

**VULNERABILITY OF SCHOOLS IN URBAN INFORMAL SETTLEMENTS TO
HAZARDS AND DISASTERS: A CASE STUDY OF NAIROBI'S MUKURU KWA
NJENGA INFORMAL SETTLEMENT**

BY

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DECLARATION

This research project is my original work and has never been submitted for examination in any other University

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LIST OF ACRONYMS

FPE...Free Primary Education

IWSC International Water and Sanitation Centre

JKIA...Jommo Kenyatta International Airport

KNPDM...Kenya National Policy for Disaster Management

NGOs...Non-Governmental Organizations

OSHA...Occupational Safety and Health Agency

SWR...Share the World's Resources

UN...United Nations

UNICEF...United Nations Children's' Fund

UNDP...United Nations Development Program

UN-Habitat...United Nations Human Settlement Program

WHO...World Health Organization.

DIPSIR...Drivers-Pressures-State-Impact and Responses

Kshs...Kenya Shillings

ABSTRACT

Informal settlements in urban areas around the world are usually faced with a number of environmental hazards largely due to the very high population densities characterising these areas. Some of the environmental hazards in the urban informal settlements include pollution, fire, demolitions, sanitation challenges, and electric faults among others. Among the informal settlements are to be found education institutions and learners usually exposed to the hazards and this is largely attributed to lack of social infrastructures as informal settlements tend to exist outside the formal provisions budgets of many urban authorities. The lack of essential services results in learners in informal settlement schools being highly exposed to many hazards. This study addressed the problem of vulnerability of education institutions and learners to the environmental hazards and disasters in terms of types of risks, factors influencing vulnerability to hazards and mitigations measures. Solutions to the problems were aimed at determining the types of hazards and disasters, factors affecting vulnerability to hazards and disasters and, appropriate mitigation measures in Mukuru Kwa Njenga schools' environment. The study used the hypotheses that there were no hazards and potential disasters facing students in the schools in Mukuru Kwa Njenga; schools in Mukuru Kwa Njenga were not located in hazardous environments making them vulnerable and lastly; there were no satisfactory mitigation measures put in place to reduce the vulnerability of Mukuru Kwa Njenga schools to hazards.

The study was carried out in Mukuru kwa Njenga informal settlements in Nairobi, Kenya where 12 primary schools and 2 secondary schools, respectively were included in the sample data. The schools included in the sample survey were purposely selected based on the fact that they were the only schools within the Mukuru kwa Njenga amongst the many schools in Mukuru informal settlement area. From the 12 primary schools and 2 secondary schools, 336 students, 64 teachers and 14 head teachers were included in the sample data. The resulting data file was used in the data analysis procedures including descriptive statistical techniques for distribution tendencies measures (central tendency

and dispersion tendency) and inferential statistical techniques mainly dealing with measures of difference. The descriptive statistical tools used included frequency tabulation and graphical representation. From the results of descriptive analysis, appropriate inferential statistical tools were identified for measuring differences in types of hazards and disasters, factors of vulnerability and mitigation measures. The inferential techniques used were chi-squares test, ANOVA and z-test (significance in all cases tested at $\alpha 0.05$).

The types of hazards and disasters facing schools in Mukuru Kwa Njenga were determined to be flooding, sewage leaks, demolitions, robbery with violence, fire and election related violence. Factors that made schools and learners to be vulnerable to the identified hazards and disasters were inadequacy of learning facilities and resources including furniture, clean food and water, inadequate disaster prevention tools like firefighting equipment, insecure environment and location in relation to proximity to some of the hazards. The mitigation measures were found to include improvement of security measures around the schools by erecting perimeter walls, gates and employing and training already employed security guards, conducting security drills, improving drainage within and around the schools, and employing guidance and counselling professionals to handle the aftermath of hazards and disasters.

This study made the following recommendations to minimize vulnerability of schools in urban marginalized areas. The schools within urban informal settlements should be helped to cope with the high population of students that they are faced with. Relevant authorities should ensure training on hazards and disaster response is given to all those who want to run private schools. The government should take necessary steps to inspect and document the school's status and the hazards they face. Further, there is need for licensed water supplying institutions to make schools a priority target for their supply. Finally, a similar research as this should be undertaken using a larger sample. This will show if the findings of this study are area specific or that the conclusions can be replicated elsewhere thus necessitating similar mitigation measures.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Nearly all major urban environments in the world have aspects of informal settlements within them where there exist unplanned human settlements that often lack tenure. Informal settlements are found in all corners of the world namely the Neza-Chalco-Itza informal settlements in Mexico city with an estimated population of four million people, Orangi town in Karachi, Pakistan, Dharavi in Mumbai, Khayelitsha in Cape town South Africa and more locally Kibera and Mukuru Kwa Njenga (Mutisya and Yarime,2011) . As a result of the quick spread of informal settlements coupled with the high movement of people to urban centres, the city, town or local; authorities face the challenge of properly adequately providing the physical and social amenities needed in such environments (UN Habitat III Issue paper, 2015). As a result of the high population densities and lack of planning in urban informal settlements, there are environmental hazards and disasters which face the inhabitants of these environments.

Informal settlements were initially treated with hostility by the concerned authorities through frequent evictions and displacements since they did not conform to the physical plans of the time but in recent times, realisation that informal settlements are a reality has resulted in some moves to accommodate the informal settlements more recently, authorities are beginning to recognise their existence and there is action aimed at provision of basic services despite the reality that lack of tenure may still be a long term problem. (Mutisya and Yarime, 2011).The problem of slums, as they are commonly known, and their growths is also recognised in the Millennium Development Goals as specified in Agenda 21 of the World leaders Conference of Rio (UN, 1992). The increasing rates of rural to urban migration plus the lack of proper planning for this immigrants leads to the poor state exhibited in slum areas (SWR, 2010).

Factors which predispose the inhabitants to hazards and disasters key among them being the rapid growth of the urban informal settlements influences the vulnerability to hazards and disasters in informal settlements in urban areas.. This rapid growth is witnessed mainly in the less developing world for instance Kenya where the informal settlements are growing at the rate of 5% and may go up to 10% within the next three decades unless positively addressed (UNDP, 2007). The lack of employment of most urban dwellers is mainly caused by the ever increasing immigration into the urban centres by rural residents resulting in the emergence of informal settlements exhibited by the absence of basic social provisions necessary for human livelihood (Mutisya and Yarime, 2011). The attempts by the local authorities to properly plan for the slum dwellers is challenged by legal constraints emanating from tenure aspects in these informal settlements. It can therefore be noted that vulnerability to hazards and disasters is greatly influenced by the prevailing environmental conditions in the urban informal settlements and that the people most vulnerable are the inhabitants of such informal settlements.

Several attempts have been made at reducing the effects of hazards and disasters on the inhabitants of informal settlements such as floodplain mapping, construction of homes in flood prone areas, adoption of land use and zoning, public awareness on disasters, proper building plans and also introduction of insurance plans to caution the affected communities (UN Habitat III Issue paper, 2015). In spite of all these, the inhabitants of urban informal settlements still face the challenges of hazards and disasters and as such this study was geared towards determining the mitigation measures to hazards and disasters in Mukuru Kwa Njenga informal settlements

1.2 Statement of the Problem

This study aimed at establishing the types of hazards and disasters in Mukuru Kwa Njenga, the vulnerability of schools within Mukuru Kwa Njenga to hazards and disasters and the mitigation measures against these hazards and disasters. Disasters and hazards comprise drought, fire, floods, train accidents, terrorism activities, ferry accidents, road accidents, HIV/Aids pandemic, earthquakes, locust invasions, livestock disease outbreaks, air accidents and human conflict.

The rate of urban population in Kenya is always rising and may reach half of Kenya's population within the next decade (Government of Kenya, 1999). This growth of urban centres coupled with the lack of amenities to hold the urban population leads to the growth and spread of slums. The study sought to assess the vulnerability of schools located in slums and more specifically Mukuru Kwa Njenga slums in Nairobi.

Mukuru Kwa Njenga informal settlements is among the many informal settlements within Nairobi County which is characterized by improper infrastructural planning and the lack of basic social amenities. About half of Nairobi's population i.e. about 59% reside in informal settlements. Known informal settlements within Nairobi include Kibera, Mathare, Korogocho and Mukuru within which are various environmental concerns namely poor drainage, poor sanitation, dumping of both biodegradable and non-biodegradable domestic and industrial waste, flooding and fire outbreaks, crime and lawlessness and as a result schools located in such environments are therefore prone to these hazards and disasters. This implies that the inhabitants of such environments are constantly faced with hazards and disasters. Of concern to this study are the types of hazards and disasters and their potential impacts on schools located within environments such as Mukuru Kwa Njenga. Mukuru Kwa Njenga slum location lies about 12 kilometres South East of Nairobi city's central business district. It has a population of about 130, 401 living in an area of 12 kilometre squared and a population density of 16,720 (2009 Kenya National Census Report, 2010).

The Kenya National Policy for Disaster Management-KNPDM (2009) views a something which negatively alters the life, environment, society or the physical well being of individuals. The resultant effect of hazard according to this view is that it does more harm to the people affected by it. KNPDM (2009) also views a disaster in terms of the affected people's ability to cope to the losses incurred by events which seriously disrupt their normal daily life. Disasters are broadly categorized by KNPDM (2009) into two categories; natural and man-made disasters. Vulnerability, as defined by the KNPDM (2009) encompasses how susceptible a society is to outcomes of a disaster within their environment with regards to their social and economic wellbeing. This means that

vulnerability is viewed from the aspect of ability to endure, cope, experience and pick up from hazardous impacts.

KNDRP, 2009 states that about 60% of Kenya's urban population live in informal settlements such as slums. Urban populations has increased in the past half century thus creating a great challenge to the provision of social amenities in these urban centers mainly in the third world countries such as. This leads to overcrowding in the slum areas and inability to live a decent lifestyle due to the absence of the social amenities.

From these definitions, it can be deduced that a hazard is therefore an event which is capable of damaging an environment be it physical or human. Vulnerability is the inability to cope with the predisposing harmful conditions in the environment. When hazards and vulnerability exist in an environment, then a disaster may occur. Therefore, a disaster is something that happens suddenly and causes much suffering or loss. It may be caused by natural causes or by human activities. It can therefore be said that vulnerability is a consequence of economic, social and political ongoing and is not solely dependent on the presence of a hazard. In a nutshell, vulnerability is the capacity to be harmed. This research asserts that schools located in the slums are often challenged by the inability to provide the basic learning materials coupled with the unconducive learning environments especially from without the school and despite the fact that there has been a general improvement in the health sector, there still exists a big challenge to the provision of good healthcare within slums due to cases of poor nutrition, lack of proper sanitation, lack of proper shelter, pollution and the ever present reality that a hazard and even potentially, a disaster may strike any time.

Ndiang'ui (2006) states that some of the schools may be lacking all the resources they need including space for school expansion meaning that they may not have the luxury of relocating to more conducive environments where they are faced with fewer challenges such as environmental noise pollution, foul smells, and water and sanitation problems. Learning being an integral part of development and in line with the Kenya Vision 2030 Development Plan, any activity affecting it should be addressed and appropriate

mitigating strategies employed so as to enable smooth learning process (Kenya Vision 2030 Development, 2007)

In summary, the study aimed at establishing the vulnerability of the schools located in the informal settlements, and more specifically Mukuru Kwa Njenga, to the hazards and disasters. The study's principal objective revolved around the question; are the schools located in the informal settlement vulnerable to hazards?

1.2.1 Research Questions

The study had the following three questions:

1. What are the types of hazards and disasters facing schools in Mukuru Kwa Njenga?
2. What are the factors affecting vulnerability of schools to hazards and disasters in Mukuru Kwa Njenga?
3. What mitigation measures are in place to minimize vulnerability of students in Mukuru Kwa Njenga Schools' environment to hazards and disasters?

1.3 Objectives of the Study

The study sought to find out:

1. The types of hazards and disasters facing students in Mukuru Kwa Njenga schools' environment.
2. Factors affecting Mukuru Kwa Njenga schools' vulnerability to hazards.
3. The mitigation measures put in place to reduce the vulnerability of students in Mukuru Kwa Njenga schools' environment to hazards.

1.4 Study Hypotheses

To guide in achieving the proposed objectives, this study will use the following hypotheses:

1. H_0 - hazards and disasters are not common in the schools of Mukuru Kwa Njenga.
2. H_0 - Schools in Mukuru Kwa Njenga are not vulnerable to hazards and disasters.
3. H_0 – There are no appropriate mitigation measures against vulnerability to hazards and disaster in schools of Mukuru kwa Njenga.

1.5 Justification of the Study

Past studies on vulnerability of urban marginalized communities to hazards has mainly elaborated on issues such as housing, flood, fires, climate change and pollution among others. The UN Rio Earth Summit in 1992 brought urban issues to the global limelight since it raised issues concerning sustainable development as noted in its Agenda 21 Habitat (2009). Gichuki (2005) had earlier raised the issue of sustainable human settlement who noted the scarcity of information about environmental problems in third world cities. At the time this study was conducted, there existed no systematic data collection on conditions pertaining to the environment in informal settlements of Nairobi except of select community studies relation to planned projects or existing projects evaluation therefore limited in scope. This study therefore helps to fill the existing gaps in data and information and also help understand the scope of environmental impacts in informal settlements. In cases where studies of urban environments had been done, focus tended to be on health (Gichuki, 2005). Where schools were considered in environmental issues (Ndiang'ui, 2006), focused tended to be on public schools and yet many schools in informal settlements tend to be private or run by Non-Governmental Organisations (NGOs). This study focused on schools in the informal settlement of Mukuru Kwa Njenga in terms of vulnerability to hazards and disasters.

Little work has been done on vulnerability of schools in informal settlements and this studies attempted to fill the gap in terms of vulnerability of Schools in urban marginalized informal schools to hazards in Mukuru Kwa Njenga of Nairobi in Kenya.

Generally, many tend to consider informal settlements as unsafe and not conducive for any meaningful learning to occur and yet there exists quite schools willing to accept the ever increasing demand for learning by children from their catchment areas. This scenario often lead question of safety and vulnerability to hazards in the schools

environments. This study therefore sought to have a measure of vulnerability of schools in Mukuru Kwa Njenga to hazards and disasters in terms of types of hazards and disasters, factors affecting vulnerability to hazards and disasters and associated mitigation measures.

