and institutional or legislative capacities to mitigate fire risks and enhance emergency response effectiveness.

Fire Disaster Preparedness: The level of readiness of Kiambu County Fire and Rescue Services to prevent, respond to, and recover from fire incidents, measured through staffing, training, equipment, and policy enforcement.

Staffing Levels: The number of fire personnel available compared to recommended NFPA staffing standards needed for effective emergency response.

Training and Capacity Building: Instruction and skill development provided to fire personnel, including basic firefighting, specialized courses, and refresher training.

Firefighting Equipment: Vehicles, tools, and protective gear used during fire response, assessed by availability, functionality, and adequacy.

Infrastructure (Fire Infrastructure): Physical facilities and systems supporting fire operations, such as hydrants, stations, access roads, and communication networks.

Fire Safety Policy: Regulations and guidelines governing fire prevention, preparedness, and response. Measured through staff awareness and enforcement levels.

Standard Operating Procedures (SOPs): Written instructions that guide fire response, inspections, communication, and equipment handling.

Fire Risk; The likelihood of a fire occurring and causing harm due to hazardous conditions or unsafe environments.

Hazard; Any condition that can cause injury, damage, or loss, including electrical faults, flammable materials, or unsafe structures.

Vulnerability: The susceptibility of people or infrastructure to harm from fire hazards due to social, economic, or environmental factors.

Risk; The probability of a fire hazard causing negative consequences when combined with vulnerability.

Exposure: The presence of people or assets in locations where they may be affected by fire hazards.

Mitigation: Measures taken to reduce fire impacts, such as inspections, hydrant installation, or enforcing safety codes.

Incident Command System (ICS): A structured, on-scene coordination system used to manage firefighting operations and resource allocation.

Fire Incident: Any unplanned fire event that threatens life, property, or the environment.

Emergency Response Capacity: The ability of a fire station to respond effectively, based on personnel, equipment, communication, and coordination.

Functional Equipment: Equipment that is in working condition and available for immediate operational use.

Adequacy of Equipment: The extent to which available equipment meets the station's operational requirements for various fire scenarios.

Hydrant Functionality: The operational status of fire hydrants in terms of water supply, accessibility, and maintenance.

Preparedness Score/Index: A combined measure of staffing, training, equipment, infrastructure, and policy enforcement used to categorize preparedness levels.

Building Inspections: Assessments conducted to check compliance with fire safety standards, such as alarms, exits, and extinguishers.

Enforcement: Actions taken by authorities to ensure compliance with fire safety regulations, including penalties and closure orders.

Community Fire Safety Awareness: The knowledge and attitude of communities regarding fire prevention, reporting, and evacuation procedures.

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
BA	Breathing Apparatus
CFR	Code of Federal Regulations
EOC	Emergency Operations Center
EMT	Emergency Medical Technician
GIS	Geographic Information Systems
IFSS	International Fire Safety Standards
IFSAC	International Fire Service Accreditation Congress
IFSTA	International Fire Service Training Association
ICS	Incident Command System
KCG	Kiambu County Government
KII	Key Informant Interview
KNBS	Kenya National Bureau of Statistics
KFS	Kenya Fire Services
LMICs	Low- and Middle-Income Countries
NACOSTI	National Commission for Science, Technology and Innovation
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
PMT	Protection Motivation Theory
SOP	Standard Operating Procedure
SPSS / Stata	Statistical Analysis Software
UNDRR	United Nations Office for Disaster Risk Reduction
USA	United States of America

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Disasters whether natural, human-induced, or technological continue to threaten global development, disrupt economies, and endanger human lives. Among these disasters, fire incidents remain one of the most frequent and devastating hazards, capable of destroying entire neighborhoods and economic zones within minutes. Globally, fire disasters account for thousands of deaths each year and cause economic damage estimated in billions of dollars (World Fire Statistics Bulletin, 2020). Because fire spreads rapidly and unpredictably, effective preparedness is essential for minimizing losses and protecting communities.

Rapid urbanization in many African counties has intensified fire risks by increasing population density, straining emergency services, and expanding informal settlements where compliance with fire safety regulations is minimal (Agyapong et al., 2020).

Research shows that inadequate fire preparedness in developing countries is often linked to weak institutional capacity, limited investment in modern firefighting equipment, and insufficient inter-agency coordination during emergencies (Mutsau & Chigwada, 2019).

According to UNDRR, counties that lack structured disaster management frameworks and operational readiness exhibit slower response times and higher fire-related mortality, underscoring the importance of preparedness systems at sub-national levels (UNDRR, 2019).

Studies conducted in Kenya reveal that county-level fire departments continue to face systemic challengesincluding underfunding, aging equipment, and inadequate

personnel trainingwhich significantly undermines their disaster response capabilities (Ngugi, Wanyama, & Otieno, 2021).

1.1.1 Global Context of Fire Disaster Preparedness

In many developed countries, fire preparedness is regarded as a core component of public safety, urban planning, and national security. Nations such as the United States, Japan, Canada, Germany, Sweden, and the United Kingdom have established comprehensive fire safety management systems guided by international standards and national legal frameworks. For example, in the United States, the National Fire Protection Association (NFPA) develops internationally recognized standards, including NFPA 1710, which outlines minimum staffing levels, response times, equipment requirements, and operational benchmarks for career fire departments (Haddow, Bullock, & Coppola, 2017).

In Japan, one of the world's most disaster-prepared nations, the fire safety system integrates rigorous building codes, compulsory annual fire drills, high firefighter-to-population ratios, and advanced technologies such as earthquake-triggered fire suppression systems (Ma & Guo, 2012). Similarly, the United Kingdom's Regulatory Reform (Fire Safety) Order 2005 requires building owners to conduct fire risk assessments and maintain safety systems, while Germany uses advanced GIS-based dispatch systems to improve response times (Roberts & McCarthy, 2021).

These global approaches demonstrate that effective fire preparedness requires a combination of trained personnel, modern equipment, supportive legislation, community awareness, functional communication systems, and sustained funding. Countries that meet these elements tend to have fewer fire-related deaths and faster response times (Coppola, 2015).

1.1.2 Fire Preparedness in low and middle income countries

In contrast, low- and middle-income countries face significant constraints that hinder effective fire preparedness. Common challenges include:

- Rapid, unplanned urbanization
- Inadequate fire stations, hydrants, and access roads
- Old or non-functional fire engines and equipment
- Chronic understaffing
- Weak implementation of fire safety regulations
- Limited training opportunities
- Low public awareness of fire safety measures

Studies show that African cities such as Nairobi, Lagos, Kampala, Accra, Johannesburg, and Addis Ababa struggle with outdated equipment, insufficient staffing, and limited disaster risk governance (Mutsau & Chigwada, 2019). Many fire emergencies escalate because fire engines arrive late, lack water, or cannot access congested informal settlements. Weak institutional frameworks, corruption, and fragmented emergency services further complicate preparedness efforts.

Weak institutional frameworks, fragmented emergency services, and inadequate governance compound the problem. While some LMICs have fire safety policies, enforcement remains inconsistent due to political interference, corruption, and resource deficiencies. As a result, communities remain susceptible to severe fire impacts, including loss of life, destruction of property, and long-term economic disruption.

1.1.3 Fire Disaster Management in Kenya

Kenya has experienced several significant and tragic fire disasters over the past two decades. Major incidents such as the Sachangwan tanker explosion (2009), Nakumatt Downtown fire (2009), the frequent Gikomba market fires, and recurrent fires in informal settlements like Mukuru and Mathare reveal deep systemic weaknesses in preparedness, urban planning, and emergency coordination (Mutinda, Karanja, & Makhonge, 2017).

Despite efforts at decentralization and policy reforms, Kenya's fire services still struggle with inadequate funding, insufficiently trained personnel, lack of equipment, poor building compliance, and weak enforcement of fire safety laws (Ngugi, Wanyama & Otieno, 2021). Many counties rely on outdated engines some more than 20 years old and operate with minimal personal protective equipment (PPE), communication gear, or breathing apparatus sets.

County governments are constitutionally mandated to provide fire services under Kenya's devolved system. However, disparities exist among counties depending on financial strength, administrative priorities, and technical capacity. While Nairobi and Mombasa have relatively more resources, counties such as Kiambu, Machakos, Uasin Gishu, Kisumu, Kajiado, and Nakuru continue to face operational and infrastructural gaps (Kamau, 2022).

1.1.4 Fire Preparedness in Kiambu County

Kiambu County situated in the Mount Kenya region bordering the Nairobi Metropolitan Region is one of Kenya's fastest-growing urban and industrial areas. With a population of 2,417,735 people (KNBS, 2019), the county hosts densely populated residential estates, large markets, educational institutions, commercial centers, informal

settlements, and manufacturing industries. This rapid growth has increased the likelihood of fire incidents due to:

- Congested markets and informal settlements
- High-rise residential and commercial buildings
- Industrial expansion
- Use of open flames in low-income areas
- Poor electrical wiring
- Overcrowded housing structures
- Inadequate enforcement of fire safety standards

Reports from the Kiambu County Disaster Preparedness and Response Plan (2021–2025**)** show a steady rise in fire incidents in towns such as Thika, Ruiru, Kiambu, Limuru, and Kikuyu (Kiambu County Government, 2021). Frequent fires in markets such as Githurai, Juja, and Thika Town have resulted in substantial property losses.

1.1.5 Challenges Facing Kiambu County Fire and Rescue Services

Despite these rising risks, Kiambu County Fire and Rescue Services face numerous challenges that compromise effective preparedness:

1. Limited Number of Fire Stations

Kiambu operates only five main fire stations, serving a rapidly urbanizing population spread over vast geographical areas. NFPA standards recommend strategic station placement so that emergency engines can reach fire scenes within 4–8 minutes, a benchmark Kiambu rarely meets due to long distances and traffic congestion (Agyapong et al., 2020).

2. Insufficient Staffing and Training Gaps

Staffing shortages are among the most critical issues facing the county. International standards recommend at least one firefighter per 1,000 residents, yet Kiambu falls far below this ratio. Many stations lack enough personnel to execute interior attacks, rescue operations, and simultaneous responses. Training gaps—particularly in advanced skills such as hazardous materials (hazmat), high-angle rescue, and incident command—further compromise response effectiveness (Sankey & Omole, 2014).

3. Aging and Inadequate Firefighting Equipment

Several fire engines are old, unreliable, or require frequent maintenance. Essential equipment such as breathing apparatus, rescue tools, PPEs, radios, and hydrants is either insufficient or not fully functional. A poorly maintained hydrant network limits water availability, forcing firefighters to rely on water tankers even in urban centers (Amoako, 2015).

4. Weak Policy Implementation and Enforcement

Although fire safety policies exist at the county level, enforcement remains inconsistent. Many commercial and residential buildings lack fire extinguishers, emergency exits, or compliance certificates. Building inspections are irregular, reactive, or hindered by political interference (Omondi, 2018).

5. Limited Public Awareness and Preparedness

Community knowledge of fire safety practices remains low. Many residents lack basic fire response skills, and public sensitization campaigns are irregular or underfunded (Njoroge, 2022).

1.1.5 Challenges Facing Kiambu County Fire and Rescue Services

Fire disaster preparedness is essential for reducing the vulnerability of communities and enhancing resilience. According to the United Nations Office for Disaster Risk Reduction (UNDRR 2019**)**, preparedness includes:

- Risk identification and mapping
- Training and capacity building
- Establishing early warning and communication systems
- Strengthening interagency coordination
- Community education and drills
- Adequate equipping of emergency response teams
- Enforcing safety policies and building regulations (UNDRR, 2019)

Preparedness increases the likelihood of timely response, reduces the scale of damage, and enhances the ability of institutions to recover after incidents. For high-density urban areas such as Kiambu, effective preparedness is critical for protecting lives, infrastructure, and economic stability.

1.1.7 Rationale for the Study

While fire incidents in Kiambu County continue to rise, there is limited empirical data assessing the actual preparedness capacity of the county's fire stations. The few existing county reports provide descriptive information but lack comprehensive analysis of staffing, training, equipment readiness, infrastructure, and policy enforcement. Without empirical evidence, it is difficult for the county government to prioritize investments, design effective fire safety programs, or allocate resources efficiently.

This study therefore fills a critical knowledge gap by providing a detailed assessment of the determinants of fire disaster preparedness in Kiambu County. The findings will

contribute to improved planning, budgeting, and implementation of fire safety interventions.

According to the World Fire Statistics Bulletin (2012), fire disasters occur universally, resulting in significant property damage, numerous fatalities, and injuries. These fires can be triggered by human activities such as carelessness or errors, or by natural forces or processes known as "anthropogenic disasters."

Andrews et al. (2015) state that human activity amplifies the likelihood of fires, transforming them into disasters akin to other natural catastrophes. Despite advancements in knowledge and technology, the global vulnerability to fire disasters has been increasing. Development has altered the social, economic, cultural, political, and environmental settings of humans, posing risks and enhancing vulnerability to fire disasters.

Hemond and Robert (2012) note that, on occasion, humans face these calamities due to ignorance of environmental hazards. The greatest number of fire-related fatalities globally have been reported in the United States of America (USA) and Canada, where fire death rates frequently exceed those in Europe by a factor of two to four. Moreover, the percentage of fire-related losses per capita in the US is among the highest. In the US, only vehicle crashes, falls, and drowning result in more accidental deaths than fires (Coppola, 2015). This trend highlights a critical area of concern for policymakers and emergency management professionals, emphasizing the need for robust fire prevention strategies and public awareness campaigns to mitigate these risks effectively.

In developed countries, fire preparedness is an integral component of urban planning and disaster risk management. Advanced nations such as Japan, the United Kingdom, and Germany have implemented stringent building codes, early warning systems, and

rapid-response fire services (Jones & Brown, 2021). The National Fire Protection Association (NFPA) and the Occupational Safety and Health Administration (OSHA) in the United States have set international standards for fire safety, covering aspects such as fire suppression equipment, staffing requirements, and training protocols.

Studies show that communities in developed nations benefit from well-funded fire departments, continuous fire fighter training, and public education on fire safety (World Fire Statistics Bulletin, 2020). By contrast, in developing nations, financial constraints, lack of expertise, and weak regulatory enforcement limit fire disaster preparedness, increasing the risk of loss of life and property (Haddow & Bullock, 2013).

Fire-related disasters have severely impacted almost all Sub-Saharan African countries, negatively affecting numerous significant economic sectors. Kenya is becoming increasingly vulnerable to the risks of fire disasters, which can result in the destruction of billions of dollars' worth of property or the loss of numerous lives. Communities in Kenya are now more susceptible due to the increase in the frequency and severity of fires over the past few years (UNISDR, 2013). This increased vulnerability is often attributed to rapid urbanization, inadequate infrastructure, and limited resources for emergency response and fire prevention.

There have reportedly been several deadly fire incidents in Kenya in the past, according to Mutinda et al. (2017). Notable fire events include the explosion of an oil tank in Sachangwan Molo on January 31, 2009, and the blaze at the downtown Nakumatt business on January 28, 2009. In Kenya, fires are predominantly started by human actions. Arson accounted for 40% of these fires, negligence and carelessness for 20%, and unknown causes for 40% of cases.

Wisner et al. (2012) also noted that a significant proportion of community fire disaster instances typically go unreported. Kenyan communities are particularly vulnerable to the devastating effects of fires due to factors such as poverty, residence in high-risk areas for fire outbreaks, and inadequate infrastructure. A wildfire could be ignited by lighting a cigarette on flammable surfaces, industrial accidents, gas leaks from seismic damage, among other causes, leading to widespread destruction.

The United Nations Office for Disaster Risk Reduction (UNISDR) (2013) reports a growing global concern about disasters, particularly in metropolitan and urban areas. This concern stems from the fact that capitals are often the centres of intellectual, diplomatic, commercial, and financial activities, serving as the economic engines of their nations. Due to rising urbanization, over half of the world's population already resides in metropolitan areas. By the end of 2025, however, most of the world's wealth and population will be concentrated in these areas, comprising over two-thirds of the global population. This urban concentration poses significant challenges for fire disaster preparedness and response, necessitating the development of advanced and resilient fire safety infrastructures.

Ejeta et al. (2015) state that disaster preparedness, which includes community understanding, readiness to respond appropriately, and rapid recovery time, is one of the essential elements of disaster risk reduction. This situation calls into question the efficacy of disaster authorities in our enterprises and highlights the necessity for Kenya to adopt a proper and efficient strategy for disaster and tragedy management. With a focus on Kiambu fire and rescue service stations, this study aims to evaluate the factors influencing Kiambu County's readiness for fire disasters. By identifying these variables, the study seeks to improve the overall efficiency and effectiveness of fire station services, thereby enhancing public safety and satisfaction.

The inadequacy of fire disaster preparedness in Kenya has been a persistent issue (Menya, 2016). Most of the emergency relief services for affected individuals are fragmented, impromptu, and temporary activities, mirroring the nation's preparedness and response to fires. This situation underscores the need for comprehensive and well-coordinated emergency management strategies. The implementation of such strategies can significantly mitigate the impact of fire disasters, ensuring that communities are better protected and more resilient.

In Kenya, fire disaster preparedness has historically been reactive, with limited pre-emptive measures (Kamau, 2022). The decentralization of disaster management to county governments underscores the need to assess fire and rescue services' readiness at the local level.

