BUILDING DISASTER RESILIENT SCHOOLS: A CASE OF FIRE MITIGATION IN SECONDARY SCHOOLS IN MACHAKOS COUNTY, KENYA

MUISYO MOSES ULANGA

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DEPARTMENT OF GEOGRAPHY AND ENVIRONMNTAL STUDIES

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DECLARATION

This project is my own original work and has not been presented for an award at any other institution.

Signed…………………………………

Date……………………………………..

MOSES ULANGA MUISYO

C50/80434/2015

This project has been submitted for examination with our approval as university supervisors.

Dr. Omoke Kennedy Japhan
Department of Geography and Environmental Studies
University of Nairobi

Signed………………………………….

Date……………………………………

Dr. Martin Marani
Department of Geography and Environmental Studies
University of Nairobi

Signed………………………………….

Date……………………………………

DEDICATION

I dedicate this work to Mr. Boniface Muisyo and Mrs. Theresia Muisyo for being part of my education journey.

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ABSTRACT

Safe schools, quality of education and training services are major concerns in Kenya's Vision 2030 development blueprint. This study aimed at assessing of the fire mitigation programs in secondary schools in Machakos County. The study had three specific objectives: (i) To determine fire mitigation measures implemented in secondary schools in Machakos County, Kenya; (ii) To assess the adequacy of fire mitigation actions in secondary schools in Machakos County, Kenya, and; (iii) To find out challenges and opportunities of fire mitigation practices in secondary schools in Machakos County, Kenya. The study collected data from a simple random sample of 173 teachers selected from a systematic random sample of 11 schools that had previously experienced fire disasters using a semi-structured questionnaire, and 81 key informants selected from among school principals, dormitory masters and matrons, school security personnel, building professionals, firemen, education officials, BOM Officials, PTA Officials and student leaders informant interview schedule. The study used an observation schedule to capture data on the extent to which schools had implemented mitigations actions. Collected data were entered into SPSS version 24 and quantitative data analysis done to generate both descriptive and inferential statistics relevant to the study objectives. The study findings show that schools implemented fire mitigations to different degrees, a wide range of fire mitigation measures including installation of fire equipment and use of sound engineering measures in buildings. Key informant interview data showed that none of the sample schools had, at the time of the study, fully conformed to the government requirements (see appendix VI) on fire mitigation. Further, the study revealed that challenges such as poor financial funding and inadequate training on fire emergencies greatly hinder efforts to build fire resilient schools. However, during KII sessions, the study noted that the schools could mobilize more financial resources towards mitigation through consultations with stakeholders. The study concluded that though all the sample schools had implemented a raft of fire mitigation measures, these mitigation measures were still largely inadequate and hence the need for improvement. The study recommended that fire resilient schools in Machakos County may only become a reality with the requisite support of stakeholders.

LIST OF ABBREVIATIONS AND ACRONYMS

BOM   Board of Management

BORAQs   Board of Registration of Architects and Quantity Surveyors Kenya

EBK   Engineers Board of Kenya

FFE   Fire Fighting Equipment

FFF   Fire Fighting Facilities

GoK   Government of Kenya

ICFI   International Committee of the Fourth International

ILO   International Labour Organization

MEST   Ministry of Education Science and Technology

MoE   Ministry of Education

NCST   National Council of Science and Technology

PMT   Protection Motivation Theory

PTA   Parent Teacher Association

SPSSS   Statistical Package of Social Sciences Software

SSS   Specific School Stakeholders

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CHAPTER ONE: INTRODUCTION

1.1 Background

Disasters are a great concern to public safety all over the world (European Commission, 2010). The threat posed by fire disaster is always present therefore, it is crucial for people to be aware on how to appropriately respond to reduce life loss, casualties and loss of property (Mondiale, 2013). Education facilities should have disaster preparedness procedures to help learners to safety. Makhanu (2009) in his study stated that, fire disaster in schools is one of the most recurring catastrophes in education facilities in Kenya. School fire disaster results to a thoughtful distraction of the institutions capability to operate adequately since it causes extensive human, property, economic or even environmental losses which exceed the ability of the affected leaning facilities to cope up with using their available resources. Secondary schools fire disasters are on the increase and have caused death of very many innocent students and destruction of property (KNAP, 2010).

According to OLA, (2014), the most notable global school fires were the; 2000 Vitupo school fire in Tuvalu with 18 deaths; 2001 Central school fire in China school with 41 deaths and 2002 Mecca school fire in Saudi Arabia with 15 deaths. Other significant fires in schools include; 2004 Kyanguli Memorial Secondary School in Machakos County fire disaster which resulted to 68 deaths; 2004 Kumbakonam school fire in Tamil Nadu in India with 94 deaths and the 2004 Beslan school fire in Russia with 334 deaths.

Pasipamire, (2011) argued that the techniques in training designers and constructors the practicalities of disaster resistance in building are the well-known mitigation actions available to disaster planners. Carolina, (2014), argued that fire safety in buildings is deemed to cover the aspects of fire prevention, firefighting and smothering techniques, and fire rescue actions. Fire safety facets include inert fire avoidance techniques and active fire avoidance techniques. It is generally understood that passive fire prevention means are a must i.e. mandatory and obligatory while active fire prevention means may be adopted as a bonus. The higher the adoption rate of the latter measures the better for the owner or user of the concerned building. Passive fire prevention/protection means

are those which are taken care of during the design stage of a building and do not need any energy consumption thereafter, which this study does not intend to evaluate.

Secondary learning centers are vulnerable to high cases of fire due to negligence, defective electrical installation and even torching (KRCS, 2008). In 2008 KRCS noted inadequate training actions for example fire response exercises, wrong fire management equipment, insufficient funding, inadequate systematic disaster mitigation action and response actions is what has made secondary schools prone to disasters (GOK, 2008). (USFADC, 2007), observed that fire emergency evacuation procedures are the leading paying contributing factors in enhancing leaning facilities safety.

Despite opportunities in Kenya policies and legislations to confront school fire disasters, a situation review from the 2011 draft Fire Safety Management Policy of Kenya, (FSMPOK) (GoK, 2011) indicated that inadequacies in the regulations and legislation, poor enforcement strategies, low public awareness on the FSMPOK, deficient early warnings for fire, insufficient skilled fire management personnel and shortage in the normalization of fire management gears greatly undermined fire mitigation efforts in the country (James, 2013). The 2011 FSMPOK was a national policy response to address these challenges and in particular would, promote in making availability of requisite institutional structures and capacities that prevent and mitigate fire risks; strengthen fire search and rescue services, and provide harmonize primary and secondary fire policies in Kenya (GoK, 2011).

This study focuses on mitigation of fire disasters especially in the secondary learning facilities sub-sector; in the wake of growing frequency, severity and magnitude of fire disasters schools in the country (Shibutse & Omuterema, 2014). This study main argument is that although most fire disasters across the globe are anthropogenic (Dynes and Russell, 2002) Kenya's fire disasters are not different (Mutugi &Maingi, 2011). Henceforth, the research assesses the adequacy of fire mitigation actions at secondary learning in Machakos.

1.2 Statement of the Research Problem

Fires in learning institutions have become a public threat due to the increased occurrences, harms and death of students as well as massive damages of material goods. In absence of sound fire mitigation strategies, learning institutions will continue to have an increased number of death toll, loss property and valuable time is wasted in doing reconstruction. Between 2007 and 2016, there were 317 schools in Kenya that experienced fire disasters and 99% of them were public schools (GoK, 2001; Daily Nation, 27th July 2016). According to Cooper (2014), there were about 120 public school fires across the country in 2016, 34 in 2013, 28 in 2012, 14 in 2011 and 20 in 2008. According to (NCRC, 2016) over 130 secondary school's infrastructures, including dormitories were destroyed by fires between May 2016 and August 2016 with most events happening in public schools.

The vulnerability of fire in Kenya schools is inclined to managerial structure of the leaning facilities because they don't have caution sign, calamity awareness procedures, fire emergency evacuation procedures and first Aid toolboxes. The structure design also increase fatalities in case of fire since, most schools dormitories only have one opening which serves as entrance and an exit. There is need to have training sessions to create awareness on learners on safety procedures, what to do in case a tragedy occurs and the planning to lessen the degree of happening of a fire tragedy. Staff members should be provided with a print of concise written guidelines to adhere to and use in case of a tragedy. Designated person is held accountable in larger educational institutes, to plan and teach employees on how to react in case of fire incidence. Fire safety policy guidelines provide that fire drill are critical therefore, schools should carry out them two times in a semester. The danger of fire occurrence is always present, and proper reaction on the danger is very vital to reduce deaths and injuries and damage of property. This is highly important for learning in the schooling institutions in order to ensure safety to them (Mondiale, 2013). Makhanu (2009), articulate that fire is one of the frequent disasters in Kenya educational centers. It is in this light that the research assess the adequacy of fire mitigation programs in secondary schools in Machakos County, Kenya

1.3 Objectives of the study

1.3.1 Specific Objectives

  i. To determine fire mitigation measures implemented in secondary schools in Machakos County, Kenya
 ii. To assess the adequacy of fire mitigation actions in secondary schools in Machakos County, Kenya
iii. To find out the challenges and opportunities of fire mitigation practices in secondary schools in Machakos County, Kenya

1.4 Research Questions

  i. What fire mitigation measures are implemented in secondary schools in Machakos County, Kenya?
 ii. Are fire mitigation actions adequately implemented in secondary schools in Machakos County, Kenya?
iii. Are there challenges and opportunities of fire mitigation practices implemented in secondary schools in Machakos County, Kenya?

1.5 Hypotheses

$H_0 1$: There is no significant difference between fire mitigation measures implemented and fire mitigation strategies in secondary schools in Machakos County, Kenya.

$H_0 2$: There is no association between adequacy of fire mitigation actions implemented and fire mitigation strategies in secondary schools in Machakos County, Kenya.

1.6 Justification and Significance of the study

Escalation of disastrous events world over has attracted an increased focus on the issues of fire disaster in learning institutions. Today, many economies in the world are spending a significant percentage of their budgetary allocation to mitigate and prepare for fire disasters affecting their countries, in order to minimize losses arising from such

events. This is in due recognition of the fact that there is no sustainable development, in the absence of appropriate disaster preparedness programs.

In the world of fire disasters in learning facilities, countries especially in the developed world have shown a marked increase in fiscal allocation to target control and prevent injuries associated with fire disasters. Scholar works by Mugiti (2012), Gichuru (2013) and Mwangi (2009) shows that learning institutions have not adequately put mitigation actions to avert or reduce fire disasters. The three studies indicate that there is inadequacy of firefighting equipment, school community not educated on fire calamity lessening and some of the institutions buildings had not adhered to physical infrastructure policies. Merely a small number of learning institutions have fire quenching cylinders in the buildings and a big number of them are not examined regularly as per the policies requirement. Therefore, this study investigated the school's mitigation measures implemented by Machakos secondary schools.

The government has put some efforts towards disaster management in this country, though a lot more is still required to be done. Students will need to be safe, operations to run persistent as well as the MOE and secondary schools' administrations to improve on their fire safety in learning institutions. The causes of these fires are also as complex and mysterious, as the effects they tag along. Information about the frequent fire disasters has been reaching every school through various means. Multiple losses lead to a state of helplessness to the survivors. This is a state of affairs into which the students many not wish to find themselves, not forgetting that they are in in school for one goal, gaining knowledge. There no scholar works in the study area which was researched to assess the adequacy of fire mitigation programs; challenges and opportunities and the mitigation measures taken to reduce associated risks and vulnerabilities.

The findings of this research are important to other researchers and scholars interested in learning more about fire mitigation in Kenyan schools. It will enable them to advance their knowledge in this arena even though they may not have the intention of applying it to existing problems.

1.7 Operational Definitions

Disaster: Refers to anything out of the ordinary incident or event in school that may cause damage to property, injury or death of someone.

Formulation: Refers to the process of planning and setting up rules, policies and guidelines for fire management.

Hazards: Potential events that have the capacity to cause harm to people and the environment.

Implementation: Refers to the process of practically putting into work, actions directed by already accepted standards.

Mitigation: Refers to the actions directed against the occurrence of fire to reduce the severity and impact when they occur.

Preparedness: Actions taken to be ready for the likelihood of an out of the ordinary event occurrence.

Prevention: Refers to measures put in-place to lessen or stop the occurrence of fire.

Principal: Refers to a school staff tasked with the overall administrative responsibilities in a secondary school.

Resilience: Refers to the ability to cope and smoothly recover from an out of the ordinary event.

Risk: Refers to the possibility of an out of the ordinary event occurrence which results to loss and hurt.

School: Refers to the registered secondary level education institutions designed for teaching students in Kenya

School safety: Refers to recommended fire management measures, formulated by relevant authority (ies) for school fire mitigation.

Vulnerability: A situation that reduces the capacity of people to respond when an out of the ordinary event occurs

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The chapter specifically focuses on mitigation procedures implemented, mitigation, adequacy of fire mitigation actions, opportunities and challenges for school fire mitigation practices in secondary schools, regulations and Acts regarding fire emergencies, fire safety plans of the school and whether schools train teachers, workers and students on appropriate responses to fire disasters

2.2 Historical Framework of School Fire Mitigation

Disasters cause significant damage to humanity through its environmental, social, and economic impact. Subsequently, the need for making of and putting into practice of disaster risk reduction policies and measures respectively (ISDR, 2002; Ginige, et.al., 2009). The concept of reducing disaster risk involves minimizing hazards and reducing vulnerability. This means improving the ability to prevent and mitigate hazards. (Ariyabandu and Wickramasinghe, 2003). Hazards are independent and maybe unavoidable, while vulnerability is dependent and a function of the level of susceptibility, risk and resilience (McEntire, 2001). Thus disaster mitigation in this context is a function of reducing susceptibility risk and increasing resilience.

Infrastructural problems in schools increase the school's vulnerability to fire. This includes construction systems and school blocks arrangements and its overwhelming capacity. Also, emergency management issues is an element in school funding, poor network with other organizations and deficient capacity to respond, make fire mitigation problematic (Gulyani and Bassett, 2007). Flammability of substances within the school premises, electric malfunctions are other unavoidable but reducible factors (USAID, 2004).

Disaster risk reduction is a globally coined and accepted concept of reducing vulnerability to disasters in the society to prevent and limit the effects of hazards (ISDR, 2004). Minimising vulnerability to fire through preparedness is a proactive approach to fire mitigation (ISDR, 1994; Sahni and Ariyabandu, 2003). Thus, reducing fire risks involves a multi-sectoral approach that factors the elements of development,

sustainable and implementable policies, targeted and guided investment programmes at the local and national level (Goodyear, 2003).

Reducing fire disasters involves advance measures to reduce risks, protect the environment, and ensured socio-economic and financial protection in order to reduce hazards and ease recovery (ISDR, 2002). To ensure the continued functioning of the society, fire disasters must be managed and this involves reducing the risks and vulnerability (Stanchion, 1997). The structuring of the society or societal systems can positively or negatively influence fire disaster vulnerability (McEntire, 2004). Thus, it is important to address social, economic and institutional issues of the society in a bid to increase the capacity to manage disaster risk (DfID, 2005; ISDR, 2005; Pelling and Holloway, 2006).

2.3 Role of School Fire Mitigation in Building Resilient Communities

Resilience is the capacity to endure, acclimatize, and recover from the crisis (UN-HABITAT, 2007a; Winser, 2006). Priorities on the energy and strength, skillful actions taken to survive disaster and effectiveness to utilize the limited resources in post-disaster are critical to resilience (Wisner, 2006). Thus, policies strengthening the capacities of disaster affected people or a person likely to be affected by disaster is important to building resilient communities (Spaliviero, 2006).