This study gives an insight on the views held by students, parents, teachers, community leaders and other stakeholders on the hazards and disasters they may face in the informal settlements. This study also brings further awareness of the problem and initiate efforts towards further research to and actions by governments and community based organizations. Mukuru Kwa Njenga was chosen because it has many environmental variables that exemplify informal settlements in Nairobi County. This study could also be replicated elsewhere and produce valid results in other informal settlements. Peoples' lives are affected by disasters when they are displaced, their means of living and property are destroyed and through loss of life. This negates the development achieved over long periods hence making it impossible to achieve the Millenium Development goal of poverty eradication.

Poverty and lack of basic resources to better the livelihoods of the urban poor has led to increase of the negative impacts of hazards and disasters thus making them very vulnerable. The Kenyan government aims at achieving a developed state status by the year 2030 through the vision 2030 policy framework. To achieve this, the government introduced the free and compulsory basic education for primary schools in 2003 and free secondary education in 2008. In doing this, there was an upsurge of student enrolment in public primary and secondary schools which surpassed government expectations leading to overcrowding in public schools. This also stretched the resources of the public schools and therefore to combat this problem, the Kenya government has encouraged the establishment of privately owned institutions to absorb more students. Elda *et. al* (2010) asserts that this situation has resulted in the categorization of formally recognized schools into to; Public schools and private schools.

The increase in population in urban areas coupled with the inability of public and private schools to absorb all the students has resulted in the sprouting of schools in many

informal settlements in Nairobi County leading to a lot of environmental challenges. This problem not only affects the Central Business District but also the residential areas which in this case would include both formal and informal settlements. Studies have been done on the challenges faced in the slum areas. This study focused on the vulnerability of students who attend the schools located in the slums as well as explain how these slum schools are coping with the numerous environmental hazards including noise pollution from roads, nearby airport, political meetings and campaigns, social centers such as stadiums, hotels, parks, industries and also religious institutions or centers. The study hoped to gather information which could be used countrywide, Government policy makers especially those at the education department, and local administrators for adoption, planning and execution of methods aimed at making the learning environments safe and learner friendly be it in the slums of Nairobi or schools located in other slums across the country. To scholars and planners, the study hoped to assist in understanding the current trends of urban school planning with emphasis on slum schools. The study also went a long way in examining the direct impacts of these hazards on the smooth learning process in the schools.

1.6 Scope and Limitations of the Study

This study had three objectives i.e. the types of hazards and disasters facing students in Mukuru Kwa Njenga schools' environment, Factors affecting Mukuru Kwa Njenga schools' vulnerability to hazards and disasters and the mitigation measures put in place to reduce the vulnerability of students in Mukuru Kwa Njenga schools' environment to hazards.

The study focused on those hazards and disasters that may be present within urban informal settlements. There may be hazards and disasters that may exist in other environments but may not necessarily be occurring in urban informal settlements. Similarly, the study focused on the factors that affect vulnerability of schools to hazards and disasters and not on the causal factors of these hazards and disasters. Additionally, the study determined the mitigation measures to the hazards and disasters facing such

schools and did not look into the coping capacities of such schools after the disasters have occurred.

In terms of population this study was confined to a larger extent on the students and mainly those in slum schools in Mukuru Kwa Njenga slums. In this regard it is vital to note that the school environment incorporates a multiplicity of varied actors (students, teachers, administrators and parents). This is because the student is the real consumer of formal learning and any negative influence on the learner hinders effective classroom learning in totality. Generally this study only observed issues in schools within the Mukuru Kwa Njenga informal settlement.

The study is a research paper which used interviews and written questionnaires to collect data. Definitions used in the research may be of two kinds i.e. those of the respondents and those used by the researcher. As a result, deductions from this study may not be construed to other populations but the one studied. The study used self reported method to collect data thus accuracy question may be raised. In such studies, respondents may choose to be honest or not and quite often therefore it cannot be guaranteed that they were actually honest. Data on this study was obtained from parents, students, teachers, government agencies and administrators of the selected slum schools. Scholars' view was also considered as well as reports and studies on the challenges facing schooling in Mukuru Kwa Njenga.

This study did not consider schools in urban formal settlements or schools in rural areas. The study limited itself to Mukuru Kwa Njenga slums in Nairobi and did not consider other slums in Nairobi or in other Kenyan towns. Additionally, although natural features combined with the economic activities of the surrounding area including geography, topography and climate are determinants of the nature of environmental hazards and disasters; these were not be separately documented by the study since they manifest themselves in the neighborhood conditions. Another limitation was the inadequate literature concerning this topic. Much of the information in this paper was collected from the field.

1.7 Operational Definitions

Hazards- Conditions within the school environment which predispose those within and around the schools to disaster.

Disaster- Any environmental loss, which exceed the ability of the affected school to cope without outside interventions thus leading to massive disruption of the functions of the school.

Vulnerability- Those characteristics and circumstances of a community, system or asset that makes it susceptible to the damaging effects of a hazard.

Mitigation measures- Efforts made by school managements to limit the effects of hazards and disasters on the school population.

Factor- Event or activity which exposes the schools' population to hazards and disasters and whose presence or absence enable the measuring of vulnerability.

Student- Is a child or pupil that attends school for purposes of learning.

CHAPTER TWO

2.0 LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This literature review aimed at capturing relevant information on hazards and disasters and their potential effect on students attending schools located in the slum areas. The specific objectives of the literature review included; To know the current trends in literature concerning vulnerability to hazards and disasters in informal settlements. To know the methodologies applied in the literature concerning vulnerability to hazards and disasters in informal settlements. To add knowledge to the existing literature on the vulnerability to hazards and disasters in informal settlements.

The literature review begins with the definitions of terminologies in urban informal settlement and environment. It then proceeds by analyzing the works of various authors and researchers on the concepts related to the already defined terminologies and their relation to the topic of research and more specifically on the types of hazards and disasters. The review then examines the occurrence of hazards in informal settlements and the vulnerability to hazards and disasters in informal settlements. Finally, the review looks at the vulnerability of schools to hazards and disasters in informal settlements. The literature review therefore proceeds from the general to the specific.

2.2. Definitions of Vulnerability Concepts, Hazards, Disaster and Informal Settlements

2.2.1 Vulnerability

There exists no universality on the meanings of the terms vulnerability, hazards, disaster and informal settlements and usage tend to vary with disciplinary background and applications and it was the lack of universality that necessitated the review of existing literature in order to have operational terms in this study. According to UNDP (2007), vulnerability encompasses those conditions emanating from situations that minimize the

coping capabilities of a society to disasters. From this viewpoint, vulnerability factors in the ability to expect, handle, avoid and manage the occurrence of a hazard. This approach offers a wide spectrum since it examines vulnerability from the community perspective. This UNDP view is supported though with improvement in the report of the KNPDM (2009) which defined vulnerability from the community perspective and its susceptibility to hazards. WHO (1999) on the other hand offers a functional definition of vulnerability by looking at the extent of exposure to hazards and the coping capacities of the people. This same view is also shared by Khisa (2008) who defines vulnerability from the susceptibility angle by looking at it as a negative outcome to exposure to a hazard. These definitions restrict themselves to the event but not consider the circumstances or the pre-disposing characteristics in the environment.

Birkmann (2004) introduces the poverty dimension in the definition of vulnerability in which vulnerability in urban dwellings context is considered in terms of poverty which is where there is inability to properly meet the basic needs required by an individual or household. This approach limits itself to the individual or household and does not look at the community or society. Ndiang'ui (2006) defines vulnerability as 'the capacity to be harmed.' This definition leaves out the social, economic and political aspects of vulnerability since it does not look at the factors that lead to this vulnerability.

This study adopted the KNPDM definition which was considered more holistic since it viewed the susceptibility of the community in relation to the negative outcomes of a hazard. With this view in mind, when analyzing vulnerability a detailed examination of the people's reaction, adaptation and coping capacities towards the hazard are key matters addressed.

Several types of vulnerability also exist especially in the slum context for example social vulnerability, Institutional vulnerability, System vulnerability, Economic vulnerability, Environmental vulnerability and vulnerability caused through unsustainable practices. This study employed more of the social aspect of vulnerability since it involves more of human aspect.

Pelling and Wisner (2009) offers a wider definition of an informal settlement as those which though illegal, the inhabitants are somehow guarded by laws that allow them ownership of those areas because they reside in such places and which lack basic social amenities, proper housing and even essential services from government agencies. More specifically, a slum environment often lacks good houses, water facilities, proper sanitation, security and the residents have little or no land tenure.

‘Informal settlements’ or slums are:

“(i) Residential areas where a group of housing units has been constructed on land to which the occupants have no legal claim, or which they occupy illegally.

(ii) Unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing)” (UN-Habitat, 2009).

2.2.2 Hazards

A hazard with reference to the WHO’s (1999) definition is a threat, which has the potential to cause damage for instance potential cause death, destruction to property, disruption of means of livelihood and harm to the environment and therefore threatens lives, the health, properties and the environments occupied by the people faced by the hazard. This viewpoint of a hazard is also shared by UN-Habitat which looks at hazards as events which can damage or degrade life, property, or the environment. Both definitions offer wide scopes and encompass all aspects of hazards.

Disasters are closely related to hazards in that when large scale hazards occur, they are referred to as disasters. Disasters therefore “ serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources”.

The Kenya National Policy for Disaster Management-KNPDM (2009) definition of a hazard is comparatively broader since it addresses all the core aspects of the environment which a hazard may be presumed to occur. It includes the social, environmental, economic and health dimensions of an activity deemed harmful to humans. It is broad

compared to the definition of hazards by Khisa (2008) who defines hazards as those conditions which pose threats to human beings and their possessions such as life, property and the wider environment.

2.2.3 Disasters

WHO (2002) definition of disaster as occurrences which lead to death, decline of health, negative change to the environment which may require help or intervention from areas not directly impacted by the event. Disasters have previously been looked at together with hazards since hazards often lead to disasters. The KNPDM definition however, does not link hazards to disasters and goes ahead to describe a an event which causes serious interruptions to the activities occurring in a society often leading to loss of human life, economic destruction and alteration of the environment and often surpasses the coping capabilities of the affected society.

Shauri (2007) offers a wider perspective of the term ‘disaster’ stating that the definition of disaster is heavily reliant on the user of the word and the environment or circumstance under which it is being used i.e. is the person using the word convinced that the word fits in the current scenario? Shauri concludes that disasters are negative and that they result in deaths, destruction of properties and that the affected society may need external help to manage the effects of the disaster.

From these definitions, this research will adopt the KNPDM (2009) definition that ‘a disaster is any serious disruption of the functioning of a society or community causing widespread human, animal, material or environmental loss, which exceed the ability of the affected society or community to cope without outside interventions’.

2.3 Types of Hazards and Disasters

The commonwealth of Australia (2006) categorizes disasters into two types, natural and non- natural disasters. These categories are further sub divided into meteorological, geological, biological and extra-terrestrial for natural disasters and for non-natural disasters human caused and technological disasters. The import of the commonwealth of Australia categorization is in indicating that not all disasters are natural events. UNDP

(2007) identified the types of natural hazards as volcanic eruptions, earthquakes, storms, mass land movements such as landslides, massive floods and earthquakes and noted that they are independently harmless. When these natural hazards come in contact with human beings, they may result in the occurrence of a disaster. The damage extent of damage caused by a disaster is heavily dependent on how vulnerable the affected people are. The more vulnerable a society is, the more the impacts felt. When disasters occur, lives are disrupted, lost and many injuries are felt. The scale of a disaster is dependent on how intense the hazard is, its level of intense and how susceptible those exposed to it are (UNDP, 2007).

The National Policy for Disaster Management-KNPDM (2009), disasters are divided into two type's i.e.

- a) Natural disasters i.e. those not directly influenced by humans and those related to climatic factors.

- b) Human made disasters which are as a direct result of human activities on the environment.

When referring to informal settlements, the National Policy for Disaster Management (2009), the categories of disasters facing informal settlements in Kenya as;

- i) Disasters caused by the environment (related to climate)

- ii) Disasters caused by Humans.

- iii) Disasters caused by Geological factors.

- iv) Disasters caused by biological factors.

Shauri (2007) lists the most common disasters in Kenya as droughts, floods, terrorism, disease epidemics, fires, landslides, earthquake and volcanic activities, industrial hazards, civil conflicts, transportation disasters, animal and pest infections.

Raphael (1986), simply divides disasters into two categories; Natural disasters which are a consequence of forces of nature and manmade disasters which are a consequence of forces of man.

2.4 Occurrence of Hazards and Disasters in informal settlements

Pelling and Wisner (2009) state that 72% of all Africa's population lives "under slum conditions" and that even though majority of the households in these slum or informal settlements are poor, not all poor households are either equally exposed or equally vulnerable to the effects of hazards and disasters since it is usually the poorest and the most recently arrived residents-frequently also the poorest- who live in the most marginal and hazardous areas. This idea is also shared by World Bank (2011) which estimates that about one billion of the six billion human populations on earth live in slums and that a great portion of people in the developing nations live in informal settlements.

Zebrowski (1998) notes that most deaths from natural disasters occur in poor and developing countries because risk assessment, safety thresh holds and mitigation measures are least likely as well as the inability to respond to disasters. This is stressed by Kovach (1995) noting that regions with the highest number of hazards are found in the developing nations such as India, Bangladesh, Philippines, the Pacific Rim and the Bay of Bengal. Similarly, UNICEF (2012) gives the example of Tropical storm Ketsana and typhoon Parma in Manila, Philippines as having killed 304 children aged between 6-18 years in the year 2009. According to Pelling and Wisner (209), about 28 African cities have experienced 166 urban disasters between 1997 to 2008 including both natural and manmade disasters affecting millions of people residing in these towns. Pelling and Wisner (2009) state that the geographical location of Harare, the capital of Zimbabwe, makes it prone and vulnerable to hazards and disasters since it lies in its own water

catchment so that industrial effluent and untreated sewage flow into the city's reservoir, Lake Chivero.

Informal settlements are mainly inhabited by poor people and as such are highly vulnerable to environmental hazards due to the nature of their residence and the near absence of required facilities (World Bank, 2011). This is further highlighted by Pelling and Wisner (2009) by stating that without proper and adequate planning to match the quick growth in urban centres, the prevailing conditions create a fertile ground for urban related disasters for example simple earthquakes may lead to structural failures in buildings, poor planning may lead to huge accidents in the industrial sector, and the absence of proper drainage patterns may lead to clogging and the emission of toxins into the environment.

