SHARING THE BURDEN OF SOLID WASTE ON SOCIETY: AN ASSESSMENT OF ENVIRONMENTAL EQUITY AT DANDORA DUMPSITE, NAIROBI, KENYA

MUTHEE, PERIS NDUTA

A PROJECT PAPER SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN ENVIRONMENTAL PLANNING & MANAGEMENT OF THE UNIVERSITY OF NAIROBI

AUGUST, 2014

DECLARATION

This research project report is my original work and has not been presented for a degree at any other University.

Signature _____ Date _____

Peris Nduta Muthee

C50/71461/2008

This research project report has been submitted for examination with our approval as University supervisors.

Signature _____Date _____

Dr. Martin Marani

Department of Geography & Environmental Studies

Signature _____ Date _____

Dr. Alice O. Odingo

Department of Geography & Environmental Studies

DEDICATION

To my family and all environmentalists

ACKNOWLEDGEMENT

The success of this work derived from the input of many people, to whom I am very grateful. In particular, I wish to thank my supervisors Dr. Martin Marani and Dr. Alice O. Odingo for their great support. I wish also to acknowledge by husband for his assistance in field work not forgetting those who were contacted as respondents in this study. I wish also to thank my data analyst Simon Mwangi for his contribution in this work.

ABSTRACT

While all members of society often appreciate and enjoy environmental improvements of civilization, a growing body of evidence reveals that environmental problems of human civilization are not borne equally by various segments of society. Quite more often than not, people with low income tend to bear greater environmental and health risks of civilization than affluent people. For example, in most cities, low-income settlements play host to most waste dumping sites while affluent communities enjoy some of the best waste management, health, water and sanitation facilities even though affluent people (by virtue of their consumption habits) generate more waste. The general objective of this study was to assess environmental equity among urban population. The specific objectives of this study were to identify common diseases attributable to the Dandora dumpsite prevalent among communities living in its neighbourhood, establish whether these diseases were suffered equally among these communities, examine if there factors that could have made part of these communities more vulnerable to health risks, and determine if there is a relationship between socioeconomic status and exposure to health hazards. The hypotheses which were tested included: there is no significant relationship between the respondent's location of residency, waste disposal mechanism, source of water and frequency of disease occurrence, there is no significant relationship between the respondent's nature of employment, household income, level of education and frequency of disease occurrence and there is no significant difference between respondent's length of stay in the current location and frequency of disease occurrence.

The study used 65 households sample drawn from 73,519 housholds in the three communities adjacent to the dumpsite. The sample was obtained through both random and non-random sampling techniques. To bring out clearly issue of environmental inequities, the study collected data from a health clinic located in middle class population to compare diseases prevalence in this populace. The study collected data using questionnaires, interviews and observations and analyzed the data using regression and chi-square tests. Charts and other relevant graphics were used to visualize the data. Regression analysis and chi-square analysis were used to test for relationships and differences in the data respectively. The analysis revealed that the socially and economically deprived persons suffer more from the consequencies of mismanaged waste even when they are in the same neighbourhood with those better off. They are also more vulnerable to health risks thus a relationship was drawn between socioeconomic status and environmental equity issues. Towards achieving environmental equity, the study recommends that the low socioeconomic persons be empowered to become the solution to the problem. There is need also to formulate environment policies geared towards alleviating the burden borne by this category of persons.

ABBREVIATIONS AND ACROYNMS

CBOs	Community Based Organisations
CCN	City Council of Nairobi
GOK	Government of Kenya
KNBS	Kanya National Bureau of Statistics
LULUs	Locally Unwanted Land Uses
MSWM	Municipal Solid Waste Management
NEMA	National Environment Management Authority
NIMBY	Not In My BackYard
UNEP	United Nations Environment Programmes
UN-HABITAT	United Nation Habitat
WHO	World Health Organisation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF PLATES

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Along with the benefits of civilization (urbanization,industrialization and agricultural intensification) also come environmental and social problems. These problems often include reduced access to drinking water and sanitation, environmental pollution as a result of inadequate industrial, domestic and municipal waste management, degradation of ecosystems and deterioration of human health. Despite such problems and associated risks, many people all over the world continue to prefer living in urban areas which also influence industrialization and agricultural intensification (UN-HABITAT, 2008). Solid waste management has become a burning issue to many governments in the world, with many countries aspiring to acquire green status. Accumulation of solid wastes on streets and in residential estates in urban areas is a major challenge to urban environmental management. In many urban areas, solid waste is inappropriately managed thereby posing danger to ecosystem sustainability and human health (Reddy, 2011).

An adequate solid waste management system consists of collection, transportation, resource recovery and disposal. In many uban centres, inadequate solid waste collection and disposal has led to piling up of solid waste heaps especially associated with many third world cities (Schübeler, 1995). Such piles are particularly evident in low-income settlements otherwise referred to as slums where waste management services are either poor or completely absent. Some low-income settlements are located near waste dumpsites. Society perceives waste management, including collection and disposal, as one of the primary responsibilities of the municipal council (Schübeler, 1995) so that most members of society often do not take responsibility to contribute towards waste management. In fact, majority of waste generators among affluent neighbourhoods pay for collection of waste but not for its disposal.The main goal in such communities is to get rid of the waste generated; the concern is rarely what happens with the waste thereafter. On the other hand, municipal councils often do have hitch in managing these wastes due to low investments in waste management infrastructure leading to lack of capacity to manage the volumes generated (Onibokun, 1999).