Indigenous knowledge, communication and skills at the local community action level holds significance for the local people to survive a disaster. Thus, the capability of disaster victims is important (Villacis and Cardona, 2004). Disasters worsen the existing social and economic status, and level of educational advancement in case of fire in schools; thus, having a potential to slow development and increase suffering (Bruneau et al, 2003). This applies to decrease in the learning process in post-fire disasters in schools.

Disaster mitigation is the continuing act to reduce disaster impact on the destruction of properties and people (McMillan, 1998). The response to the disaster has changed overtime from providing relief materials and aids to disaster preparedness and mitigation. Considering that some disasters are unpreventable due to unavoidable hazards, mitigation of vulnerability becomes important as the best strategy to reduce the effect of disaster and enhance coping and recovery strategy (GoI, 2009). Mitigation

actions help to alleviate or decrease the disaster impact. Such actions consist of but boundless to land use, formulation and implementation of building codes concerning hazard risks, public awareness and education on disasters reduction, assessment and analysis of hazards and vulnerability (Government of India, 2012).

According to Morales (2002), disaster mitigation can be categorized into physical and non-physical mitigation. The former is a capital investment on physical constructions which are inclusive of hazard resistant construction and engineering measures while the latter constitutes elements of development capacity and restrictions, awareness and education, legal and policy framework. The Indian Disaster Management agrees that both categories encompass legal and regulatory approaches, economic and environmental measures, and engineering and socio-economic undertakings to reduce hazard risks (Government of India, 2013)

Therefore, fire disaster mitigation is mechanisms engineered to enhance knowledge about fire hazards and reduce fire vulnerability, achievable by planning and preparing for disaster and post-disaster actions using science and engineering.

2.4 School Fire Mitigation Measures and Actions

Mitigation actions in schools involve efforts directed towards engineering and spatial planning, economic and institutional management, societal and conflict reduction in school areas. A study by Eric (2001), pointed that school fire mitigation takes into consideration the followings practices: good structural designs, considerable and maximizable use of school space, student welfare, impartial and reliable disciplinary measures, students' integration, students' multicultural sensitivity anger, counseling and emotional management.

The UN in 2010, piloted a global campaign that calls for the well-being and security of 1 million schools and hospitals. The campaign stressed the mitigation of disasters in schools through mobilization of resources and awareness (United Nations, 2010). One of the most famous reactionary fire prevention practices were recorded in Italy (Brannigan & Carter, 1998). But over the years, countries around the world have proactively developed fire mitigation approaches that put school fire safety and response into consideration.

In the US, State Department of Health, 2003 acknowledged the creation of Health and Safety Advisory Committee with the aim to advance disaster mitigation policies and practices in schools. The U.K, through the 2005 Regulatory Reform of 2005, the State witnessed the legislative rationalization of fire mitigation in 2006. The reform outlined the responsibilities and roles in the management of fire within organizations (Furness & Muckett, 2007). In the Netherlands, disaster mitigation in schools is emphasized through improved incidence response within school premises and capacity building (Soomeren, 2002).

The Ministry of Education in Trinidad and Tobago made provisions for an enabling learning environment for school pupils, student and teachers across the nation through the Education Act. The Act empowered school principals to supervise the personal safety of students and school personnel and coordinate the school management in ensuring an annual review of the emergency disaster procedures which includes fire incidences (MOE Trinidad and Tobago, 2005). After the Kumbhakonam fire tragedy in 2004 in India, Many States governments notably the Haryana state government began school fire programs and policies. Those policies ensured the compulsory right of children to safe and quality education within the school premises (Haryana Government Education Department, n.d).

In Tanzania, the MOE through Secondary Development Programme II (SEDEP II) 2010-2014, made provisions for disaster safe secondary schools. The program stressed fire mitigation actions through improved infrastructural standards and reduction of overcrowding in school hostels and classrooms with the intention of reducing effects and significances of a school fire (The United Republic of Tanzania, 2010).

White (2011), the fire safety systems should include emergency strategies providing the actions and steps to be utilized to act in circumstances of disasters such as fire, extremism and chaos. Students' wellbeing is very crucial in schools since it offers guardians and school stakeholders' faith that the learners welfare and security is in schools is good. Nakitto et.al., (2012) observed that majority number of learning centers in Uganda didn't have safety procedures. This resulted to recommendations by the MOE to lay down safety strategies. In his study, Ndiang'ui (2006) discovered vulnerability of institutes in Kenya to fires was susceptible by managerial framework of majority of the institutions. The institutions failed to have; cautioning signs, disaster

preparedness programs, fire evacuation preparedness plans and first aid gears. The study made suggestions on the need to draw safety guidelines to avert any threats and to deal with catastrophes.

In 2001, the MoE of Kenya issued the No. G9/1/169 school safety Circular in pursuant of disaster mitigation in schools. The Circular outlined that: there should be two fire drills every year in schools; dormitories and specials rooms should have emergency doors; there should be no grilles in dormitory's windows and should open outwards; door should be double and open outwards; there should be provision of firefighting equipment; classrooms should be constructed away from the direction where laboratories are located, while kitchens and play fields with their longer sides to run in an east to west direction. In 2008 the MoE launched the School Safety Standards Manual which outlined fires related mitigations in its call for the safe physical infrastructures and buildings, school environment and disaster risk reductions in school.

The MoE of Kenya, in 2012, formulated the MOE Directorate of Quality Assurance & Standards Ref No MOE HQS/3/13/2 which in part 8, stressed fire safety standards (Ministry of Education, 2012). The 2013 Basic Education Act Ref No. 14 calls for pre-primary education institutions to have a Management Committee tasked to guarantee the provision of physical, mental and social safety of children as part of an effort to enhance societal development and conflict reduction. The call further stressed the creation of Board of Management (BOM) tasked to ensure the rights, welfare and safety of pupils teaching and administrative staff (The Republic of Kenya, 2013).

2.4.1 Engineering and Spatial Planning

According to Watts (2006), in order to enhance fire mitigation, the design and construction of buildings and the environment must put-into consideration a significant action to: minimize the risk to fire occurrence through use of non-combustible building materials and ensured building spacing; delay spread of fire flames through creation of fire tight compartments and thick concrete walls; provide adequate escape routes through provision of short distance escape routes, corridors and open stair cases; fire defense system that provides detection, warning, immediate firefighting techniques/materials and distress call access; and access of fire brigade team to the building through provision of unobstructed open space. The Ministry for Local

Government, in 1968 captured the study by Watts in section 17 and 18 of 1968 Kenya Building Code.

In planning for fire mitigation, a study by Grimaldi and Simonds (2001) outlined that there should be: clear and detailed records of the buildings and grounds plan comprising of the installations; knowledge of the location of firefighting equipment, water supply, hydrants and standpipes; plans of, storage of, and alternatives to the public, private and natural water sources; knowledge on the use, limitation and maintenance of first responder firefighting equipment; coordination and networking between facility manager and fire department; and knowledge about human resource and users of facilities and services provided in order to have a non-overwhelming or over-capacitated situation.

Hackett and Robbins (2010) outlined the following survival skills during fire incidents: smoke proofing which is blocking any smoke leaking into the hiding room preferably using wet clothing; personal conduct which involves calmness, panic prevention and strategic thinking to finding a way out; and blaze proofing which involves sensing, with feeling senses, and moving closer towards cool areas and avoiding hot areas.

2.4.2 Economic and Institutional Management

White (2011) identified that in order to increase fire mitigation readiness level; there is a need for enhanced strategies. According to GoI-UNDP (2008), the Indian government have made efforts to ensure that schools in India have adopted measures that include: education of the school community on awareness to critical incident risks; sensitization on precautionary measures and how to prevent those risks, training of the student and teachers on the required skills to handle critical incidents; and regular exercises and drills to update and review the management practices.

This preposition was put into consideration in the Kenya MoE 2008 guideline for schools and expounded that school needs to organize, plan and implement measures that ensure the wellbeing of students in the school environment. Thus, all schools in Kenya need to form a team tasked with the specific responsibility to: review action to address the protection needs of the school; mobilize resources to protect the staff and students in the school environment; establish networks to protect the school; engage

relevant stakeholders; create safety awareness policies and guidelines to protect the school; and continually review such programs.

According to Nyakundi, (2012), before 2006 as fire incidence continues to increase and as part of economic efforts to fire mitigation, the GoK gave about 810 million Ksh to School through the Ministry of Education to facilitate the procurement of firefighting equipment. The fund was disbursed specifically to 717 provincial boarding schools. However, property insurance in schools as part of the broader economic investment on mitigation is still underutilized.

A study by Otieno (2010) highlighted that to institutionalize fire mitigation in the education sector, the Kenya National Fire Brigade Association called for the introduction of fire education in schools curriculum to reduce fire injuries and manage fire incidence through the creation of awareness.

2.4.3 Social development and conflict reduction

Dwyer *et al*., (2000), stated that the school management body needs to have strong leadership, design guidelines for fire mitigation programs, and train staffs to implement those programs. According to Walker et al (2004), poor management and protection precipitate indistinct student behaviour, students' and administrative' ineffectiveness and violent incidents. Such violent behaviour may lead to violent incidents like fire which not only destroys life and property but additionally stall the performance of students.

Sadker *et al*., (2000) stated that a wide variety of measures need to be in place to holistically address encompassing mitigation measures, and such measures will enhance social network among members of the community and reduce anger and pressure that can lead to violent acts.

The Kenya MoE (2008) under its measures for the wellbeing and protection of students calls on school-based stakeholders, parents and learners to ensure the minimization of the risks to disasters which can result to death, injury and property destruction. This is to insure that the students in school environments have access to disaster safe learning environment.

2.5 Challenges and Opportunities to School Fire Mitigation Targeting

The challenges to school fire include but not limited to policy, legal, institutional, socio-cultural and administrative barriers.

2.5.1 Policy and legal barriers

Okumbe (2001) and MoE (2008) outlined that, the disaster mitigation measures need to be continually reviewed for effectiveness. Omolo et *al.,* (2010) discovered that inadequate funding is the major hindrance to the implementation of school fire mitigation policies and practice as he observed in Kisumu County. Also, Kirui, Mbugwa & Sang (2011) noted that the underfunding in schools limits an adequate putting into practice of fire mitigation values in learning facilities.

2.5.2 Institutional and administrative barriers

According to US Department of Education (2004), the steps towards school incident management planning involves firstly, conducting an assessment for the school environment, the formation of the incident management team, formulation of approaches and implementation of violent prevention strategies. Furthermore, Cornacchia et al in his study in 1984 stated that schools need to put into the account, stepwise procedures to the measures on how to avoid and cope with critical incidents. The US report on crime and safety showed that 90% of schools within 1996/1997 had zero tolerance policies for fire (US Department of Education, 2004)

In New Zealand, sprinkler systems are of national priority for infrastructural protections against fire. However, those systems of fire protection are often giving less priority in organizations since the maintenance of such system is ignorantly considered expensive while factually not considering the benefit of such system in fire mitigation (Carter, 1999). A study conducted by Hall in the US discovered that sprinklers reduce the average loss from fire by 67%. A study by Shelton, Owens, & Song (2009) discovered that ninety-five percent of schools have fire alarms, eighty-six percent installed fire extinguishers and fifty-four percent installed fire sprinklers.

In Tanzania, Kahwa (2009) called for capacity building and enforcement of fire mitigation standards in schools. He found that few (11.7%) schools had undergone fire

safety inspection and no school had been certified by the appropriate authority as fire safe school. Nakitto and Lett in 2012 found that 84 % of schools in Uganda had no fire mitigation strategy or plans.

A study by Nakitto and Lett (2012) revealed that eighty-four percent of facilities had no active fire mitigation plans and that a high number of institutions in Uganda are not sound equipped to respond and cope with fires. The study calls for the formulation of school fire mitigation policies by the MOE, and the adherence to such guidelines by the school management (Nakitto & Lett, 2012). In Kenya, Rugut in 2003 and Nderitu in 2009 discovered that the standards in the implementation of fire mitigation were in shortfall due to ineffective implementation and inspection officers from the MoE. Wanaina (2012) calls for adequate planning to enhance fire mitigation in schools since those practices are absent.

Rono *et al*., (2009) found that teacher and school administrative staffs in Turkana have never participated in fire drills and exercise; and most of those staffs have not undergone any skilled training on how to mitigate critical incidents. These situations are not uncommon in Kenya's public secondary schools as Nderitu (2009) pointed out that in Kiambu County, most school principals have not organized any fire drills or exercise in their schools; and only small number of principals are knowledgeable on fire drills and fire management skills. In Kisumu, Omolo and Simatwa (2010) noted that just a sizeable number of institutions have fire extinguishers and majority of the schools were overcrowded.

A study by Makhanu (2009) in Kenya, stated that most learning institutions lack fire response team or department, and the those that have teams in-place are not properly trained in firefighting and response. He also noted that school buildings are not adequately equipped with firefighting equipment.

Training on fire safety enhances knowledge on accuracy to fire respond which reduces the level of causalities (Huseyin & Satyen, 2006). In Kenya, Nderitu (2009), Gichuru (2013), and Onderi & Makori (2013) pointed out that there is minimal training done in learning facilities and thus, a compromise to fire mitigation in schools.

2.5.3 Socio-cultural barriers

However, Crooks et al., in 2008 noted that sustaining fire mitigation principles have always been a challenge due to no commitment, lack of enthusiasm, and substandard leadership on the part of the administrative unit and school staff. As noted by Fullan (1991) and Furlong *et al.*, (2006), the failure to implement policy is factored by commitment, willingness, readiness, and attitude of school staff. Additionally, Luneburg in 2006 stated that continuous awareness measures increase the motivation to sustained incident management practices, and such measures should be implemented at the institution senior management level, staff, student and parent level. In addition, the involvement of the education interested party such as MOE, school administration and the local county is very vital. The Red Cross (2001) noted that the predominant challenge to addressing school fires is high indiscipline among the students. Deliberate fires are intentionally caused fires. Nderitu (2009) stated that secondary school fires in Kenya are usually caused by students protesting their discontent with the school administration, non-implementation and non-compliance with the school fire mitigation policies.

2.6 Theoretical framework

2.6.1 The Protection Motivation Theory

PMT is a model from wellbeing behaviour adjustment model. PMT explicitly outline how people or an individual is able to implement defensive processes as an approach to cope and recover from an extraordinary event (Rogers, 1983). PMT explains the possible distresses which are resultant poorly implemented actions that increase vulnerability and disaster risks (Perloff & Bay, 1991).

PMT outlines that the resolute to protect oneself from harm is factored firstly *by the threat* which includes the likelihood of severity and vulnerability; and secondly *by coping ability* which includes perceived efficacy and self-efficacy. In application to this study, the threat is the perceived severity of fire hazards and the likelihood of fire occurring; while the coping abilities are fire mitigation measures available and the school's ability to successfully enact those measures.

PMT asserts that such intent to protect oneself are met with efforts based on the available cost to reduce the hazard risk and the potential benefit from reducing the risk

(Pechmann, 2003). The theory was adopted in the study since for schools to mitigate fire disasters, the school must have knowledge about school fire risks, and act through mitigation plans to reduce fire disaster impact, enhance coping mechanism and recovery strategies. Nevertheless, financial and institutional capacity gaps create a limitation on the seriousness of effort by schools to mitigate fire hence resulting to higher vulnerability and low level of preparedness against school fire.

2.7 Conceptual Framework

The conceptual framework in Figure 2.1 depicts the interrelationship between school based factors (independent variables) and fire mitigation (dependent variable). The conceptual framework demonstrates that fire mitigations in Machakos County are influenced by a sub-set of 3 independent variables which included: Mitigation Measures implemented Adequacy of mitigation actions and Challenges and Opportunities which schools are experiencing. Some of the selected indicators for interdependent variable included; frequency of fire incidences, Implementation of evacuation plan, Installed Firefighting equipment, Building Engineering aspects, Adequate First Aid Training, Funding and Institutional and policy coordination. Some of the dependent variable indicators included; low levels of vulnerability to fire hazards, High level fire preparedness, awareness, response and coping strategies and Safe learning environment. The research used the independent variables to determine their effects on the Fire Mitigation on public schools in Machakos County, Kenya.