Zebrowski (1998) explains vulnerability from the viewpoint of an earthquake scene by stating that the death toll of an earthquake is determined by the kind of buildings in the environment. Earthquakes do not kill; buildings do since the buildings must be vulnerable to the hazards for them to kill as in the case of the earthquakes in Iran (1968) and Turkey (1967) which killed more than 100,000 people.

UN Habitat (2009) states that slum houses lack tenure, proper sanitation, suitable structures and building materials, poor locations in hazard prone areas, congestion leading to diseases and absence of water services. According to UN Habitat poverty is predominant in slum environments and the residents are economically deprived of proper means of livelihood, lack of jobs is rampant, and the residents are discriminated and stigmatized due to the nature of the environments they live in.

UN Habitat states that all challenges faced by urban cities are majorly found in the slum environments for example the massive dumping of waste in slums, lack of proper land tenure, pollution, high rates of disease infection including HIV Aids where women and children are the most vulnerable, high rates of criminal activities, and at times lack of good administrative structures and control.

Various scholars have written on the potential causes of hazardous situations to the children. When students are exposed to aircraft noise especially around airports, they might develop heart troubles, hypertension, cardiovascular drug use and higher blood pressure (Stansfeld and Matheson, 2011).

Natural hazards experienced in Kenya are wide ranging including mud slides and land slide, forest fires especially in dry areas, flooding especially in the plains or river mouths, lightening especially where there are no arrestors, and drought which affects a greater part of the northern section of the country (UNDP, 2007). Additionally, there is the prevalence of diseases key among them being the HIV Aids pandemic which at one time was declared a disaster. All these hazards are related in that one often leads to the other eventually negatively impacting on the lives of millions.

Some hazards and disasters such as war or large scale conflicts are not restricted to slum areas but their effects are far and wide since they also affect children in many ways by exposing them to numerous dangers (UNICEF, 1987) and thus this research sought to determine the kinds of hazards and disasters that affect the children in schools within Mukuru Kwa Njenga informal settlements and the mitigation measures put in place to minimize their effect on the schools.

2.5 Vulnerability to Hazards and Disasters in informal settlements

Hazards and disasters in informal settlements are usually made worse by:

- (i) The living environments in terms of locations in which such areas exist as highlighted by Pelling and Wisner (2009) that the poor people in urban areas are proximately close to hazards thus increasing their vulnerability for example the accident in Bhopal in India.
- (ii) The absence or lack of adequate action to minimize the extent to which one is exposed to the hazard or disaster. This is due to the presence of the more demanding aspects of the slum areas such as the requirement to meet basic needs thus relegating the need to avoid a disaster.

This is also stressed by the NDRP asserting that the high poverty levels in Nairobi are the reason urban dwellers are highly vulnerable to disasters such as rising crime and civil unrest, infrastructure failures and diseases especially communicable diseases.

UNICEF (2012) states that slums are an expression of deprivation and exclusion and that children living in such environments are faced with increased risk of illnesses, under nutrition and death due to inadequacy of safe drinking water and sanitation. This is further highlighted by Shauri (2007) that vulnerability has worsened by the quick rise in population, urban poor, increased disagreements over resources, disease outbreaks and poor planning. Despite the effort by the Kenya government to address inequalities within slums in Kenya, there it is still a big challenge. (UN, 2006). For example in Kibera slums in Nairobi, which has an estimated population of about 500,000 people half being children under the age of 18 years, challenges such as lack of proper sanitation, water and criminal activities are commonplace. (UN, 2006). Hazards are ever present in the slum areas and many of them, especially the natural hazards are interrelated since one hazard often leads to another as noted by Nomdo (2002):

Examples of slum areas in third world cities which are vulnerable to hazards and disasters such as Dar-es-Salaam where more than half of Dar es Salaam's residents reside in slums which face challenges such as flooding, disease outbreaks, criminal activities and poor infrastructural facilities. Such is also the case in Sao Paulo {Brazil} and Jakarta {Indonesia} (World Bank, 2011).

The rate of growth of informal settlements in Kenya is ever increasing and may reach double digits within the next three decades unless action is taken to curb the growth (UNDP, 2007). UN-Habitat (2009) states that the poor lack means of empowering themselves thus the persistent vulnerable conditions they find themselves in.

The inadequacy of houses in informal settlements, inadequacy of water, and frequent cases of people being evicted and absence of numerous other services are a great concern in urban informal settlements (Amnesty International (2009). Most urban planners and policy makers do not include slums in their plans thus locking them out of key essential

services. This has necessitated the need for the Non Governmental bodies to fill the gap left so as to alleviate the suffering of the urban poor who reside within the slums.

Available laws dictating the construction methods to be used in urban areas are not followed and there is absence of further action to those who break such laws. In some cases, there is collusion between the landlords and the local authorities in the breaking of the laid down procedures (Amnesty International Annual Report, 2009).

Within slums, there exists lack of good infrastructure, security, ethnic conflicts, high rates of criminal activities, gang related violence and general disregard of the law (UN-Habitat 2009).

Vulnerability of informal settlements to hazards and disaster is increased by the features of the structures therein. Often, they are of low quality materials sourced from within the slum and usually poor quality which are easy to break or tear (Source: Morrissey and Taylor 2006, p100).

2.6 Vulnerability of schools to Hazards and Disasters in informal settlements

According to Pelling and Wisner (2009), increasing rates of atmospheric pollution in the informal settlements are a prime contributor to poor health in children living in these environments. A study of 433 first grade school children from the low income Alexandria township of Johannesburg found that 78% of children had levels of lead in their blood exceeding international standards and this is likely because of breathing vehicle emissions (Pelling and Wisner, 2009).

UNESCO highlights key challenges to education in slum areas as overcrowding, inadequate and poor school infrastructure; a point similarly stated by UNICEF that about half of children in urban areas of Africa and Asia are highly vulnerable to exploitation and hazardous work. This is further echoed by her majesty Queen Rania Al Abdullah of Jordan in her address to UNICEF when she says that informal settlements in Arab nations are hazardous to children, lacking in adequate sanitation and drinkable water and overcrowded thus aggravating the precarious health conditions of the children. Schools in

slums face various challenges such as overcrowding, inadequate and poor school infrastructure, HIV/Aids pandemic and an unfriendly school environment especially for girls UNESCO, 2010.

McEntire (2004) states that slum residents especially school going children rarely have proper information concerning hazards and disasters and are therefore often caught unawares when these disasters occur. Even in instances where they get the information quite early, they are usually not in a position to act accordingly due to the lack of mitigating resources in the slums. This greatly increases their vulnerability. UNICEF (2012) also noted that there is a tendency by human rights groups to focus their energies to rural children with the thought that the children in urban areas already have access to such services. This leads to inadequacy of information among the children in urban informal settlements.

Planning is also a major problem in the slum environments where the schools are located since they are erected in precarious locations in the slum areas such as next to rail-line or next to gaping holes thus exposing the students to great danger due to the ever lurking potential for disasters. McEntire concludes that there are links between development, vulnerability and disasters and that if development occurs haphazardly, vulnerability will be increased and additional disasters will result while when development is well-planned, vulnerability will be reduced and disasters will be less frequent or severe.

Most schools in Nairobi have not been properly inspected by the health department and inspections are not as frequent as they should be hence the environments in which such schools are located are not safe for learning purposes (Daily Nation, March 2000). Factories and traffic create excessive noise and pollution, causing concentration and respiratory problems as noted by UNICEF that in 2005 in Nairobi, chronic exposure to pollutants led to more than 60% of respiratory diseases among children in urban informal settlements. According to Wanjir, *et al* (2002) the high population and congestion in slums are environmental hazards and make the slum areas vulnerable to disease outbreaks especially in children. Wanjir, *et al* asserts that the sewerage problems in slums have

impacted heavily on the health of the residents who include students who usually suffer health consequences such as gastro-intestinal and respiratory diseases.

Photograph 1: Glorious Land Academy: A Primary School in Mukuru Slums



(Source; Researcher Camera, 2014)

Patel (2008) acknowledges that developing nations have higher vulnerability rates to hazards and disasters due to the lack of emergence response facilities in such countries and this is evidenced by the massive negative impacts these disasters have on them; a case in point is the earthquake which occurred in 2008 in China where over 100,000 deaths of children was reported.

The East African Standard acknowledges that schools' environment in Kenya have been degraded thus affecting education standards and quality in the learning system. Additionally, there are instances of criminal activities which in turn take alot of the children's learning time (East African Standard, 1999). A Ministry of education Commission of Inquiry on Kenya's education system (1999) stated that the decline in

quality of education within the schools can also be linked the inappropriate environments within these learning environments. Wanjir, *et al*(2002) in their research conducted in Nairobi's Githembe slums, Nairobi, assert that the lighting systems used by learners in the slum areas may cause breathing problems to the children as they learn since most of the structures in which they learn do not have proper aeration.

Mbatha (2009) highlights the challenges and potential dangers posed by congestion in classrooms as is common in slum schools by stating that upon the introduction of Free Primary Education (FPE) in Kenya in 2002, student populations doubled leading to congestion and eventual spread of respiratory and communicable diseases within the classrooms citing a disastrous case in Mukuru Kwa Njenga slums where such diseases lead to death of many students.

Photograph 2: Drainage Challenges in Mukuru Kwa Njenga



(Source; Researcher Camera, 2014)

Slum settlements still face the challenge of inadequate schools, lack of proper clinics and poor access roads and for the few lucky ones who reside next to these health facilities, they cannot afford the high cost of treatment in the health centres. Muya (2007)

summarised the resultant impacts and challenges facing schools in urban informal settlements as lack of proper physical facilities, high dropout rates especially for girls, child labour, absenteeism, child labour, sickness due to hazardous environment, drug abuse and peer influence all increasing the vulnerability of these schools to hazards and disasters.

UNICEF (2012) concluded that it is children who are most vulnerable during emergencies because of the rapid spread of diseases, lack of proper security, chaos and inadequacy of sanitation especially since informal settlements are generally crowded leading to humanitarian challenges.

2.7 Government of Kenya Policies and Initiatives To Prevent and Control Disasters

Kenya is part of the global village and therefore what happens locally may reflect the global picture. About a third of Kenyans reside in urban environments of which more than half reside in slum areas. These residents face the following challenges: Marginalization, Deprivation, Housing, Employment/underemployment, Education, Health, Insecurity, Planning, Resource allocation, Land Tenure and Administration, Legal, Governance and Institutional issues.

The Kenya government has attempted to initiate ways of tackling these challenges. However, little has been done to curb the housing problem especially of the low income populace. In spite of the local governments attempts to construct cheap affordable houses in slum areas; the lack of proper management has made the housing menace to persist. In the 1970s, joint government and World Bank initiatives to provide cheap affordable housing to low income earners such as those found in informal settlements led to the construction of houses in Umoja and Dandora areas of Nairobi. However, with time, these houses have also responded to forces dictating housing prices thus rendering them too expensive for the urban poor.

Currently, there have been joint programmes by NGOs, Government and local administrations to ensure that there is adequate housing and provision of other essential

services to those residing in urban informal settlements. Such initiatives have included Kenyan Slum Upgrading Program and Kenya Informal Settlements Improvement Project. These programmes are however challenged by the lack of a legal framework and policy and as a result, the government has set up the Slum Upgrading and Prevention Policy (NSUPP) which is now more coordinated and better placed to address the challenges faced by the previous measures.

The National Slum Upgrading and Prevention Policy (NSUPP 2012)

The Government under the Ministry of Housing, formulated the process of developing the NSUPP. This was as result of a multi stakeholder process held under the auspices of the Multi- Stakeholder Support Group Forum (MSSG). The need for NSUPP had initially been agreed upon during the MSSG held in November 2011. In July 2012 a draft concept was developed and the same was formally inaugurated in December 2012. Work commenced under a coordinating secretariat, steering committee, and various thematic groups.

The NSUPP encompasses policy and legal frameworks such as the National Housing Policy 2004, the National Land Policy 2009, the Constitution of Kenya 2010, the Draft National Urban Development Policy (NUDP) and Kenyan Vision 2030. The documents explicitly provide for the need to have a slum upgrading policy.

The Constitution of Kenya 2010 under Article 43 guarantees the right to accessible and adequate housing. Article 21 states that the Government should put in place proper laws and actions so as to achieve the goal of provision of adequate housing to its citizens. By developing the NSUPP the Government is discharging its mandated constitutional obligation. All these endeavors by the government are aimed at mitigating the hazards and disasters faced by the inhabitants of urban informal settlements such as Mukuru kwa Njenga.

Internationally and regionally perspective Kenya has signed agreements which articulate the right to housing as their core content and some these agreements are geared at addressing housing problems in slum areas.

The Policy is therefore properly anchored on clear factual, policy and legal basis.

Work Done To Date

To date the following has-been achieved by team:

- Detailing of a comprehensive concept note to serve as framework for the National Slum Upgrading and Prevention Policy formulation (Feb/Mar 2012);
- Popular endorsement of the concept note by the Multi-stakeholder Support Group Forum (April 2012);
- Establishment of coordination unit (secretariat) and activation of a technical Reference Group (April 2012);
- Activation of a multi-ministerial Steering Committee (July 2012);
- Appointment and commissioning of seven Thematic Groups constituted by 100 professionals and practitioners from government, civil society and private sectors respectively (Oct 2012);
- Development of preliminary policy thematic content (Oct-Nov 2012); and · Formal inauguration of the NSUPP formulation process (Dec 2012). - Formation of seven thematic groups who have conducted analyzed secondary data and undertaken field visits
- Development of emerging issues and recommendations papers by the thematic groups (April 2013)

2.8 Summary of Literature review

The literature review of this study indicates that disasters have for a long time been a challenge to mankind. Due to increasing populations, urbanization, modernity and scientific inventions, disasters and hazards have become complex and will continue being complex resulting in massive loss of life and property. Man therefore endeavors to find

mechanisms to minimize the impacts of these disasters and hazards. To achieve this, man must ensure that hazards and disasters are tackled at their source points by reducing vulnerability to these disasters and hazards. Vulnerability assessment such as the one in this study will therefore provide emergency prevention, mitigation, preparedness, response and recovery. With this recognition, this research will seek to investigate the vulnerability of schools in urban informal settlements to hazards and disasters.