Kiambu County, being part of the Nairobi Metropolitan region, has experienced increasing cases of fire-related incidents in recent years. According to the Kiambu County Disaster Preparedness Report (2021), major fire disasters have affected residential areas, markets, and industrial zones.

One of the major challenges facing Kiambu County is the rapid urbanization and expansion of informal settlements. These areas are highly prone to fire outbreaks due to congested housing, use of open flames for cooking, and inadequate road access for emergency responders (Mwangi & Wanjiru, 2020).

Kiambu County has experienced increasing cases of fire-related incidents, making fire disaster preparedness a crucial area of concern. A well-structured fire response system requires adequate staffing, well-maintained equipment, proper infrastructure, and efficient policies (Jones & Brown, 2021). This study focuses on Kiambu County Fire

and Rescue Services, evaluating factors that influence preparedness, including staffing, training, equipment availability, infrastructure, policies, and enforcement.

Assessing Kiambu County's fire preparedness against NFPA, OSHA, and UNDRR frameworks reveals significant gaps. NFPA 1710 recommends that fire stations be positioned strategically to achieve a response time of four minutes for the first arriving engine and eight minutes for full deployment. In Kiambu, response times average 15 to 20 minutes due to insufficient stations and poor road infrastructure (Kiambu Fire Department Annual Report, 2021).

Similarly, the OSHA fire brigade standard (29 CFR 1910.156) mandates that fire fighters undergo regular training in fire suppression, hazardous materials handling, and rescue operations. In contrast, only 30% of Kiambu's fire fighters receive annual refresher training (County Fire Training Report, 2022).

The study's objective is to investigate the factors affecting fire disaster preparedness by Kiambu County fire and rescue services. By identifying these variables, the study aims to enhance the efficacy and efficiency of fire station services, thereby improving public safety and satisfaction.

Additionally, the United Nations Office for Disaster Risk Reduction (UNDRR) emphasizes the importance of disaster risk reduction strategies such as community education programs and investment in resilient infrastructure. Implementing these measures could significantly improve Kiambu's preparedness levels.

Conclusion

The study highlights the inadequacy of fire disaster preparedness in Kiambu County compared to international benchmarks. Insufficient infrastructure, low budget allocations, inadequate staffing, and weak policy enforcement contribute to the

county's vulnerability to fire disasters. Addressing these issues requires immediate intervention, including increased investment in modern fire equipment, structured training programs for firefighters, enforcement of fire safety regulations, and community sensitization programs.

By enhancing its fire preparedness, Kiambu County can reduce fire-related risks, align with international best practices, and protect lives and property more effectively. This study will provide critical insights into improving fire disaster management, benefiting policymakers, emergency responders, and the general public.

1.2 Research problem statement

Fire disasters remain a major public health and development challenge, particularly in rapidly urbanizing regions where population growth, commercial expansion, and infrastructural pressures outpace the capacity of emergency services. Despite global evidence showing that effective fire preparedness reduces mortality, response time, and economic losses (Coppola, 2015; UNDRR, 2019), many developing countries continue to experience significant preparedness gaps driven by inadequate staffing, limited equipment, weak institutional frameworks, and insufficient training (Agyapong et al., 2020).

Although Kenya has made progress in decentralizing disaster management functions to county governments, evidence shows that county-level fire services remain under-resourced and structurally weak (Ngugi, Wanyama, & Otieno, 2021). Recent fire incidents in Kiambu's major urban centers such as Thika, Ruiru, Githurai, and Kiambu town have exposed persistent failures in emergency response, including delayed deployment, inadequate water supply, limited hydrant functionality, poor communication systems, and insufficiently trained personnel.

Kiambu County, situated within the Nairobi Metropolitan Region, faces increasing fire risks due to rapid urbanization, congested markets, proliferation of high-density housing, and growing industrial activity conditions that heighten both the likelihood and severity of fire-related emergencies.

County audits and independent assessments indicate that fire stations within Kiambu operate with staffing levels below internationally recommended standards, rely on aging or unserviceable engines, and lack specialized equipment such as breathing apparatus, rescue gear, and functional communication devices (Kiambu County Government, 2021; County Fire Audit, 2022). These systemic weaknesses are compounded by inconsistent enforcement of fire safety policies and low levels of public compliance with fire regulations.

Despite recurring fire incidents and clear institutional gaps, there is limited empirical evidence assessing the comprehensive preparedness capacity of Kiambu County Fire and Rescue Services. Existing reports are largely descriptive and do not adequately analyse the combined influence of staffing, training, equipment adequacy, infrastructure functionality, and policy enforcement on overall preparedness. The absence of such data constrains evidence-based decision-making, resource allocation, and the development of effective fire disaster mitigation strategies.

In addition, the county's firefighting equipment and infrastructure are highly constrained. Several fire engines are aging, frequently out of service, or incapable of meeting the demands of large-scale emergencies. Critical equipment such as breathing apparatus sets, protective clothing, rescue tools, radios, and hydrants are either insufficient, obsolete, or poorly maintained (County Fire Audit, 2022). Poor hydrant

functionality and unreliable water supply further compromise response effectiveness, often forcing responders to rely exclusively on water tankers even in urbanized areas.

Moreover, enforcement of fire safety regulations across Kiambu County remains inconsistent. Studies reveal gaps in building inspections, weak compliance with fire safety standards, and limited penalties for violations in commercial, residential, and industrial premises (Ngugi et al., 2021). As a result, many structures lack functional fire extinguishers, emergency exits, or proper electrical installations, increasing the likelihood and severity of fire incidents. Political interference, inadequate inspection personnel, and limited public awareness exacerbate these problems, allowing high-risk environments to persist.

Despite the rising trend of fire incidents and growing evidence of systemic weaknesses, there has been no comprehensive empirical assessment examining the combined influence of staffing, training, equipment adequacy, infrastructure, policy enforcement, and overall preparedness in Kiambu County. This lack of data creates a critical knowledge gap that hinders effective planning, budgeting, and policy implementation.

Therefore, this study seeks to evaluate the level of fire disaster preparedness in Kiambu County by examining staffing and training adequacy, equipment and infrastructure availability, and the effectiveness of fire safety policy implementation and enforcement. The findings will provide empirical evidence to guide county decision-makers in strengthening fire disaster preparedness in line with national expectations and international standards.

1.3 Study Objectives

This section presents the overarching objective and the specific aims that guided the study. The objectives were formulated to align with the core determinants of fire disaster preparedness as identified in the literature and contextualized within Kiambu County's fire risk environment.

1.3.1 General Objective

The overall objective of this study was to evaluate fire disaster preparedness within the Kiambu County Fire and Rescue Services by examining staffing capacity, equipment availability, and policy enforcement mechanisms**.**

1.3.2 Specific Objectives

The study was guided by the following specific objectives:

1. To determine the adequacy of staffing levels and the extent of training among fire and rescue personnel at Kiambu County fire and rescue services
2. To evaluate the availability, functionality, and adequacy of firefighting equipment and supporting infrastructure within Kiambu County Fire and Rescue Services.
3. To examine the level of awareness, and enforcement of fire safety policies and regulations in fire disaster preparedness at Kiambu County Fire and rescue services

1.4 Research Questions

The study sought to answer the following research questions:

1. In what ways do staffing levels and the nature of training among fire personnel influence fire disaster preparedness in Kiambu County Fire and rescue services?
2. What is the current state of availability, functionality, and adequacy of firefighting equipment and infrastructure within Kiambu County Fire and Rescue Services?
3. How effective are the existing fire safety policies and enforcement mechanisms in promoting fire disaster preparedness in Kiambu County fire and rescue services?

1.5 The Study's Significance

The findings of this study will support evidence-based planning and budget allocation for fire preparedness in Kiambu County. The results will be valuable to: **This study is significant to several stakeholders:**

a) **County Government of Kiambu**

   The findings will guide public investment decisions by highlighting priority areas such as staffing, acquisition of equipment, maintenance of hydrants, and expansion of fire stations.

b) **Fire and Rescue Departments**

   The study will assist operational teams in identifying gaps in training, human resource distribution, equipment readiness, and emergency procedures.

c) Policy Makers and Planners

The results will provide evidence for strengthening building inspection systems, updating fire safety policies, and improving enforcement mechanisms in line with national and international standards (Haddow et al., 2017).

d) Researchers and Academics

The study contributes to limited literature on fire preparedness at county level in Kenya and supports future comparative studies across counties (Agyapong et al., 2020).

e) Local Communities and Businesses

Improved preparedness translates to better protection of lives, livelihoods, and infrastructure, reducing economic losses associated with fire events.

By aligning findings with international standards such as NFPA (2016) and UNDRR (2019), the study supports efforts toward improved emergency preparedness and resilience.

1.6 Limitations and Delimitations of the Study

Limitations:

1. The study covered only five major fire stations, excluding emerging sub-stations.
2. Data collection was affected by COVID-19 restrictions.
3. Some data were self-reported and subject to bias despite triangulation.
4. Financial constraints limited broader geographical coverage.

Delimitations:

1. Geographically limited to Kiambu, Ruiru, Thika, Limuru, and Kikuyu fire stations.
2. Operational scope focused on staffing, infrastructure, training, and policy enforcement.
3. Respondents were restricted to firefighters, station commanders, and county officials.
4. Theoretical scope guided by NFPA, OSHA, and UNDRR frameworks.

1.7 Assumption of the Study

The study assumes:

1. Respondents provided accurate and honest information.

2. Reviewed station records were up-to-date.

3. The stations represent the county's overall fire preparedness status.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Fire disaster preparedness has become an increasingly important subject of academic and policy inquiry owing to the rising frequency, complexity, and destructive potential of fire incidents globally. The dynamics of urbanization, population density, technological development, and climate variability have dramatically altered the nature of fire risks, requiring a deeper scholarly exploration of how institutions, communities, and governments organize themselves to prevent, manage, and recover from fire-related disasters. Literature on fire management shows that preparedness is not a singular or isolated concept but a multi-layered process shaped by organizational systems, human capacity, resource availability, legislation, environmental conditions, and socio-economic contexts (Haddow, Bullock, & Coppola, 2017).

This chapter evaluates fire disaster preparedness from theoretical, global, regional, and national perspectives, focusing on the determinants that influence preparedness in institutional settings such as Kiambu County Fire and Rescue Services. It begins with a theoretical framework based on Protection Motivation Theory, Resilience Theory, and Systems Theory, which together offer a comprehensive lens for understanding the complex interplay between individual behavior, institutional capacity, and systemic coordination in emergency preparedness. This is followed by an in-depth discussion of the global disaster management cycle and how fire preparedness is conceptualized across different jurisdictions. The chapter then critically reviews empirical studies from high-income, middle-income, and low-income countries to illustrate similarities and differences in preparedness approaches. Finally, the literature review brings the

discussion to the Kenyan and Kiambu County context, examines gaps, and offers a conceptual framework guiding the current study.

2.2 Theoretical Framework

The theoretical framework grounds the study in established scholarly thinking, offering perspectives that clarify why institutions behave as they do in preparedness contexts and how various factors contribute to or hinder fire readiness. Three theories—Protection Motivation Theory (PMT), Resilience Theory, and Systems Theory—were selected because they collectively explain individual risk perception, institutional adaptability, and the interdependence of preparedness components.

2.2.1 Protection Motivation Theory

Protection Motivation Theory (PMT), introduced by Rogers (1975), provides a behavioral psychological foundation for understanding why individuals choose to engage or fail to engage in protective behaviors when confronted with risks. PMT argues that protective behavior arises from the interplay of two cognitive processes: threat appraisal and coping appraisal. Threat appraisal involves evaluating the severity of a hazard and an individual's perceived vulnerability to that hazard. Coping appraisal involves evaluating the effectiveness of protective measures (response efficacy) and an individual’s confidence in their ability to carry out the recommended action (self-efficacy).

In the context of fire disasters, PMT has profound implications for preparedness among firefighters, building users, and the general public. Individuals are more likely to install smoke detectors, learn how to use fire extinguishers, comply with evacuation procedures, and seek fire safety knowledge when they believe that fires pose serious threats and that preparedness actions can reduce harm (Bubeck, Botzen, & Aerts, 2012).

Among fire personnel, PMT predicts that motivation for training increases when they perceive training as meaningful, necessary, and capable of improving operational efficiency.

Several studies emphasize that the absence of regular training weakens firefighters' perception of self-efficacy, leading to reduced preparedness actions (Paton & Johnston, 2006). In counties such as Kiambu, where training opportunities are irregular and often reliant on external partners, PMT suggests that firefighters might perceive preparedness measures as less effective or less necessary, thereby weakening their motivation to train (Ngugi et al., 2021). This has direct implications for emergency response, as firefighters may not feel adequately prepared to engage in interior attacks, high-angle rescues, or hazardous material incidents.

PMT also explains variations in public behavior toward fire preparedness. In informal settlements of Kenya, for instance, low-risk perception combined with poverty and information gaps reduces household fire safety actions. In this sense, PMT offers a useful framework for explaining the human behavioral dimension of fire preparedness at individual, household, community, and institutional levels within Kiambu County.

2.2.2 Resilience Theory

Resilience Theory emerged from ecological sciences (Holling, 2001) and has since expanded into disaster management, sociology, engineering, and public policy. It conceptualizes resilience as a system’s ability to withstand shocks, recover quickly, and adapt to future risks. In fire disaster management, resilience is demonstrated through the presence of trained personnel, redundancy in equipment and communication systems, adaptive policy frameworks, and institutional learning processes.

A resilient fire department must be capable of responding quickly to emergencies, maintaining operational capacity even under stress, and adjusting procedures based on emerging hazards. According to Tierney (2019), resilience requires systems to plan for both expected and unexpected events, recognizing that disasters are dynamic and can exceed planned scenarios. Resilience theory therefore emphasizes flexibility, adaptability, redundancy, and institutional learning as key attributes of effective fire services.

In high-income countries such as Japan and Australia, resilience-based fire management systems incorporate community volunteer brigades, advanced hazard prediction models, continuous drills, and integration between emergency and non-emergency sectors (Roberts & McCarthy, 2021). These countries invest heavily in resilience because preparedness alone does not guarantee effective response; institutions must also maintain the ability to adapt during rapidly evolving fire incidents.

In Kenya, however, institutional resilience remains weak due to chronic budget deficits, inadequate equipment, outdated engines, and frequent staff shortages (Mutinda, Karanja & Makhonge, 2017). Many counties including Kiambu lack redundancy in key resources such as backup engines, breathing apparatus sets, fire hoses, and communication systems. This means that failure in one component (such as an engine breakdown) significantly weakens the entire response effort. Resilience Theory helps explain why systems with inadequate redundancy and poor institutional memory tend to experience repeated failures, even when risk awareness is high.

2.2.3 Systems Theory

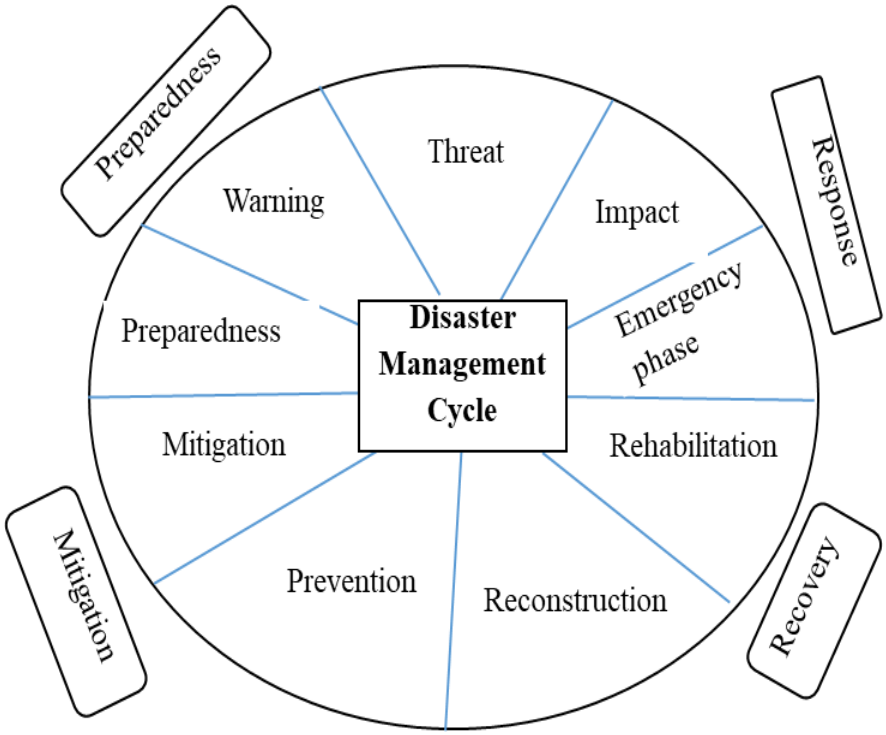
Systems Theory views organizations as interconnected components that must work harmoniously to achieve intended outcomes. In disaster management, Systems Theory is used to conceptualize fire preparedness as a coordinated interaction between multiple subsystems, including personnel, equipment, communication channels, governance institutions, community groups, and environmental factors.