Independent variable   **dependent variable**

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┌─────────────────────────────┐
│ Mitigation Measures         │
│ implemented                 │
│                             │
│   ✓ Frequency of fire       │
│     incidences              │
│   ✓ Implementation of       │
│     evacuation  plan        │
│   ✓ Installed Firefighting  │
│     equipment               │
│   ✓ Fire awareness,         │
│     trainings, drills and   │
│     exercise                │
└─────────────────────────────┘                    ┌──────────────────────────────┐
                                                    │ **Fire Mitigation**          │
┌─────────────────────────────┐                     │                              │
│ Adequacy of mitigation      │                     │   ✓ Low levels of            │
│ actions                     │                     │     vulnerability to fire    │
│                             │                     │     hazards                  │
│   ✓ Building Engineering    │────────────────────▶│   ✓ Reduced fire impact and  │
│     aspects                 │                     │     damages with less        │
│   ✓ Adequate First Aid      │                     │     injuries and no death    │
│     Training                │                     │   ✓ High level fire          │
│   ✓ Adequate disaster       │                     │     preparedness, awareness, │
│     Activity coordination   │                     │     response and coping      │
│   ✓ Adequate Regular        │                     │     strategies.              │
│     disaster preparedness   │                     │   ✓ Safe learning            │
└─────────────────────────────┘                     │     environment              │
                                                    └──────────────────────────────┘
┌─────────────────────────────┐
│ Challenges and Opportunities│
│                             │
│   ✓ Funding                 │
│   ✓ Staff and student's fire│
│     training                │
│   ✓ Institutional and policy│
│     coordination            │
│   ✓ County and government   │
│     technical support on    │
│     fire                    │
└─────────────────────────────┘
```

Figure 2.1: Conceptual Framework
Source: Author, 2019.

The objective of fire safety from the conceptual model can thus be summarized as follows;

    i.   To minimize the probability of fire occurrences.

    ii.   To provide sufficient facilities for fighting and escape of occupants from the building.

iii. To minimize fire spreading to the infrastructures within the school communities.

iv. To safeguard the occupiers from the negative effects of fire losses.

On this study, fire mitigation is treated as the dependent variable which is being influenced by following independent variables; fire mitigation measures, adequacy of fire mitigation action as well as the challenges and opportunities embraced by numerous players. Variations among the three independent variables will have change the degree of fire mitigation within any school facility or other buildings. Firefighting equipment are availed as reactive measures in controlling fire emergencies. Trained firefighting marshals can use the fire management tools such as fire hydrants, fire suppression tools and different types of fire extinguishers among others equipment to put off fires within infrastructures. Fire prevention mechanisms are used are proactive strategies to curb fire disasters before they occur. They also help in eliminating, controlling or minimize fires at the incipient stage. Some of the strategies used as proactive actions include; fire awareness programs, planned fire drills, fire resilient construction designs and materials and training of teachers, security officers and students on ways to counter and act in incident of fire emergency. Construction materials and furnishings can be subjected to fire-resistance tests such as degree of combustibility and flammability. This is to maximize passive fire prevention strategies of buildings.

Mitigation is a long-term effort aimed at reducing loss of lives and properties by reducing the effects of disasters. Mitigation involves pre-planning for tragedies which comprises of repetitive financial allocations to physical and non-physical issues with aim to lower or eradicate future risks. Mitigation strategies employs medium and long-term strategies of safety since mitigation forms a core pillar in emergency preparedness and management in modern world. In a nutshell, it portrays a classical example of planning things in advance and putting tirelessly efforts in achieving specific goals of eradicating or minimizing the risks of a disaster.

2.7 Summary of Knowledge Gaps in Literature and Focus of the Study

2.7.1 Knowledge Gaps

The reviewed scholar works for the research indicated that fire adversity mitigation is indispensable in all secondary schools and fatalities, harms or property loses can be lessen of the appropriate fire actions are drawn and implemented, further, the level of adherence with school wellness and security guidelines has been found to be most wanting. Despite the fact that some schools have gone a step forward to install fire-fighting tools and renovated the school buildings to aid in averting the fire dangers, other schools are yet to implement any measures. In addition to that, even the schools which have taken a bold step in putting the safety mechanisms, it can be noted that the schools have not adequately equipped the institutions with the fire control tools adequately and also training and awareness of fire is still lacking. This makes the school ill-prepared in case of fire incidences. This implies that there is still a knowledge gap as far as fire disaster mitigation of schools is concerned. That made imperative to carry out this study.

CHAPTER THREE: METHODOLOGY

3.1. Introduction

This chapter provides an overview of the research methodology; it includes research design, study area, data collection source and method, data collection tools, target population, sampling techniques and size, data analysis and research ethics.

3.2 Study Area; Machakos County

3.2.1 Location and topography

Machakos County is situated in eastern part of Kenya. The area covered by the county is 6,208 square km and it has a population of 1,098,584 as per 2009 census. Its population annual Growth Rate is 1.7 % with a current estimate of 264,500 households of which only 17% accessing electricity. Its capital town Machakos is cosmopolitan and is located 64 kilometers southeast of Nairobi. Today Machakos borders counties of Nairobi and Kiambu to the west, Embu to the north, Kitui to the east, Makueni to the south, Kajiado to the south west, and Muranga and Kirinyaga to the North West(Kenya Population and Housing Census, 2009) (Figure 3.1).

3.2.2 Climate and Rainfall

The prevailing local climate in the county is semi-arid. The County experiences changeable and unpredictable rains of less than 500mm annually, with short rains in October through to December and the long rains in late March to May as per Machakos County Integrated Development Plan, 2015. Most school fire disaster in this region occurs in first and second term of school calendar that is between May and September which corresponds to the hot and dry months in the region (Omoyo *et al*., 2015).

3.2.3 Socioeconomics

The county has a population of 1,191,300, crude birth rate (per 100 population) of 94, unemployment rate (15-64 years) of 13.9%, Population growth rate of 2.8% and poverty rate of 24.1% as per the census of 2009. Machakos County is designed in Vision 2030 to be part of the metropolitan city of Nairobi. Majority of the habitants in the county are the Kamba community which originate from Bantu group and mainly practice subsistence farming with maize, beans, sorghum and millet being able to grow in semi-arid areas (Machakos County Integrated Development Plan, 2015).. The county is boosted my ecotourism with local green spaces such as Machakos People's Park being able to attract people from Machakos and other neighboring counties. Other

tourism attraction sites include 14 Falls in Donyo Sabuk among others. The county also is expected to be among host of the planned Konza Technology City which is expected to create more revenue to the county and attract more investors in the region(Machakos County Integrated Development Plan, 2015)..

3.2.4 Education

Machakos County is boosted with 190 secondary school (private and public) which ranges from national secondary to Sub-county schools. The county has also universities such as Machakos University, Scott Theological University, St. Paul's University and South Eastern Kenya University (SEKU). Other notable leaning institutions include training institutes such as Machakos Technical Training Instute for the Blind among others. The literacy level in the county is estimated to be high at 82.3% representing population that is able to read and write (Machakos County Integrated Development Plan, 2015). The gross attendance ratio in secondary school is 130,261.9 while the secondary school gross enrollment is 289,557 as per the Machakos County Integrated Development Plan, 2015).

3.2.5 Disaster

Kenya has continued to face a rising number of disasters which make the country susceptible to disaster attacks. Some of notable disasters in Kenya include; floods, hunger, drought, school fires, landslides, HIV and AIDs and other epidemic outbreaks. Machakos County is due to its climate and inadequate rainfall; it's highly affected by drought and rampant schools fires for example Kyangulli School fire in 2001 which cause 68 fatalities (Ministry Of State For Special Programmes Office of The President, 2009). In 2014, the county government of Machakos came up with Disaster and Emergency Management Policy which outlined the functions of the County Assembly, County Executive (Administration and Management) and County Emergency Staff – Fire fighters and ambulance personnel to enable the county control the disasters (Machakos County Disaster & Emergency Management Policy, 2014).
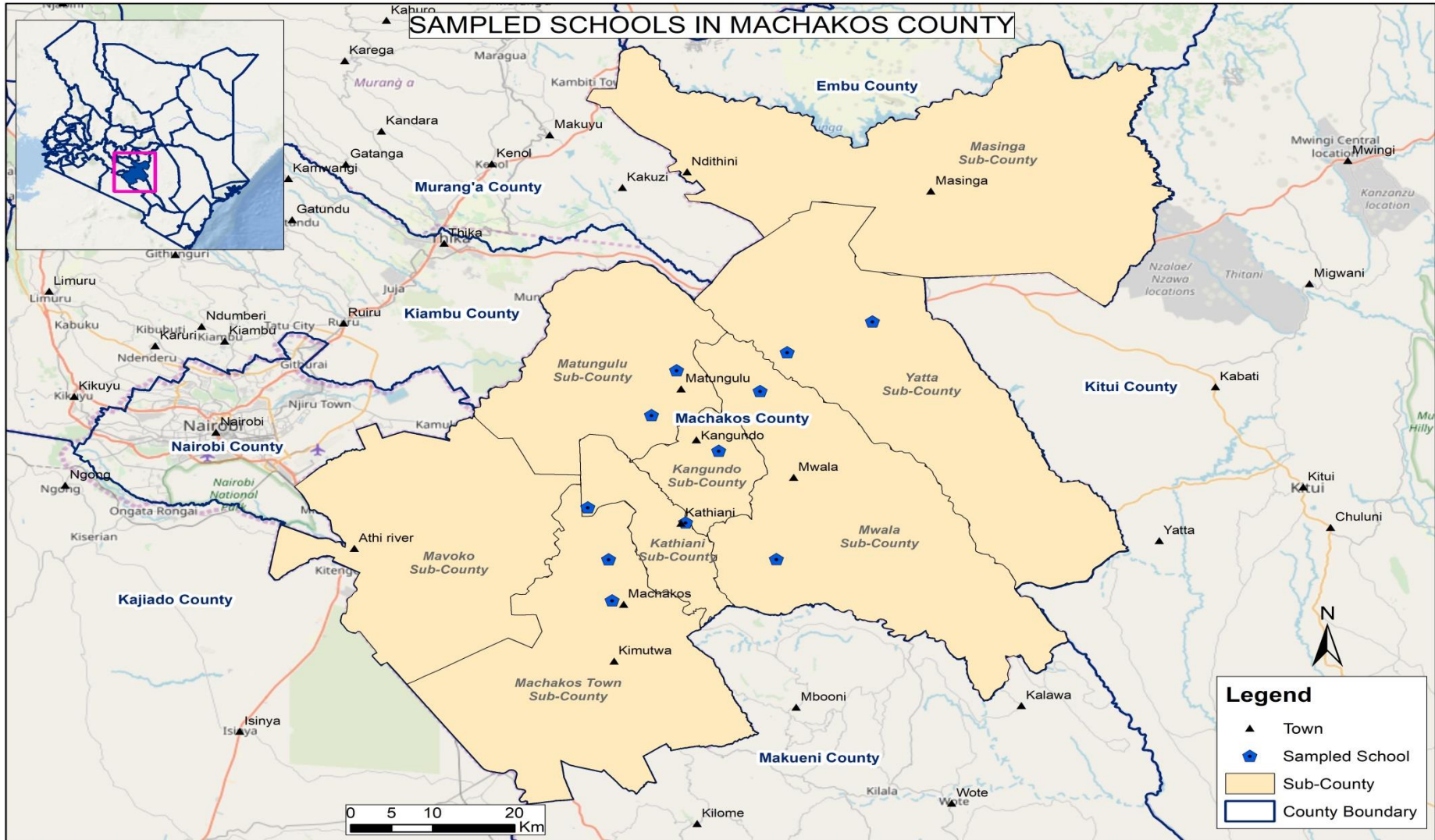
Map 3.1: Location of Machakos and Secondary Schools

3.3 Research Design

This study follows a descriptive research design as it explores the perceptions and opinions of school heads, teachers, security personnel and student regarding the extent of fire disaster mitigations in their schools based on the deployments and awareness of the programs. Descriptive design is a common research design when researchers conduct a research to explore phenomenon that is not commonly evaluated (Kothari, 2012). The findings of such inquiry can help to establish the relationships and statistical differences between a class of items and the results can help future researchers to improve on the particular issues under inquiry.

3.4 Population and Sample

3.4.1 Target Population

The Study target population was public secondary schools in Machakos County which had fire incidences in the last 2 years (2017 and 2018), 33 schools as per the data provided by Department of Education in Machakos County. The researcher narrowed down to 11 schools due to; inadequate financial resources and time constraints. That was supported by the fact that the researcher was driven to study on fire mitigation and all the 33 schools had a common observable characteristic, fire disaster within the last two years (2017 and 2018). The total population for the study was 753 which were formed by teachers from the 11 schools and the key informants.

3.4.2 Sample and Sampling Design

The sample size for the study was drawn from teachers and key informants: (Principals/Deputy Principal, Dormitory Master Representative, Dormitory Matron Representative, Student Representative (Form 4 student simple randomly chosen from the school register through time spend in school inclusion criteria), Security office representative, BOM representative, and PTA representative from all the selected 11 schools. Other purposively key informants selected include; BORAQs representative, EBK representative, MOE Department of Education in Machakos County representative, and Department of Fire in Machakos County representative). This study's sample size determination was based on Krejcie and Morgan 1970 as shown on appendix V. The study used a mixed sampling design. The researcher selected 11 public secondary schools from the 33 using a systematic random sample of technique at interval of 3. In order to apportion the teachers' sample of 173, teachers from the 11 schools were selected through simple random sampling after proportionate percentages which correspond to the representation of teachers' sample size. This category presented a total sample of 173. Purposive

sampling was also used to select respondents on the basis of their interaction with firefighting cases in public secondary schools in Machakos County and this category presented a total sample of 81. The main sample size of the study accumulated to 254 from the teachers and key informants. In the study, the schools were treated as the units of observations while teachers from the selected schools were treated as unit of analysis.

3.5 Methods of Data collection

The study collected data using three different approaches: a survey questionnaire administered to teachers; key informant interviews, and observations.

3.5.1 Survey Questionnaire

A questionnaire which consisted of closed-ended questions prepared by the researcher with aim of collecting information from the teachers in the study. Questionnaires were the main instruments of data collection based on the fact that they provided an opportunity to collect data systematically and analyze it for strategic decision making. The constructs of the questionnaire were measured using a Likert scale where 5 denotes strongly disagree, 4 denotes disagree, 3 denotes neutral, 2 denotes agree and 1 denotes strongly agree. The researcher was assisted by research assistants who had been trained on the questionnaire.

3.5.2 Key Informant Interviews

In-depth interviews herein the study referred as KII were used to collect data from Principals/Deputy Principals representative, Dormitory Master's representative, Dormitory Matron's representative, Student Representative, Security office's representative, BoM representative, and PTA representative from the 11 schools. Other purposively key informants selected include; BORAQs representative, 1 EBK representative, MOE Department of Education in Machakos County representative, and Department of Fire in Machakos County representative. The identified KII in the study were chosen in respect to their interactions with fire disasters within public secondary schools in Machakos County. A face to face approach and telephone calls were used by the researcher and aided by trained researcher assistants. Interviews were conducted to triangulate the results collected from survey questionnaires.