The study examined previous studies related to the study and this helped the researcher in understanding the nature of hazards in urban marginalized schools and also provide a basis for assessment. The literature review was done due to the following issues: the hazards and potential disasters to schools, what makes the schools to be vulnerable to hazards and disasters and what are the appropriate mitigation measures towards hazards and disasters. Further this literature review aimed at shedding light on the current research material about vulnerability of the urban marginalized to hazards and disasters, identify the methodologies used in research concerning urban marginalized communities and add knowledge to the existing body of literature discussing vulnerability of the urban marginalized communities and schools.

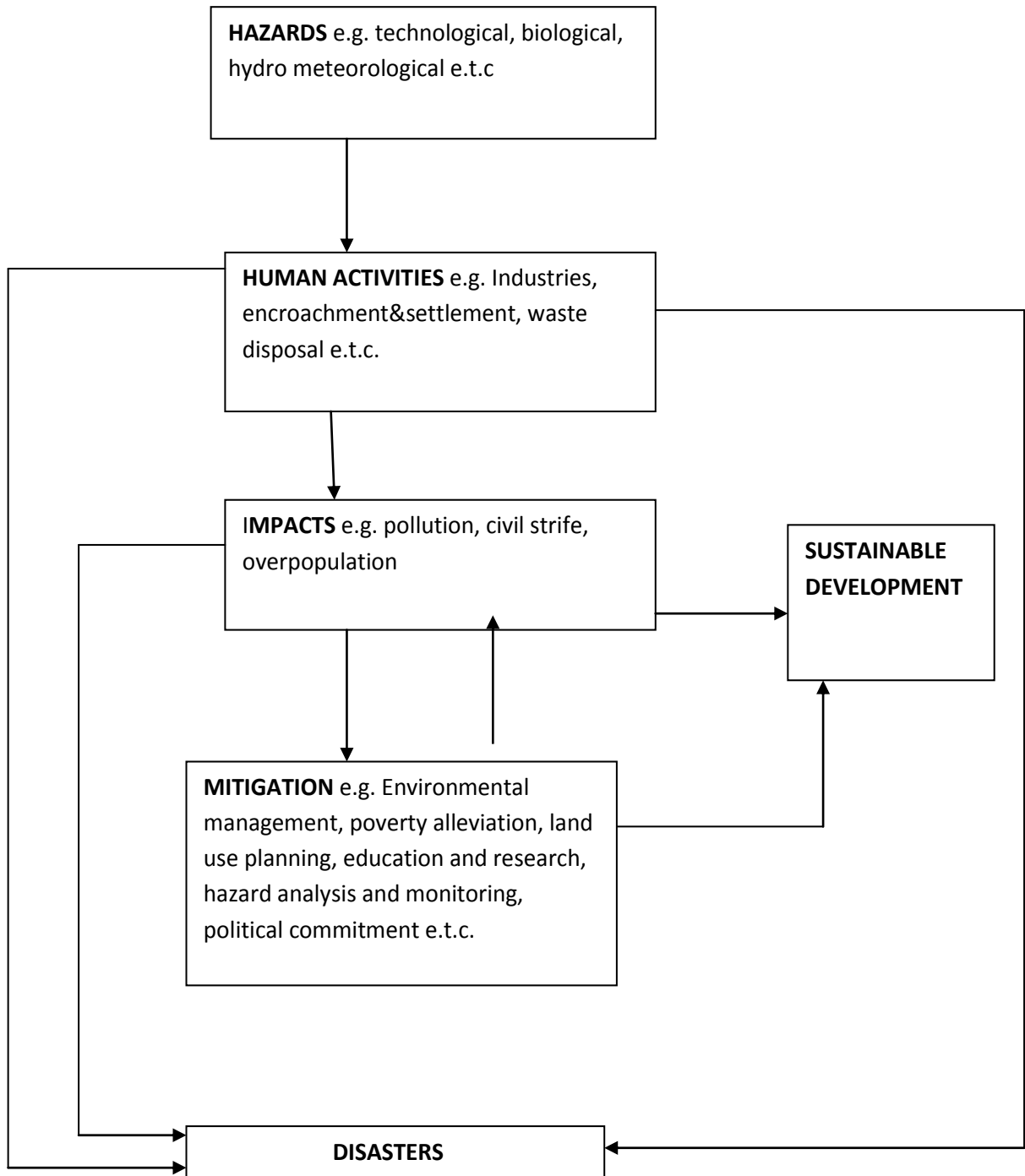
2.3 Conceptual Model

Birkmann (2004) states that the Pressure and Release conceptual model views disaster as the intersection of two forces i.e. those that generate vulnerability on one hand and the presence of a hazard on the other.

In this framework, vulnerability is seen from three different progressive points i.e. root causes, dynamic pressures and unsafe conditions. Root causes relate to the pre-existing environmental conditions which are then acted upon by dynamic pressures to create unsafe conditions. The framework further stresses that measuring vulnerability should go beyond the identification of vulnerability and further address underlying driving forces and root causes so as to clearly understand why people are vulnerable. In this research, the framework highlights the fact that human activities are the major root cause of disasters in the informal settlements. Hazard mitigation therefore minimizes the chances of disaster occurrence. Lack of a good drainage system in Mukuru is a major problem,

which enhances such vulnerability to disease epidemics and flooding. Lack of a specific dumping site means the residents have to dump wherever they can further blocking the drainage network that is now almost non-existent. Others include; permanent or temporary displacement of people increased incidences and outbreaks of water-borne, vector-borne, rodent-borne and infectious diseases and finally damage and destruction of infrastructure when the impacts of human activities are mitigated upon, a sustainable environment is created. Accordingly, if mitigation measures are put in place and implemented, disasters will be averted thus leading to sustainable development. The model thus addresses the key question of; why are people vulnerable to hazards and disasters

Figure 2.1 CONCEPTUAL MODEL



Source: Modified from Birkmann, 2004

CHAPTER THREE

3.0 STUDY AREA

3.1 Location and Size:

Mukuru Kwa Njenga informal settlement is located in Mukuru Kwa Njenga location in Nairobi County, Kenya at longitude 1.3047° South and 36.885° East and 1.18° South and 36.53° East covering an estimated 80 acres. Mukuru Kwa Njenga is an administrative location in the larger Embakasi Division in Nairobi's East lands area where a majority of informal settlements are found. Though predominantly urban, the informal settlement residents lack title deeds on the places they reside in.

3.2 Physiography

3.2.1 Geology and Soil

The rock structure is mainly impermeable igneous rocks of intermediate type composing mainly of andesite and trachyte forms. This greatly influences the drainage pattern of the area in that all the water channels are directed at Mugumoini River though they are mostly blocked due to the human settlement and rampant pollution in the area. The location is mainly made of black cotton soil with occasional phonolite clay soil especially along the swampy areas such as Transami zone (Owuor, 2010).. The area is also a quarrying zone where there has been extensive extraction of building materials leaving the base rocks bare and weak thus interfering with the geological stability of the area.

3.2.2 Topography

Mukuru Kwa Njenga informal settlement has a generally flat, plain relief gently sloping topography sloping from the southern sections to the northern parts, almost featureless with less than three degrees gradient. The location stands at an elevation of 1,661 meters above sea level. Sections of Mukuru have rugged terrains due to the excavations due to quarrying. Mugumoini River flows across the informal settlement from the South eastern side where there exists the industrial area to the Northern side of the settlement next to Donholm estate (Owuor, 2010).

3.2.3 Climate

Mukuru Kwa Njenga experiences similar climatic conditions as that experienced in the wider Nairobi. Located in the tropical region, Mukuru Kwa Njenga experiences moderate temperatures June-July being the coolest while January-February being the hottest. Average daily temperatures are 18 degrees Celsius while rainfall amounts range between 500mm to 1000mm of per annum. The area has two rain seasons for example short rains from October to December and long rains from March to May. It is during such rains that the area experiences sporadic floods (Owuor, 2010).

3.2.4 Drainage

The study area is well drained due to the gently sloping terrain and has one river flowing through it i.e. the Mugumoini River which flows into the larger Nairobi River. However, due to the general topography of the area coupled by the fact that zones such as Transami are officially gazette wetlands, water flow in the area is nearly stagnant. Artificial water channels are mostly blocked and there is spillage of water out of the water ways into pathways and roads (Owuor, 2010).

3.2.5 Vegetation

Mukuru Kwa Njenga location is in an area which was initially zoned as an industrial zone and the surrounding land uses are mainly industrial and residential (informal settlements, low income and the middle income). The natural vegetation of the area have been interfered with and altered by the intruding human settlements and the once marshy vegetation now remains in only selected areas (Owuor, 2010). Nearly all spaces available are now occupied by industries, office spaces and residential areas.

3.3 Socio-Economic Characteristics

Established in 1958, it sits on land that was once part of farm owned by white settlers to house farm laborers. It eventually became a place for poor people to build dwellings rapidly becoming overpopulated to what it is today. According to Amnesty International (2009), Mukuru Kwa Njenga, which lies 10 kilometres to the south east of Nairobi city centre has a population of about 75,000. According to 2009 Kenya Population and Housing Census Report (2010), the population of Mukuru Kwa Njenga is 130,401. It had 49,198 households with a density of 16,720 persons per square kilometre.

The area exhibits a cosmopolitan demographic environment comprising nearly all the major ethnic Kenyan communities. Due to the lack of proper land tenure system in the location, there are frequent evictions and high crime rates due to high unemployment rates especially among the youths. A majority of the residents are casual labourers working in the adjacent industrial area and neighbourhoods earning very low incomes.

The informal schools within Mukuru kwa Njenga which the community relies upon are managed by private individuals. Health service provision in the slum is also in the hands of private individuals who run them as small private businesses.

Mukuru Kwa Njenga informal settlement is located in Mukuru Kwa Njenga location which is divided into two sub locations (i.e. Kwa Njenga and Kware) and these sub locations are further subdivided into 12 sections namely 48, M.C.C, Wape, Milimani, Sisal, Riara, Vietnam, Transami, Kimondo, Lucky Summer A, B and C. Additionally, the education department has divided Mukuru Kwa Njenga location into five zones namely Embakasi, Kayole, Riara, Milimani and Mukuru Kwa Njenga. This study used the education department's classification.

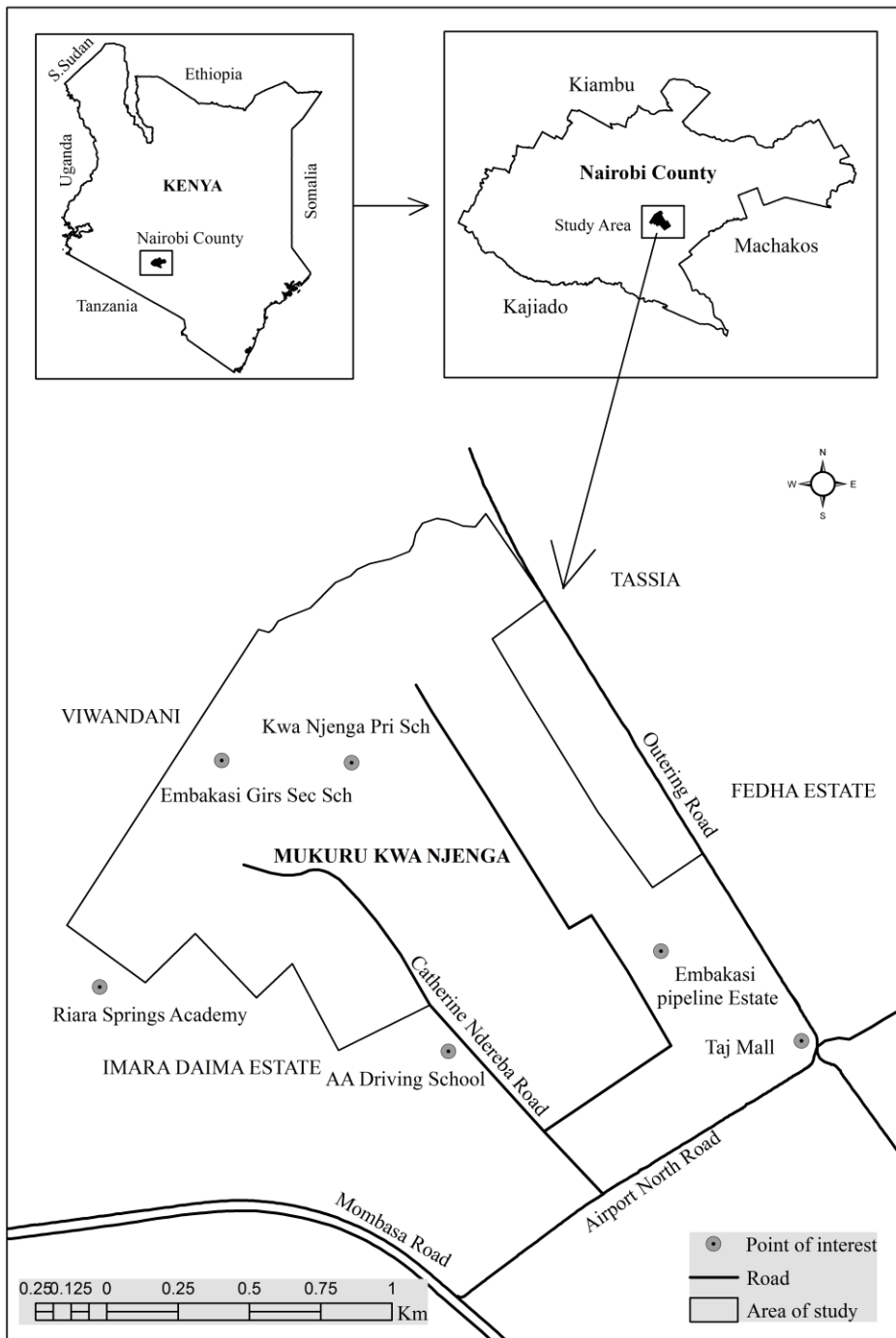


Figure 1; 1 Map of study area

Source: Mwakavi, 2016

CHAPTER FOUR

4.0 METHODOLOGY

4.1 Data Types and Sources

To address the stated study problems, meet the objectives and test hypotheses, data was collected on the following variables so as to get the required information on the types of hazards, disasters, and factors affecting vulnerability to hazards and associated mitigation measures. To get the information on hazards and disasters in the Mukuru Kwa Njenga area in Nairobi, the key variables included:

- the physical environment
- location and accessibility of the schools
- the mitigation measures in place

The physical environment in this study included the classrooms' safety and building material characteristics; the gate characteristics in terms of security, material used to construct it, and its accessibility in terms of emergency as escape route; fence (materials used to construct the fence, nature of the fence i.e. live, stonewall, barbed wire etc.); presence of dangerous electric connections and; drainage systems within schools (with regard to sewer system, water channels, flood prevention, mitigation strategies and water storage facilities available). The information on all these variables was acquired through field surveys and therefore the resulting data were all primary type. The location and accessibility in this study referred to the distance of the schools and more particularly the classrooms to open sewer/manholes, clogged drainages, and loose electric poles/wires, transport means (railway line) and noisy places (Appendix VI). Mitigation refers to the act of lessening the severity or intensity of a negative activity. The mitigation measures put in place in this study referred to the efforts put in place by relevant authorities to minimize the impacts of hazards and disasters. The variables used were; checks for matchboxes, drug and alcohol, phones, weapons and the search frequency, relevant training on hazard and disaster control, fire drills, presence of club activities dealing with

hazards and disasters within schools, availability of hazard and disaster management equipment (fire extinguisher) and also the security standards (security personnel and training, proper fence, gate in and around the school).