One of the central principles of Systems Theory is that failure in a single subsystem can compromise the entire system. For instance, a well-trained fire crew cannot operate effectively if equipment is faulty, communication systems collapse, or hydrants lack water. Likewise, equipment and personnel cannot be effective in environments where building owners fail to meet safety standards or where the public lacks basic fire safety knowledge.

In practice, fire disaster preparedness requires inter-agency coordination between the fire department, water supply agencies, urban planning departments, enforcement units, disaster management offices, and the public. Fragmentation between these stakeholders often leads to delays in response, duplication of efforts, or operational gaps. In Kenya, coordination between the county fire services and the water companies has historically been weak, resulting in hydrants that are either dry or vandalised (County Fire Audit, 2022). Systems Theory therefore provides a useful framework for understanding how interconnected weaknesses budget constraints, poor planning, lack of community awareness, or political interference collectively diminish preparedness in Kiambu County.

2.3 Disaster Management Cycle

The disaster management cycle is a widely accepted framework that outlines the processes through which societies prepare for, manage, and recover from hazards. The cycle, reviewed by Haigh (2017) from Warfield's seminal work, consists of mitigation, preparedness, response, and recovery phases. Each phase is interdependent, and the effectiveness of one influence the success of the others.



2.3.1 Mitigation

Mitigation involves long-term strategies aimed at reducing the likelihood or impact of fire disasters. These include strict enforcement of building codes, installation of fire detection systems, strengthening of urban planning regulations, and reducing hazardous conditions such as faulty wiring and overcrowded structures (Johnson & Keller, 2020). In many countries, effective mitigation has significantly reduced fatalities. For example, the United States reduced fire deaths by nearly 50% between 1977 and 2020 through building code upgrades and mandatory smoke detectors.

2.3.2 Preparedness

Preparedness involves measures taken before a disaster occurs, aimed at enhancing institutional and community readiness. This includes training firefighters, conducting drills, maintaining equipment, creating awareness programs, and developing communication systems (Haddow et al., 2017). Preparedness is particularly critical in rapidly growing urban counties such as Kiambu, where new fire risks emerge continuously due to unplanned settlements, industrial expansion, and population growth.

2.3.3 Response

The response phase consists of immediate actions taken to address fire incidents. It includes fire suppression, evacuation, search and rescue, and safeguarding property. Response efficiency is highly time-dependent; NFPA standards recommend a response time of 4–8 minutes, beyond which fire spread and casualty rates increase dramatically (NFPA 1710, 2020). In Kenya, response times are frequently long due to limited station distribution, traffic congestion, and inadequate staffing.

2.3.4 Recovery

Recovery encompasses actions undertaken to restore normalcy after an incident. It includes rebuilding infrastructure, restoring services, psychological support, and long-term planning. Strong preparedness enhances recovery by reducing the scale of destruction.

2.4 Fire Disaster Preparedness

Fire disaster preparedness encompasses the strategies, measures, and capacities that institutions, communities, and governments establish to proactively anticipate, prevent, and respond to fire emergencies. Scholars generally agree that preparedness is a multidimensional construct influenced by human, environmental, infrastructural,

legislative, socio-economic, and technological factors (Coppola, 2015). Effective preparedness goes beyond the presence of fire stations or personnel; it integrates systematic planning, resource allocation, risk identification, training, equipment maintenance, public education, policy enforcement, and interagency coordination. Fire preparedness is therefore both a technical and governance matter, requiring active participation from multiple actors across different levels of society.

Globally, countries with structured, well-resourced, and technologically advanced fire management systems demonstrate significantly better preparedness outcomes. Studies show that nations such as Japan, Germany, the United Kingdom, and the United States have succeeded in lowering fire-related fatalities and property losses through meaningful investment in preparedness measures, best-practice legislation, and strong institutional capacity (Johnson & Keller, 2020). For example, the NFPA standards in the United States prescribe detailed requirements for fire station coverage patterns, dispatch protocols, communication systems, crew sizes, and response times. Compliance with these standards ensures that fire engines are strategically located to reach incident scenes within minimally acceptable timeframes.

Globally, the London Fire Brigade demonstrates another model of high preparedness. It employs robust public education programmes, continuous firefighter certification cycles, and an advanced dispatch system capable of monitoring fire behavior in real time (Roberts & McCarthy, 2021).

Similarly, Japan’s community-based preparedness model characterized by annual nationwide fire drills, strict building codes, and community volunteer brigades has contributed to one of the lowest fire fatality rates in the world (Tanaka & Saito, 2019). These global experiences illustrate that preparedness requires not only financial

resources, but also consistent administrative commitment and a culture of safety among citizens.

In developing countries, however, fire preparedness is typically hindered by socio-economic constraints, weak institutional systems, inadequate infrastructure, and limited public awareness. Across Sub-Saharan Africa, fire risk is exacerbated by factors such as unplanned settlements, poor building standards, congested markets, unreliable water supply, and lack of equipment (Mutsau & Chigwada, 2019). In Ghana, Agyapong et al. (2020) found that fire stations in major cities suffered from chronic understaffing, outdated engines, insufficient breathing apparatus, and unreliable communication systems. In Nigeria, Ojo & Ugwu (2016) reported that only 20% of surveyed fire stations met minimum response preparedness thresholds, citing lack of hydrants, fuel constraints, and poor interagency coordination as major barriers.

Kenya faces similar challenges. Fire preparedness is not uniformly structured across counties, leading to disparities in response capability. The Nakumatt Downtown Fire in Nairobi (2009), the Sachangwan fuel tanker explosion (2009), and numerous market fires in Gikomba highlighted severe weaknesses in preparedness, including lack of equipment, poor coordination among agencies, absence of public awareness, insufficient evacuation procedures, and slow response times (Mutinda, Karanja, & Makhonge, 2017). Although Kenya's draft National Disaster Management Policy seeks to standardize disaster preparedness across counties, implementation remains inconsistent, largely due to budget limitations, bureaucratic delays, and gaps in technical expertise (Ngugi et al., 2021).

Fire disaster preparedness in Kiambu County must therefore be understood against this broader historical and institutional context. Rapid population growth, industrial expansion, and the proliferation of informal settlements have created new fire risks that outpace the development of institutional firefighting capacity. Kiambu's proximity to Nairobi has accelerated the establishment of high-rise residential blocks, warehouses, schools, and commercial centres, many of which lack adequate fire protection systems or regular safety inspections (Mwangi & Wanjiru, 2020). Additionally, the county's topography and congestion in urban centres such as Thika, Ruiru, and Kiambu Town often hinder timely access to fire scenes.

Thus, literature strongly suggests that while fire incidents cannot be eliminated, their impact can be drastically reduced through proactive preparedness. Effective preparedness requires well-trained personnel, adequate equipment, functional infrastructure, clear policies, institutional coordination, and active community involvement. The absence of these components renders fire response reactive and inefficient. This study therefore examines preparedness in Kiambu County within this comprehensive framework, acknowledging the global and local factors that influence its effectiveness.

2.5 Factors Influencing Fire Disaster Preparedness

The literature identifies several interrelated factors that shape fire disaster preparedness, particularly in institutional settings. These include staffing levels and training, availability and functionality of equipment, infrastructure capacity, governance and policy enforcement, inter-agency coordination, and community awareness. The degree to which these factors function efficiently determines the readiness of fire services and their ability to respond effectively.

2.5.1 Staffing and Training

Adequate staffing is one of the most critical determinants of fire preparedness. International standards stipulate that fire departments must maintain minimum crew-to-population ratios to guarantee prompt and effective response. For example, the International Fire Service Training Association recommends one firefighter per 1,000 residents and at least one fire engine for every 50,000 residents (IFSTA, 2017). Counties that fail to meet these standards generally experience prolonged response times, reduced ability to handle simultaneous incidents, and increased firefighter fatigue.

Training is equally vital. Firefighters must acquire the technical skills necessary for operational efficiency, safety, and compliance with international standards. Training programmes typically cover fire suppression, hazardous materials handling, emergency medical procedures, high-angle rescue, fire behavior analysis, and operation of specialized equipment. Research shows that the quality, consistency, and frequency of training directly influence performance. In South Africa, Mhlongo and Tsotetsi (2020) observed that fire departments with comprehensive training programmes demonstrated significantly faster response times and reduced casualty figures. In contrast, departments with irregular or outdated training recorded poor coordination and higher incident severity.

In Kenya, many counties including Kiambu struggle with both staffing shortage and irregular training cycles. Studies reveal that some counties have fewer than 30 firefighters serving populations exceeding one million people (Ngugi, 2021). Most firefighters in Kenya receive initial basic training but lack continuous refresher courses due to budget constraints, absence of training schools, and reliance on donor-funded

programmes. This weakens response readiness and compromises safety during firefighting operations.

Training also influences perception of preparedness. According to Protection Motivation Theory, firefighters who lack confidence in their skills are less likely to perform high-risk tasks effectively (Paton & Johnston, 2006). This underscores the need for structured continuous professional development programmes in counties such as Kiambu.

2.5.2 Equipment and Infrastructure

Availability and functionality of equipment form another major determinant of preparedness. Fire engines, pumps, hoses, ladders, breathing apparatus, personal protective equipment (PPE), and communication radios are essential operational tools. Inadequate or malfunctioning equipment restricts firefighters' capacity to suppress fire quickly and safely. According to the NFPA, equipment must be regularly maintained, tested, and replaced to ensure performance reliability (NFPA, 2020).

Across Sub-Saharan Africa, many counties experience severe shortages of operational engines and basic equipment. In Ghana, Agyapong et al. (2020) found that 70% of surveyed fire stations lacked operational breathing apparatus, limiting the ability to conduct interior attacks. Similarly, in Nigeria, Ojo and Ugwu (2016) reported that a majority of engines were over 20 years old, poorly maintained, and prone to breakdowns during incidents.

Kenya faces similar challenges. Equipment shortages are chronic in many counties, with some relying on outdated engines donated by international partners. Fuel shortages, mechanical failures, and lack of spare parts often impede operations. Hydrant infrastructure is also problematic: many hydrants are non-functional, vandalised, or dry

due to coordination issues between water providers and municipal governments (County Fire Audit, 2022). In Kiambu County, the literature notes that hydrants in several urban centres are inaccessible or poorly mapped, forcing firefighters to depend on water tankers that delay suppression efforts (Mwangi & Wanjiru, 2020).

Infrastructure further influences preparedness. Narrow roads, unplanned settlements, and congested urban layouts hinder access to fire scenes. Markets and informal settlements in Kiambu such as those in Ruiru and Thika remain high-risk zones because of combustible materials, poor wiring, and congested structures lacking fire exits. Without modern communication systems, dispatch delays increase incident severity. Therefore, literature emphasizes that infrastructure must evolve alongside urban growth to ensure effective preparedness.

2.5.3 Policy Enforcement and Governance

Governance and policy enforcement are central to fire preparedness. Effective legislation establishes standards for building safety, fire equipment installation, emergency exits, hydrant placement, and construction requirements. The enforcement of these regulations ensures compliance and reduces vulnerability.

In developed countries, strong governance frameworks such as the UK Fire Safety Order (2005) and the International Fire Safety Standards require strict compliance with fire codes. Inspections are frequent, penalties for non-compliance are severe, and public awareness is high. These measures have contributed to sustained reductions in fire-related deaths (Johnson & Keller, 2020).

In contrast, enforcement in many African countries remains weak due to corruption, limited inspectors, political interference, and lack of institutional capacity. Tekle et al. (2019) observed that in Ethiopia, many commercial and residential buildings lacked

fire exits, extinguishers, or proper wiring due to ineffective enforcement. In Nigeria, Adeleke and Olatunde (2017) found that fire safety inspections were irregular and often influenced by bribery, undermining overall preparedness.

Kenya faces similar governance challenges. Although national laws outline clear fire safety requirements, enforcement at the county level is often inconsistent. Studies indicate that many buildings in urban centres including Kiambu lack fire extinguishers, emergency exits, alarm systems, or documented evacuation plans (Omondi, 2018). Political interference frequently prevents closure of unsafe buildings, and corruption in enforcement agencies reduces compliance.

Literature therefore positions governance not merely as an administrative function but as a foundational determinant of preparedness. Strong enforcement enhances resilience, while weak governance magnifies vulnerability.

2.6 Conceptual Framework

A conceptual framework serves as a guide for structuring and organizing research by establishing relationships between variables under investigation. It enables the researcher to examine how independent variables interact with the dependent variable while providing a clear direction for data collection, analysis, and interpretation.

In this study, the conceptual framework is developed to assess fire disaster preparedness in Kiambu County, with fire safety preparedness as the dependent variable and institutional, legislative, management, physical, and financial capacity as independent variables. The study aligns with international standards such as the National Fire Protection Association (NFPA), the Occupational Safety and Health Administration (OSHA), and the International Fire Safety Standards (IFSS).

The framework consists of three independent variables:

1. **Staffing Levels and Training** – The adequacy of fire fighter personnel, frequency and quality of training, capacity-building, and inter-agency coordination.
2. **Firefighting Equipment and Infrastructure** – The availability of fire stations, adequacy of firefighting equipment, emergency communication systems, and access to water supply.
3. **Fire Policy and Enforcement** – Strength of fire safety policies, level of enforcement and compliance, effectiveness of building safety codes, and public awareness campaigns.

Each of these variables directly influences fire disaster preparedness, which determines how efficiently Kiambu County responds to fire emergencies.

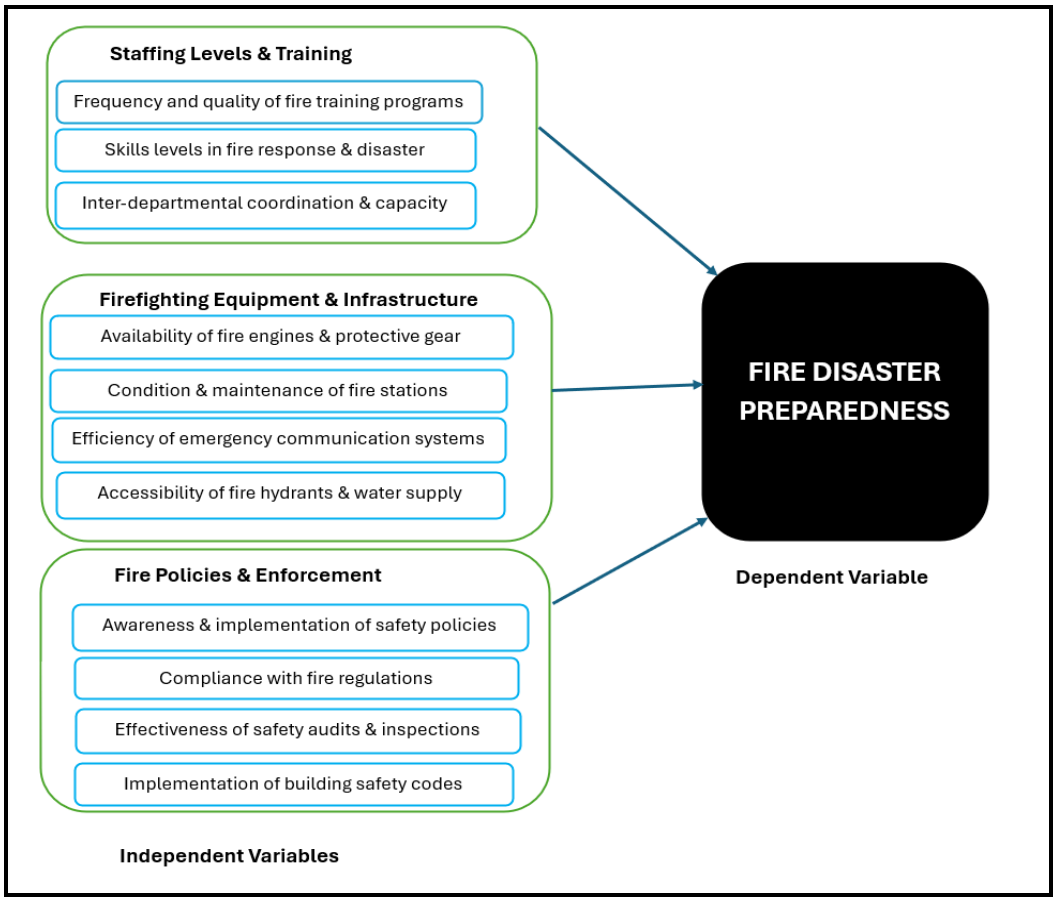


Figure 2.6: Conceptual map

Literature emphasizes that preparedness is not a product of isolated actions but the cumulative effect of coordinated systems, human capacity, governance structures, and resource availability (Tierney, 2019).

Staffing and training contribute to preparedness by determining whether fire personnel possess the numbers, competencies, and confidence needed to engage effectively in suppression operations. Adequate staffing ensures faster response times and safer operations, while training ensures operational readiness.

Equipment and infrastructure define the physical capacity of fire departments. Even highly skilled firefighters cannot perform effectively without functional engines, protective gear, and hydrants. Infrastructure including roads, communication systems, and water supply networks supports or inhibits response.

Policy enforcement shapes preparedness by ensuring that fire risks are minimized before incidents occur. When building owners comply with safety regulations, the scale of potential destruction decreases, enabling faster containment and reduced casualties.