3.5.3 Observations

An observation checklist was developed by the researcher to collect first-hand information through photography and recording of activities or events at real time. The method was administered through direct observations by the researcher. An observation checklist guide was

developed in reference to the government standards and guidelines on fire mitigation (See Appendix VI).

3.6 Pilot Test

3.6.1 Validity

The three types of validity include Content validity, Predictive validity and Construct validity (Creswell, 2014). In this research, the indicators that are linked to the objectives of the study came from literature and were subjected to a review process by the researcher together with the supervisors. Thus, both face validity which researcher's conviction that the instruments are genuine and sampling validity were conducted. That served to ensure that right content was captured in the instrumentation and relevant study constructs were adequately incorporated to enhance robustness of the study results.

3.6.2 Reliability Testing

The reliability test is the test of reliability of the instrument in terms of its ability to post same results assuming similar contexts and setups. Researcher ensured that respondents were acquainted with questions and by requesting them to complete the instrument thoroughly free from biases. Also, test of internal consistency of the instrument was done using Cronbach's Alpha test and the statements in the instrument with alpha of below 0.7 detected to ensure higher correlations of the constructs in the instrument.

3.7 Data Analysis and Presentation

Collected data in the questionnaire was first screened for cleaning, sorted and entered in Statistical Package for Computer Packages version 24 to be analyzed. Descriptive statistics was conducted in form of frequencies tables, percentages, mean scores and standard deviation. Chi-square test statistic and the resultant cross-tabulations was used as the non-parametric statistics to measure the dependence of the respondents in various schools and their knowledge of the fire mitigations strategies employed. Therefore, the percentages in the cross-tabulations together with the chi-square statistic will be presented in tables and diagrams to depict the results more clearly. Table 3.1 shows the objectives, indicators and test statistics to be employed to measure the perceptions and knowledge of the respondents regarding the fire resilience in the schools.

Table 3.1: Summary of methods used in data analysis

Objectives	Indicators	Measuring Scale	Type of Statistical Analysis	Tool of Analysis
To determine fire mitigation measures implemented in secondary schools of Machakos County	• Number of fire cases in the last 5 years • Estimated property damage and loss • Implemented firefighting equipment • Recent Fire Training on fire disaster • School members trained on first aid • Evacuation drill per term undertaken • Adequate security lightening in school • Adequacy of Structural engineering and spatial planning of the school facilities	Interval	Non-Parametric	Descriptive Statistics, percentages, chi-square tests
To assess the adequacy of fire mitigation actions in secondary schools of Machakos County	• Availability of adequate fire exits in dormitories • Availability of fire resilient construction materials • Classroom and dormitories windows without grills • Width between the beds (at least 1.2 M) • Availability of conspicuously marked emergency exists • Presence of well labeled fire signage's • Availability of clear and wide gangways (at least 2 M) • Width of the emergency exits (at least 1.52 M wide) • Availability of training to school fire marshals or staff • Availability of adequate firefighting equipment • School community evacuation plan • School community first aid education • Sufficient first aid facilities	Interval	Non-Parametric	Descriptive Statistics, percentages, chi-square tests

Objectives	Indicators	Measuring Scale	Type of Statistical Analysis	Tool of Analysis
	• Regular disaster preparedness provides • Disaster activities coordination			
To find out opportunities and challenges for school fire mitigation practices in secondary schools of Machakos County	• Regular review of the fire disaster manuals and policies • Intuitional and administrative challenges on fire mitigation • Provision of Fire disaster trainings to staff • Adequacy of funds availability for fire disaster • County and government technical support on implementation of fire disaster mitigations	Interval	Non-Parametric	Descriptive Statistics, percentages, chi-square tests

Source: Fieldwork, 2019.

3.8 Test of Hypotheses

The study used regression analysis to determine the contribution of predictors to dependent variable. Coefficient of determination was used to explain the amount of change in dependent variable being explained by the independent variable while F-ratio was used to determine the statistical significance of the model. The hypotheses that were tested in this study are in Table 3.2 below.

Table 3.2: Models for Testing the Hypotheses

Objective	Hypotheses	Tet statistic	Justification
To determine fire mitigation measures implemented in secondary schools in Machakos County, Kenya	**Hypothesis 1** H_0: There is no significant difference in fire mitigation measures implementation across secondary schools in Machakos County, Kenya	Pearson Chi-Square test of independence	Reject H_0 if $p \leq 0.05$ otherwise fail to reject H_0 if $p \geq 0.05$

| To assess the adequacy of fire mitigation actions in secondary schools in Machakos County, Kenya | **Hypothesis 2** H_0: There is no significant difference in the adequacy of fire mitigation actions implemented across secondary schools in Machakos County, Kenya | Pearson Chi-Square test of independence | Reject H_0 if $p \leq 0.05$ otherwise fail to reject H_0 if $p \geq 0.05$ |

Source: Fieldwork, 2019.

3.9 Ethical Considerations

To conduct this study, the proposal was submitted to University of Nairobi Ethical Review Committee for ethical approval. Research permitted was obtained from National Commission of Science Technology and Innovation (NACOSTI) and approval from Machakos County government was also requested. An Informed consent was developed and administered to the participants. The respondents were given the will to participate or not throughout the study period. The research was didn't offer any inducements or rewards to participants to ensure there was no biasness. The study retained confidentiality throughout the study period. Permission for data or photographs was sought from the relevant management or respondents before any taking of photographs or collection of data. Any collected information during the study was strictly used for research purposes only and stored, analyzed and reported in formats that won't allow identification of the individual participant. There were no invasive procedures carried out on the participants, so no physical risks will be encountered.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0. Introduction

This chapter, organized in six sections, presents results and findings on socio-demographics, fire mitigation measures, fire mitigation actions, and opportunities and challenges of fire mitigation practices in public secondary schools in Machakos County. In presenting results, the chapter first presents descriptive statistics on each of the variables, which is then followed by inferential statistics to test the hypotheses and make inferences. The chapter is guided by the research questions vis-à-vis objectives in order to ensure logical flow.

4.1 Respondents characteristics

4.1.1 Response Rate

The researcher administered 173 questionnaires to the respondents and 125 administered questionnaires were filled and returned. Mugenda and Mugenda (2003) stated that a return rate of 70% and above rate is considered to be very good. Therefore, 72% response rate attained from the questionnaires administered in this study was good. The high response rate can be attributed to the willingness of the respondents to participate in the study. The respondent's school types are as shown in table 4.3 below.

Table 4.3: Respondents type of school Type

		Frequency	Percent	Valid Percent	Cumulative Percent
	Boys	71	56.8	56.8	56.8
	Girls	17	13.6	13.6	70.4
Valid	Mixed	37	29.6	29.6	100.0
	Total	125	100.0	100.0	

Source: Primary data (2019)

The findings in table 4.3 show that 71 respondents were from boy's schools while were 17 from girls and 37 from mixed schools to make a total of 125 respondents. The results indicate that the three types of schools were included. The fact that most respondents were from boys schools suggests that there are more male teachers or that the male teachers are more willing to provide the information for the study results. More important however, is that at least the three types of schools participated in the survey.

4.1.2 School Type and Gender of the Respondents

The study results for the designation of the respondents and their gender were as shown in table 4.4 below.

Table 4.4: Respondents gender * Respondents type of school Crosstabulation

			Respondents type of school			
			Boys	**Girls**	**Mixed**	**Total**
Respondents gender	Male	Count	67	0	21	88
		% within Respondents type of school	94.4%	0.0%	56.8%	70.4%
	Female	Count	4	17	16	37
		% within Respondents type of school	5.6%	100.0%	43.2%	29.6%
Total		Count	71	17	37	125
		% within Respondents type of school	100.0%	100.0%	100.0%	100.0%

Source: Primary data (2019)

The findings in table 4.4 above confirms that majority of the respondents were male. Eighty eight respondents were males while 37 were female. Interestingly, the cross-tabulation results suggest that girl schools have more female teachers while boys' schools have more male teachers. For mixed schools, the teacher gender ratio is quite balanced since 21 were male and 16 female. It is however important to note that respondents from the three category of schools were represented.

4.1.3 Respondents Academic Qualification

The study evaluated the level of education of the respondents. The results were presented through histogram diagram shown in figure 4.2.
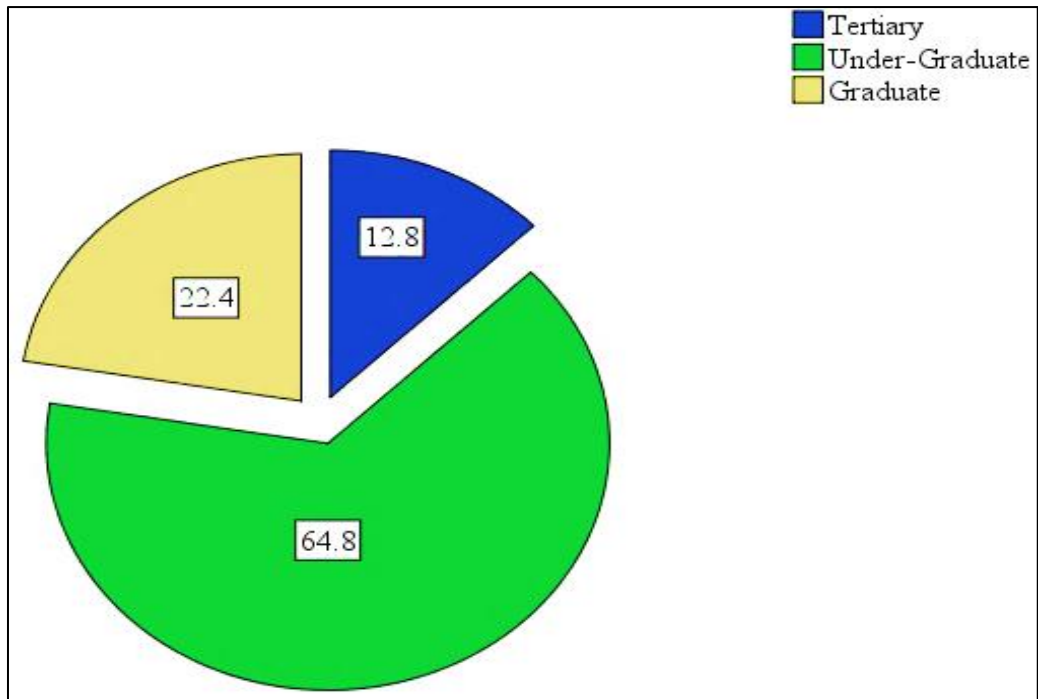
Figure 4.2: Academic Qualification of Respondents

Source: Primary data (2019)

The results above from figure 4.2 show that 22.40% of the respondents were graduates while 64.80% were undergraduates and 12.80% had tertiary level of education. The high number of teachers with an undergraduate degree and postgraduate degrees indicate that the teachers in the sampled schools have a reasonably high level of education to understand and respond to the study constructs.

4.1.3 Respondents Duration of Service in the School

The study also analyzed the duration the respondents had been in the school across the three types of schools: boys school, girls school and mixed school. That can help to depict the respondent's awareness of the school and therefore their authoritativeness in responding to the asked questions. The results were as shown in table 4.5.

Table 4.5: Duration of Service in the School * Type of school Crosstabulation

| | | | Respondents type of school | | | |
			Boys	Girls	Mixed	Total
Respondents years in the school	1-5 years	Count	53	11	28	92
		% within type of school	74.6%	64.7%	75.7%	73.6%
	6-10 years	Count	3	6	7	16
		% within type of school	4.2%	35.3%	18.9%	12.8%
	11-15 years	Count	7	0	1	8
		% within type of school	9.9%	0.0%	2.7%	6.4%
	16-20 years	Count	7	0	0	7
		% within type of school	9.9%	0.0%	0.0%	5.6%
	20 and above	Count	1	0	1	2
		% within Respondents type of school	1.4%	0.0%	2.7%	1.6%
Total		Count	71	17	37	125
		% within Respondents type of school	100.0%	100.0%	100.0%	100.0%

Source: Primary data (2019)

The results in table 4.5 show that most respondents (92: 73.6%) had worked in their school for a period between 1-5 years, 12.8% had worked in their school for a duration of 6-10 years, while 6.4%, 5.6% and 1.6% had worked in the school for 11-15 years, 16-20 years and over 20 years respectively. Across the school type, boys' schools had more respondents. Overall, the respondents had been in the schools for reasonable number of years to comment on the issues under discussion. The experience on cases of fire disasters from teachers who spent more than two years had a good percentage of 73.6% and therefore, it was adequate to give the researcher reliable information on the history of fire disasters in in the sampled public secondary schools in Machakos County.

4.1.4 School Details

According to the study, 71 of the respondents were from boys schools, 17 of the respondents were from girl's schools while 37 of the respondents were from mixed schools. Since respondents composed of those who had experiences with fire instance, it implies that boy's schools were hard hit by fires as compared with girls or mixed schools. This could be attributed to the cultural expectations that boys are hardy and rugged. This is in line with (Mwenda, 2008), who found out that, young people were obsessed with burning, vandalism and destruction of their own institutions. The study revealed that 95 of the respondents were from boarding schools while 6 from day schools and 24 from mixed day and boarding schools. This was congruent to

(Kukali and Kabuka, 2009), who found out that fire disaster preparedness and risk factors in boarding schools indicates that, in 2008 fires in boarding schools was higher than in mixed day and boarding schools by 40% and were caused by faulty electrical installations, misuse of electrical appliances and arson as shown on table 4.6.

Table 4.6: School Details

| | | | Respondents type of school | | | |
			Boys	Girls	Mixed	Total
School status	Boarding	Count	65	17	13	95
		% within type of school	91.5%	100.0%	35.1%	76.0%
	Day	Count	6	0	0	6
		% within type of school	8.5%	0.0%	0.0%	4.8%
	Mixed day and boarding	Count	0	0	24	24
		% within type of school	0.0%	0.0%	64.9%	19.2%
Total		Count	71	17	37	125
		% within type of school	100.0%	100.0%	100.0%	100.0%

Source: Primary data (2019)

4.2 Tests of Statistical Assumptions

4.2.1 Multicollinearity Diagnostics