The information on the above variables were acquired through observation, field surveys, analysis of existing records and face to face discussions and the resulting data were both primary and secondary types. On the factors affecting vulnerability of schools to hazards and disasters, the variables used were safety standards in and around the schools (presence of fence, gate, security personnel, security checks, adequacy of classrooms, chairs, toilets, fire extinguishers, first aid kits and clean water), disaster plans within the school, hazard and disaster training within the school, and the physical location of the school in relation to rivers, health facilities and roads and railway line.

4.2. Data Collection

4.2.1. Reconnaissance Survey

The fieldwork commenced with a pre-visit of the study area to familiarize the researcher with the aspects of the area, to identify appropriate data collection instruments, to get acquaintance with the likely respondents, to know the appropriate sample size to use and also to check the effectiveness of the data collection tools in the study.

From the reconnaissance, the study established that there were 14 schools within Mukuru Kwa Njenga with student population of 3063 and a teachers' population of 176 and this was sourced from Nairobi city council's education department and from reconnaissance field observations in 2013. The reconnaissance also revealed that for pupils in primary school, only those in class 6, 7 and 8 could respond effectively to the question items in the questionnaire and while in the secondary schools it was the form 3 and 4 students who had had long enough stay in the school environment to provide experiential information on hazards and disasters, constituting a sampling frame of 1913 students. It was also established that there were a total of 176 teachers of which 14 were the school principals.

4.2.2. Sampling Frame and Sample Size

There were 3063 students in the 14 schools in Mukuru Kwa Njenga that would have constituted the study population for the student data but only those pupils in class 6, 7 and 8 at Primary level and students in form 3 and 4 at Secondary level, 1913, constituted the sampling frame for the student data. From the target population of 1913, a sample of 336 students was drawn representing both primary school pupils of classes 6-8 and secondary school students of Forms 3-4 in Mukuru Kwa Njenga. The data obtained for this study was obtained through stratification of the population in classes. The students' sample of 336 was arrived at using the Krejcie and Morgan (1970).

Sampling research requires proper methods of arriving at appropriate sample size. Krejcie & Morgan (1970) determined a formula to ease the process of coming up with a reliable sample through a process which determines all the sampling needs. This study thus derived its sample size using the pre determined formula.

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

Where S is the required sample size; X^2 is the table value of chi square for 1 degree of freedom at the desired confidence level (3.841); N is the population size; P is the population proportion (assumed to be 50 since this would provide the maximum sample size); D is the degree of accuracy expressed as a proportion (0.05)

Source: Krejcie & Morgan, 1970

Further this paper used random sampling which acted as a basic form. A sampling frame was first made from which samples were drawn bearing in mind that each sample needed to have an equal chance of being selected in each sampling round. To avoid bias in the sampling procedure, samples were picked randomly so that each individual sample remaining in the frame has an equal chance of being picked. (Kanupriya, 2012).

The method generated a sample of 322 students but 14 more students were included to provide proportional representation among the 14 schools in Mukuru Kwa Njenga. For

the teachers' sample, a sample frame of 176 teachers resulted in 64 teachers being drawn using the Krejcie and Morgan (1970) method. For the principals of the 14 schools, all were included in the study to have general administrative issues in hazards and disasters within the Mukuru Kwa Njenga school environments.

4.2.3. Data Collection Instruments

Data for this study were collected using three instruments and these were field questionnaire; camera and; observation record book. The questionnaire was designed to capture three categories of respondents and these were students; teachers and; principals. This categorization resulted in three types of questionnaires and this was necessary in providing various views on hazards, disasters and mitigation measures given various residencies, duration of stay, exposures and responsibilities in the school environments of Mukuru Kwa Njenga.

The study used open ended and closed questionnaires whereby the questions which were open ended questions assisted in getting unprompted opinions while the closed ended questions addressed the pre-determined answers to questions so as to restrict the respondents to a defined response area required to address the stated study questions and objectives.

Observation notebooks were used to record it included noting down the presence or absence of emergency preparedness, prevention and mitigation measures that had been put in place. It had key items such as types of hazards visible to the researcher, features in the study area which increase vulnerability to hazards and disasters in the environment and visible remedies or mitigation measures to the hazards and disasters observed. In this case, items noted in the notebook included nearness to the stream, precariously hanging electricity cables, presence of dumped waste around the school, poorly stocked medical facilities, presence of fire extinguishers, presence of security personnel at the gates among others.

Camera was used to capture important physical features relevant to the objectives of the study at the time of field survey such as potential hazards and indicators of mitigation

strategies to these hazards as shown in Photos 1, 2, 3 and 4 in appendix VII. This provided pictorial evidence of hazardous elements in the study area and remedial measures taken by the authorities to curb them.

4.2.4. Data Analysis

The data collected from the field were first edited for completeness and consistency. The sample data from the field were numbered and then coded resulting in a data entry book. The resulting data template was used to create a digital data file in SPSS and Microsoft Excel computer programs. The resulting data file was subjected to quality assessment in terms of accuracy, precision and completeness. A frequency distribution analysis on all variables was then used as a tool for identifying outliers and missing responses which were then confirmed with the results in the questionnaires and observation checklist sheets. The clean data files were then used to create the study database file from which all the variables required to address the stated questions were available.

To generate information from the sample data file, descriptive statistical procedures were used to measure distribution tendencies in the sample data for description. The descriptive techniques used were frequency tabulation and graphing to provide information on the types of hazards and disasters, factors affecting vulnerability to hazards and disasters and the mitigation measures. From the frequency analyses results, the variables required in giving indications of associations and differences in the sample data distributions were identified for cross tabulation analyses. The variables used in the cross tabulations were school and hazard types; birth position; fence; teachers' qualification and experience; training on security; training on disaster management; the distance from school.

4.3 Determination of Types of Hazards and Disasters

In determining the types of hazards and disasters present in the study area, the research employed descriptive statistics to measure the distribution tendencies in the sample data. The descriptive procedure used was frequency analysis (tabulation and graphing) and measures of central tendency (mean, and mode).

For frequency analysis procedure, all variables in the data files were included resulting in frequency tables, pie charts and bar charts which were used to identify the types of hazards and disasters.

The analysis of variances (ANOVA) was used to compare the common types of hazard in the schools in Mukuru Kwa Njenga. This was done by comparing the different means from the analyzed data and respondents. Where the hypothesis to be tested concerns various populations, this method is employed.

Explanation

In this research certain differences may occur. But this difference may also be the result of certain other factors which are attributed to chance and which are beyond human control. This factor is termed as “error”. Thus, the differences or variations that exist within a distribution of hazards may be attributed to error.

H₀ - There are no hazards and potential disasters facing students in the schools in Mukuru Kwa Njenga.

4.4 Determination of factors affecting Vulnerability to Hazards and Disasters

To generate information from the sample data file on factors affecting vulnerability to hazards and disasters, descriptive statistical procedures were used where to measure distribution tendencies in the sample data for accurate description. The descriptive techniques used were cross tabulation and graphing to provide information on the expected factors affecting vulnerability to hazards and disasters. From the frequency analyses results, the variables required in giving indications of associations and differences in the sample data distributions were identified. The variables were birth position, teacher qualification, and location of school, school facilities, and time taken to school.

To determine the factors affecting vulnerability of schools to hazards the chi-square test for independence was used.

H₀ - Schools in Mukuru Kwa Njenga are located in hazardous and disaster prone environments making them vulnerable.

4.5 Determination of Mitigation measures

The determination of mitigation measures of the potential hazards and disasters also involved descriptive statistics where measures of central tendency such as mode were used together with tables, graphs and pie charts to give frequency distributions. Variables considered here included the availability of fence around the school, security around the school, training on hazard and disaster management in the school and the presence of hazard and disaster management facilities such as firefighting tools.

From the three related observations a z-test was carried out to determine the types of mitigation measures ascribed to the different types of hazards that may occur. Z-tests give a similar recognition but for data samples above 30 responses. A difference is more likely to be meaningful and “real” if the difference between the averages is large, the sample size is large, and responses are consistently close to the average values and not widely spread out (the standard deviation is low).

The z-test is important when testing relationships in large enough data samples that t-tests cannot handle.

H₀ – There are NO mitigation measures put in place to reduce the vulnerability of Mukuru Kwa Njenga schools to hazards and potential disasters.

CHAPTER FIVE

5.0 RESULTS AND DISCUSSION

5.1 Introduction

This chapter gives a detailed data analysis of the collected data. A discussion is given in relation to the three research questions, on how vulnerability of schools in urban informal settlements relates with environmental disasters.

The respondents filled the students' questionnaire (Appendix III). They thus furnished me with information that was useful in answering the first and second research questions for this study:

1. What are the types of hazards and disasters facing students in the schools in Mukuru Kwa Njenga?
2. Which are the factors affecting vulnerability of students in schools located in Mukuru Kwa Njenga?

The second and third categories of the study were teachers and head teachers respectively. A total of 64 teachers responded to the teachers' questionnaire (Appendix V), with each school being represented by between 2 and 5 teachers. Each of the schools was represented by one head teacher, principal, manager or owner, filling the head teacher's questionnaire (Appendix II). That yielded 14 respondents in the head teachers' category. Both groups responded to questionnaires that provided information for answering the second (above) and third study questions, which was:

3. What are the mitigation measures put in place to reduce the vulnerability of Mukuru Kwa Njenga schools to hazards and potential disasters?

5.2 Types of Hazards and Disasters facing Schools in Mukuru Kwa Njenga

All the 336 student respondents participated in answering the questionnaires and research questions. 168 of the 336 (50%) indicated that their schools had experienced a hazard with the most common ones being flooding, sewage leaks, fire outbreaks and election related violence. Most of the hazards mentioned were man-made hazards with flooding being the only natural hazard facing schools in Mukuru Kwa Njenga.

Majority of the hazards occur due to the constant demolitions of school structures which at times were done when students were either in class or within the school compound, forcing them to scamper for safety and in the process endangering their lives. The demolitions often occur due to the lack of proper documentation of the parcels of land on which the schools lie. It was mentioned by 54 respondents, forming 16.1% as is shown in the pie chart after the table below.

The study also found out that illegal electric connections were prevalent. Most of the electric cables were part of the illegal connections and have therefore been disconnected by the electricity authorities who cared not to properly remove them. Some of the illegal electric connections were still in place at the time of the research and they were obtained from nearby power lines.

Photograph 3: Illegal Electric Connections in Mukuru



(Source; Researcher Camera, 2014)

Fire related disasters were rampant within the schools as a result of fire outbreaks in the school kitchen since it was observed that nearly all the schools in Mukuru use firewood to cook food. However, these fires never resulted into any fatalities but destroyed lots of school property. The fires easily spread within the schools and even beyond the school compound due to the nature of building materials, which are easily combustible, used in the construction of the school buildings

Photograph 4: Fire Incident in Mukuru Slums



(Source; Daily Nation, November, 25 2013)

When it rains heavily, the nearby river channel which is already clogged with debris fills to capacity and spills into neighboring areas some of which are school compounds. In one incident, the school compound was flooded for more than one week and the school activities had to be moved to a nearby residential building until the flood waters subsided.

There were also cases of raw open sewage flowing through the school compounds while in some cases; the sewage was flowing right outside the school gate making it difficult for the students to access the school. The ever present foul smell and insects from the sewage are a great hazard to the health of the students.

The researcher found out that the violence was election related since it was during the campaign period and it was violence which began from outside the school and spilled into the school compound as people scampered to safety. Student also that said that two of their teachers physically fought over politically related topics prior to the general election. At times violence also emanated from defense of grabbed school land since the grabbers often resort to violence so as to occupy the grabbed land.

The 64 teacher respondents also answered the hazard occurrence survey. They were split in half, one half saying that their schools of work had never experienced any hazard, while the other half said that their schools had experienced them. The respondents indicated that the schools that had experienced hazards, majorly experienced demolitions. Other hazards includes sewage, floods and fires.. Four teachers said that 3 people were injured during the hazards.

Head teachers also gave their responses on disaster occurrence variables. All of them (100%) agreed that their schools had experienced a disaster. Half of them further stated that demolition was the kind of hazard. A 71.4% majority said that there had been injuries during the hazards. A similar percentage said there had not been any life loss in such hazards. All the respondents except one said there had been property loss during the hazards.

5.3 Factors affecting vulnerability of schools located in Mukuru Kwa Njenga to hazards and disasters

From the data set most students face hazards and disasters while at school. Among the 336 student respondents, 214 (63.7%) felt that the chairs in their schools were not enough; Two hundred and ten (62.5%) felt that toilets were not enough; two hundred (59.5%) felt that fire extinguishers were not enough; and a similar 200 students felt that first aid kits were not enough.

On access to clean water in the school, 60.4% felt that there wasn't enough. Results from the responses to the demographic variables exposed that majority of schools found in Mukuru Kwa Njenga informal settlements are located in Mukuru Kwa Njenga zone.