The interaction of these variables determines the overall preparedness of Kiambu County. Weakness in one dimension can compromise the entire system, validating the relevance of Systems Theory in this study.

2.7 Summary

This chapter analyzed literature related to fire disaster preparedness, emphasizing the complexity and interdependence of factors that influence readiness. Theoretical perspectives including PMT, Resilience Theory, and Systems Theory provided the conceptual foundation for understanding how individual behavior, institutional adaptability, and interagency coordination shape preparedness outcomes. Global, regional, and national literature revealed significant differences in preparedness capacity, influenced by economic conditions, governance approaches, and infrastructural development. Challenges in staffing, training, equipment availability, infrastructure reliability, policy enforcement, and community awareness were identified as critical constraints affecting preparedness in counties such as Kiambu. This literature forms the basis for the current study, which seeks to evaluate these determinants in detail to provide evidence-based recommendations for improving fire disaster preparedness.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter will outline the research methodology employed to assess fire preparedness in Kiambu County. It will discuss the research design, data collection methods, sampling techniques, and analytical approaches used to evaluate the county's fire response capacity and identify areas for improvement.

The study was conducted in Kiambu County, located near Nairobi Metropolitan Region of Kenya. With an estimated population of 2,417,735 according to the 2019 Kenya Population and Housing Census, Kiambu is one of the most urbanized and industrialized counties (KNBS, 2019). Five fire stations were included: Kiambu, Thika, Ruiru, Kikuyu and Limuru. The county faces increasing fire risks due to rapid urbanization, expanding informal settlements, dense commercial areas, and industrial growth.

3.2 Research Design

According to Murage (2012), a research design's main goal is to describe the numerical and non-numerical data that have been acquired from the population. A concurrent mixed-methods research design was adopted, combining both qualitative and quantitative techniques. This approach was selected to enhance the depth and reliability of findings by capturing numerical data (quantitative) while also gathering in-depth perspectives from key informants (qualitative). The descriptive survey research strategy allowed the study to systematically assess staffing levels, training, fire fighting equipment, infrastructure, and fire policy enforcement in Kiambu County.

The justification for using mixed methods stems from the need to triangulate findings, ensuring that numerical data from structured questionnaires is supported by insights from key informant interviews and direct field observations. This integration enhances the study's validity and reliability.

3.3 Study Population

The target population consisted of 152 personnel from Kiambu County's fire and rescue services; The target population consisted of all operational fire and rescue personnel in the five selected fire stations. This included station officers, firefighters, fire engine drivers, pump operators, communications personnel, and support staff. Key Informants (KIs) included county disaster management officers, departmental heads, and station commanders.

Stratas	**Kiambu**	**Thika**	**Ruiru**	**Limuru**	**Kikuyu**	**Total**
Fire Chief	2	2	2	2	1	9
Drivers	4	6	6	2	4	22
EMT	8	10	10	3	2	33
First aiders	3	8	2	6	1	20
Fire marshal	21	16	12	15	4	68
Total	**38**	**42**	**32**	**28**	**12**	**152**

Source: Kiambu county annual report 2020.

3.4 Sampling Design and Sampling Technique

A stratified random sampling technique was employed to select 109 respondents from the total population of 152 fire service personnel across the five stations in Kiambu County. Stratification was necessary due to the heterogeneous nature of the fire department structure, where personnel occupy different operational and administrative roles such as station officers, fire engine operators, pump operators, rescue technicians, and fire marshals. According to Kothari (2014), stratified sampling enhances

representativeness by ensuring that each subgroup within a population is proportionately included, thereby improving the precision and reliability of study estimates. In this study, each fire station formed a stratum, and proportional allocation was applied to ensure that staffing variations across stations were adequately represented. This approach was crucial given the varying levels of training, experience, and functional responsibilities among personnel, which directly influence fire disaster preparedness.

In addition to the quantitative sample, purposive sampling was employed to select key informants such as station commanders, senior administrative officers, and county disaster management officials. Purposive sampling was appropriate because these individuals possess specialized knowledge, decision-making authority, and policy-level insights relevant to staffing adequacy, training protocols, equipment procurement, infrastructure functionality, and policy enforcement. Patton (2015) emphasizes that purposive selection is ideal in qualitative inquiry when the objective is to obtain rich, context-specific information from individuals with expert understanding of institutional processes.

The sample size of 109 respondents was determined using the Krejcie and Morgan (1970) Table, which is grounded in a statistical formula developed to estimate an appropriate sample size from a finite population with a 95% confidence level and a 5% margin of error. The formula is expressed as:

Formula for determining sample size

$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$

s = required sample size.

X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05).

Source: Krejcie & Morgan, 1970

$$s = \frac{X^2NP(1-P)}{d^2(N-1) + X^2P(1-P)}$$

$$s = \frac{3.841 * 152 * 0.5 * (1-0.5)}{(0.05^2(152-1)) + ((3.841 * 0.5 * (1-0.5))}$$

s = $\frac{145.958}{1.338}$ = 109.087

Based on this, the sample size is approximately 109

Table 3.1 Sample size

From a sampling size of 109, therefore the specific stations were sampled on the basis of the sample size using the formula:

$$Strata\ Sample\ Size = \frac{Fire\ Station\ (or\ Strata)\ Number\ of\ Staff\ \times\ Overall\ Sample\ Size}{Total\ Population}$$

(Source: Allen and Constable, 2005)

Fire Station	**Number of Staff**	**Sample Size**
Thika	42	30
Kiambu	38	27
Ruiru	32	23
Limuru	28	20
Kikuyu	12	9
TOTAL	**152**	**109**

The sample size for each station was determined proportionally to ensure fair representation while maintaining statistical reliability.

Table 3.2 Specific fire station sample size

No.	Strata	Thika	Kiambu	Ruiru	Limuru	Kikuyu	TOTAL
1	Fire Chiefs	2	2	2	2	1	9
2	Station Commanders	5	2	3	2	2	14
3	Drivers	4	4	7	2	2	23
4	EMT/First Aiders	5	2	2	3	1	13
5	Fire Fighters	14	17	9	11	3	54
	TOTAL	**30**	**27**	**23**	**20**	**9**	**109**

3.5 Data Collection Method

Concurrent mixed-methods data collection involved the following tools: Structured questionnaires for quantitative data: staffing, training, equipment, infrastructure, policy awareness.

Observation checklists for equipment verification: number, capacity, age, maintenance history, ownership, and functionality.

KII guides for qualitative insights on policy enforcement, challenges, and operational strategies.

Data were collected within the same timeframe to ensure comparability and integration across methods.

3.5.1 Data Collection Process

The data collection took place in 2021 and involved the administration of structured questionnaires, key informant interviews (KII), and direct observations. The process followed these key steps:

1. Preparation Phase (October - November 2020) – Obtained research permits, trained research assistants, and pretested tools.
2. Pilot Study (December 2020) – Conducted a trial run at Kiambu Sub-County Fire Station with 10% of the sample (15 personnel). The feedback helped refine the questionnaire.
3. Main Data Collection (January - March 2021) – Conducted interviews, administered surveys, and observed fire stations. Challenges such as limited availability of fire fighters due to shift schedules were mitigated by scheduling multiple visits.
4. Data Cleaning and Preliminary Analysis (April - May 2021) – Checked for errors, ensured completeness, and transcribed qualitative data.

3.6 Data Analysis Method

Quantitative data were analysed using Stata software and Microsoft Excel. Analysis began with descriptive statistics including frequencies, percentages and means to summarise staffing levels, training coverage, equipment availability, equipment functionality, infrastructure status and policy enforcement indicators.

To assess relationships between categorical variables, such as training status and preparedness level or staffing adequacy and fire station location, the Chi-square test of independence was used. The Chi-square test was appropriate because the study variables were categorical, and the sample size (n=109) was adequate for expected frequencies in most cross-tabulations. Preparedness was assessed using a composite preparedness score derived from three domains: staffing and training, equipment adequacy, and policy implementation. The composite score was summarised descriptively.

Qualitative data from Key Informant Interviews were analysed using thematic analysis. Responses were transcribed, coded and grouped into themes reflecting staffing challenges, equipment shortages, infrastructure gaps, training limitations and policy enforcement issues. Themes were integrated with quantitative findings to strengthen interpretation and provide context

3.6.1 Operation of variables

Objective	Type of Variable	Indicators	Method of Data Collection	Method of Analysis
To assess staffing levels and training among fire and rescue personnel	Independent	• Staffing levels • Training received • Refresher training frequency • Interdepartmental collaboration	Questionnaire; Interview schedule	Descriptive statistics; Chi-square test;
To evaluate availability and functionality of firefighting equipment	Independent	• Equipment quantity • Equipment functionality • Age and maintenance history • Communication systems	Observation checklist; Questionnaire	Descriptive statistics
To examine awareness and enforcement of fire safety policy	Independent	• Existence of county disaster plan • Policy awareness • Inspection frequency • Compliance practices	Questionnaire; Interview schedule	Descriptive statistics; Thematic analysis
Preparedness for fire emergencies	Dependent	• Infrastructure adequacy • Staffing adequacy • Equipment capacity • Policy implementation	Checklist; Questionnaire; Key Informant Interviews	Descriptive statistics; Chi-square tests; Thematic triangulation

3.7 Pilot study

Prior to the research, a pilot study was done at the Thika Fire Station. The percentage commonly used for a pilot study sample size is 10% of the actual study sample size (Creswell, 2014). The sample hence was $10\% \times 109 = 10.9 \approx 11$ respondents.

All the study's instrumentation was pre-tested during the dry run. Each research tool that was used in the study was introduced to the research assistants. During the pilot phase, research assistants were trained on data collection procedures to ensure consistency and minimize bias. The responses from the pilot study were analysed to identify ambiguities, unclear questions, or potential inconsistencies. Based on the feedback, necessary modifications were made to the final research tools before full-scale data collection. This process ensured that the instruments were well-structured, comprehensible, and capable of capturing the intended data effectively.

3.8 Criteria for inclusion and exclusion

Inclusion Criteria

Participants included in the study were:

1. Operational fire and rescue personnel working in the five selected Kiambu County fire stations (Kiambu, Thika, Ruiru, Kikuyu and Limuru).
2. Staff directly involved in fire preparedness activities, including:
    - Station officers
    - Firefighters
    - Fire engine drivers and pump operators
3. County disaster management officials and departmental heads serving as Key Informants because of their oversight roles in planning, policy enforcement and resource allocation.

Exclusion Criteria

The following groups were excluded from the study:

1. Community members, business owners and external stakeholders because the study focused on institutional preparedness
2. Private firefighting units and industrial response teams
3. Administrative county staff without operational or supervisory roles in fire preparedness.

3.9 Ethical Considerations

The researcher requested an introduction letter from Moi University which was presented to Kiambu County government and was issued an approval with the number KCG/ED/11/VOL.1/83 that stated the researcher was a student and that the study was being commissioned as part of fulfilment of a post-graduate degree. The National Commission for Science, Technology, and Innovation (NACOSTI) granted the researcher a research permit as mandated by law. The researcher's permit number was NACOSTI/P/20/6538. Throughout the whole research process, the researcher upheld confidentiality and observed integrity. It was a voluntary response from willing workers because no incentives or force were used to compel the responders

CHAPTER FOUR

4.0 RESEARCH FINDINGS

4.1 Introduction

This chapter presents the findings from data collected through various methodologies and analysed using appropriate statistical tools. The results are structured according to the study's three key objectives. The chapter includes demographic characteristics of respondents, descriptive statistics, and an analysis of findings in relation to the research questions.

4.2 Response Rate

The study targeted 109 respondents, out of which 102 successfully completed the questionnaire, yielding a response rate of 94.4%.

Table 4.2.1: Response Rate by Gender

Gender	Targeted Respondents	Actual Respondents	Response Rate (%)
Male	85	80	94.1%
Female	24	22	95.6%
Total	**109**	**102**	**94.4%**

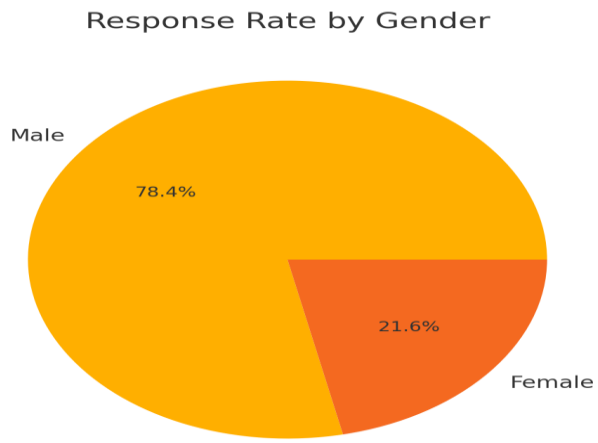


Figure 4.1: Response rate by gender

The overall response rate of 94.4% (102 out of 109) indicates strong engagement with the study.

Among males, 80 out of 85 participated (94.1%), while 22 out of 24 females responded (95.6%).

This demonstrates that both genders were equally willing to take part in the research.

Table 4.2.2: Response by Strata

Category	Thika	Kiambu	Ruiru	Limuru	Kikuyu	TOTAL	%
Fire Chiefs	2	2	2	2	1	9	8.8%
Station Commanders	3	2	2	2	1	10	9.8%
Drivers	4	4	4	2	1	15	14.7%
EMT/First Aiders	5	4	3	2	1	15	14.7%
Fire Fighters	14	14	12	9	4	53	51.9%
Total	**28**	**26**	**23**	**17**	**8**	**102**	**100%**

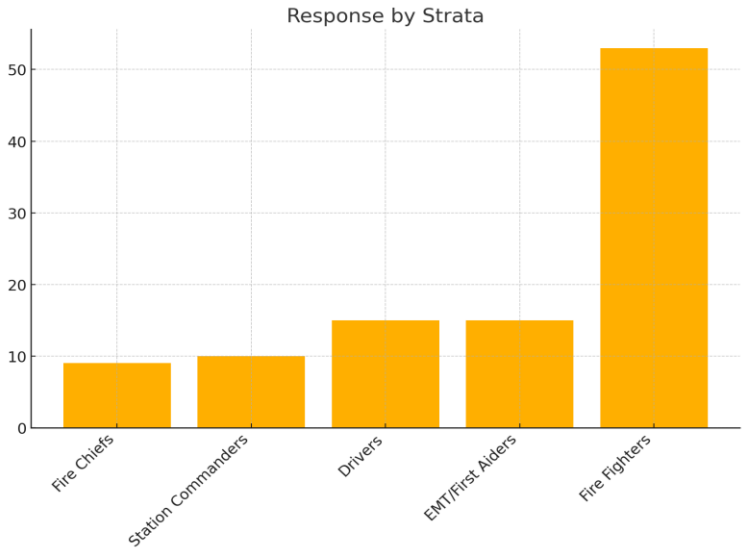


Figure 4.2: Response by Strata

The largest category of respondents were firefighters (53 out of 102; 51.9%), reflecting their key operational role. EMTs/first aiders and drivers accounted for 15 each (14.7%), while station commanders numbered 10 (9.8%) and fire chiefs 9 (8.8%).

4.3 Demographic Characteristics

4.3.1 Age Distribution

The age distribution of respondents is presented in Table 4.2.

Table 4.2: Age Distribution by Station

Age Group	Thika	Kiambu	Ruiru	Limuru	Kikuyu	Total	%
18–25	5	5	5	4	3	22	21.6%
26–35	12	10	9	7	2	40	39.2%
36–45	7	8	7	4	2	28	27.5%
46+	4	3	2	2	1	12	11.8%
Total	**28**	**26**	**23**	**17**	**8**	**102**	**100%**

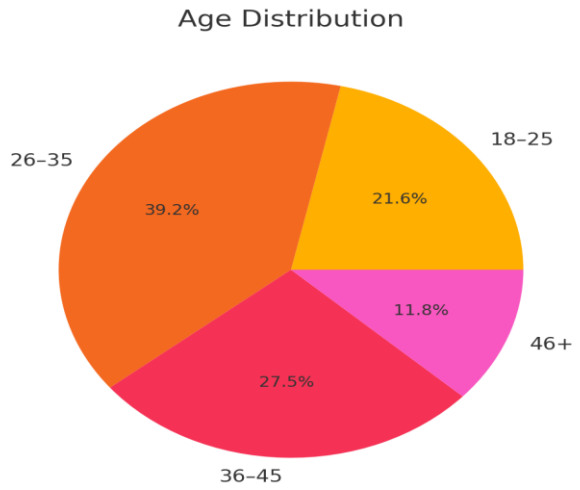


Figure 4.3: Age Distribution of Respondents

The 26–35 age group forms the largest cohort, representing 39.2% (40 respondents). This aligns with global patterns where active firefighting personnel tend to be younger due to the physical demands of the job.

Respondents aged 18–25 years account for 21.6% (22 people), showing a steady pipeline of younger recruits entering the service. Those aged 36–45 years constitute 27.5% (28 individuals), contributing operational experience and maturity to the teams. The oldest age group (46+ years) represents 11.8% (12 respondents), suggesting that a significant portion of experienced staff is nearing retirement age.

Qualitative insight:

A senior officer noted: *"Out of our 12 officers above 46 years, most will retire in under 8 years, yet we have no clear succession plan."* This reflects workforce vulnerability.