Multicollinearity is a situation whereby the predictors correlate strongly amongst themselves. Regression analysis technique assumes that there is no multicollinearity (Field, 2014). This assumption was therefore tested using Variance Inflation factor (VIF). To test for multicollinearity, the values of the items of the indicators for each independent variable were aggregated to get a composite mean. The decision rule used was that if VIF is equal to or greater than 10 then there is a problem with multicollinearity (Field, 2014). According to this study VIFs of all the independent variables ranged from 1.259 to 2.393 which is less than 10. This entails that multicollinearity was not a problem therefore the decision to use regression analysis was justified.

4.2.2 Test of Normality

Regression analysis (Ordinary Least Square) being a parametric test assumes that data is coming from a normally distributed population (Field, 2014). It is for this reason that a normality test was carried out using Shapiro-Walks. Shapiro-walks give a W statistic. When W statistic is equal to 1 then the data is perfectly normal. In this study W statistics for the variables ranged from 0.91 to 0.96. As these values were close to 1, it implies that the data was close to normal as

indicated in Table 4.7. At this juncture, the normality statistical property was met. It should be pointed out that perfect normality does not obtain in real life situation.

Table 4.7: Tests of Normality

Description	Shapiro-Wilk Statistic	DF	Sig
Mitigation Measures	0.96	253	0.001
Adequacy of Fire Mitigation actions	0.94	253	0.001
Challenges and Opportunities	0.91	253	0.001

Source: Primary data, 2019.

4.2.3 Linearity Test

Regression analysis assumes that there is a linear relationship between the independents and dependent variable (r>0) (Mugenda and Mugenda, 2008). In this study the linearity of relationship was explored using scatter plots. To this end, fire mitigation was treated as the dependent variable while mitigation measures implemented, adequacy of mitigation actions, challenges and opportunities were taken as independent variables. The tests established that there is a linear relationship between independent and dependent variables thereby justifying the use of regression.

4.3 Fire Mitigation Measures undertaken in schools

About ninety two percent of all surveyed teachers said that their schools experience 1-3 cases of fire in the last 5 years (Figure 4.3). 8% of the respondent indicated that their institutions had fire in the last 4-6 years.
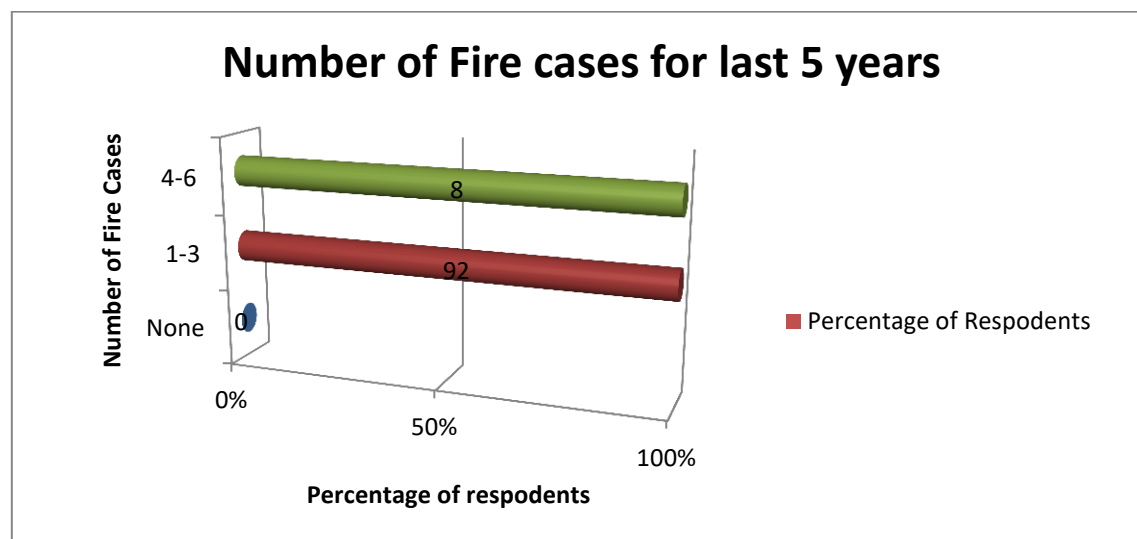
Figure 4.3: Number of fire cases in the last 5 years

Source: Primary data (2019)

Figure 4.3 shows the 92 % sampled schools had 1-3 fire incidences between 2013 to 2018. This shows that there were repetitive cases of fire incidences occurrence in same schools. A study by Makhanu (2009) in Kenya, stated that most learning institutions lack fire response team or department, and the those that have teams in-place are not properly trained in firefighting and response. He also noted that school buildings are not adequately equipped with firefighting equipment as an integral tool for fire mitigation measures. The information collected during the KII highlighted that although the fire disasters have reduced from 2013-2018 as compared to 2008-2012, most schools had not fully implemented the mitigation actions stipulated in the No. G9/1/169 school safety Circular in pursuant to build resilient disaster school communities. The same was noted by the researcher during the observation session. The researched observed that the schools had not provided adequate firefighting equipment.

The study noted that 92% of the respondents settled that their schools lost an average of 1-3 million through fire.
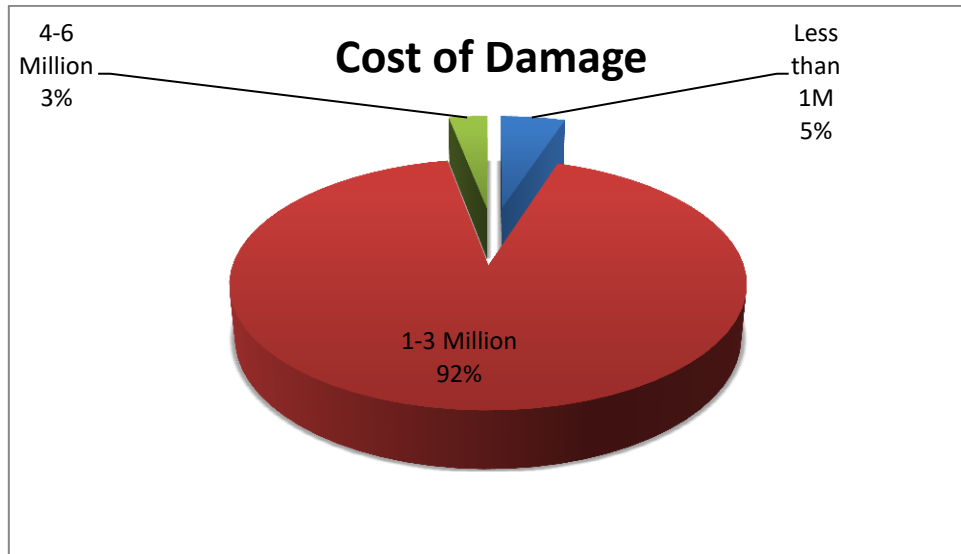
Figure 4.4: Cost of damage by fire disasters in sample schools 2008-2018

Source: Primary data (2019)

The survey questionnaire data analyzed shows that between 2013-2018, 92% of the sampled schools indicated that the cost of damage from fire was estimated to be between 1-3 Million Kenya shillings in each school as shown in figure 4.4. KNAP (2010), found out that, secondary schools fire disasters are on the increase and have caused death of very many innocent students and destruction of property. Key Informant such as school principals and BOM representatives highlighted that, schools loss costly properties due to fire disasters. PMT explains the possible distresses which are resultant of poorly implemented actions or measures increase vulnerability and disaster risks (Perloff & Bay, 1991). That can be connected by the fact that the researcher during observation session noted that most schools had not provided fire disaster training techniques such as provision of wide or at least 2 Meters wide doors, provision of adequate and working fire hydrants or hose reels as argued by Ayonga (2016).

Table 4.8 reveals that 80% of the respondents disagreed that their schools had installed active fire hydrants with a mean score of 3.61. 81% of them agreed that their school had not provided fire extinguishers with a mean score of 3.58. 85% of them disagreed that their schools were built with fire-resistive materials with a mean score of 3.33. 9% of the respondents agreed that the schools had provided standard fire exits in places such as dormitories and labs, with a mean score of 2.78, while 60% of the respondents were neutral that the schools have provided

standard had fire exits. 43% of them agreed that the schools had fire protection devices such as circuit breakers and automatic fire sprinklers in generator rooms with a mean score of 2.47, while 25% of the respondents were indifferent that the schools had not provided fire protection devices. 9% of the respondents strongly agreed on having fire blankets with a mean score of 2.38 and 72% of the respondents disagreed on having fire escape ladders provided in schools in areas such as labs, storeyed classrooms and dormitories with a mean score of 2.31. 70% of the respondents agreed that the schools had not installed heat/smoke detectors with a mean score of 3.41. 74% of the respondents disagreed that the institutions and installed fire alarm within fire prone buildings with a mean score of 3.41. 19% of the respondents agreed that they did not have installed fire hose and nozzles with a mean score of 2.80. 36% of the respondents agreed that the schools had fire sand buckets, with mean score of 2.10 while 31% of the respondents were neutral. 77% of the respondents agreed that they had reliable water supply within the specific areas at the schools to aid in putting off fire emergencies with a mean score of 2.05.

Table 4.8: Provided Fire Mitigation Measures

STATEMENT	5	4	3	2	1	Mean	SD
Installed Fire hydrants	56%	24%	11%	07%	02%	3.61	.664
Installed Fire extinguishers	61%	20%	09%	09%	01%	3.58	.587
Used Fire-resistive materials in building	49%	36%	08%	01%	06%	3.33	.596
Reworked or provided standard Fire exits	21%	10%	60%	00%	09%	2.78	.884
Installed Fire protection devices e.g. automatic sprinklers in generator area and circuit breakers	21%	11%	25%	40%	03%	2.47	.673
Availed Fire blankets	13%	18%	49%	11%	09%	2.38	.456
Installed Fire escape ladder	51%	21%	09%	16%	03%	2.31	.356
Installed Heat/smoke detectors	46%	24%	21%	08%	08%	3.41	.781
Installed Fire alarm	41%	33%	17%	04%	05%	3.41	.780
Installed Fire hose and nozzles	11%	08%	11%	31%	39%	2.80	.687
Provided Fire sand bucket	09%	21%	31%	31%	06%	2.10	.574
Provided Reliable water supply	03%	07%	13%	21%	56%	2.05	.321

Source: Primary data (2019)

As shown in Table 4.8, it was indicated that the mean score for 5 of the 12 statements was more than 3.00 indicating that a few respondents agreed with the statement while the rest either disagreed or were neutral. These findings also imply that to a larger extent more than 58% of the schools did not comply with fire mitigation measures. Safety of students is of great significance in a learning institution since it guarantees parents and the stakeholders' confidence and trust of a secure environment for students. During KII, the study also revealed that the schools had not implemented the mitigation measures as per the Fire Safety Management Policy of Kenya (FSMPOK). That was attributed due to factors such as; poor enforcement strategies, low public awareness on the FSMPOK and insufficient skilled fire management personnel.

4.4 Adequacy of Fire Mitigation Actions

Fifty nine percent of the respondents disagreed that their fire/emergency exits were clear and conspicuously marked while 41% of the respondents agreed that their fire/emergency exits were clear and conspicuously marked as shown on figure 4.5. Carolina, (2014), argued that fire safety in buildings is deemed to cover the aspects of fire prevention, firefighting and extinguishing methods, and fire salvage operations.
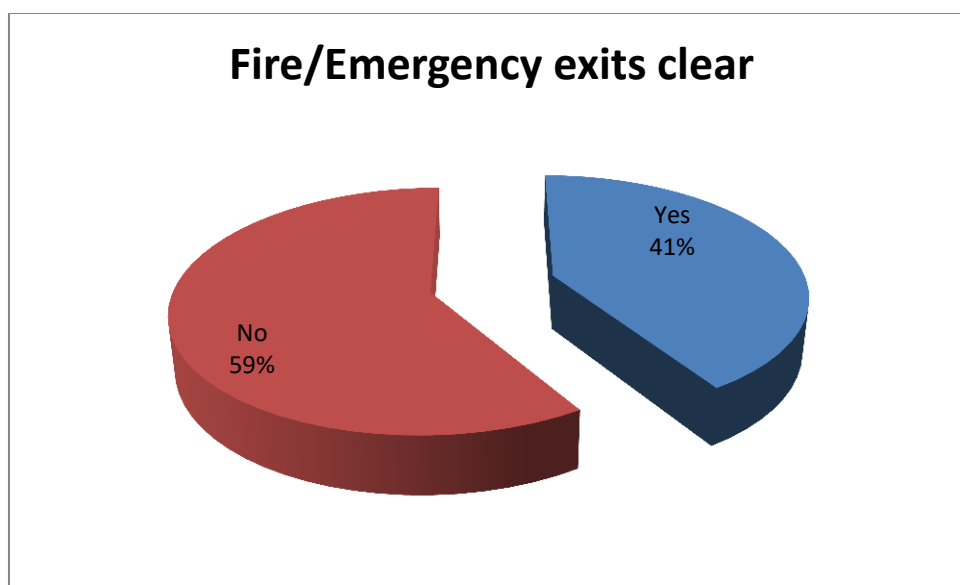

Figure 4.5: Fire/emergency Exits clear and Conspicuously Marked

Source: Primary data (2019)

From figure 4.5, the study revealed that more than half of the sampled schools had not provided fire emergency exits that were clearly and conspicuously marked. MOE Directorate of Quality Assurance & Standards Ref No MOE HQS/3/13/2 in part 8, stressed fire safety standards

(Ministry of Education, 2012). The standard states each dormitory should have a door at each end and additional emergency exit purposely to serve for emergency purposes and should be clearly labeled "Emergency Exit". That is contrary to what the researcher noted during the observation session as majority of the schools the existing emergency had to provide or clearly labeled. Key informant such as security office representative confirmed that most of the schools had not provided additional middle doors to serve for emergency purposes. Grimaldi and Simonds (2001) outlined that there should be: clear and detailed records of the buildings and grounds plan comprising of the installations to minimize fire disasters in public secondary schools.

According to the study, 82% of the respondents agreed that their schools had pathways of at least 2 metres while 18% of the respondents disagreed that their schools had pathways of less than 2 metres as shown in figure 4.6. Carolina, (2014), argued that fire safety in buildings is deemed to cover the aspects of fire prevention, firefighting and extinguishing methods, and fire salvage operations.
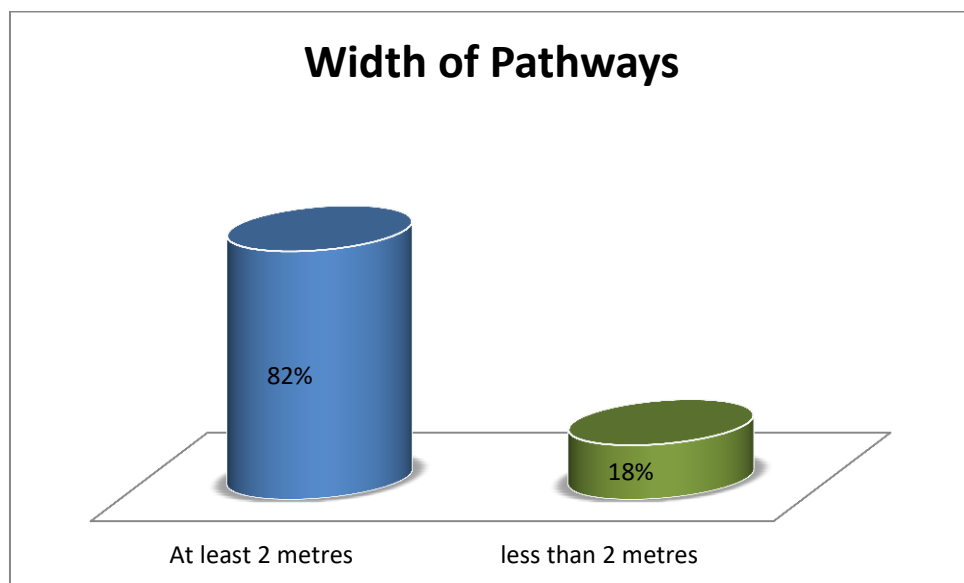
Figure 4.6: Width of Pathways

Source: Primary data (2019)

The survey questionnaire information collected in figure 8 reveals that eighty-two percent of the respondents agreed their school had not provided the standard width of pathways as stipulated in the guidelines from Directorate of Quality Assurance & Standards Ref No MOE HQS/3/13/2 (Ministry of Education, 2012). The standard clearly states that the pathways should be not less

than 2 metres. That is concurrent according to Watts (2006) that to enhance fire mitigation, the design and construction of buildings and the environment must put-into consideration a significant action to: minimize the risk to fire occurrence through provision of spacious adequate pathways and open staircases. The study also revealed the information to be true during KII with security office representatives who highlighted that majority of dormitories had the pathways filled with student's boxes hence making them dangerous to escape in even of fire. The researcher also noted the same during observation sessions as one of the dormitories in Machakos Boys High School had pathways less than 2 meters wide as shown in Plate 4.1.

Plate 4.1: Dormitory showing pathways less than 2 Meters and boxes placed on them

Source: Primary data (2019)

The study revealed that 83% of the respondents agreed that their schools had dormitories whose size is more than 200 square metres, 4% of the respondents agreed that their schools had dormitories whose size is 150- 200 square metres, while 12% of the respondents agreed that their schools had dormitories whose size is 50-100 square metres according to figure 4.7.
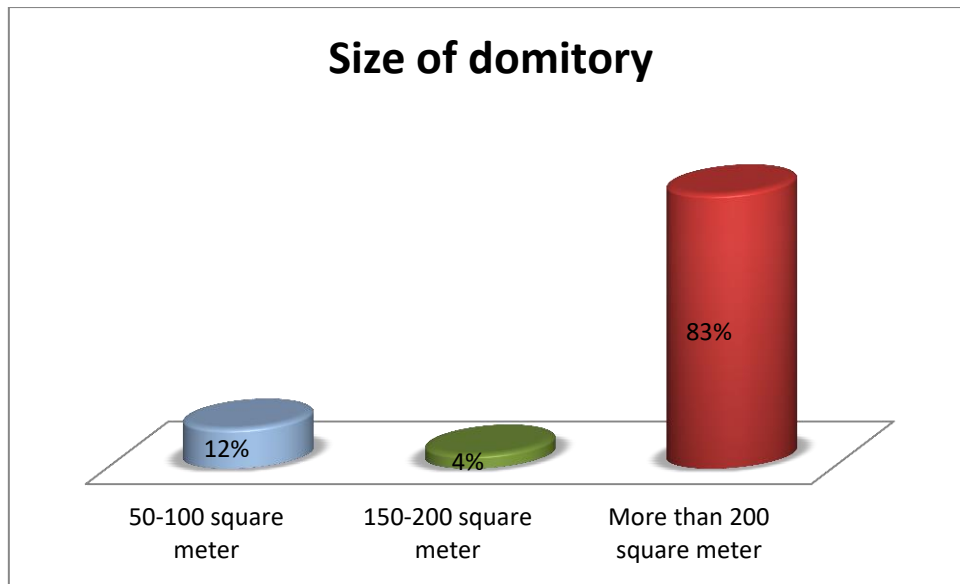
Figure 4.7: Size of Dormitory

Source: Primary data (2019)

From figure 4.7, the survey questionnaires data collected shows that majority of schools had dormitories whose size is 150-200 square metres. That means the dormitories required additional emergency exit doors on each side to aid the students escape in event of fire. According to the Ministry of Education (2012) Directorate of Quality Assurance & Standards Ref No MOE HQS/3/13/2, all the dormitory doors should be wide to at least 5 feet wide and be able to open outwards freely. The dormitory masters informed the researcher that the dormitory doors were not closed from outside during time when student are inside. However, they highlighted that some dormitories carried a higher number of students in contrast to the guidelines of Directorate of Quality Assurance & Standards on fire safety on school (Ministry of Education (2012). The researcher observed that some of the dormitories lacked emergency doors despite having a high capacity of students during data collection.

The study revealed that 46 % of the respondents agreed that their schools had 50-100 beds in the dormitories, 36% of the respondents agreed that their schools had 0-50 beds in the dormitories, while 17% of the respondents agreed that their schools had 100-150 beds in the dormitories as shown in figure 4.8.
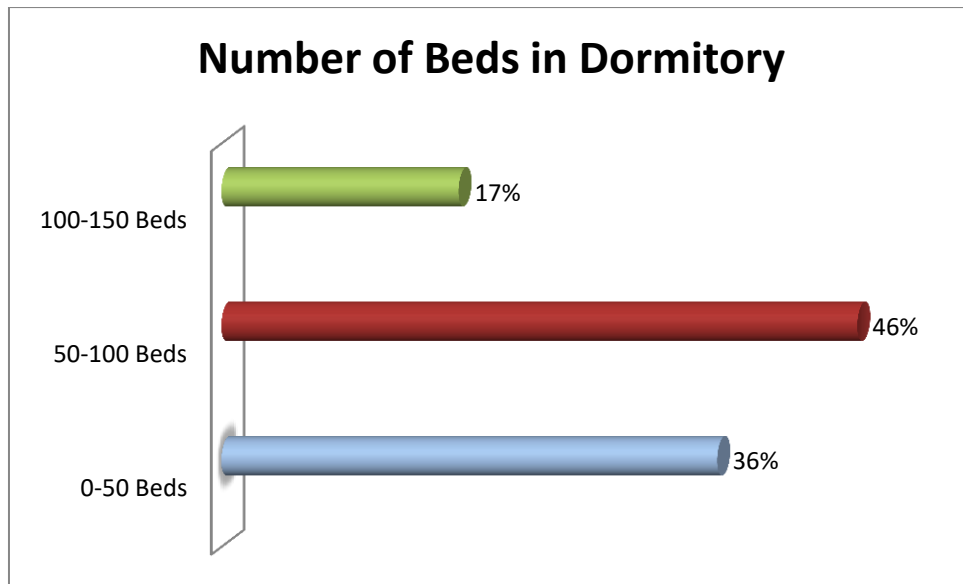
Figure 4.8: Number of beds in the dormitory

Source: Primary data (2019)

Relating these findings with the revelations of figure 4.8 of over 200 square metres worth of space in the dormitories, then it is apparent that there's moderate spacing in the dormitories in Machakos County. The key informants such principals and dormitory masters stated that the schools had the required number of beds per dormitory and spacious enough to provide easy escape access during fire emergency. The same can be correlated to the researchers finding during observation that majority of dormitories were spacious hence showing good engineering and planning designs. All those findings conforms to arguments of Watts (2006), that in order enhance fire mitigation, the design and construction of buildings and the environment must put-into consideration a significant action to minimize the risk to fire occurrence through use of non-combustible building materials and ensured building spacing and dormitories capacity.

Table 4.9 shows 71% of the respondent agreed that their exits are clear of obstructions at all times with a mean score of 3.13. 73% of the respondents agreed that their fire extinguishers are placed in positions where they are easily accessible with a mean of 3.11. 51% of the respondents disagreed that their combustible materials have not been used for decorations or finishing of the school's buildings with a mean score of 2.80. 71% of them disagreed that their dormitories have open wiring which can be a source of fire with a mean of 2.80. 44% of them disagreed that their dormitories had sockets, with a mean score of 2.11, while 37% of the respondents were neural that their dormitories had socket. 73% of the respondents agreed that exit doors of buildings in the school swung outwards. 87% of the respondents disagreed that boarding facilities have not