There is high demand for the few available spaces in the school and the parents are willing to bring their children to a congested classroom than have them roaming in the informal settlement. Water is not available in all the schools. In schools where water is available, it is supplied by illegal water pipe connections. Water is also supplied by small water vendors who hawk it just outside the school compounds. The water vendors obtain their water from the nearby estates such as pipeline and Imara Daima which have more stable water flow from the County council or from private homes which have boreholes. It was further discovered that even though some schools have clean drinking water, the sources of these water could not be confirmed since they were supplied by unlicensed mobile water vendors who were not willing to reveal their sources.

In some schools where there were fire extinguishers, some were defective and a majority of the students and teachers did not know how to operate them. Safety is also compromised in the school due to the absence of a proper fence around the school, the persistent chaotic scenes within the school environs, lack of ever present guards at the school entrances, the presence of exposed electric cables and wires in the school buildings and the existence of precarious buildings used as classrooms. Some schools are also erected in dangerous places such as on top of other buildings.

Students carry weapons or possess weapons within the school compounds. The students admitted that even though the students were in some cases searched when entering the school compound, they often were able to conceal or find alternative ways of getting the weapons into the school compound. The presence of such weapons in schools is a great hazard and a potential disaster in the learning institutions. It should be noted that even though the purpose of carrying these weapons or 'tools' as they are locally known was not to use them within the schools, their mere presence within the school means they can be used at any time should there be a conflict between the students.

Half of the student respondents, felt safe while school while the other half did not feel safe. The 64 teacher respondents were also interviewed to obtain data that would be used for assessing the vulnerability status of the schools. Majority of them 52 (81.3%) indicated that they had never had any trainings on hazards. Majority also indicated that

they had never faced any hazards at their work places 44 (68.8%). Among those who had encountered hazards within their work places, 5 of them sited sewage passing through class as the hazard. Four mentioned sewage near school and other 4 mentioned fire incidences.

Fifty six (87.5%) of the teachers sampled felt that their working environments were safe from hazards. Further, majority of the respondent teachers 50 (78.1%) said that their schools had guidance and counseling programs.

In schools where there were boarding facilities, the numbers of fire extinguishers were few and would not effectively put out a fire. In addition, the emergency exits were hard to come by or were available but were either locked tight or were blocked by other erected buildings. Matrons were also not resident in the schools.

First aid kits are available in most of the schools. The available kits, however, lack most of the tools needed in the kit. The kits were maintained by student clubs within the schools such as Guidance clubs, First Aid clubs, Scouts clubs and the Life skills clubs because of the high turnover of the teaching staff or absentee teachers which necessitated the school management to leave the kits in the hands of students.

Majority of the teachers also indicated the inadequacies within their schools. Fifty nine (92.2%) said that classes were inadequate; the same 92.2% teachers said that dormitories were inadequate; sixty (93.8%) said that toilets were inadequate; again 60 said that playing fields were inadequate; twenty eight (43.8%) said that laboratories were inadequate; and lastly 57 (89.1%) said that fire extinguishers were inadequate. The tables below show the figures.

Majority of the teacher respondents 38 (59.4%) showed that within the past one year, a student had not been affected by a disaster within their schools. The other 26 students reported at least one disaster within the previous year.

Fire tragedy was cited as the disaster that had affected the most students within the past one year with nineteen teachers (29.7%) mentioning fire. The 14 Head teachers also took

part in the schools vulnerability assessment with (71.4%) recording that tap water and boreholes were available.

5.4 Hazards And Disaster Mitigation Measures In Schools In Mukuru Kwa Njenga

This section summarizes data on measures put in place to lessen the likelihood and effects of a hazard or disaster. Only teachers and head teachers responded to the queries in this category.

Each of the 64 teachers responded to the questions. A 71.9% majority said that their schools were making efforts to minimize potential hazards and disasters. The schools have tried to have the teachers teach sufficient number of lessons and not to overwork them. This is to allow the teachers to spend more time with the students thus averting any disaster within the school. Most of the teachers said that their schools are undertaking purchase of fire extinguishers as a means to minimize hazards.

Two of the sampled schools have also erected a perimeter wall on one side of their school thus saving the students from the dust blown by wind from that direction. However, majority of the teachers said that their schools did not have proper fences around them (67.2%); a 57.8% majority said their schools did not have proper gates.

Some of the schools' managements have installed proper gates at the main entrances and hired watchmen to man them. Despite this, the gates are often vandalized by thieves who are believed to be scrap metal dealers out to make a quick kill.

Some schools which had proper gates conduct searches for their students almost on a daily basis. However, most students have either come into the school compound with matchboxes/cigarette lighters or they were never checked for presence of such when entering the school compound. Out of those whose schools had proper gates at the entrance, 54.7% had watchmen stationed at those gates. The other 45.3 did not have watchmen at the gates. Watchmen were mentioned by a 60.9% majority to be the ones in charge of security in the schools.

Forty two out of the 64 respondents indicated that the security personnel in their schools did not have any training. It was stated by 82.8% of the respondent teachers that in case of emergency, the school directors would be contacted. The head teacher or the chairman would be contacted incase the director was not available. It was found out that 75% of the respondents did not have telephone facility in their schools to be used during emergencies especially at night. Only 16 out of the 64 respondents (25%) had telephone facilities to be used in case of emergencies. It was also found out that a slight majority of the schools from which the teachers were, relied on firewood as their fuel for cooking. 34 (53.1%) of the 64 respondents used firewood for cooking while the other 30 (46.9%) indicated that charcoal was used for cooking. The 14 heads of schools responded to this category as follows. A 57.1%, majority, recorded that their schools had proper fences around them; a similar percentage said their schools did not have proper gates at entry points and another similar percentage recorded Majority of the head teachers also noted that watchmen were in charge of security within their schools (42.9%)

Ten (71.4%) of the head teachers stated that the security personnel in their schools were not trained. Schools have initiated training on hazard and disaster management in efforts to minimize the potential hazards and disasters. Schools organized fire drills for both students and teachers. However, this was refuted by the teachers of the said schools who said that the headmaster simply invited his relative who works in the fire department, who brought him one fire extinguisher and that no fire drill was conducted.

Schools have put in place proper guidance and counseling programs within their schools. In one particular case, the school has gone ahead and hired a professional counselor who comes to the school on a fortnight basis. Most schools however have put in place various clubs to help inculcate emergency response skills into the students. These clubs include debate, scouts, first aid etc. Red Cross and Scouts clubs are among the most popular clubs for students in the schools sampled. Most of the schools sampled also lacked adequate hazard and disaster plans for any eventuality in case a disaster occurred. A majority of the head teachers were non-committal when asked how soon they would put in place a proper plan, mostly citing financial constraints.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

In this chapter, a summary of the entire study is given, the main findings of the study are summarized and conclusions drawn. Areas of further research and recommendations are also suggested.

6.2 Summary of Research

This study had a purpose of establishing key factors that make schools in urban marginalized informal settlements vulnerable to hazards and disasters. The study thus attempted to identify the types of hazards and disasters in informal settlements, their causes, nature, their chances of affecting the schools and possible mitigation measures for reducing their impacts.

The study was carried out in Mukuru Kwa Njenga informal settlement, Nairobi County. The selection of Mukuru Kwa Njenga as the site of the study was because it is one of the informal settlements in Nairobi with characteristics similar to the other urban marginalized informal settlements in Nairobi County and thus would give a fair representation of all of them.

All schools in Mukuru Kwa Njenga constituted the target population. Questionnaires were designed for both students and teachers, in-depth interviews were conducted with school head teachers and local administrators and where possible, an observation checklist was also used.

The researcher administered the questionnaires through individual visits to the schools. In-depth interviews were conducted with the head-teachers and where possible with their deputies before and after the administration of the questionnaires in the classrooms.

Data analysis was done by first editing the questionnaires for completeness and consistency and then coding to enable the grouping of responses into categories. Descriptive statistics was then used to summarize the data.

6.2.1 Population and Physical facilities

The research findings showed that the school with the least number of students has 90 students while that with the highest number of students has 450 students. However, in nearly all the schools sampled in this study, the student population clearly overwhelmed the physical facilities available in their environment. In one particular case, the initial classroom constructed had to be altered by adding iron sheets to one side of the class to accommodate the extra number of students. The school administration went on to eventually build another classroom on top of the other one in pure disregard of the students' safety while in school. When queried on this issue, the teachers stated that the need to accommodate more students necessitated the expansion adding that no formal approval was needed from the local authorities for such alterations.

However, this was disputed by the local authority officials who said that so long as they could come to an 'unofficial' agreement with the school authorities, then the school could expand or alter the designs of their buildings as much as they wished. Some of the local administrators also did not know their role in the approval of such alterations. This research also discovered that owing to the physical location of such some of the schools in Mukuru Kwa Njenga, the representatives of the government authorities responsible for the maintenance of education standards rarely go to such areas to inspect the physical facilities in such schools. In cases where they actually manage to get to the school compound, they do not actually go to the classroom to see for themselves the physical conditions but rather they only believe what the school authorities tell them in the offices or staffroom. Such cases showed open corruption deals by the officials or total neglect and disregard of professional etiquette.

The schools in Mukuru Kwa Njenga do not have enough desks for the students. In most cases, the desks meant for two students were used by four to five students.

It is also not uncommon to find students sitting on the classroom floors or on broken 20 liter jerry-cans and carton. Some of the desks are also broken with nails precariously protruding and thus accidents emanating from such nails are common. In addition to the, for the students who sit on the classroom floor, there are great health risks especially during the rainy seasons when the floor is generally damp and cold. In one particular case, the passing of sewage water through the classroom posed a great health hazard to the students.

The toilet facilities in the schools are inadequate and nearly all the schools sampled had only pit latrines rather than the water toilets. For the schools which had toilets, they were unhygienic and posed great dangers in terms of the gaping holes in them. Some of the students sampled confirmed having narrowly missed falling into the pit latrines whenever they visited the toilets and latrines.

This inadequacy is further highlighted by the teacher data where 93.8% of the teachers sampled stated that the toilet and toilet facilities are not enough to serve the schools. This poses a great health risk since it could lead to outbreak of diseases in or around the schools. This may also eventually affect the general performance of both teachers and students since the teachers and students will spend time looking for alternative toilets.

6.2.2 Water and firefighting facilities

Water availability in the schools studied was limited to basic. Drinking water is not available for everyone; each student is responsible for his/her own drinking needs.

Teachers and other school workers have a common drinking water pot in the staffroom.

Water for abolition is not available as well. Students don't have water to wash their hands after visiting toilets/latrines. The neighbors to the schools, including shops and personal residences play an important role of helping with water for drinking.

Firefighting skills do not exist in the urban settlement schools. This study found that fire drills have not been given a priority in these schools. Most of the schools count on luck and probabilities. The risk for fire outbreak was relatively high in the schools owing to the poor electrical connections and even wooden building materials.

Both teachers and students confirmed that the fire extinguishers were either not enough or dysfunctional. These facilities were nonexistent and the school administrations saw no need to purchase them since other fire control measures could be used such as the use of water in case of a fire outbreak. Interestingly, there were also no sign of water facility enough to put out a huge fire in case of an outbreak. This showed total negligence on the part of both the government and the school administrations.

6.2.3 Early warning systems, General precautions and Security

This study came to a finding that schools in urban informal settings are not prepared to deal with disasters. Elements of early warning are not in place, starting with telephones to alarms. They are either never installed, or at least if they were once installed, they can't be traced at present, possibly due to lack of maintenance that followed their installation.

Bureaucracies that exist within the urban settlement schools also impede early warning in case of disaster, or a security procedure. School directors or owners are the sole decision makers, leaving those running the schools without command even in cases that require urgent response. All other employees follow only the official communication from these owners, which most of the times was found to be untimely.

6.2.4 History of disasters and disaster preparedness

Disasters were found to have occurred in most of the urban settlement schools, with demolitions being the most widely experienced. This is anticipated to continue due to the nature of land tenure system in places like Mukuru Kwa Njenga slums. There is no defined ownership. Land grabbing and squatting are options of occupancy.

Both students and school workers, including teachers were found to be non-conversant with emergency procedures such as first aid. They are rarely exposed to trainings on

disaster preparedness and response strategies. This trend applies across the occupants of the schools- students, teachers, managers and security personnel.

6.3 Conclusion

The schools in informal settlements are highly vulnerable to environmental hazards. Flooded and water logged environments such as the case in Mukuru kwa Njenga are key aspects of vulnerability in the urban marginalized environments. Such environments directly affect the health of children who inhabit them leading to health complications such as asthma, water borne diseases and frequent colds.

Housing in the informal sector is also an indicator of the challenges bedeviling such environments. Due to the levels poverty witnessed in the informal settlements, the income standards of the residents cannot enable them to put up decent and quality structures some of which house the schools. As a result, the structures are poorly constructed at times in water channels leading to blockage of drainage channels and also conflict with the local authorities. This has forced them to try out new methods like community maintenance of organizations in charge of setting up construction laws, drainage and even toilets.

Additionally, of the three categories of respondents interviewed, it emerged that the children are the most vulnerable to hazards and disasters. This is because most of them inhabit the informal settlements and face the day to day hazards to which their environment exposes them to. Even though the teachers and head teachers also face hazardous situations in Mukuru kwa Njenga, it emerged that most of them do not actually live in the informal settlement and only come to work in the schools and go back home in the evening. Some of the teachers also work in the schools for short durations before getting better employments elsewhere.

In conclusion, The poor within informal settlements are not able to come up with proper designs and plans of the structures like houses which they use leading to their increased vulnerability. The poverty levels in urban areas especially in the informal settlements

cannot allow the inhabitants to get proper employment, save, acquire assets which they have tenures and also plan their livelihoods due to their stable incomes. This has made the key occupations within the informal settlements to be low paying ones such as plumbing, masonry, public service transport operators and carpentry. This leads to them occupying disaster prone areas in informal settlements where they are exposed to hazards continually. Should disasters occur in such environments especially in the schools; its impacts will be heavily felt by all within the environment. It is just by chance that these environmental hazards have not struck; of at least the incidences of the strike are not well documented and publicized.

6.4 Recommendations and areas for further research.

6.4.1 Areas for further Research

Having completed my study on this topic, I would recommend that;

Other studies be conducted on vulnerability of schools in urban formal settlements.