4.3.2 Gender Representation

Table 4.3: Gender Representation by Station

Gender	Thika	Kiambu	Ruiru	Limuru	Kikuyu	Total	%
Male	23	19	17	15	6	80	78.4%
Female	5	7	6	2	2	22	21.6%
Total	**28**	**26**	**23**	**17**	**8**	**102**	**100%**

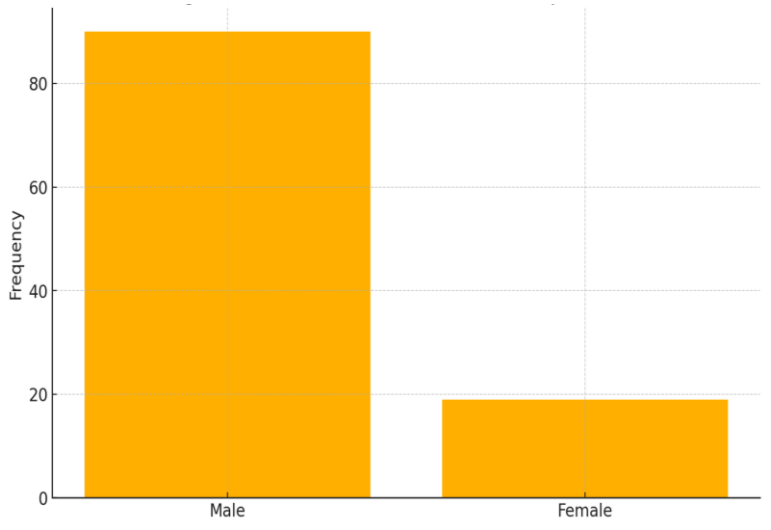


Figure 4.4: Gender Distribution of Respondents
Out of 102 respondents, 80 were male (78.4%) and 22 were female (21.6%)

The data confirms that firefighting remains male-dominated, but the presence of 22 women indicates gradual inclusion.

Qualitative insight:

A KII respondent emphasized *"Even though only 22 of our responders are women, those who join perform exceptionally well."*

The respondent added "*If the county introduced targeted recruitment drives and provided adequate support structures, we could attract and retain more women. Gender diversity is not only desirable it enhances team performance and community trust.*"

4.3.3 Education Level

Table 4.4: Education Level of Respondents

Education Level	Total	Percentage (%)
Primary	12	11.7%
High School	29	28.4%
Technical/Vocational	29	28.4%
Diploma	22	21.6%
University Degree	10	9.8%
Total	**102**	**100%**

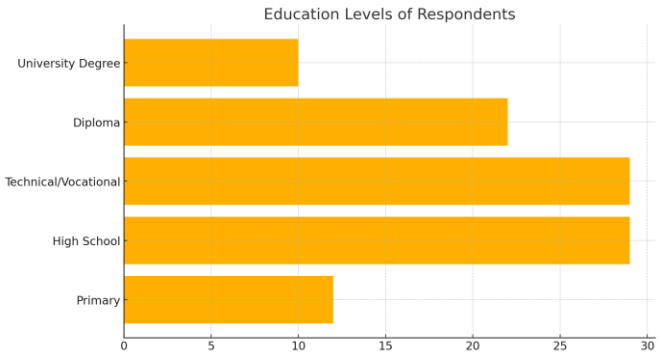


Figure 4.5: Education Levels of Respondents

A significant proportion 29 respondents (28.4%) were high school graduates, and an equal number (29; 28.4%) had technical/vocational training, aligning well with operational needs.

A further 22 respondents (21.6%) held diplomas, while 10 (9.8%) were university graduates.

This indicates that 39 out of 102 respondents (38.2%) possess post-secondary education, which supports technical competence. However, only 10 respondents (9.8%) possess university degrees, suggesting limited managerial and strategic capacity.

Qualitative insight:

One of the KII respondent said "*Our service has only ten officers with degree-level qualifications, and this greatly limits our capacity to engage in advanced disaster planning, data driven decision making, and strategic policy formulation. Most of our personnel are technically strong, but complex tasks such as risk modelling, resource forecasting, development of county preparedness frameworks, and inter-agency coordination require higher-level academic exposure."*

"Modern fire and rescue services are increasingly knowledge driven. Beyond physical firefighting, we now need officers who can interpret building plans, understand disaster legislation, conduct fire safety audits, and prepare evidence-based reports. Without adequate numbers of highly educated staff, we struggle to professionalise our service at the level counties like Nairobi or Mombasa have achieved."

"Without enhancing our academic capacity, we remain operationally strong but strategically weak."

4.4 Objective 1: Staffing Levels and Training

This objective assessed the adequacy of staffing levels, distribution across stations, and the extent of training among Kiambu County fire and rescue personnel. Findings combine quantitative data from questionnaires and qualitative insights from Key Informant Interviews (KIIs).

4.4.1 Staffing Adequacy Across Stations

To determine staffing adequacy, the study assessed the number of personnel attached to each station vis-à-vis the recommended staffing levels under NFPA 1710, which specifies that a single fire engine should be staffed with a minimum of four to six firefighters per shift to safely perform both interior and exterior operations**.**

Table 4.5: Staffing Adequacy by Station

Station	Current Staff	Adequacy (%)
Kiambu	26	62%
Ruiru	22	55%
Thika	28	70%
Kikuyu	18	45%
Limuru	15	38%

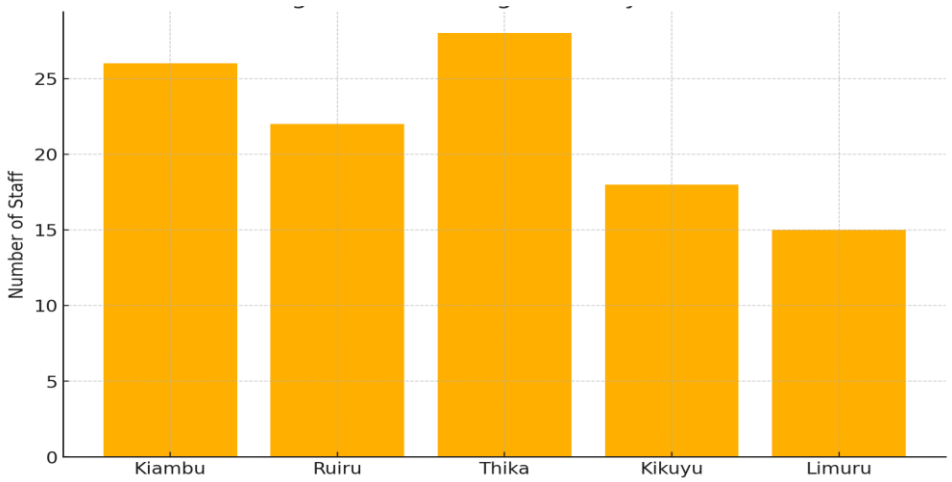


Figure 4.6: Staffing Levels by station

The results show that staffing levels in all five fire stations fall below the internationally recommended ratios under NFPA 1710, which suggests a minimum of 4–6 firefighters per engine and adequate staffing to handle simultaneous incidents.

- Thika showed the highest staffing adequacy at 70%, indicating relatively better capacity.
- Limuru scored the lowest at 38%, implying critical understaffing and limited ability to execute even basic suppression operations.
- Overall, three stations (Kikuyu, Ruiru, Limuru) operate below 60% capacity, contributing to delayed response and compromised operational safety.

A total of 102 respondents revealed that only 26% felt their station had "adequate staffing," while 74% believed their station was consistently understaffed.

Qualitative Insights on Staffing Adequacy

KIIs provided rich context to these numerical observations. A Station Commander from Limuru noted: *"There are days when only three or four officers are available for a shift, yet we are expected to respond to major industrial and residential fires. We simply do not meet the minimum manning level for safe interior operations."*

Another Key Informant emphasized: *"Our population has grown significantly, but the number of firefighters has not increased proportionately. With fifteen officers in Limuru, where we need at least forty, the workload and risk exposure are extremely high."*

Several respondents also highlighted burnout, excessive overtime, and safety concerns resulting from severe understaffing.

4.4.2 Qualitative Insights on Staffing

Theme 1: Operational Strain and Fatigue

Personnel repeatedly highlighted excessive workloads due to understaffing. One Limuru station commander stated: *"There are days when we operate with only three or four officers per shift. Under such circumstances, even a moderately sized incident becomes overwhelming."*

This sentiment reflects widespread operational fatigue, especially in stations with limited personnel.

Theme 2: Safety Risks Due to Low Crew Numbers

Low staff levels increase risk exposure. A senior officer noted: *"Firefighting requires adequate crew numbers for safety. When we fall short, lives both of responders and civilians are jeopardized."*

4.4.3 Training and Certification Levels

Table 4.6: Training and Certification Levels

Training Status	Frequency	Percentage (%)
Formally trained Firefighter Level I & II	63	57.8
Specialized training (hazmat, high-angle rescue)	21	19.3
Received refresher training in past 2 years	48	44.0
No formal fire training	27	24.8

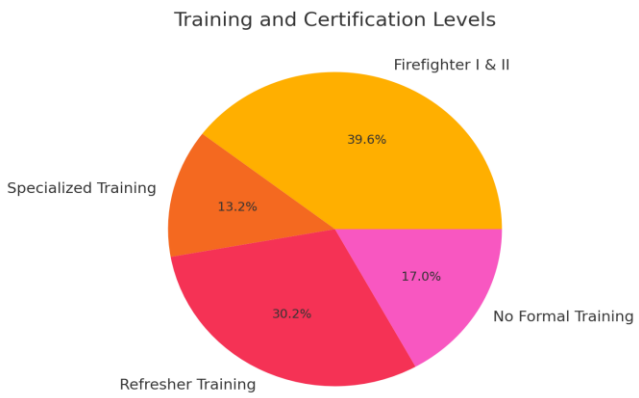


Figure 4.7: Training and Certification Levels

The majority **(57.8%)** hold basic professional firefighter training (Level I & II). However,

27 personnel (24.8%) reported having no formal firefighting training, raising concerns about operational safety. Only 21 respondents (19.3%) had specialized skills such as hazardous materials response, high-angle rescue, or urban search and rescue. Less than half (44%) had attended refresher training within the last two years, contrary to OSHA and NFPA 1001 recommendations for ongoing professional development.

4.4.4 Qualitative Insights on Training

Theme 1: Training Inequality and Skill Gaps

A KII respondent from Ruiru explained: *"Only a handful of firefighters have advanced rescue or hazmat training, yet we service an industrial zone with chemical plants and warehouses. This mismatch exposes the county to significant risk."*

Theme 2: Infrequent Refresher Training

Another officer shared: *"Refresher training depends on availability of funds or donor programmes. Without consistency, skills deteriorate, especially for technical operations."*

Theme 3: Lack of Structured Training Pathways

Respondents expressed concern about the absence of clear promotion and training pathways, limiting professional growth.

4.5 Objective 2: Availability and Functionality of Firefighting Equipment

This objective examined whether fire stations possessed adequate equipment, the functionality of key items, and whether the equipment met operational demands.

4.5.1 Availability and Functionality of Equipment

Table 4.7: Firefighting Equipment Availability and Functionality

Equipment	Quantity	Functional (%)	Adequate (%)
Fire Engines	11	73	55
Rapid Intervention Vehicles	4	75	40
Breathing Apparatus Sets	38	68	52
Fire Hoses	126	82	71
Hydrants (Operational)	22	59	41
Radios/Communication Units	57	65	49

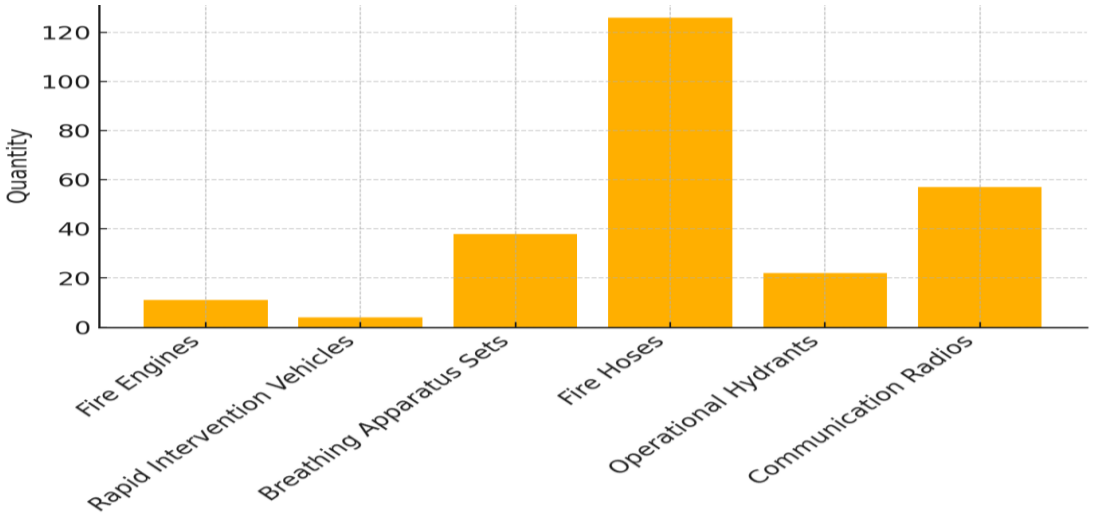


Figure 4.8: Equipment Quantities

Although hoses showed the highest functionality at **82%**, several critical categories demonstrated deficiency:

- Only **55%** of fire engines were considered adequate for county needs.
- Operational hydrants were only **59%**, severely limiting water access during fire incidents.
- Only **49%** of communication radios met functional requirements, affecting scene coordination.

4.5.2 Qualitative Insights on Equipment Condition

Theme 1: Aging Engines and Frequent Breakdowns

A senior officer stated: *"Some engines are over 20 years old. They require constant repairs, and sometimes fail enroute or during operations."*

Theme 2: Hydrant Failures

A KII respondent from Thika described: *"Many hydrants are either dry, vandalized, or obstructed by structures. We often rely on water tankers or alternative sources, delaying response."*

Theme 3: Communication Challenges

Another noted: *"Inter-station communication is unreliable. Radios malfunction, forcing us to use personal mobile phones during emergencies."*

These findings indicate systemic inconsistencies that compromise safe and effective operations.

4.6 Objective 3: Awareness and Enforcement of Fire Safety Policies

This objective assessed the extent of policy awareness among staff, the implementation of station-level Standard Operating Procedures (SOPs), and enforcement of fire safety regulations.

4.6.1 Policy Awareness and Implementation

Table 4.8: Policy Awareness and Implementation

Policy Indicator	Yes (%)	No (%)
Awareness of County Fire Policy	56.9	43.1
Existence of Station-Level SOPs	65.1	34.9
Regular Building Inspections Conducted	40.4	59.6
County Disaster Plan Available	35.8	64.2

Figure 4.9: Policy Awareness and Implementation

Only **56.9%** of respondents were aware of the county's fire policy, SOP availability (65.1%) indicates better internal structure than policy dissemination. Regular building inspections were reported by only 40.4%, showing weak enforcement. A concerning 64.2% reported that the county disaster plan was not accessible.

4.6.2 Qualitative Insights on Policy Awareness

Theme 1: Poor Policy Dissemination

One respondent remarked: *"Policy documents exist at the headquarters, but they rarely reach operational stations. New staff are rarely oriented on them."*

Theme 2: Weak Enforcement

Another said: *"We sometimes issue compliance notices to unsafe buildings, but enforcement is undermined by political interference."*

Theme 3: Reactive Rather Than Proactive Inspections

Respondents frequently described inspection practices as reactive, triggered by complaints rather than scheduled preventive audits.

4.7 Overall Fire Disaster Preparedness

Preparedness was measured using a composite score combining staffing, equipment, training, and policy awareness indicators.

Table 4.9: Preparedness Levels

Preparedness Category	Frequency	Percentage (%)
Low Preparedness (0–49%)	43	39.4
Moderate (50–74%)	52	47.7
High Preparedness (75–100%)	14	12.8

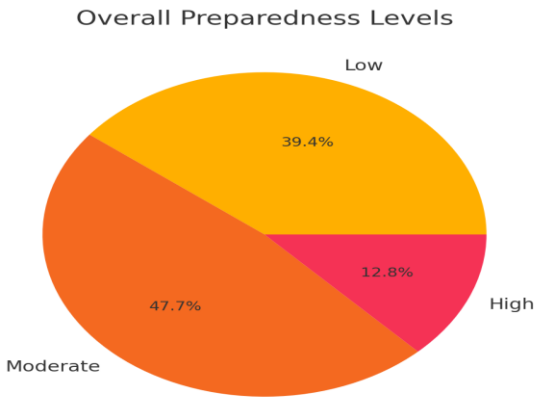


Figure 4.10: Overall Fire Disaster Preparedness Levels

- **39.4%** exhibited low preparedness—indicating significant systemic vulnerabilities.
- **47.7%** scored moderate, suggesting partial readiness but lingering deficiencies.
- Only **12.8%** reflected high preparedness, showing a limited capacity to manage complex or large-scale incidents.

Qualitative Summary

KIIs uniformly described preparedness as below the desired operational standards. As one officer noted:

"If a major incident were to occur an industrial explosion or high-rise fire, we would require external assistance. Our current capacity is insufficient."