been designed to lock students in the school buildings such as dormitories. This implies that it's true that actually, boarding facilities in Machakos secondary schools have been designed to lock up students. This has been confirmed by 6% of the respondents who agreed that boarding facilities have not been designed to lock in students. Further 77% of the respondents disagreed that their school classes had emergency exit doors or constructed in a manner to allow occupants easy escape.

Table 4.9: Adequacy of Fire Mitigation Actions

Statement	1	2	3	4	5	Mean	SD
Exits are clear way from obstructions at all times	53%	18%	12%	10%	07%	3.13	.544
Fire extinguishers are placed in positions where they are easily accessible	44%	29%	11%	09%	07%	3.11	.487
Combustible materials have not been used for decorations or finishing for school's buildings	11%	21%	17%	41%	10%	2.80	.421
Does the dormitories have open wiring which can be source of fire	09%	11%	09%	59%	12%	2.80	.374
Does the dormitories have socket?	05%	14%	37%	38%	06%	2.11	.343
Does the classes have sockets	03%	06%	09%	63%	19%	2.03	.296
If the classes have sockets, are they well maintained?	03%	14%	21%	56%	06%	2.03	.264
Windows in the school have been grilled	81%	07%	05%	04%	03%	3.13	.664
Exit doors in buildings in the school swing outwards	57%	16%	09%	03%	15%	3.11	.884
Boarding facilities have not been designed to lock in students	04%	02%	08%	31%	56%	2.80	.587
Does the classes have emergency exit doors or constructed in a manner to allow occupants easy escape?	10%	05%	08%	16%	61%	2.80	.673
Halls have emergency doors and fire extinguishers	03%	13%	17%	23%	44%	2.11	.596

Source: Primary data (2019)

As shown in Table 4.9, it was indicated that the mean score for 4 of the 12 statements was more than 3.00 indicating that a few respondents agreed with the statement while the rest either disagreed or were neutral. That shows majority of public secondary schools in Machakos County had not adequate fire mitigation actions in place. For instance, the study also revealed that 67% of the respondents disagreed that their school halls had emergency doors and fire extinguishers. This is in line with Omolo and Simatwa (2010) who found out that only a few secondary schools have fire extinguishers; and the majority of the schools were overcrowded. Quality Assurance & Standards Ref No MOE HQS/3/13/2, from the Ministry of Education (2012), clearly states that dormitory windows should not be grilled and be able to open outwards easily. That was in contrast with the survey questionnaire data collected from teachers with 81% of the respondents strongly agreed that the schools had grilled windows. During the KII sessions, representative from Fire Department of Machakos County clearly highlighted that the schools poses great dangers to students in event of fire since some had grilled windows. That was confirmed by the researcher during the observation session as shown below in Plate 4.2.


Plate 4.2: A recent burnt dormitory with semi-grilled windows in Machakos Boys

Source: Primary data (2019)

4.5 Challenges and Opportunities

According to the study, 68% of the respondents agreed that their schools did a review of disaster mitigation policy over time as shown on figure 4.9. These findings are consistent with Okumbe

(2001) and MOE (2008) outlined that, the disaster mitigation measures need to be continually reviewed for effectiveness.
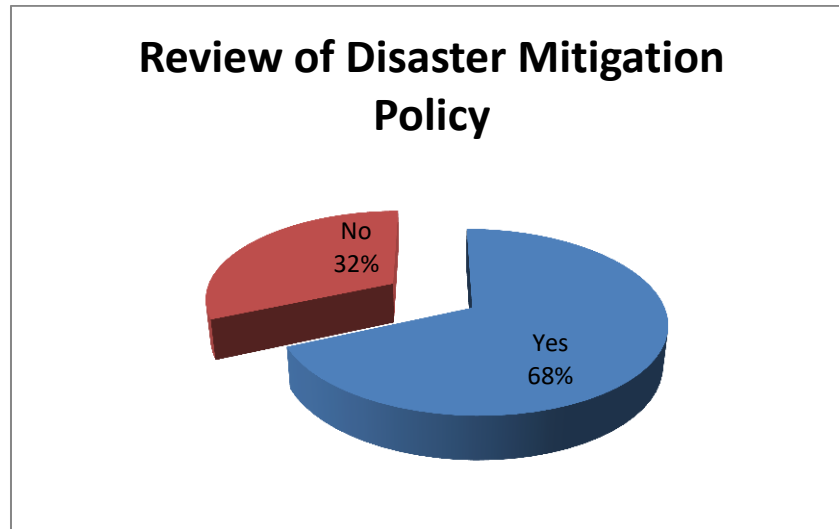

Figure 4.9: Review of Disaster Mitigation Policy

Source: Primary data (2019)

From figure 4.9, sixty-eight percent of the teachers indicated that their schools had reviewed their disaster mitigation policy. That was in line with School Safety Policy by the Ministry of Education (2008). The SSP requires school heads to promote fire safety awareness, conduct fire safety drills and, response and prevention training at least twice in every school term as well as; provide adequate firefighting equipment. The same can be supported by the 2011 FSMPOK which is a national policy response to address these challenges and in particular would, promote make availability of requisite institutional structures and capacities that prevent and mitigate fire risks; strengthen fire search and rescue services, and provide harmonize primary and secondary fire policies in Kenya (GoK, 2011). During a Key Informant interview session with the MOE Department of Education, Machakos County representative, the researcher noted that the schools fire disasters in schools which had reviewed their disaster policy in line with the current policies had reduction in fire disasters. Property and fatality cases had highly reduced in schools that had reviewed their disaster policy. However, it was also noted that the institutions experienced challenges such as; awareness training in policy review and financial resources to implement the policies. The study noted that, schools could utilize other means of financial resource mobilization such as increment of the schools upon discussion with all stakeholders to schools so as to source disaster mitigation funds.

The study revealed that 70% of the respondents agreed that their schools took advantage of fire mitigation requirements while 30% disagreed that their schools took advantage of fire mitigation requirements as shown on figure 4.10.
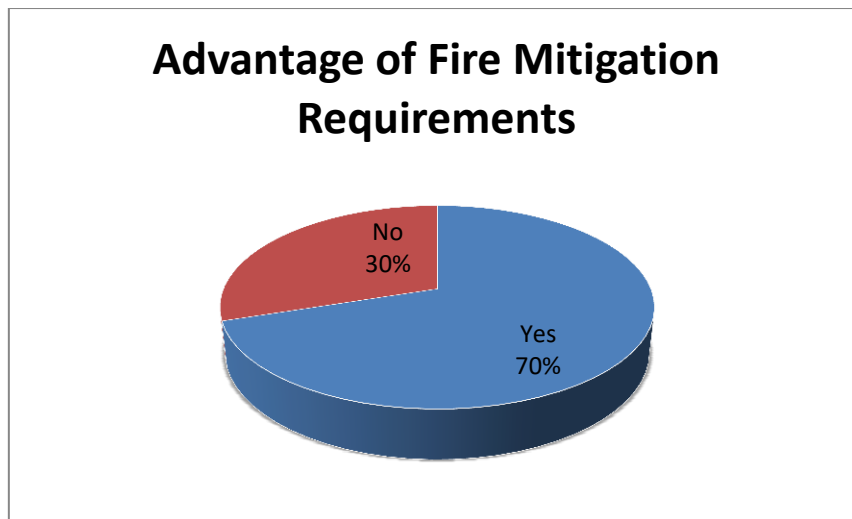
Figure 4.10 Advantage of Fire Mitigation Requirements

Source: Primary data (2019)

From Figure 4.10 above, the results shows that public secondary Schools in Machakos County have took advantage of the fire mitigation requirements. That can be connected from the results of figure 4.9 that 68% of schools had reviewed their disaster policy. From the discussion above, the study reveals that the schools had taken advantage of the requirements of the Quality Assurance & Standards Ref No MOE HQS/3/13/2, from the Ministry of Education (2012). During the Key Informant sessions, majority of principal/deputy principal representatives clarified that the new constructed or planned institution buildings had considered emergency exits as a requirement and that was mounted in ensuring fire disaster resilient school communities using best engineering designs. The interpretation can be tied to Makhanu (2009) that buildings construction, installation and maintenance processes, including periodic inspections should be done in a sound manner to ensure safety and usability of firefighting equipment. The principals/deputy principals' representatives clarified that schools faced financial resources to ensure implementation of all requirements of the 2011 FSMPOK. The safety policy requires that all dormitories and classes should have an emergency exits that is not less than 2 Meters wide. However, the study noted the schools can utilize some opportunities such as sourcing financial resources from Non-governmental organizations to construct standard facilities. BORAQs and EBK representatives also highlighted that the schools need to source for

experienced and registered architects, planners and engineers who could aid the schools plan for standard facilities at accommodative construction fee.

From table 4.10, the study revealed that 81% and 7% of the respondents strongly agreed and agreed respectively that the schools in Machakos County faced challenged on implementation of the policies and legislations with a mean of 3.13. 73% agreed that their schools were facing financial challenges in building fire disaster resilient schools. The study noted that the survey questionnaire respondents disagreed that their schools had institutional and administrative challenges to build fire disaster free schools recording 87% .61% of the respondents agreed that schools were facing challenges social challenges in building fire disaster resilient schools while 10% disagreed social cultural effects had challenges in having free fire disaster schools. 67% of the recorded respondents disagreed that there were opportunities in building fire disaster resilient schools. The same can tied with 59 % of the respondents disagreed that there was an opportunity to source for more resources through increment of schools. However, 68% of the respondents agreed that there were opportunities in promotion of disaster resilient schools through activities such as awareness creation and trainings on fire.

Table 4.10: Challenges and Opportunities

Statement	5	4	3	2	1	Mean	SD
Challenges on							
Policy and legislation implementation	81%	07%	05%	04%	03%	3.13	.664
Funding	57%	16%	09%	03%	15%	3.11	.884
Institutional and Administrative	04%	02%	08%	31%	56%	2.80	.587
Social cultural have no significant effect	10%	05%	08%	16%	61%	2.80	.673
Opportunities on							
Building safe school communities	03%	13%	16%	19%	49%	2.03	.245
Resource mobilization e.g. adding school fees	02%	15%	24%	53%	06%	2.03	.139
Promotion of disaster resilient schools e.g. through awareness creation and trainings	44%	23%	17%	13%	3%	3.01	.596

Source: Primary data, 2019.

From the results of table 4.10, it was noted that there were challenges in implementation of the fire safety and quality standards such as 2011 FSMPOK and guidelines of Directorate of

Quality Assurance & Standards Ref No MOE HQS/3/13/2 of 2012 from MOE (2012) According to table 4.11, 88% of the respondents agreed that their schools had challenges on policy and legislation on matters of fire mitigation, only 7% of the respondents disagreed that their schools had challenges on policy and legislation on matters of fire mitigation while 5% of the respondents were neutral. On the other hand, 73% of the respondents agreed that their schools had fire mitigation funding challenges. This is consistent with. Omolo et *al.* (2010), who found out that inadequate funding is the major hindrance to the implementation of school fire mitigation policies and practice as he observed in Kisumu County. Also, Kirui, Mbugwa & Sang (2011) noted that the underfunding in schools limits an effective implementation of fire mitigation standards in schools. The study further revealed that 87% of the respondents disagreed that institutional and administrative hiccups were challenges in fire mitigation in secondary schools in Machakos County, 6% of the respondents agreed that institutional and administrative hiccups were challenges in fire mitigation in secondary schools in Machakos County while 8% were indifferent. The findings were consistent with Cornacchia (1984) who found out that schools need to put into account, stepwise procedures to the measures on how to avoid and cope with critical incidents to be effective. The study further revealed that The survey questionnaire data as discussed above was also supported by the KIIs such as school principal/deputy who confirmed that the schools were facing several challenges such as policy and legislation implementation, inadequate financial resources to adopt best engineering designs and renovate old structures and institutional and administrative dares such as lack of fire disaster awareness and trainings. From the primary data collected through survey questionnaires, 77% of the respondents agreed that there were socio-cultural challenges affected fire mitigation in secondary schools in Machakos County, 15% of the respondents disagreed that socio-cultural challenges affected fire mitigation in secondary schools in Machakos County while 8% of the respondents were neutral that socio-cultural challenges affected fire mitigation in secondary schools in Machakos County. Data collected form KIIs showed that social-cultural challenges affected students' behavior and that promoted fire disasters in secondary schools. The findings were consistent with the Red Cross (2001) who noted that the predominant challenge to addressing school fires is high indiscipline among the students. Nderitu (2009) also stated that secondary school fires in Kenya are usually caused by students protesting their discontent with the school administration, non-implementation and non-compliance with the school fire mitigation policies.

Further, the study found out that 68% of the respondents disagreed that there were no opportunities to build safe school communities. This can be related by the response of 59% teachers who indicated the schools in Machakos county were not able to source for more financial support from increasing the school fees. The same can be supported by the data that was collected from principal/deputy principal representative where majority stated that the schools were working from tight regulations which barred them from increasing school fees. The researcher also noted that the Machakos County is positioned at 33 out of 47 counties in Kenya as per the poverty index levels KIHBS (2009).Therefore, from the sated secondary data, the study noted that parents from Machakos County were not financially well-up and thus they were not able to fund schools to promote fire disaster resilient school communities. 16% of the respondents agreed that safe school communities could be exploited in secondary schools in Machakos County while 16% of the respondents were indifferent that safe school communities could be exploited in secondary schools in Machakos County. According to the study, 59% of the respondents disagreed that resource mobilization could be exploited in secondary schools in Machakos county. On the other hand 17% of the respondents agreed that resource mobilization could be exploited in secondary schools in Machakos County while 24% were indifferent that resource mobilization could be exploited in secondary schools in Machakos County. Machakos County, 16% of the respondents disagreed that promotion of disaster resilient schools could be exploited in public secondary schools in Machakos County while 17% were indifferent that promotion of disaster resilient schools could be exploited in public secondary schools in Machakos.

According to the findings of this study, there is a relationship between fire mitigation challenges and opportunities and Fire Mitigation in public secondary schools in Machakos County. This concurs with the findings of a study by Makhanu (2009) in Kenya, stated that most learning institutions lack fire response team or department, and the those that have teams in-place are not properly trained in firefighting and response. He also noted that school buildings are not adequately equipped with firefighting equipment. The findings are congruent with (The World Bank 2010), who found out that disaster mitigation faces numerous challenges associated with non-existent or ineffective mitigation strategies, low capacities; (including funding); and most importantly, weak disaster governance frameworks