Studies that seek to explain the vulnerability of schools in rural settlements should also be embarked on by scholars. This will bring out the contrast in the kinds of hazards faced in different environmental settings.

A similar research as mine should also be done, using a larger sample.

6.4.2 Recommendations

Having undertaken this study on the vulnerability of schools in urban informal settlements, I recommend as follows;

School within the urban informal settlements be helped to cope with the high population of students that they are faced with. This should include adding more teachers to reduce the student: teacher ratio.

Government through Ministry of Education and related authorities take necessary steps to inspect and document the schools' status, including the hazards that they face.

Relevant authorities to ensure that training on hazards and disaster response is given to all those who want to start and run private schools. These trainings should also be extended to all the employees in these institutions.

Water supplying institutions like Nairobi water and Sewerage Company should make schools a priority target for their supply. If not, they should license specific vendors to do the supply, and not any other random vendor.

REFERENCES

Amnesty International Report, 2009. The State of the World's Human Rights. Amnesty International Limited, London.

Birkmann, J. 2004. Vulnerability Assessment: The First Step towards Sustainable Risk Reduction. Logos Verlag, Berlin.

Bowler P, 1998. Cause and effects of Noise Pollution. University of California, Irvine.

Centre on Human Rights and Evictions, 2009. Submission to the UN Committee on Economic, Social and Cultural Rights, New York.

Commonwealth of Australia, 2006. Hazards, Disasters and your community. Emergency Management Australia, 7th edition, Canberra.

Daily Nation Newspapers, 2012. 'Memories of tragedy still hang in the air at ground zero.' 27th September, 2012 edition.

East African Standard Newspapers, 1999.

Eldah L., 2010: The Impact of skills Development on Competitiveness; Empirical Evidence from a Cross Country Analysis. [Educational Policy Analysis Archives]

Environmental Health Perspectives, 2005. The effects of living in a Noisy World: Vol. 113, No. 1, January.

Gichuki, G., 2005. Environmental Problems and Human Health in Urban Informal Settlements; A case Study of Mukuru Kwa Njenga, Nairobi. A Master's Degree Project Presentation, University of Nairobi, Kenya.

Gloag, D., 1980. *Noise and Health: Public and Private Responsibility*. Oxford University Press, London.

Khisa, J., 2008. *The vulnerability to occupational hazards among workers at the building construction site; a case study of Nairobi*. University of Nairobi.

Kothari, C. R. (2004). *Research Methodology; Methods & Techniques*, New Age International Publishers, New Delhi, India.

Krejcie, R. V. and Morgan, D. W. (1970). *Determining Sample Size for Research Activities*, *Educational and Psychological Measurement*, 30, 608, Sage Publications.

Mbatha, M, 2009. *Actualizing Free Primary Education in Kenya*, *The Journal of Pan African Studies*, Vol. 2, No. 8, March 2009.

McEntire, D., 2004. *Disciplines, Disasters and Emergency Management*. Charles Thomas Publisher, London.

Mutisya, E. and Yarime, M., 2011. *Understanding the grassroots dynamics of slums in Nairobi: The Dilemma of Kibera Informal Settlements*. *International Transaction of Engineering, Management, Applied Sciences and Technologies*. Volume 2, No.2

Ndiang'ui J. 2006. *Vulnerability of Kenyan Schools to disaster; a case of Nairobi Public Secondary Schools, Kenya*.

"Owuor, S.O. (2010), *Climate change vulnerability, risk, impact and adaptation in Nairobi's informal settlements of Korogocho and Mukuru Kwa Njenga*. Oxfam Workshop. Nairobi, Kenya, March 18." 2010.

Patel, M., 2008: *Disaster Prevention for Schools Guidance for Education Sector Decision Makers*. UNISDR, Geneva.

Pelling, M. and Wisner, B., 2009: *Disaster Risk Reduction; Cases from Urban Africa*. Earthscan Publishers, London.

Raphael, B.1986. When Disaster Strikes: How Individuals and communities cope with catastrophes. Basic Books, Inc. Publishers, New York.

Republic of Kenya, 2007: Kenya Vision 2030 Development Plan. Government Printer, Nairobi.

Republic of Kenya, 2009: Kenya Draft National Policy for Disaster Management; February 2009. Government Printer, Nairobi.

Republic of Kenya, 2009: Kenya National Disaster Response Plan 2009. Government Printer, Nairobi,

Republic of Kenya, 2009: Kenya National Disaster Response Plan, 2009. Government Printer, Nairobi.

Republic of Kenya, 2010: Kenya National Census Report 2009, Government Printer, Nairobi.

Share the World's Resources-SWR, 2010. The Seven Myths of Slums; Challenging Popular Prejudice about the World's Urban Poor. London.

Shauri, S. 2007. Social services in Disaster situations in Kenya. IFRA working Papers, Nairobi.

Spektor, D., 1991. Effects of Heavy Industrial Pollution on Respiratory Function in the Children of Cubatao, Brazil: A Preliminary Report. Environmental Health Perspectives Vol. 94. pp. 51-54, 1991

Stansfeld and Matheson, 2003. Noise Pollution: Non-auditory effects on health. British Medical Bulletin, Vol. 68. 2003. (<http://www.bmb.oxfordjournals.org/>) {Accessed 20th November, 2011}

Stansfeld, S. and Haines, M., 2001. Mental Health: A follow up study of effects of chronic aircraft noise exposure on child stress responses and cognition. *International Journal of epidemiology*, 2001; 30: 839-845

Star Newspaper, 2012. Slum dwellers don't need charity, but opportunities. 17th June, 2012 edition, Nairobi, Kenya.

United Nations Children's Fund, 1987. New York.

United Nations Convention on the Rights of the Child, 1990. New York.

United Nations Development Programme, 2007. New York.

United Nations Settlement Programme, 2009. *The Challenge of Slums; Global Report on Human Settlements 2009*. Earthscan Publications Limited, London.

United Nations, 2006. *The United Nations and Kenya: Fifty years of partnership*. UN office, Nairobi.

Vincent, K., 2004. *Creating an index of social vulnerability to climate change for Africa*. Tyndall Centre Working Paper No. 56, Norwich.

Wanjir, C.O, T.O. Oogo, J.M. Mwangi, J.M Wainaina, F.A. Hawa, S.M. Muthwii, I. Seki, Wamalwa, Y. Osaki, 2002: *Housing and Sanitation and their association with gastro-intestinal and respiratory illnesses; A case study of Githembe slums, Nairobi, Kenya*.

Wisner, 2004. *Assessment of capability and vulnerability mapping; Disasters, Development and People*. Earthscan Publishers, London.

World Bank, 2011. *Climate change, disaster risk and the urban poor: Cities Building Resilience for a changing world*, Washington.

World Health Organization, 1999. Community Emergency Preparedness: A manual for managers and policy makers, WHO, Geneva.

World Health Organization, 2002. Alcohol, Drugs and Development, WHO, Geneva.

APPENDICES

Appendix I: List of Schools, Number of Teachers and Students

	SCHOOL NAME	NUMBER OF TEACHERS	NUMBER OF BOYS	NUMBER OF GIRLS	TOTAL NUMBER OF STUDENTS
1.	EMMANUEL EDUCATIONAL CENTRE	8	110	101	211
2.	GREENVIEW ACADEMY	12	70	56	126
3.	JAOMBI COMMUNITY FOUNDATION EDUCATION CENTRE	7	72	65	137
4.	KWA NJENGA BAPTIST NEEDY ACADEMY	12	172	130	302
5.	JOCADA ACADEMY	6	40	60	100
6.	PALACE EDUCATION CENTRE	10	80	60	140
7.	JOHPEN PRIMARY SCHOOL	8	130	140	270
8.	GRAMOJOY ACADEMY	20	200	250	450

9.	ST. CASPERS ACADEMY	12	75	175	250
10.	NEW DAWN COMMUNITY SCHOOL	9	50	47	97
11.	GLORIOUS LAND ACADEMY	10	70	62	132
12.	KWA NJENGA PRIMARY SCHOOL	21	220	198	418
13.	TUMAINI MIXED SEC. SCHOOL	11	50	40	90
14.	EMBAKASI GIRLS HIGH SCHOOL	30	0	340	340
TOTAL		176	1339	1724	3063

Source: City council of Nairobi, Education Department, 2013

Appendix II: Questionnaire for Principal/Manager/Head teacher

I am Okello Lameck Ochieng', a postgraduate student at the University of Nairobi pursuing a Master of Arts course in the Department of Geography and Environment. I am carrying out a study on the vulnerability of schools in urban informal settlements to environmental hazards. This is a partial fulfillment of the requirements for the course.

I wish you to help me fill in this questionnaire provided as honestly and accurately as possible. Your responses will be treated with utmost confidentiality and will not be used for any other purpose other than this research. You are not required to write your name on the questionnaire.

Kindly fill the section of the questionnaire relevant to you.

Thank you.

Lameck Ochieng' Okello

Part One: Background information

Name of School.....

Zone.....

Q1. Please indicate the position you hold in the school

- a) Principal/Head teacher
- b) Manager
- c) Other Please Specify_____

Q2. Indicate your sex

- a) Male b) Female

Q3. For how long have you been in this school? _____

Q4. What is the type of your school?

- a) Boys day Girls day
- b) Boys boarding Girls boarding
- c) Mixed day Mixed boarding

Q5. If Q4 above is a mixed school, what is the number of?

- a) Girls b) Boys

Q6. Indicate the total number of;

- a) Students b) Streams per form

Q7. Does your school have enough classrooms? _____

Part Two: Vulnerability Assessment

Q8. What water provision facilities are available in your school? _____

Q9. What lighting facilities are available in your school? _____

Q10. Is there an alarm system available in your school? _____

Q11. Does your school have first aid kit in?

a) Dormitories _____

b) Laboratories _____

c) Kitchen/ Dinning hall _____

d) Classrooms _____

Q12. Are there enough fire extinguishers in the school? _____

Part Three: Hazard and Disaster Mitigation Measures

Q13. Does your school have a proper fence around the school compound?

Q14. Does your school have a proper gate at the school's main entrance?

Q15. If Q14 above is yes, is there a watchman stationed at the gate?

Q16. Who is in charge of the security of the school?

Q17. What relevant training does your security personnel have?

Q18. In case of an emergency in the school, who is contacted first?

Q19. Are telephone facilities available in school in the event of need especially at night?

Q20. Approximately how old is the oldest building in the school compound?

Q21. When was the last check on physical facilities by the relevant government authorities? _____

Q22. If Q21 above is none, why?

Q23. If Q21 above is yes, how frequent are the checks?

Q24. If there is any cooking done in the school, indicate what the school uses for cooking? _____

Part Four: Hazard Occurrence

Q25. Has the school ever experienced any hazardous or disastrous event?

a) Yes [] b) No []

Q26. If Q25 above is yes, indicate which hazard(s)/disaster(s) have been experienced?

Q27. Was any one injured?

a) Yes [] b) No []

Q28. If yes, how many? _____

Q29. How many deaths occurred from the hazard/disaster? _____

Q30. Was there any loss of property?

a) Yes [] b) No []

Q31. Which of the items listed below does the school check for from the students in the dormitories/classrooms?

a) Matchboxes/cigarette lighters []

b) Alcohol/Drugs []

c) Phones []

d) Weapons []

Q32. How frequent are the above searches? _____

Q33. If your school has a dormitory, does the matron in charge of a house/dormitory live within the dormitory with students?

a) Yes [] b) No []

Q34. Have you had any talk/lecture or any education programs on hazards/disaster in school?

a) Yes [] b) No []

Q35. If yes, how often? _____

Q36. Has any demonstration on the use of fire extinguishers have been held in the last two years in the school? _____

Q37. If yes above, who took part in the demonstrations? _____

Q38. Has any fire drill been conducted in the school in the last two years?

Q40. If yes above, who took part in the drill? _____

Q41. Is there a disaster/ preparedness plan in the school?

a) Yes [] b) No []

Q42. If yes above, why?

Q43. If no to Q41 above, why?

Q44. Please identify any clubs in your school with skills to respond to emergencies:

Appendix III: Questionnaire for students

I am Okello Lameck Ochieng', a postgraduate student at the University of Nairobi pursuing a Master of Arts course in the Department of Geography and Environment. I am carrying out a study on the vulnerability of schools in urban informal settlements to environmental hazards. This is a partial fulfillment of the requirements for the course.

I wish you to help me fill in this questionnaire provided as honestly and accurately as possible. Your responses will be treated with utmost confidentiality and will not be used for any other purpose other than this research. You are not required to write your name on the questionnaire.

Kindly fill the section of the questionnaire relevant to you.

Thank you.

Lameck Ochieng' Okello

Part One: Background Information

Name of School.....

Zone.....

Q1. Gender? Female [] Male []

Q2. How old are you?

Q3. What class are you in?

Q4. How long have you been in this school?

Q5. Where do you live?

Q6. Do you have?

i) both parents []

ii) Mother only []

iii) Father only []

iv) No mother or father []

Q7. What is your position in the family? _____

Q8. Who do you stay with? _____

Q9. Do you have everything you need when going to school?

Yes [] No []

Q10. Do your parents/guardians accompany you when you are going to school?

Yes [] No []

Q11. How long does it take you to move from your home to school? _____

Part Two: School environment

Q12. For the facilities listed below, tick the ones which are not enough in your school.

[] Classrooms

[] Chairs

[] Toilets

[] Fire extinguishers

[] First aid kit

Q13. Do you have clean drinking water in your school?

Yes [] No []

Q14. Is your school located near a river/stream?

Yes [] No []

Q15. If yes to Q14, How far? _____

Q16. Has anybody from your school ever drowned in the river?

Yes [] No []

Q17. If yes to Q16, when? _____

Q18. How far is the nearest health center from your school? _____

Q19. Do you feel safe in school?

Yes [] No []

Q20. If No to Q19, why? _____

Part Three: Hazard Occurrence

Q21. Has the school ever experienced any hazardous/disastrous event?

a) Yes [] b) No []

Q22. If Q21 above is yes, indicate which hazard(s) or disaster(s) have been experienced?