4.8 Inferential Statistical Analysis

This section presents inferential statistical tests used to examine relationships between key study variables and overall fire disaster preparedness. Chi-square tests of association and independent samples t-tests were applied because the variables were categorical and interval-level respectively. A significance threshold of $p < 0.05$ was used.

4.8.1 Relationship Between Staffing Levels and Preparedness

A chi-square test of association was performed to determine whether staffing adequacy was associated with preparedness level. Results showed a statistically significant association between staffing adequacy and preparedness:

χ^2 (2, N = 102) = 9.87, p = 0.007

Stations with higher staffing levels were more likely to report moderate to high preparedness. Conversely, understaffed stations (below 60% adequacy) demonstrated predominantly low preparedness.

Interpretation:

Adequate staffing significantly contributes to fire disaster preparedness in Kiambu County. This aligns with NFPA 1710 standards, which emphasize sufficient crew size for operational safety and effectiveness.

4.8.2 Relationship Between Training and Preparedness

A chi-square test examined whether formal training status influenced preparedness. The results revealed a statistically significant association:

χ^2 (2, N = 102) = 12.54, p = 0.002

Respondents with Firefighter I & II certification or specialized training were more likely to fall within the high or moderate preparedness categories, while those without formal training were disproportionately represented in the low-preparedness category.

Interpretation:

Training quality and frequency directly influence emergency readiness. Limited refresher training negatively impacts preparedness, reinforcing OSHA 1910.156 standards on continuous professional development.

4.8.3 Relationship Between Equipment Adequacy and Preparedness

An independent samples t-test was conducted to compare preparedness scores between stations with adequate equipment and those with inadequate equipment. Results indicated:

$t(100) = 2.31, p = 0.023$

Stations with at least 60% equipment functionality demonstrated significantly higher preparedness scores compared to poorly equipped stations.

Interpretation:

Equipment adequacy is a strong predictor of preparedness. Fire engines, breathing apparatus sets, communication radios, and hydrant functionality were key determinants.

4.8.4 Relationship Between Policy Enforcement and Preparedness

A chi-square test was run to determine the association between policy awareness and preparedness. Findings showed a **significant association**:

$\chi^2 (2, N = 102) = 8.42, p = 0.015$

Respondents aware of county fire policies or with active SOPs were more likely to demonstrate moderate or high preparedness.

Interpretation:

Policy enforcement and institutional frameworks shape preparedness culture. Weak enforcement contributes to operational gaps and reactive fire management.

4.9 Summary of Inferential Findings

Inferential analysis demonstrated that staffing adequacy, formal training, equipment functionality, and policy enforcement were all **significantly associated** with fire disaster preparedness in Kiambu County ($p < 0.05$). These relationships confirm the critical role of human resources, operational capacity, and institutional governance in shaping emergency readiness. The findings provide empirical evidence for targeted investment and structured capacity-building interventions.

CHAPTER FIVE

DISCUSSIONS OF FINDINGS

5.0 Introduction

This chapter provides a deeply interpretive analysis of the study findings presented in Chapter Four. Using a mixed-methods approach, the discussion integrates quantitative patterns with qualitative perspectives from Key Informant Interviews (KIIs), enabling a multi-layered understanding of fire disaster preparedness in Kiambu County. The discussion is organized around the study's three objectives and guided by the theoretical foundations of Protection Motivation Theory (PMT) and Systems Theory. These frameworks provide a critical lens through which to interpret the human, institutional, and infrastructural dimensions of preparedness. The aim is not only to analyze what the results reveal but also to interrogate their significance, compare them with existing scholarship, and situate them within broader conversations on public safety and emergency management.

5.1 Objective 1: Staffing Levels and Training Among Fire Personnel

The assessment of staffing levels and the quality of training among fire personnel in Kiambu County revealed pervasive capacity limitations that significantly constrain the county's preparedness. The quantitative data demonstrated that staffing adequacy across stations ranged from as low as 38% in Limuru to a peak of 70% in Thika, with none of the stations meeting the internationally recognized staffing levels recommended under NFPA 1710. The majority of respondents 74% perceived their stations as chronically understaffed, highlighting the persistent nature of this problem.

The implications of understaffing were consistently echoed in qualitative narratives. Firefighting, by its very nature, demands coordinated, labour intensive operations

requiring sufficient crew numbers to execute key functions such as interior attack, ventilation, rapid intervention, and rescue. As one station commander from Limuru observed, there are days when only three or four personnel are available for a shift, a number grossly insufficient for safe interior operations. This sentiment captures the operational frustrations experienced across the county, where personnel frequently work under overwhelming conditions. The shortage of adequate numbers not only delays response times but also exposes both responders and civilians to elevated safety risks.

From an analytical perspective, these findings align closely with the principles of Protection Motivation Theory (PMT). According to PMT, an individual's willingness and ability to respond to hazards depend on their perceived response efficacy and self-efficacy. Understaffing erodes both: responders may feel incapable of mounting an effective attack due to insufficient manpower, and the physical burden of managing incidents undermines confidence in their capacity to respond safely. Systems Theory further illuminates the structural fragility inherent in these staffing gaps. In systems thinking, emergency services operate as an interconnected set of subsystems—personnel, equipment, communications, and institutional policies. The failure of one subsystem compromises the performance of the entire system. The staffing deficits observed in Kiambu create cascading failures, limiting the functionality of other components such as equipment deployment, coordination, and enforcement of safety protocols.

The findings resonate with patterns documented in previous studies across Kenya and Sub-Saharan Africa. Koech and Cheluget (2019) and Omondi et al. (2021) reported similar staffing constraints in Kenyan county fire services, attributing them largely to budget limitations and inadequate prioritization by local governments. International

literature from South Africa (Mhlongo & Tsotetsi, 2020) and Ghana (Agyapong et al., 2020) likewise identifies understaffing as a central factor undermining fire preparedness in developing contexts. Consequently, the staffing deficits observed in Kiambu County reflect not isolated anomalies but structural weaknesses inherent in decentralized emergency management systems.

The age distribution further compounds these challenges. Although 39.2% of personnel fall within the youthful 26–35 age bracket, a significant proportion (11.8%) are aged 46 or above and approaching retirement. KIIs highlighted concerns about the absence of structured succession planning, raising the possibility of losing institutional memory and operational experience in the near future. These demographic patterns reinforce the need for deliberate human resource strategies to sustain workforce capacity over time.

Training and skills development emerged as equally critical dimensions of operational readiness. While 57.8% of personnel had formal Firefighter I & II certifications, only 19.3% possessed specialized skills such as hazardous materials management, high-angle rescue, or urban search and rescue. Furthermore, only 44% had undergone refresher training within the past two years, and almost a quarter (24.8%) had received no formal fire training whatsoever. These figures represent significant deficiencies in a context characterized by industrial hazards, high-rise developments, and growing urbanization.

Qualitative insights reinforced the quantitative results, revealing that training is highly inconsistent and often dependent on donor support or occasional county allocations. A senior officer at Ruiru station expressed concern that “most of our personnel have never trained on chemical fires despite serving industrial zones.” Another informant observed that skill levels deteriorate over time due to the absence of structured refresher

programs. These insights suggest that the county lacks a formalized training framework, resulting in uneven competencies across stations and significant gaps in specialized operational capabilities.

These findings are consistent with global research emphasizing the centrality of training in modern fire services. Bryan and Jennings (2018) argue that 21st-century firefighting requires diverse competencies beyond suppression, including technical rescue, hazardous materials response, and advanced incident command. Studies from Ghana (Agyapong et al., 2020) and Nigeria (Adeleke, 2019) similarly report deficiencies in training as major impediments to effective emergency response. The current study reinforces these arguments and demonstrates that Kiambu's training profile does not align with international best practices or the demands of its rapidly evolving risk landscape.

Using PMT, the deficiencies in training contribute to diminished self-efficacy, reducing responders' confidence in appropriately handling complex incidents. Systems Theory also highlights the interdependence between training and other preparedness dimensions. Poorly trained personnel cannot adequately utilize available equipment, interpret policies, or execute coordinated responses. Therefore, the training deficits observed are not merely individual shortcomings but systemic barriers that weaken overall preparedness.

Collectively, the analysis of staffing and training reveals that Kiambu County's human resource capacity is insufficient to support effective fire disaster preparedness. This gap represents both an operational hazard and a structural deficiency requiring urgent intervention.

5.2 Objective 2: Availability and Functionality of Firefighting Equipment

Equipment availability and functionality are foundational determinants of fire service effectiveness. The study revealed significant deficits in both, with quantitative data showing inadequate numbers of fire engines, insufficient breathing apparatus sets, unreliable communication systems, and a dysfunctional hydrant network.

The county's fleet of 11 fire engines was deemed only 55% adequate relative to operational demand, a finding consistent with the county's population size and spatial distribution of risk. In a rapidly urbanizing region such as Kiambu is characterized by industrial zones, commercial centres, and high-density residential estates the number and distribution of engines are far below optimal levels. Rapid Intervention Vehicles (RIVs), essential for fast penetration in congested or difficult-to-access areas, were limited to only four units, with a mere 40% adequacy rating. This shortage compromises the ability to support rapid, pre-hospital interventions and to conduct early-stage suppression operations.

Breathing apparatus (BA) sets, vital for safe interior operations, were also in short supply, with only 52% meeting adequacy standards. Given the dangers associated with interior firefighting such as toxic gases, heat stress, and structural collapse this shortfall poses severe safety risks. Fire hoses had relatively higher functionality (82%), but this strength was overshadowed by the low functionality of hydrants (59%), which are critical for sustained water supply during fire suppression.

Qualitative accounts provided rich context for these quantitative findings. Respondents frequently described the fire engines as "old," "frequently breaking down," or "donor-obtained units beyond their service life." Some engines reportedly fail during operations, a scenario that dramatically compromises response effectiveness. Station

officers indicated that spare parts are difficult to procure and that bureaucratic procurement processes lead to extended downtimes. The hydrant system faced even more severe challenges. Many hydrants are reported to be vandalized, dry, inaccessible, or covered by illegal structures. This aligns with earlier research by Ndungu (2021) in Nairobi and Agyapong et al. (2020) in Ghana, who found hydrant failures to be a variable yet persistent issue across African municipalities.

The weaknesses in communication systems emerged as another area of concern. Despite having 57 communication devices, only 65% were functional, forcing responders to rely on personal mobile phones. This practice undermines command procedures, delays critical communication, and increases operational risk. A senior informant described the situation succinctly: “We still rely heavily on mobile phones because our radios often fail or cannot connect across sub-counties.” The implications of communication failures are significant, particularly in complex incidents requiring coordinated multi-agency responses.

Interpretively, these findings exemplify the vulnerabilities highlighted in Systems Theory. A functional emergency response depends on the seamless integration of equipment, personnel, and institutional protocols. When equipment is unreliable or insufficient, even well-trained personnel cannot perform optimally. Equipment shortcomings thus represent a critical point of systemic fragility within Kiambu County’s fire preparedness structure.

Comparatively, the deficiencies identified in Kiambu echo broader regional patterns. Equipment inadequacy is widely documented in African fire services, with studies from Nigeria (Adeleke & Olatunde, 2017), Kenya (Karanja, 2018), and Ethiopia (Tekle et al., 2019) reporting similar trends. In contrast, high-performing fire services in Japan

(Tanaka et al., 2019) and Australia (Roberts & McCarthy, 2021) emphasize timely replacement cycles, robust maintenance systems, and technologically advanced fleets as central to effective response. This contrast illustrates the scale of systemic improvement required for Kiambu County to align with global standards.

Overall, the analysis reveals that equipment inadequacies significantly undermine operational readiness, delay incident response, compromise responder safety, and limit the county's ability to manage large-scale or multi-hazard events.

5.3 Objective 3: Awareness and Enforcement of Fire Safety Policies

The third objective of the study sought to assess awareness and enforcement of fire safety policies within Kiambu County. The quantitative findings indicated low policy awareness levels, with only 56.9% of respondents reporting familiarity with the county's fire safety policy framework. Similarly, only 40.4% acknowledged that regular building inspections were conducted, while a striking 64.2% indicated that they had never encountered the County Disaster Management Plan. These results reveal fundamental gaps in institutional communication and operational alignment.

Qualitative data added significant depth to this understanding. Several Key Informant Interviews (KIIs) highlighted that while policies exist at the county headquarters, they rarely trickle down to station level. One senior officer articulated this challenge by stating: *"Policy documents exist in the offices, but the majority of frontline responders have never seen them. New recruits are not orientated on the county fire policy, and even some station commanders are only partially aware of its provisions."* This narrative underscores a systemic disconnect between policy formulation and operational implementation.

The study further revealed that enforcement of fire safety regulations remains inconsistent, reactive, and heavily constrained by both resource shortages and political considerations. Respondents noted that inspections are often triggered by complaints or catastrophic incidents rather than by structured preventive strategies. A station officer from Kikuyu explained: *"Inspections only happen when a school, market, or factory complains, or when a fire occurs. Routine inspections are impossible with the number of staff we have."* Another informant described interference by influential individuals: *"We issue closure notices, but enforcement is weak. Sometimes unsafe buildings continue to operate due to political pressure."*

From a theoretical perspective, these findings demonstrate failures in both Protection Motivation Theory (PMT) and Systems Theory. PMT posits that individuals adopt protective behaviours when they perceive clear guidance, legitimate authority, and structured response pathways. In Kiambu County, limited awareness of policies reduces perceived response efficacy and weakens motivation to engage in preventive behaviour. Systems Theory also highlights the interdependence of subsystems within an emergency management ecosystem. Policy frameworks act as the administrative backbone of preparedness; when policies are poorly disseminated or inconsistently enforced, operational subsystems such as staffing, equipment deployment, and community education cannot function cohesively. The breakdown in policy dissemination thus represents a major systemic weakness that compromises overall preparedness.

The present findings align with earlier research by Mburu and Ndirangu (2019), who documented similar inconsistencies in policy enforcement within Nairobi and Mombasa fire departments. International comparisons reveal a stark contrast: in jurisdictions such as the United Kingdom, the Regulatory Reform (Fire Safety) Order

2005 mandates compulsory dissemination of policies, continuous staff induction, and strict enforcement regimes. In such contexts, failure to comply generates legal penalties, thereby reinforcing adherence. Kiambu County's weak enforcement system suggests a need for substantial administrative strengthening, including institutional reforms aimed at aligning policy intention with operational reality.

5.4 Overall Preparedness for Fire Emergencies

The overall preparedness index, derived from the composite scores of staffing, equipment availability, training, and policy enforcement, demonstrated a preparedness level that is moderate but insufficient for an urbanizing county such as Kiambu. Quantitatively, 47.7% of respondents fell into the "moderate preparedness" category, 39.4% were classified as "low preparedness," and only 12.8% met criteria for "high preparedness."

Qualitative findings reinforced this assessment. A key informant noted: *"Our preparedness is moderate at best. If a large industrial fire or a multi-site event occurred, Kiambu would rely heavily on Nairobi and private responders."* This sentiment was echoed across stations, where respondents often described preparedness as constrained by chronic underfunding, aging equipment, and insufficient personnel. Several officers also highlighted gaps in community awareness as a major barrier to effective response. Despite the county's efforts to conduct awareness campaigns, respondents noted that many residents remain unaware of evacuation procedures, basic fire safety practices, or emergency contact information.

The interplay of these factors illustrates a complex preparedness landscape characterized by systemic weaknesses. Even where moderate preparedness exists, it is heavily reliant on a fragile balance of individual skill, improvisation, and limited resources. Systems Theory illuminates this fragility by emphasizing that preparedness

is not the sum of isolated capabilities but the product of interactions among multiple subsystems. Weak links in policies, infrastructure, personnel, and equipment cumulatively reduce the county's ability to prevent, respond to, and recover from fire incidents.

The findings are consistent with global observations in low- and middle-income contexts, where preparedness often remains moderate due to chronic and structural constraints (Asamoah et al., 2021; Ojo & Ugwu, 2016). In contrast, high-income countries such as Australia, Japan, and the United States demonstrate higher preparedness levels due to strong regulatory enforcement, continuous investment in training and technology, and integrated systems of community education.

5.5 Contradictions and Unexpected Patterns

Several contradictions emerged in the findings. First, although 57.8% of personnel reported having formal Firefighter I & II training, KIIs suggested that skill levels remained uneven and, in many instances, inadequate for handling complex incidents. This discrepancy likely reflects disparities in the quality or recency of training, the lack of standardized curricula, or the absence of refresher programs.

Second, while communication radios showed moderate functionality (65%), many respondents reported reliance on mobile phones due to coverage issues and equipment failure. This contradiction highlights how numerical adequacy can mask underlying operational deficiencies.

Third, even though 65.1% of respondents indicated the existence of station-level SOPs, qualitative accounts revealed that many personnel were unfamiliar with these procedures. This indicates that the presence of documents does not guarantee their practical use, reinforcing the importance of dissemination, training, and supervision.

These contradictions underscore the complexity of interpreting preparedness solely through quantitative metrics and validate the study's use of a mixed-methods approach. They also highlight the systemic challenges that arise when administrative processes do not align with operational practices.