4.6 Pearson Chi-Square test of Independence

Pearson Chi-Square test was used to test the association between school type and both (1) the fire mitigation measures implemented and (2) the adequacy of fire mitigation actions

implemented in secondary schools in Machakos County, Kenya. The two factors were measured by getting the geometric mean of the 5 point Likert scale ratings for various relevant constructs. In the Pearson Chi-Square test for independence, the two factors (1) fire mitigation measures implemented and (2) the adequacy of fire mitigation actions implemented were treated as dependent factors for each test that was run. The results are presented in tables 4.11 and 4.12 respectively. The level of significance 0.05 was taken as the level of decision criteria where the null hypothesis was rejected if the value was lower than 0.05 and accepted if the value was greater than 0.05.

4.6.1 Test of Hypothesis One

$H_0$1: There is no significant difference in fire mitigation measures implementation across secondary schools in Machakos County, Kenya

This hypothesis sought to answer the question whether secondary schools in the study region had implemented requisite fire mitigation measures. Particularly, the study would like to determine whether there is a significant difference in the implementation of the fire mitigation measures amongst boy schools, girl's schools and mixed schools. The Pearson Chi-Square test and the resultant cross-tabulations are shown in table 4.11. The actual counts and expected counts in the various statistics do not differ significantly. It is however notable, is that most respondents (84.8%) disagreed that their school had implemented fire mitigation measures. Also, 12.8% of the respondents strongly disagreed while 2.4% were neutral. That suggests that the schools had not implemented the requisite measures to avert or deal with occurrence of fire disasters.

Pearson Chi-Square test of independence sought to determine whether there is a significant difference in implementation of the fire mitigation measures. The cross-tabulations show that the count and expected count do not differ very much. Again, the responses show that the schools have not implemented most fire mitigation measures. Pearson Chi-Square statistic 2.34 and p-value 0.673 indicate that confirms the null hypothesis in table 4.11. Since the Chi-Square test p-value is greater than the target 0.05, there is no statistically significant difference in the fire mitigation measure implementations in the schools. That implies that fire mitigation measures implemented are not dependent on a particular type of school; whether it is for boys, girls or mixed. We conclude that the schools have all not implemented the fire mitigation measures.

Table 4.11: School type * Fire Mitigation measures Implementation Crosstabulation

			Fire Mitigation Measures Implementation			
			Strongly disagree	Disagree	Neutral	Total
Respondents school type	Boys	Count	10	60	1	71
		Expected Count	9.1	60.2	1.7	71.0
		% within type of school	14.1%	84.5%	1.4%	100.0%
	Girls	Count	2	15	0	17
		Expected Count	2.2	14.4	.4	17.0
		% within type of school	11.8%	88.2%	0.0%	100.0%
	Mixed	Count	4	31	2	37
		Expected Count	4.7	31.4	.9	37.0
		% within type of school	10.8%	83.8%	5.4%	100.0%
Total		Count	16	106	3	125
		Expected Count	16.0	106.0	3.0	125.0
		% within type of school	12.8%	84.8%	2.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.340[a]	4	.673
Likelihood Ratio	2.434	4	.656
N of Valid Cases	125		

a. 5 cells (55.6%) have expected count less than 5. The minimum expected count is .41.

Source: Primary data (2019).

Discussion of Findings on the Relationship between fire mitigation measures and school type

$H_0$1: There is no significant difference in fire mitigation measures implementation across secondary schools in Machakos County, Kenya

The study findings shows that there is no significant difference in fire mitigation measures implementation across secondary schools in Machakos County, Kenya and the null hypothesis was affirmed. Therefore, the extent of fire mitigation measures is independent from the school type. Thus, whether a school is a boys', girls' or mixed students, the management, at least as per the results in the findings, do not enhance or decrease their fire disaster preparedness. Therefore, there is need to emphasize on fire preparedness in all schools. These findings are consistent with Sadker *et al*. (2000) stated that a wide variety of measures need to be in place to holistically

address encompassing mitigation measures, and such measures will enhance social network among members of the community and reduce anger and pressure that can lead to violent acts.

4.6.2 Test of Hypothesis Two

H₀2: **There is no significant difference in the adequacy of fire mitigation actions implemented across secondary schools in Machakos County, Kenya**

The second hypothesis is about the respondent's feeling of the adequacy of the fire mitigation measures implemented. It is important to understand the extent of implementation of fire preparedness measures may be low, but if the stakeholders feel they have done enough, they may not improve efforts. The results are as shown in table 4.12 below.

Table 4.12: Respondents' school type* Aadequacy of fire mitigation actions Cross tabulation

			Adequacy of Fire Mitigation Actions			
			Adequate	Inadequate	Very inadequate	Total
Respondents school type	Boys	Count	9	59	3	71
		Expected Count	11.4	55.7	4.0	71.0
		% within School Type	12.7%	83.1%	4.2%	100.0%
	Girls	Count	3	14	0	17
		Expected Count	2.7	13.3	1.0	17.0
		% within School Type	17.6%	82.4%	0.0%	100.0%
	Mixed	Count	8	25	4	37
		Expected Count	5.9	29.0	2.1	37.0
		% within School Type	21.6%	67.6%	10.8%	100.0%
Total		Count	20	98	7	125
		Expected Count	20.0	98.0	7.0	125.0
		% within School Type	16.0%	78.4%	5.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.023[a]	4	.285
Likelihood Ratio	5.597	4	.231
N of Valid Cases	125		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is .95.

Source: Primary data (2019).

According to the findings in table 4.12 the cross-tabulation table shows that the count and expected count are not very different. The expected count is what would be observed if there was no association between school type and feeling of adequacy of the fire mitigation measures implemented. The results of the findings also indicate that the respondents generally feel that the measures implemented are inadequate. That is so because, 78.4% felt that the measures are inadequate, 5.6% very inadequate while only 16.0% felt that the measures are adequate. To that extent, majority of the respondents (84%) at least felt that the implemented fire mitigation measures are inadequate.

The Pearson Chi-Square test statistic 5.023 and p-value 0.285 confirms the null hypothesis. Since p-value is greater than 0.05, it indicates that the adequacy or inadequacy of the fire mitigation initiatives is not dependent on school type. This indicates that whether the school is for boys, girls or mixed have no implemented adequate fire mitigation actions and therefore action need to be taken to avert fire incidences.

Discussion of Findings on the relationship between Adequacy of Fire Mitigation Actions and school type

$H_0 2$: There is no significant difference in the adequacy of fire mitigation actions implemented across secondary schools in Machakos County, Kenya

According to the findings of the study, there is no relationship between adequacy of fire mitigation actions and type of school among the public secondary schools in Machakos County. It is also revealed that respondents generally that the fire mitigation actions are generally inadequate. Inadequacy of mitigation actions affects fire mitigation since occurrence of fire in a school with no measures to avert or deal with the fire would experience devastating damage. This might explain the huge losses associated with occurrence of fire in public schools. Fire calamities are popular in learning institutions locally (MOEST, 2001). Fire exposure to institutions of learning can be attributed to several factors such as failure to have safety procedure such as lack of exit points, lack of firefighting tools and inadequate Fire Fighting facilities among others (Oduor, 2012).

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

This chapter outlines summary of findings as per the study objectives, conclusions and recommendations of the study. The study recommendations were drawn from the findings and conclusions.

5.1.1 Fire Mitigation Measures

According to the study, fire mitigation measures have not been implemented into satisfaction in the public schools. The fire mitigation measures implemented do not differ across the school types, such as boys, girls and mixed schools. The findings revealed that fire mitigation measures are not dependence on type of public secondary schools in Machakos County. According to the study findings, fire mitigation measures have not been implemented in all schools irrespective of whether it is for boys, girls or mixed. These findings are consistent with Sadker *et al*. (2000) stated that a wide variety of measures need to be in place to holistically address encompassing mitigation measures, and by involving various stakeholders to ensure risks are mitigated before they occur such measures will enhance social network among members of the community and reduce anger and pressure that can lead to violent acts.

5.1.2 Adequacy of Fire Mitigation Actions

According to the findings of the study, adequacy of fire mitigation actions is not dependent on school type among public secondary schools in Machakos County. The study observed that the schools adequacy to mitigate against fire disaster occurrences needs urgent attention. Notably, the study revealed that schools classes had emergency exit doors or constructed in a manner to allow occupants easy escape. However, the study discovered that school halls do not have emergency doors and fire extinguishers. This is in line with Omolo and Simatwa (2010) who found out that only a few secondary schools had fire extinguishers; and the majority of the schools were overcrowded. It was also revealed that inadequacy of fire mitigation actions significantly affects fire occurrences causing huge financial losses.

5.1.3 Opportunities and Challenges

The study established that schools did not review their disaster mitigation policies over time. This is consistent with Okumbe (2001) and MOE (2008), who outlined that, disaster mitigation

measures need to be continually reviewed for effectiveness. According to the study, there is a linear relationship between fire mitigation challenges and opportunities and Fire Mitigation in public secondary schools in Machakos County. This concurs with the findings of a study by Makhanu (2009), which stated that most learning institutions lack fire response teams or department, and those that have teams' in-place are not properly trained in firefighting and response. He also noted that school buildings are not adequately equipped with firefighting equipment. The findings are also congruent with (The World Bank 2010), who found out that disaster mitigation faces numerous challenges associated with non-existent or ineffective mitigation strategies, low capacities; (including funding); and most importantly, weak disaster governance frameworks.

The study established that schools had challenges on policy and legislation on matters of fire mitigation. Similarly schools were found to have disaster mitigation funding challenges. This is consistent with. Omolo et *al.* (2010), who found out that inadequate funding is the major hindrance to the implementation of school fire mitigation policies and practice. Kirui, Mbugwa & Sang (2011) also noted that underfunding in schools limits an effective implementation of fire mitigation standards. The study further revealed that institutional and administrative hiccups were challenges in fire mitigation in secondary schools. The findings were consistent with Cornacchia (1984) who found out that schools need to put into account, stepwise procedures to the measures on how to avoid and cope with critical incidents to be effective.

5.2. Conclusions

The study confirms that fire mitigation actions in most schools are inadequate. The firefighting equipment available in most schools is fire extinguishers, fire alarms and fire exits. The other firefighting equipment are very inadequate. Study findings revealed that kitchen laboratory and halls have the necessary equipment for fire disaster. However, fire extinguishers were found not to be accessible; exits are there but had obstructions and classroom doors mostly and outwards. It can therefore be concluded that schools have made an effort to improve fire disaster preparedness but their preparedness in still poor and needs to be improved.

It can further be concluded that most schools are not prepared in fire disaster management because most of them have evacuation plans which have never used. Most schools have only one assembly point while the majorities have none. Based on the findings, school teachers are not well trained on fire safety because there has not been a fire disaster management program for secondary schools formulated by all stakeholders. Majority of schools do not have individuals in

the school who are trained on what to do in case of a fire disaster. It can therefore be concluded that schools are not well prepared in fire disaster management because there has been few collaborative efforts of all involved stakeholders to have a fire disaster program for public secondary schools on fire disasters mitigation.

5.3. Recommendations

1. Recommendations for School Communities