Q23. Was any one injured?

a) Yes [] b) No []

Q24. If yes to Q23, how many? _____

Q25. How many deaths occurred from the hazard/disaster? _____

Q26. Which of the items listed below does the school check for from the students in the dormitories/classrooms?

a) Matchboxes/cigarette lighters []

b) Alcohol/Drugs []

c) Phones []

d) Weapons []

Q27. How frequent are the above searches? _____

Q28. If your school has a dormitory, does the matron in charge of a house/dormitory live within the dormitory with students?

a) Yes [] b) No []

Q29. Have you had any talk/lecture or any education programs on disaster in school?

a) Yes [] b) No []

Q30. If yes, how often? _____

Q31. Has any demonstration on the use of fire extinguishers have been held in the last two years in the school? _____

Q32. If yes above, who took part in the demonstrations? _____

Q33. Has any fire drill been conducted in the school in the last two years?

Q34. If yes above, who took part in the drill? _____

Q35. Please identify any clubs in your school with skills to respond to emergencies:

Appendix IV: Questionnaire for Teachers

I am Okello Lameck Ochieng', a postgraduate student at the University of Nairobi pursuing a Master of Arts course in the Department of Geography and Environment. I am carrying out a study on the vulnerability of schools in urban informal settlements to environmental hazards. This is a partial fulfillment of the requirements for the course.

I wish you to help me fill in this questionnaire provided as honestly and accurately as possible. Your responses will be treated with utmost confidentiality and will not be used for any other purpose other than this research. You are not required to write your name on the questionnaire.

Kindly fill the section of the questionnaire relevant to you.

Thank you.

Lameck Ochieng' Okello

Part One: Background Information

Name of School.....

Zone.....

Q1. Please indicate the position you hold in the school

a) Head teacher []

b) Teacher []

c) Other [] Please Specify_____

Q2. Indicate your sex

a) Male [] b) Female []

Q3. For how long have you been in this school? _____

Q4. How many children are enrolled in your school/center,
Girls.....Boys.....

Q5. How many teachers are in your school? Female_____ Male_____

Q6. What is your qualification? _____

Q7. How would you describe your work load in the school?

Sufficient Overworked under worked

Part Two: School Vulnerability

Q8. Do you have any training on hazard and disaster management?

Yes No

Q9. Have you ever faced any hazardous or disastrous situation in your work environment?

Yes No

Q10. If yes to Q9 above, Specify_____

Q11. Is your working environment safe from hazards and disasters?

Yes No

Q12. Does your school have any guidance and counseling program?

Yes No

Q13. On average, how many students do you teach per class? _____

Q14. Which of the following facilities are inadequate in the school?

Classrooms []

Dormitories []

Toilets []

Playing field []

Laboratory []

Fire extinguishers []

Q15. How would you best describe attendance of pupils in your school?

Regular []

Irregular []

Q16. If irregular above, give reasons _____

Q17. Has any student(s) in your school been affected by any disaster within the last one year?

Yes [] No []

Q18. If Yes to Q17 above, specify _____

Q19. What was the cause of the disaster mentioned _____?

Part Three: Hazard and Disaster Mitigation Measures

Q20. Does your school make any effort to minimize the potential hazards and disasters?

Yes [] No []

Q21. If yes in Q20 above, specify_____

Q22. Does your school have a proper fence around the school compound?

Q23. Does your school have a proper gate at the school's main entrance?

Q24. If Q23 above is yes, is there a watchman stationed at the gate?

Q25. Who is in charge of the security of the school?

Q26. What relevant training does your security personnel have?

Q27. In case of an emergency in the school, who is contacted first?

Q28. Are telephone facilities available in school in the event of need especially at night?

Q29. If there is any cooking done in the school, indicate what the school uses for cooking?

Part Four: Hazard Occurrence

Q30. Has the school ever experienced any hazardous event?

a) Yes [] b) No []

Q31. If Q30 above is yes, indicate which hazard(s) have been experienced?

Q32. Was any one injured?

a) Yes [] b) No []

Q33. If yes, how many? _____

Q34. How many deaths? _____

Q35. Was there any loss of property?

a) Yes [] b) No []

Q36. Which of the items listed below does the school check for from the students in the dormitories/classrooms?

a) Matchboxes/cigarette lighters []

b) Alcohol/Drugs []

c) Phones []

d) Weapons []

Q37. How frequent are the above searches? _____

Q38. If your school has a dormitory, does the matron in charge of a house/dormitory live within the dormitory with students?

a) Yes [] b) No []

Q39. Have you had any talk/lecture or any education programs on disaster in school?

a) Yes [] b) No []

Q40. If yes, how often? _____

Q41. Has any demonstration on the use of fire extinguishers have been held in the last two years in the school? _____

Q42. If yes above, who took part in the demonstrations? _____

Q43. Has any fire drill been conducted in the school in the last two years?

Q44. If yes above, who took part in the drill? _____

Q45. Is there a disaster/ preparedness plan in the school?

a) Yes b) No

Q46. If yes above, why?

Q47. If no to Q46 above, why?

Q48. Please identify any clubs in your school with skills to respond to emergencies:

Appendix V: NEA Sample size vs. Total Population

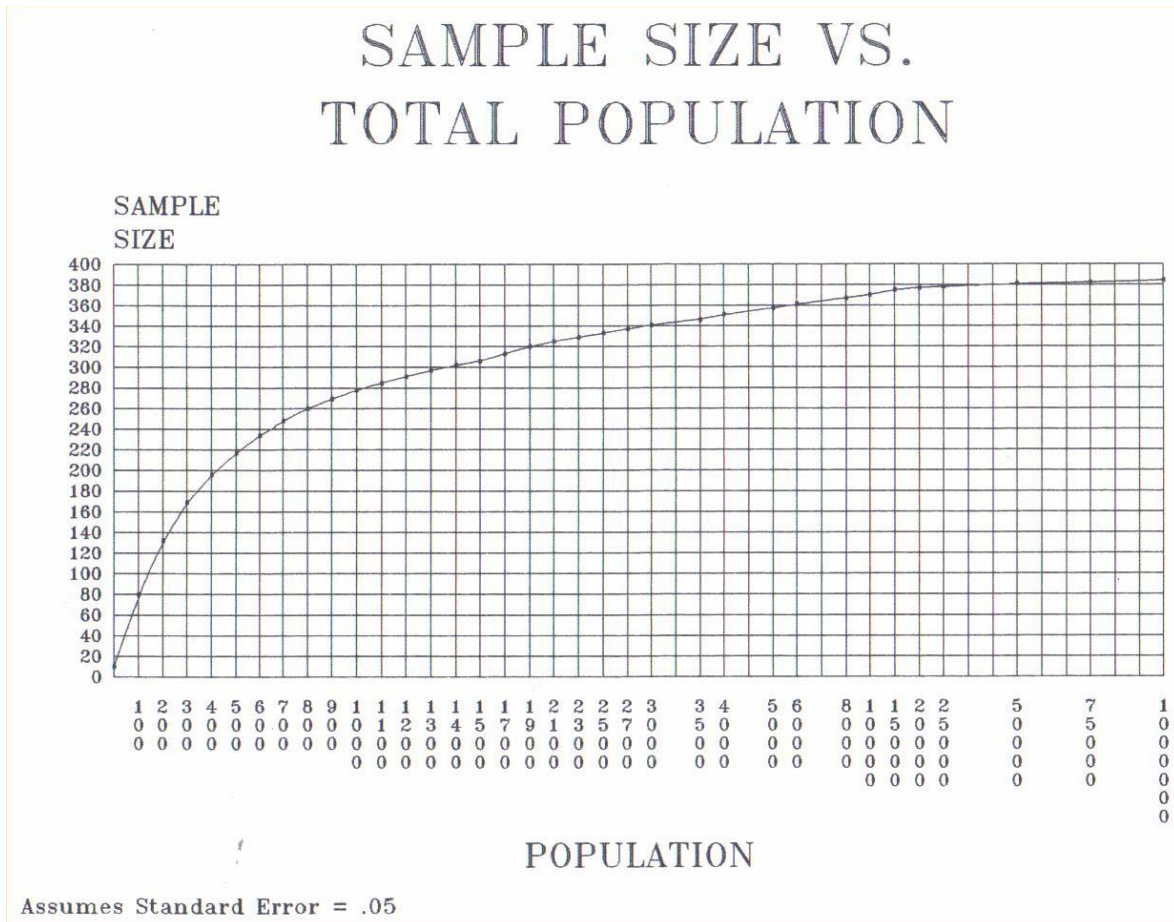


Table 9 NEA Sample Size vs Total Population

Source: Krejcie and Morgan, (1970)

Appendix VI: Distance from Classroom to Hazard (in meters)

SCHOOL NAME	Distance to Open sewer/Manhole	Distance to clogged drainage	Distance to loose electric pole/wires	Distance to railway line	Distance to Noisy places	Average distance to hazards
EMMANUEL EDUCATIONAL CENTRE	2	5	1	300	10	63.6
GREENVIEW ACADEMY	10	2	200	1000	5	243.4
JAOMBI COMMUNITY FOUNDATION EDUCATION CENTRE	6	10	2	400	3	84.2
KWA NJENGA BAPTIST NEEDY ACADEMY	15	100	170	350	50	137
JOCADA ACADEMY	17	50	3	65	40	35
PALACE EDUCATION CENTRE	24	60	30	500	80	138.8
JOHPEN PRIMARY SCHOOL	28	70	45	1500	45	337.6
GRAMOJOY ACADEMY	40	60	75	200	10	77
ST. CASPERS ACADEMY	20	30	100	50	15	43
NEW DAWN COMMUNITY SCHOOL	70	65	25	600	25	157
GLORIOUS LAND ACADEMY	40	50	20	800	16	185.2
KWA NJENGA PRIMARY SCHOOL	10	30	84	900	20	208.8
TUMAINI MIXED SEC. SCHOOL	16	20	70	300	18	84.8
EMBAKASI GIRLS HIGH SCHOOL	30	50	300	1500	200	416

Distance from nearest classroom to hazard (in meters)

Appendix VII: Photographs From Study Area



1 Photo of a school entrance: exhibiting precariously hanging iron sheets used as class wall and loose electric cables next to them.



2 Photo of a classroom floor: Exhibiting gaping holes on the classroom floor base which pose a great health hazard to students



3 Classroom wall: exhibiting cracks on wall and gaping holes posing a hazard to the students.



4 Sewage and Noise hazards: Exhibits sewage flowing through school and a worship place adjacent to it.



5 School entrance: exhibits precariously hanging electric cables at the entrance of the school

Appendix VIII: Checklist for study area

Potential Issue	Tick if Yes	Suggested Action
Outside school compound (immediate environment)		
Are there any open sewers/man holes in the immediate vicinity of the school?		
Are paths leading to the school clean and easily accessible?		
Are paths leading to the school prone to transport related accidents such as trains, motor vehicles, motorcycles, bicycles and donkey carts?		
Are there loose electric cables and wires which pose a risk to the students?		
Within School compound		
Is there a lockable and manned gate at the entrance		

of the school to prevent any unauthorised entries?		
Is the school compound neatly kept including absence of any hazardous material likely to cause injuries to students?		
Are the toilets and latrines in good conditions, accessible and clean for use by students?		
Is there any open sewer or manhole within the school compound which can cause injuries to the students?		
Are there disaster control appliances such as fire extinguishers?		
Is there a designated fire of emergency assembly point/area within the school?		
Within classroom environment		
Is there proper ventilation in the classroom?		
Is the classroom congested?		
Does the classroom building structure look safe for learning purposes?		
Is the lighting in the room likely to affect the students within the classes?		
Is there enough furniture for use by students within the classes?		

Table 10 Checklist for study area

Appendix IX: ANOVA CALCULATIONS

total sum of squares	5438.2
Sum of squares within groups	4598.70833
sum of squares between groups	839.49167

sum of squares between groups

degrees of freedom

Sum of squares within groups

degrees of freedom

Degrees of freedom

Numerator	2
Denominator	17

419.745835

49.38186294

F-ratio 8.5

F(2,17)=8.5

p. value <0.5 0.5

critical value from computed table 3.59

Reject null hypothesis

Appendix X Chi square Test

Chi-Square Test

Observed Frequencies				
	Column variable			
Row variable	V1iny	V2SIS	V3HAS	Total
R1 (yes)	23	167	163	353
R2(no)	61	163	136	360
R3(missing)	171	6	37	214
R4 (other)	81	0	0	81
Total	336	336	336	1008

Expected Frequencies				
	Column variable			
Row variable	V1iny	V2SIS	V3HAS	Total
R1 (yes)	117.6667	117.6667	117.6667	353
R2(no)	120	120	120	360
R3(missing)	71.33333	71.33333	71.33333	214
R4 (other)	27	27	27	81
Total	336	336	336	1008

Data	
Level of Significance	>0.05
Number of Rows	4
Number of Columns	5
Degrees of Freedom	9

Results	
Critical Value	16.91898
Chi-Square Test	
Statistic	538.4784
p-Value	3.3E-110
Reject the null hypothesis	

*Expected frequency assumption
met*

Calculations

fo-fe		
-94.6667	49.33333	45.33333
-59	43	16
99.66667	-65.33333	-34.33333
54	-27	-27

(fo-fe) ² /fe		
76.16242	20.68366	17.46553
29.00833	15.40833	2.133333
139.2539	59.83801	16.52492
108	27	27

Appendix XI Hypothesis Testing

Enter your information into cells B4-B8	
What is the hypothesized value for the mean μ ?	0
What is your Level of Significance (alpha)?	0.05
What is the size of your sample (n)?	64
What is the value of your sample mean (x-bar)?	1.1875
What is the value of the Sample Standard Deviation (s)?	0.039

Degrees of Freedom for the test = (sample size - 1)	63
<i>The value of your test statistic for the t-test equals</i>	243.5897436

Use this first section **ONLY** when testing $H_a: \mu > \text{specific number}$

Upper-Tail Test	
Upper Critical Value	1.669402222
<i>p</i>-Value	0.074
Do not reject the null hypothesis	

Use this second section **ONLY** when testing $H_a: \mu < \text{specific number}$

Lower-Tail Test	
	-
Lower Critical Value	1.669402222
<i>p</i>-Value	0.0374
Do not reject the null hypothesis	

Use this third section **ONLY** when testing $H_a: \mu \neq \text{specific number}$

Two-Tail Test	
	-
Lower Critical Value	1.998340543
Upper Critical Value	1.998340543
<i>p</i>-Value	0
Do not reject the null hypothesis	