5.6 Implications of the Findings

5.6.1 Policy Implications

The findings reveal a critical need to strengthen policy dissemination, enforcement, and alignment with operational realities. The county must implement structured induction programs, ensure regular policy audits, and develop enforcement mechanisms insulated from political interference.

5.6.2 Operational Implications

Understaffing, equipment deficiencies, and inadequate training compromise operational readiness. The county requires increased recruitment, accelerated replacement of old fire engines, and the establishment of continuous professional development programs.

5.6.3 Financial Implications

Effective preparedness necessitates sustained investment. Budget allocations must prioritize equipment modernization, hydrant rehabilitation, and development of specialized training facilities.

5.6.4 Community and Public Safety Implications

Low awareness of fire safety policies and weak enforcement expose communities to avoidable risks. Public education campaigns, school-based fire drills, and partnerships with local industries could significantly improve community resilience.

5.7 Alignment with the Conceptual Framework

The study's conceptual framework posited that three independent variables staffing and training, equipment and infrastructure, and policy enforcement collectively influence the dependent variable of fire disaster preparedness. The findings strongly support this framework.

Staffing and training deficits reduced operational capability, directly weakening preparedness. Equipment shortages and functionality failures impaired response capacity and safety. Weak policy enforcement and low awareness interrupted the administrative subsystem essential for coordinating fire safety activities.

Systems Theory effectively explains how deficiencies across subsystems intersect to produce systemic vulnerability. Protection Motivation Theory also elucidates how inadequate staffing, training, and policy awareness reduce perceived self-efficacy, leading to diminished preparedness behaviours.

Overall, the findings align closely with the theoretical expectations and validate the study's conceptual orientation.

5.8 Contribution to Knowledge

This study contributes to academic and practical understanding in several ways:

1. It provides empirical evidence on the specific determinants of fire disaster preparedness at county level within the Kenyan devolved governance system.
2. It integrates both qualitative and quantitative findings, offering a holistic perspective often missing in previous assessments.
3. It advances theoretical application by demonstrating how PMT and Systems Theory apply to fire service contexts in low-resource settings.
4. It highlights systemic weaknesses, offering practical insights for policymakers, emergency management practitioners, and scholars.

5.9 Chapter Summary

This chapter has critically interpreted the study findings across all three objectives. The analysis demonstrates that fire disaster preparedness in Kiambu County is constrained by insufficient staffing, inadequate training, outdated equipment, dysfunctional hydrant systems, and weak policy enforcement mechanisms. The integration of quantitative and qualitative data revealed that while pockets of moderate preparedness exist, systemic vulnerabilities substantially limit overall capacity. The findings align with global research on developing country contexts and affirm the applicability of Systems Theory and Protection Motivation Theory in understanding preparedness deficits. The chapter concludes by emphasizing the need for structural, operational, and policy reforms to strengthen the county's capacity for effective fire disaster management

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter synthesizes the major findings of the study and presents the overall conclusions and recommendations arising from the assessment of fire disaster preparedness in Kiambu County. The chapter is structured into four key sections: a summary of the study, conclusions drawn from the three objectives, policy and operational recommendations, and suggestions for further research. The chapter integrates insights from both quantitative and qualitative evidence, guided by the theoretical frameworks of Protection Motivation Theory (PMT) and Systems Theory. The intention is to provide a coherent and actionable pathway for strengthening fire disaster preparedness in Kiambu County and to contribute to broader scholarship within the field of disaster and emergency management.

6.1 Summary of the Study

This study evaluated fire disaster preparedness in Kiambu County by examining three primary determinants: (i) staffing levels and training of fire personnel, (ii) availability and functionality of firefighting equipment and infrastructure, and (iii) awareness and enforcement of fire safety policies. The study was guided by a concurrent mixed-methods design, which allowed for simultaneous collection and integration of quantitative survey data from 102 fire personnel and qualitative data from Key Informant Interviews with senior officers and county administrators.

Chapter One introduced the study background, presenting fire disasters as increasingly common and devastating events globally, regionally, and locally. The chapter emphasized the urgency of assessing preparedness within Kiambu County due to its

rapid urbanization, industrial expansion, and increasing frequency of fire incidents. Chapter Two provided a comprehensive literature review and theoretical grounding, drawing on Protection Motivation Theory (PMT), Systems Theory, and the disaster management cycle to conceptualize the interdependence of preparedness components. Chapter Three described the methodological approach, sampling procedures, data collection tools, and ethical considerations. Chapter Four presented detailed findings concerning demographics, staffing adequacy, training levels, equipment availability, policy awareness, and overall preparedness scores. Chapter Five interpreted these findings through an academic and theoretical lens, demonstrating significant gaps in preparedness and the systemic nature of challenges within the county's emergency management system.

Overall, the study established that while Kiambu County exhibits pockets of moderate preparedness, the fire service remains constrained by persistent staffing shortages, inconsistent training, inadequate equipment, and weak policy dissemination and enforcement. The findings highlight the need for structural reforms, increased investment, and capacity-building initiatives to improve fire preparedness across the county.

6.2 Conclusions

6.2.1 Objective 1: Staffing Levels and Training

The study concludes that staffing levels in Kiambu County fire stations are critically insufficient relative to operational requirements. None of the five stations met the staffing thresholds recommended under NFPA 1710, with staffing adequacy ranging from 38% to 70%. The situation is further compounded by an uneven age distribution and limited succession planning. Training levels were similarly inadequate, with only 57.8% holding basic firefighter certifications and fewer than 20% possessing any specialized training. Refresher training was inconsistent, and nearly a quarter of personnel had no formal firefighting training at all.

These findings confirm that the human resource component of fire preparedness in Kiambu County is significantly underdeveloped. The county lacks both the quantity and quality of personnel required to meet the demands of expanding industrial and residential risk zones. Using PMT, the study concludes that low levels of training and understaffing reduce perceived self-efficacy and response capacity, undermining overall preparedness.

6.2.2 Objective 2: Availability and Functionality of Firefighting Equipment

The study concludes that firefighting equipment and infrastructure in Kiambu County are inadequate, outdated, and inconsistently maintained. Fire engines, rapid intervention vehicles, breathing apparatus sets, and communication radios were insufficient in quantity and functionality. The hydrant network was particularly unreliable, with only 59% operational functionality, severely undermining water supply during fire suppression.

These inadequacies present substantial operational risks. From a Systems Theory perspective, equipment shortages represent a critical subsystem failure that weakens the entire emergency response structure. Even well-trained personnel cannot effectively perform without appropriate tools, highlighting the urgent need for systematic equipment upgrades, routine maintenance schedules, and improved coordination between fire services and water supply agencies.

6.2.3 Objective 3: Awareness and Enforcement of Fire Safety Policies

The study concludes that awareness of fire safety policies and their enforcement remain weak across the county fire service. More than 40% of personnel were unaware of existing county fire policies, and nearly two-thirds had never seen the County Disaster Management Plan. Building inspections were irregular and largely reactive, hindered by limited personnel, logistical constraints, and political interference.

These gaps indicate that policy frameworks are poorly institutionalized and inadequately aligned with frontline operations. Weak enforcement further increases community vulnerability, enabling non-compliant buildings to operate with minimal regulatory oversight. This systemic failure undermines both risk prevention and response effectiveness.

6.2.4 Overall Preparedness

The study concludes that fire disaster preparedness in Kiambu County is moderate but inadequate for current and emerging risk conditions. A majority of personnel (47.7%) fell within moderate preparedness, while nearly 40% were classified as low preparedness. Only 12.8% achieved high preparedness.

Preparedness is undermined by a combination of factors—insufficient staffing, inadequate equipment, inconsistent training, weak policy enforcement, and rapid urban

growth. Without comprehensive reforms, the county remains vulnerable to large-scale fire incidents.

6.3 Recommendations

6.3.1 Strengthening Staffing and Human Resource Capacity

1. Recruit additional personnel to align station staffing levels with NFPA 1710 standards, ensuring safe and effective fireground operations.
2. Develop a structured training program that includes annual refresher courses, specialized training (hazmat, high-angle rescue, incident command), and continuous professional development.
3. Implement a succession planning framework to prepare for expected retirements among senior personnel.
4. Introduce incentives for higher education, including scholarships for degree programs in disaster management, engineering, and public safety.

6.3.2 Upgrading and Maintaining Firefighting Equipment

1. Modernize the fleet by replacing old fire engines and procuring specialized units (aerial ladders, foam tenders, rescue vehicles).
2. Rehabilitate the hydrant network in collaboration with water agencies, ensuring all hydrants are functional, mapped, and monitored.
3. Procure adequate breathing apparatuses, PPE, and communication equipment to meet operational needs.
4. Establish an equipment maintenance unit with a scheduled servicing plan and standardized reporting procedures.

6.3.3 Strengthening Policy Dissemination and Enforcement

1. Institutionalize mandatory policy induction for all new personnel and conduct regular policy orientation workshops.
2. Ensure county fire safety policies are accessible at all stations, both in print and digital formats.
3. Increase staffing and logistical support for inspection teams, enabling routine inspections of commercial, industrial, and residential facilities.
4. Develop enforcement mechanisms free from political interference, including legal frameworks that mandate immediate closure of non-compliant premises.

6.3.4 Enhancing Community Preparedness

1. Conduct county-wide fire safety campaigns targeting schools, markets, factories, and residential estates.
2. Promote community-based fire wardens, especially in informal settlements where fire risk is highest.
3. Expand training programs on first aid, evacuation procedures, and extinguisher use for the public.
4. Establish a county fire safety hotline that is well-publicized and supported by rapid dispatch protocols.

6.3.5 Strengthening Inter-Agency Coordination

1. Enhance collaboration between fire services, police, health services, county planning units, and water agencies.
2. Integrate fire preparedness into urban planning, ensuring that new developments include hydrants, access roads, and built-in fire safety systems.
3. Develop formal mutual aid agreements with neighbouring counties and private fire services for large-scale incidents.

6.4 Suggestions for Further Research

1. An evaluation of public awareness and household-level fire preparedness within informal and high-density settlements in Kiambu County.
2. A comparative analysis of fire incident trends in urban versus peri-urban zones within the county.
3. A cost-benefit analysis of modernizing county fire services, including procurement of technology-based solutions such as GIS, drones, and smart hydrant systems.

6.5 Chapter Summary

This chapter has synthesized the study's major findings, drawn conclusions based on the three objectives, and offered comprehensive recommendations to strengthen fire disaster preparedness in Kiambu County. The findings demonstrate that significant improvements are necessary in staffing, training, equipment, policy enforcement, and community engagement. By addressing these systemic gaps, the county can substantially enhance its resilience to fire emergencies and safeguard lives, property, and economic development.

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Photographic Evidence

Plate 4.1: Kiambu Fire Station Offices

Plate 4.1: *Kiambu Fire Station offices and fire trucks (Author, Field Study, 2020).*

Plate 4.2: Ruiru Fire Station & Fleet

Plate 4.2: *Limuru Fire Station (Author, Field Study, 2020).*

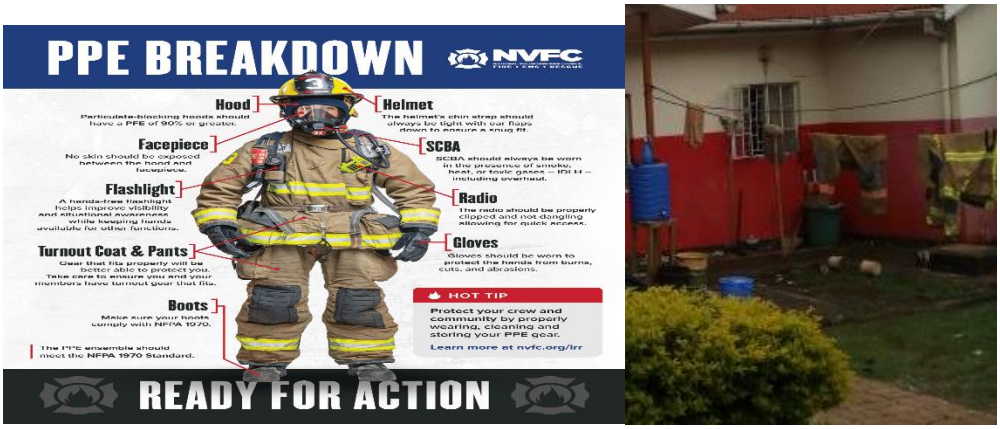


Plate 4.3: *Fireproof clothing and standard firefighter personal protective equipment (PPE) for reference during field study and sample PPEs at the fire stations (Field Study, 2020)*

APPENDICES

APPENDIX I: STUDY BUDGET

	ITEM	UNIT COST	QUANTITY	TOTAL COST
1	**Proposal writing**			
	Printing	700	6	4200
	Binding	300	6	1800
2	**Data collection**			
	Questionnaire printing	120	50	6000
3	Internet	4000	1	4000
4	Research Assistant	2000	2*3days	12,000
5	**Final report**			
	Printing	500	3	1500
	Spiral binding	150	3	450
	Hardcover binding	800	3	2400
6	Miscellaneous	10,000	1	10,000
	Grand Total			**42,350**

APPENDIX II: SCHEDULE OF WORK

Item	Activity	Mar–Dec 2021	2022	2023	2024	Jan–Nov 2025
1	Proposal Writing	✓				
2	Proposal Presentation	✓				
3	Proposal Submission	✓				
4	Proposal Approval	✓				
5	Data Collection	✓				
6	Data Analysis & Report Writing		✓	✓	✓	
7	Report Submission to Supervisors		✓	✓	✓	
8	Mock Defense					**Mar–25**
9	Final Report & Defense					**Nov–25**

APPENDIX III: QUESTIONNAIRE FOR FIRE AND RESCUE PERSONNEL

Title: Evaluation of Fire Disaster Preparedness in Kiambu County Fire and Rescue Services

SECTION A: GENERAL INFORMATION

1. **Name (Optional):** _____
2. **Designation/Position:** _____
3. **Fire Station:** (Tick one)

   ☐ Kiambu ☐ Thika ☐ Ruiru ☐ Limuru ☐ Kikuyu
4. **Years of Experience:** _____
5. **Age:** _____
6. **Highest Level of Education:** (Tick one)

   ☐ No formal education ☐ Primary school

   ☐ High school ☐ Technical/Vocational

   ☐ Diploma ☐ University degree or higher

SECTION B: STAFFING LEVELS AND TRAINING

7. Total number of personnel at your station: _____
8. Average number of staff per shift: _____
9. Number of staff required to operate one fire engine: _____
10. Are current staffing levels adequate? ☐ Yes ☐ No

    If No, estimated shortage: _____
11. Have you received formal training in firefighting? ☐ Yes ☐ No

12. If Yes, indicate type of training received (tick all that apply):

☐ Firefighter I & II

☐ Disaster Management

☐ Certified Fire Inspector (CFI)

☐ Incident Command System (ICS)

☐ Hazardous Materials (HAZMAT)

☐ Urban Search and Rescue (USAR)

☐ First Aid / EMT Training

13. Frequency of refresher training:

☐ Monthly ☐ Quarterly ☐ Annually ☐ Rarely ☐ Never

14. Challenges related to training (tick all that apply):

☐ Limited resources and funding

☐ Inadequate training environments

☐ Weak inter-agency coordination

☐ Limited refresher training

☐ Emerging and complex fire risks

15. Staffing challenges faced (tick all that apply):

☐ Personnel shortages

☐ Burnout and fatigue

☐ Low remuneration

☐ Limited career progression

☐ Aging workforce and lack of succession planning

SECTION C: FIREFIGHTING EQUIPMENT AND INFRASTRUCTURE

16. Average emergency response time:

☐ Less than 5 minutes ☐ 5–10 minutes

☐ 10–15 minutes ☐ More than 15 minutes

17. Factors affecting response time (tick all that apply):

☐ Traffic congestion

☐ Lack of sufficient fire engines

☐ Delayed reporting

☐ Poor road infrastructure

☐ Poor dispatch coordination

18. Does your station have adequate firefighting equipment? ☐ Yes ☐ No

19. If No, indicate what is lacking (tick all that apply):

☐ Personal Protective Equipment (PPE)

☐ Fire suppression equipment (hoses, nozzles, extinguishers)

☐ Rescue and forcible entry tools

☐ Radio/communication equipment

☐ Specialized firefighting equipment (aerial ladders, fire trucks)