The study recommends that, school management should consider adding the firefighting equipment like fire exits, reliable water supply, fire extinguishers, smoke detectors, fire blankets, fire fighters' outfits, fire hydrants, fire escape ladder and fire hose and nozzles so that they become adequate and proportional to the number of buildings and people in the schools. It is also recommended that the firefighting equipment in schools should be inspected more often to ensure that they are always in a working condition. The study further recommended that fire extinguishers be easily accessible, windows should not be grilled, exits should be cleared of obstructions, fire extinguishers should be increased and doors should open outwards. School principals, teachers and students should be made aware of evacuation plans, they should also have fire alert systems and conspicuously well labeled fire assembly points in case of a fire. School communities should as well have trained personals of fire marshals such as security officers and teachers on how to use the fire equipment in school in case of a fire disaster. Trained First Aiders should also be available and refreshing training courses administered yearly to them on how to handle fire casualties. Firefighting experts should also be invited in schools to talk to the stakeholders on fire disaster management.

2. Recommendations for the National Government

The study recommends an assessment of school environment, the formation of the incident management team, formulation of approaches and implementation of violent prevention strategies. The study also recommends that schools need to put into account, stepwise procedures to the measures on how to avoid and cope with critical incidents. The government ought to ensure that, fire mitigation measures and policies for schools need to be continually reviewed for effectiveness. The government also needs to adequately fund fire mitigation policies and practices to ensure effective implementation of fire mitigation standards in schools in the country. The government needs to set out programs to mitigate losses through various fire management policies and guidelines. It is also recommended that the government through the

ministry of Education needs to set school safety programs to promote security of school learning environment by promoting behavioral discipline.

3. Recommendations for the County Government

The study recommends County Governments to effectively plan for fire mitigation. There should be: clear and detailed records of the buildings and grounds plan comprising of the installations; knowledge of the location of firefighting equipment, water supply, hydrants and standpipes; plans of, storage of, and alternatives to the public, private and natural water sources. They should have best knowledge on the use and maintenance of first responder firefighting equipment; coordination and networking between School principals and fire department. In addition, through early coordination with school representative in event of fire outbreak, they should have knowledge about human resource (number of students in respective schools in the county) and users of facilities and services provided (dormitories, labs, kitchen or classes) in order to have a non-overwhelming or over-capacitated situation.

4. Recommendations for professional Bodies

Since disasters are a great concern to public safety, and that the threat of fire disaster is always present, it is recommended that professional bodies need to take up the issue of awakening professional practice. Professional bodies have been recommended to organize, plan and implement measures that ensure the wellbeing of professional practice. Professional bodies need to form a team tasked with the specific responsibility to: review actions to address the protection needs of schools; mobilize resources to protect the staff and students in the school environment; establish networks to protect schools; engage relevant stakeholders; advice stakeholders to create safety awareness policies and guidelines to protect schools; and continually review such programs.

5.4 Suggestions for further study

The study methodology has targeted public schools who expressed their opinions on the adequacy of fire mitigation programs in secondary schools in Machakos County, Kenya. As a future avenue of research, there is need to carry out a research on the effectiveness of the policies and regulations from the government on fire mitigation is secondary schools.

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APPENDICES

APPENDIX I: INTRODUCTORY LETTER TO RESEARCH PARTICIPANTS

Dear Respondent:

My name is MOSES ULANGA MUISYO, a student in the University of Nairobi, carrying out a research on the **Building Disaster Resilient Communities: A Case of Fire Mitigation in Secondary Schools of Machakos County, Kenya.** The purpose for this questionnaire is to assess the prevention and mitigation mechanisms of fire in boarding secondary schools in Machakos County. Your contribution in giving accurate information will aid a solution the objective mentioned. Your responses will be treated as confidential and solely for the purpose of this research.

MOSES ULANGA MUISYO
C50/80434/2015

Note: Your participation is voluntary and you may wish to stop if you feel uncomfortable.

APPENDIX II A: INSTRUMENTS OF DATA COLLECTION

SCHOOL NAME: _____

Date: _____

Ref No.: _____

SECTION A: PERSONAL / SCHOOL DETAILS

Please answer the questions appropriately by placing a tick [√] against your option or by filling in the blank space provided

1. What is your gender?
   a. Male [ ]
   b. Female [ ]

2. Indicate the number of years you have been in the school
   a. 1 - 5 years [ ]
   b. 6 - 10 years [ ]
   c. 11 - 15 years [ ]
   d. 16 - 20 years [ ]
   e. 20 and above [ ]

3. Type of your school
   a. Boys [ ]
   b. Girls [ ]
   c. Mixed [ ]

4. What is the status of your school?
   a. Boarding [ ]
   b. Day [ ]
   c. Mixed day and boarding [ ]

5. Kindly tick your academic qualifications as applicable below.
   a. Secondary ( )
   b. Undergraduate ( )
   c. Postgraduate ( )

6. What category is your school? Tick as appropriate.
   a. National ( )

b. County ( )

　　　c. Sub-County ( )

Mitigation Measures

7. How may fire cases have been reported for the last 5 years

　　　a. None

　　　b. 1-3

　　　c. 4-6

　　　d. 7-9

　　　e. 10 and above

Can you quantify the cost of property damage during the above incidence(s)?

　　　i. Less than 1,000,000

　　　ii. 1,000,000-3,000,000

　　　iii. 3,000,000-6,000,000

　　　iv. 6,000,000-9,000,000

　　　v. Above 9,000,000

STATEMENT	Very adequate (Available and serviced upto date)	Adequate	Neutral	Inadequate	Very inadequate
Fire hydrants					
Fire extinguishers					
Fire-resistive materials					
Fire exits					
Fire protection devices					
Fire blankets					
Fire escape ladder					
Heat/smoke detectors					
Fire alarm					
Fire hose and nozzles					
Fire sand bucket					
Reliable water supply					

8. Are the Fire Fighting equipment in your school adequate?

a. Yes ( )

b. No ( )

c. I don't know ( )

9. Kindly indicate the level of adequacy of the following Fire Fighting equipment in your school

10. Are there any recent training on fire related disasters in the school?

a. Yes [ ]

b. No [ ]

11. Who trains you on fire safety preparedness?

a. Fire brigadiers [ ]

b. Private Consultant Fire Trainers [ ]

c. Teachers [ ]

d. Any other, specify_____

12. If YES on question 9, what have they been trained in? Tick (√) where applicable

a. Preventing disasters in school [ ]

b. Operating firefighting gadgets [ ]

c. Contacting police or emergency numbers [ ]

d. Operating an emergency kit [ ]

e. Evacuation measures [ ]

f. Firefighting techniques [ ]

g. Servicing of the gadgets [ ]

h. Contact person to give directions [ ]

i. Other (specify)

13. If YES on question 9, are the skills acquired during fire drills useful in handling fire disasters in the school.

a. Strongly agree [ ]

b. Agree [ ]

c. Neutral [ ]

d. Disagree [ ]

e. Strongly disagree [ ]

14. Please rate the following statements using the key below. Tick (√) as appropriate

Statement	YES	NO
The school community undertakes evacuation drills		
Evacuation drills are undertaken once a term		
First aid education is provided to the school community		
The school has sufficient first aid facilities		
First Aid kit is easily accessible to most people		
The school holds regular disaster preparedness meetings with the school community members		
There is adequate security lighting in the school		
Mechanisms for co-coordinating various disaster activities exist in the school		

Mitigation Actions

15. Are there fire exits in your dormitories?

    a. Yes

    b. No

16. How wide are the pathways or passageways?

    a. At least than 2 meters

    b. Less than 2 meters

    c. Less than 1 meters

17. What is the number if bed capacity for the above dormitory

    a. 0-50

    b. 50-100

    c. 100-150

    d. 150-200

    e. 200-250

    f. 250-300

18. How many emergency doors (clearly marked doors) are available?

    a. None

    b. 1-2

c. 2-4

d. 4 and above

19. Kindly indicate your level of agreement to the following statements in relation to school buildings and fire safety where: Strongly Agree = SA, Agree = A, Disagree = D and Strongly Disagree = SD

Statement	SD	D	N	A	SA
Exits are clear of obstructions at all times					
Fire extinguishers are placed in positions where they are easily accessible					
Combustible materials have not been used for decorations or finishing					
Does the dormitories have open wiring which can be source of fire					
Does the dormitories have socket?					
Does the classes have sockets					
If the classes have sockets, are they well maintained?					
Windows in the school have not been grilled					
Exit doors in buildings in the school swing outwards					
Boarding facilities have not been designed to lock in students					
Does the classes have emergency exit doors or constructed in a manner to allow occupants easy escape?					
Halls have emergency doors and fire extinguishers					

Challenges and Opportunities

20. Does your school review disaster mitigation policies over time?
Yes   {   }   No   {   }

21. Does your school take advantage of emerging fire mitigation requirements?
Yes   {   }   No   {   }

22. Kindly indicate your level of agreement to the following statements in relation to challenges and opportunities; where: Strongly Agree = SA, Agree = A, Disagree = D and Strongly Disagree = SD

Statement	SA	A	N	D	SD
Challenges on					
Policy and legislation					
Funding					
Institutional and Administrative					
Social cultural have no significant effect					
Opportunities on					
Building safe school communities					
Resource mobilization e.g. adding school fees					
Promotion of disaster resilient schools e.g. through awareness creation and trainings					

APPENDIX II B: KEY INFORMANT INTERVIEW SCHEDULE FOR KIIs

1. How many cases of fire hazards happened in Machakos secondary school only for the past two years?

2. Can you quantify the cost of property damages?

3. What are the major causes of fire accidents in the secondary schools?

4. Is fire safety at school part of your normal school inspections before registration?

5. What is the requirement area size for secondary school? (Average standard area per students in square meters))

6. Do you work with fire and rescue force in the day to day activities to ensure fire safety at secondary schools?

7. Are you doing training/awareness for fire preparedness in secondary school?

8. Do you have any fire safety curricula for schools?

9. Do you involve other relevant department in the inspection of secondary schools? Which one?

10. Do the schools have a copy of fire safety standards manual (2008) for school in Kenya?

11. In your own opinion how has it been implemented?

12. What is your opinion on the implementation of the government policy of safety standards and guidelines?

13. What are the possible constraints to compliance to fire safety standards and guidelines

14. Have you ever received any complaints from the public or students about the deliberate plans to start fire in schools?

15. If yes what action your department normally take to solve the problem.

APPENDIX II C: OBSERVATION CHECKLIST FOR SCHOOLS

School Hazard Mitigation Checklist

SCHOOL NAME: _____

Date:_____

Ref No.:_____

ITEMS	CHECK	
Office rooms: Objects from above		
ceiling	unsuspended	☐
Fire sprinklers	brace to wall or ceiling joist	☐
Hanging lights, fans, plants, mobiles, displays	Close hooks	☐
Ceiling fans	Secure to ceiling joist	☐
Picture frames	Close hooks	☐
Tall furniture		
Tall bookcases, cabinets, coat closets	Anchor to wall studs & shelving straps; has no heavy object	☐
File cabinets		☐
Lab cabinets	Chemical and breakable items in low cabinet	☐
Cafeteria		
Cupboards	Safety latches	☐
Gas appliances	Safety chain for gas cylinders, Flexible connectors/hose, attach to wall stud	☐
Refrigerator		☐
Tables	Secure to floors with straps or bolts	☐
Glass		
Windows and transoms	Safety glass and safety film, blinds, curtains	☐
Fire Exit		
Route	Free from obstruction and objects	☐
Point/Assembly	Clear written/sign post	☐

Classrooms/ Dormitories		
Blocks	Fire extinguishers	☐
Learning rooms	adequate doorways opens outwards and should not be locked from outside at any time when learners are inside	
	without grills windows	☐
	7.5m x 5.85m or 7.5m x 6.0m terms of length and width	☐
	Maximum of 30 learners in one-seater desks or 40 learners in two seater desks	
	Directional and Caution Signage	☐
	No open electric wires and sockets	☐
Story block	Wide stairways and located at both ends of the building	
Dormitory Halls	1.2 metres space between the beds (at least); corridor or pathway space (not less than) 2 metres; (at least) 5 feet wide doorways	☐
	Have a door at each end and an additional emergency exit at the middle.	☐
	Windows without grills and opens outwards	☐
	Functioning fire extinguishing equipment at each exit with fire alarm fitted at easily accessible points.	☐
	Directional and Caution Signage	☐
	No open electric wires and sockets	☐

APPENDIX III: RESEARCH PERMIT

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/18079/25710**
Date: **2ⁿᵈ October, 2018**

Moses Ulanga Muisyo
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *"Building disaster resilient communities: A case of fire mitigation targeting in secondary schools of Machakos County, Kenya"* I am pleased to inform you that you have been authorized to undertake research in **Machakos County** for the period ending **2ⁿᵈ October, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Machakos County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner
Machakos County.

The County Director of Education
Machakos County.

APPENDIX IV: KREJCIE & MORGAN TABLE

Table 3.1									
Table for Determining Sample Size of a Known Population									
N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384
Note: N is Population Size; S is Sample Size						*Source: Krejcie & Morgan, 1970*			

APPENDIX V: LIST OF PLATES
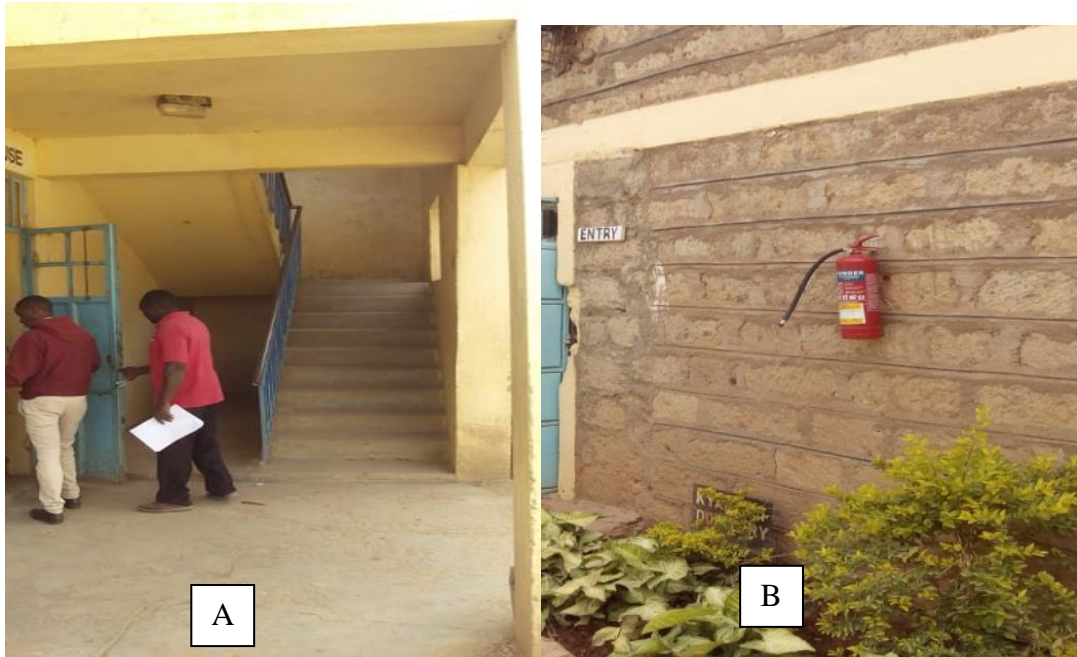
Plate 3: Observation of engineering (A) and fire safety equipment (B)

Plate 4: Good engineering design with additional emergency door at sides (A) and Semi-grilled window at burnt Malinda dormitory in Machakos Boys (B)