20. Rate the maintenance of equipment (1 = very poor, 5 = excellent):

☐ 1 ◇ 2 ◇ 3 ◇ 4 ◇ 5

21. Does your station have adequate infrastructure? ☐ Yes ☐ No

22. If No, indicate major challenges (tick all that apply):

☐ Poor water supply and hydrant systems

☐ Weak communication systems

☐ Lack of maintenance/workshop facilities

☐ Inadequate storage facilities

☐ Inadequate fire station coverage

23. Does the station receive adequate funding? ☐ Yes ☐ No

24. If No, indicate funding gaps:

☐ Procurement of modern equipment

☐ Training and capacity building

☐ Salaries and staff retention

☐ Infrastructure maintenance

25. Is there a systematic record-keeping system for fire incidents? ☐ Yes ☐ No

26. Frequency of post-incident evaluations:

☐ After every major incident ☐ Monthly

☐ Annually ◇ Rarely/Never

SECTION D: FIRE POLICIES AND ENFORCEMENT

27. Are you aware of fire preparedness policies in Kiambu County? ☐ Yes ☐ No

28. If Yes, which policies? (Tick all that apply):

☐ Fire Risk Reduction Regulations

☐ OSHA Fire Safety Rules

☐ National Fire and Rescue Services Policy

☐ Kiambu County Fire Safety Act

☐ Building Code and Fire Safety Requirements

☐ Other (Specify): _____

29. Effectiveness of policies (1 = ineffective, 5 = highly effective):

☐ 1 ◇ 2 ◇ 3 ◇ 4 ◇ 5

30. Challenges to policy enforcement:

    ☐ Low compliance among buildings

    ☐ Insufficient enforcement staff

    ☐ Bureaucracy and weak legal framework

    ☐ Informal settlements and rapid urbanization

    ☐ Poor coordination between county departments

    ☐ Resistance from business owners

31. Are fire safety regulations strictly enforced in Kiambu County?

    ☐ Yes ☐ No

SECTION E: RECOMMENDATIONS

32. What recommendations would you give to improve preparedness? (Tick all that apply):

    ☐ Community fire safety awareness

    ☐ Improved firefighter training

    ☐ Modern equipment and infrastructure

    ☐ Strengthened policy enforcement

    ☐ Enhanced communication and coordination

    ☐ Increased budget allocation

    ☐ Climate-related fire preparedness

Additional Comments:

_____

_____

_____

APPENDIX IV: OBSERVATION CHECKLIST

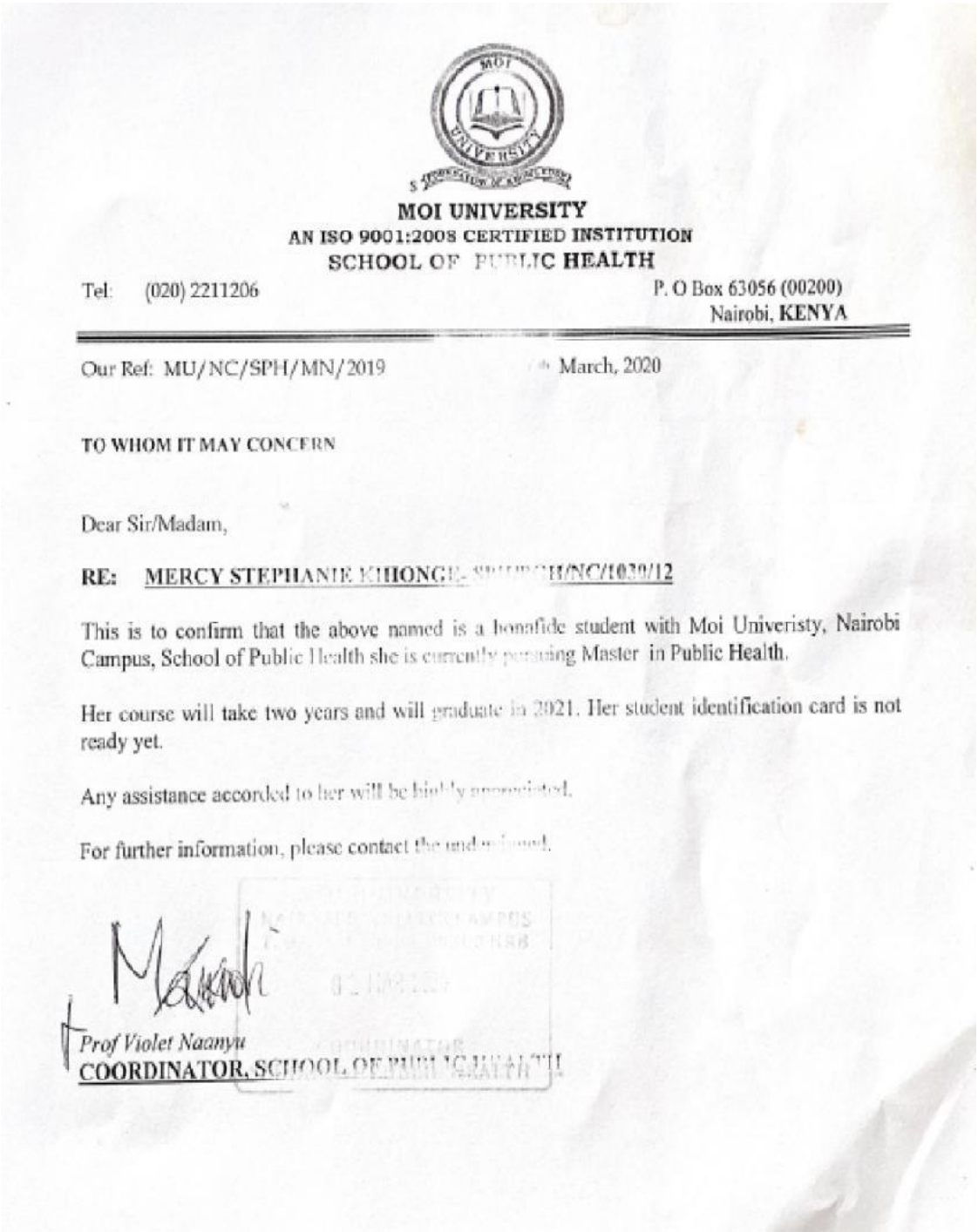
Checklist for Assessing Fire Station Infrastructure and Equipment

Item	Non-functional	Functional	Adequate	Inadequate
Fire station structure	☐	☐	☐	☐
Fire engines	☐	☐	☐	☐
Rapid intervention vehicles	☐	☐	☐	☐
Ambulances	☐	☐	☐	☐
First aid equipment	☐	☐	☐	☐
Hoses and nozzles	☐	☐	☐	☐
Breathing apparatus sets	☐	☐	☐	☐
Rescue tools	☐	☐	☐	☐
Personal Protective Equipment (PPE)	☐	☐	☐	☐
PPE storage	☐	☐	☐	☐
Water storage facilities	☐	☐	☐	☐
Fuel storage facility	☐	☐	☐	☐
Nearby hydrants	☐	☐	☐	☐
Communication centre	☐	☐	☐	☐
Radio systems	☐	☐	☐	☐
Sanitation facilities	☐	☐	☐	☐
Accommodation facilities	☐	☐	☐	☐
Repair and maintenance workshop	☐	☐	☐	☐

APPENDIX V: INTERVIEW GUIDE FOR FIRE CHIEFS AND STATION COMMANDERS

1. How would you describe the current staffing levels in your station?
2. What key challenges affect staffing adequacy and deployment?
3. How do you assess the level of training and skills among your personnel?
4. What gaps exist in refresher and specialized training (ICS, HAZMAT, etc.)?
5. How adequate is the firefighting equipment available in your station?
6. What challenges affect equipment maintenance and replacement cycles?
7. Describe the condition of hydrants, water supply, and infrastructure.
8. How aware are personnel of county and national fire safety policies?
9. What factors hinder effective policy enforcement and building inspections?
10. What improvements are necessary to strengthen fire preparedness in Kiambu County?

APPENDIX VI: INTRODUCTION LETTERS



MOI UNIVERSITY
AN ISO 9001:2008 CERTIFIED INSTITUTION
SCHOOL OF PUBLIC HEALTH

Tel: (020) 2211206

P. O Box 63056 (00200)
Nairobi, **KENYA**

Our Ref: MU/NC/SPH/MN/2019

6th March, 2020

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: MERCY STEPHANIE KIHONGE- SPH/MPH/NC/1039/12

This is to confirm that the above named is a bonafide student with Moi Univeristy, Nairobi Campus, School of Public Health she is currently pursuing Master in Public Health.

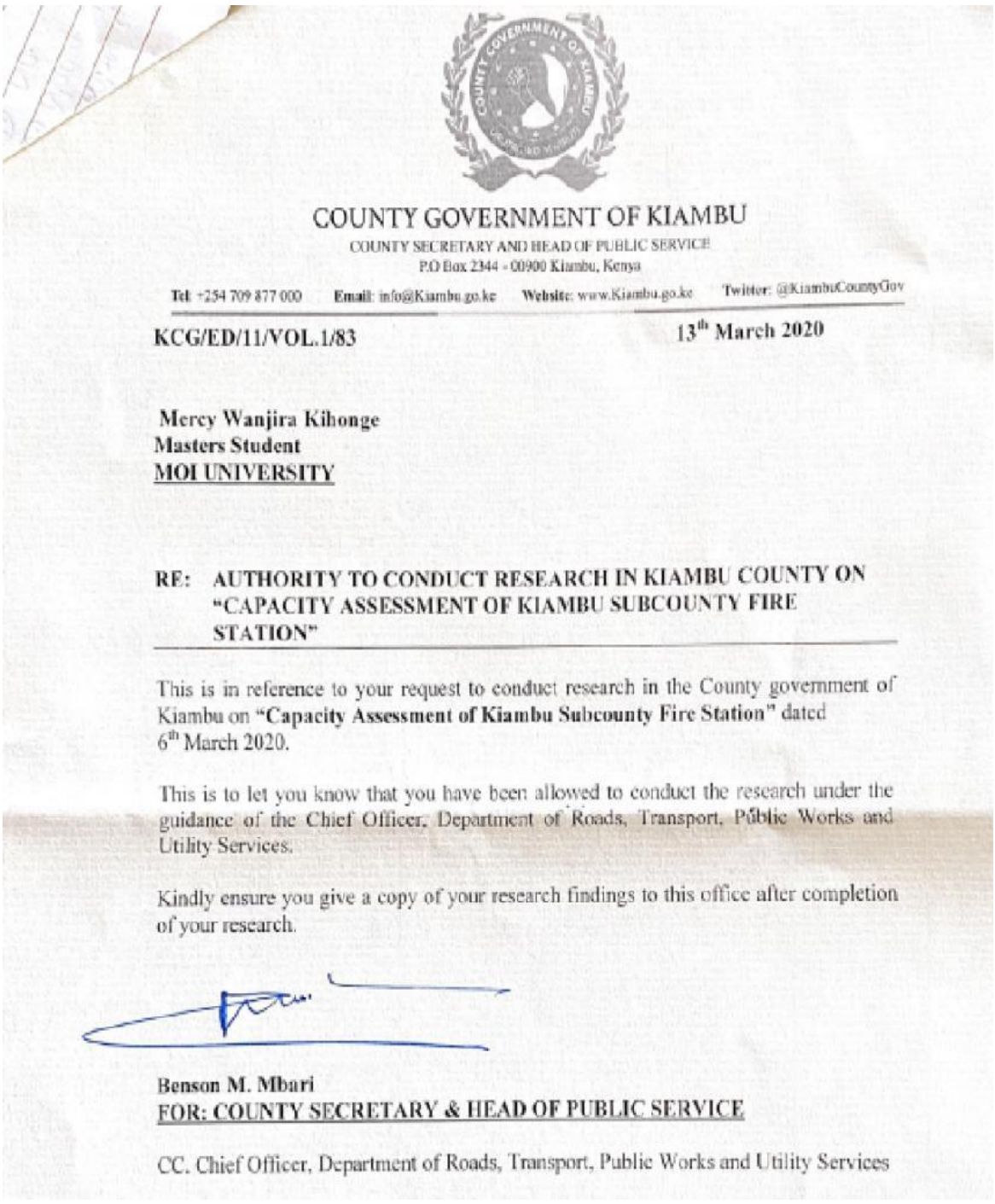
Her course will take two years and will graduate in 2021. Her student identification card is not ready yet.

Any assistance accorded to her will be highly appreciated.

For further information, please contact the undersigned.

Prof Violet Naanyu
COORDINATOR, SCHOOL OF PUBLIC HEALTH

APPENDIX VII:KIAMBU COUNTY APPROVAL



COUNTY GOVERNMENT OF KIAMBU

COUNTY SECRETARY AND HEAD OF PUBLIC SERVICE
P.O Box 2344 - 00900 Kiambu, Kenya

Tel: +254 709 877 000 Email: info@Kiambu.go.ke Website: www.Kiambu.go.ke Twitter: @KiambuCountyGov

KCG/ED/11/VOL.1/83 13th March 2020

Mercy Wanjira Kihonge
Masters Student
MOI UNIVERSITY

RE: AUTHORITY TO CONDUCT RESEARCH IN KIAMBU COUNTY ON "CAPACITY ASSESSMENT OF KIAMBU SUBCOUNTY FIRE STATION"

This is in reference to your request to conduct research in the County government of Kiambu on **"Capacity Assessment of Kiambu Subcounty Fire Station"** dated 6th March 2020.

This is to let you know that you have been allowed to conduct the research under the guidance of the Chief Officer, Department of Roads, Transport, Public Works and Utility Services.

Kindly ensure you give a copy of your research findings to this office after completion of your research.

Benson M. Mbari
FOR: COUNTY SECRETARY & HEAD OF PUBLIC SERVICE

CC. Chief Officer, Department of Roads, Transport, Public Works and Utility Services

APPENDIX VIII: NACOSTI LICENSE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **961286**

Date of Issue: **09/September/2020**

RESEARCH LICENSE

This is to Certify that Ms.. Mercy Stephanie Kihonge of Moi University, has been licensed to conduct research in Kiambu on the topic: FIRE DISASTER PREPAREDNESS-A CAPACITY ASSESSMENT OF KIAMBU COUNTY FIRE RESCUE SERVICES for the period ending : 09/September/2021.

License No: **NACOSTI/P/20/6538**

961286

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX IX: INFORMED CONSENT FORM

MOI UNIVERSITY COLLEGE OF HEALTH SCIENCES / MOI TEACHING AND REFERRAL HOSPITAL
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC) INFORMED CONSENT FORM (ICF)

Study Title: KIAMBU COUNTY'S FIRE AND RESCUE SERVICES' CAPACITY ASSESSMENT RELATING TO FACTORS AFFECTING FIRE DISASTER PREPAREDNESS
Name of Principal Investigator(s): MERCY STEPHANIE WANJIRA KIHONGE

Name of Organization: KIAMBU COUNTY GOVERNMENT DEPARMENT OF FIRE AND RESCUE SERVICES

Informed Consent Form for: FIRE AND RESCUE SERVICES DEPARMENT IN KIAMBU COUNTY

This Informed Consent Form has two parts:

- Information Sheet (to share information about the study with you)
- Certificate of Consent (for signatures if you choose to participate)

You will be given a copy of the signed Informed Consent Form

Part I: Information Sheet
Introduction: You are being invited to participate in a research project. You are given this information to learn more about the study. Please read this form completely. You will have the option to ask questions. You will be provided a copy of this permission form for your records if you want to participate in the study.

Purpose of the study: To evaluate the Kiambu Fire Department's level of preparation, pinpoint any gaps, and offer suitable suggestions for enhancing and improving efficient fire catastrophe preparedness strategies.

Type of Research Project/Intervention: To gather data for the study, self-administered questionnaires with both open-ended and necessary questions will be used. Respondents will be led by the research assistant. The study will also encourage the use of photography, an observation checklist, and an interview schedule for the key informants.

Why have I been identified to Participate in this study? due to the fact that you are employed by the County of Kiambu's Department of Fire and Rescue Services, the study's focus.

How long will the study last? You won't participate in this study for longer than six (6) weeks. During that time, research assistants will present the questionnaire and interview schedule, and they'll conduct follow-up checks to make sure the research fits the criteria for data analysis.

What will happen to me during the study? We need your assistance to better understand the fire disaster readiness of the Kiambu county fire and rescue services. If you agree, you

will be required to complete a questionnaire that is divided into two parts: part A is used to get general information on firefighters, and part B is used to gather data on the research's theme areas, which include evaluating the financial management, physical infrastructure, and legislative capacities. The chief fire officer and the members of the fire department are the subjects of the questionnaire. Key informants, such as the financial/human resources and physical planners, are required to respond to the interview schedule. The research assistant will conduct the one-on-one interview.

What side effects or risks I can expect from being in the study? There won't be any trials in the study; instead, it will just include gathering data, so there won't likely be any negative side effects.

Are there benefits to taking part in the study? This study may be useful to you if it allows you to share your opinions on solutions to problems that could arise while performing your tasks.

Reimbursements: There will be no payment of any kind; participation is voluntary.
Who do I call if I have questions about the study? In case of any questions, please contact me: Mercy Kihonge 0724178978.
You may contact Institutional Review Ethics Committee (IREC) 053 33471 Ext.3008. IREC is a group of people that reviews studies for safety and to protect the rights of study subjects.
Will the information I provide be kept private? All reasonable efforts will be made to keep your protected information (private and confidential. Protected information that is, or has been, collected or maintained and can be linked back to you. Using or sharing ("disclosure") of such information must follow National privacy guidelines. By signing the consent document for this study, you are giving permission ("authorization") for the uses and disclosures of your personal information

Part II: Consent of Subject:

I have read or have had read to me the description of the research study. The investigator or his/her representative has explained the study to me and has answered all of the questions I have at this time. I have been told of the potential risks, discomforts and side effects as well as the possible benefits (if any) of the study. I freely volunteer to take part in this study.

_____	_____	_____
Name of person Obtaining Consent	Signature of person	Date
Printed name of Investigator	Signature of Investigator	Date