Unequal interests and power arrangements have allowed waste generated by the rich to be dumped in neighbourhoods where the poor live (Bullard, 1994). In fact, there may exist a general thinking that dumping waste in poor neighbourhoods offers certain solutions and remedies of sorts to the poor people who are seen to earn a living from such dumpsites. In other words, the poor are expected to thrive on waste materials generated by the rich. This thinking is true for many cities across the third world where a large number of people eke out a living by scavenging from dumpsites. In the third world, this problem is blamed on weak or absent laws and policies for waste management and a weak civil society movement in the waste sector(Schübeler, 1995). The global scenario shows that some unscrupulous developed countries target Third World countries for waste dumping either through government-to-government agreements or through interests of transnational corporations (Bullard & Johnson, 2000). Such international waste exchanges often create and maintain unequal and unjust waste burdens within and between the affluent and the poor world. Transboundary shipment of waste materials from the developed nations, where regulations and laws are more stringent, to nations with weaker environmental governance infrastructure is a common phenomenon (Edelstein, 1990 & Beasley, 1990).

Developing nations generally lack capacity to develop and maintain efficient waste disposal infrastructure and many rely on open site dumping (Beed & Bloom 1995). It is estimated that in most developing countries, only about one third of the total solid waste generated is collected by municipal services of which only 5% is disposed of in an environmentally sound manner (Schübeler 1995). Third World governments often site dumpsites in communities that do not have a voice making them recipients of Locally Unwanted Land Uses (LULUs) (Pellow 2004). Dumpsites change the value of property of the place where they are located, destroy the visual and aesthetic value of a place and generally reduce the quality of life due to absence of a clean environment. Also, dumpsites breed many disease vectors and the people who live near such site often suffer widespread health and social consequences.

Overall, poor people often bear greater environmental and health risks than their more affluent counterparts (Bryant &Mohai 1992, Bullard 1994). Studies (Bryant &Mohai 1992, Bullard 1994 & Bullard, & Johnson, 2000) show that there is a correlation between disproportionate distribution of environmental risks and benefits, and socio-economic status. Such study findings often stir grassroots activism in an attempt to change the way government implements environmental, health and civil rights laws. In response, governments may formulate policies to reduce the most serious risks.

In developing nations, there is only a scanty literature on the distribution of environmental risks and benefits across different population groups. Many studies (Bryant &Mohai, 1992, Bullard, 1994, Faber & Krieg 2002 & Bullard, & Johnson, 2000), conducted in developed countries show differential distribution of environmental risks along a rich-poor divide. In these studies carried out in developed countries, race was a key determining factor of who gets what environmental risks, how much, and when (environmental equity). However, such evidence based on race cannot be generalized to nations where racism is a non-issue. Combined with other factors such as economic status, race has taken the predominant position of enhancing environmental inequities in developed countries (Faber, 1998 & Faber & Krieg 2002). The current study sought to provide evidence on environmental inequities in a non-racist sociocultural environment. Socio-economic status was assumed to play a more significant role in the distribution of environmental risks than any other factors.

The current study thus used socio-economic status to establish the distribution of environmental risks posed by solid waste at the Dandora Dump Site in Nairobi, Kenya. The study assembled evidence to assess the extent to which the poor of Nairobi bear the burden of solid waste disposal, taking the case of the Dandora dumpsite.

1.2 Statement of the Problem

UNEP in 2007 projected that in 2009, the total amount of solid waste generated in Nairobi on a daily basis would be between 3,000 to 3,200 tons (UNEP, 2007). In 1999, the solid waste generated per day was estimated to be 1,530 tons (UNEP, 2007).

This implies that the generation of solid waste in the city had doubled over ten years, a trend that is expected to continue due to the rapid urbanization rates being recorded. Previous studies (UN_HABITAT, 2008 & Zamberia, 2007) found that over 50 per cent of Nairobi residents do not enjoy any solid waste collection services as the city authorities only collected approximately 1,560 tons or about 48-52% of solid waste per day of the total waste generated (UNEP, 2007). The records of the City Council of Nairobi account for collection levels of 430 tons per day, and the Dandora dumpsite weighbridge records an average of 830 tons per day being disposed there. The recycling sector accounts for less than 200 tons per day, a limited fraction of the total generated solid waste (UNEP, 2007).

The city population is increasing at steady rates (UNEP, 2007), but the public facilities fall further behind in solid waste management operations. The impact of an inefficient solid waste management system is felt most by the poor in terms of environmental health risks associated with solid waste dumpsites being located in their neighborhoods, and the vulnerability of the poor to such risks thus creating environmental inequities. The Dandora dumpsite being a major disposal site of solid waste generated in Nairobi and its environs has raised concern over health implications among the poor communities neighbouring the dumpsite from various quarters. The Dandora dumpsite affects particularly residents of Dandora, Korogocho, and Kariobangi, who constitute the immediate neighbourhood communities to the Dandora dumpsite. Study conducted by UNEP (2007) on Dandora dumpsite and Korogocho estate highlighted the key environmental factors which have great contribution in public health. These included air, water and soil pollution resulting to potential exposure to toxic heavy metal causing respiratory tract abnormalities, cancers, amoebiasis among other diseases. Hospital waste not classified as Municipal solid waste (biological waste) is also illegally disposed at the dumpsite exposing the neighbouring communities to diseases such as HIV/AIDS and hepatitis.

Despite the human health risks posed by the dumpsite to especially these communities, Dandora dumpsite remains a beehive of waste dumping activities while planning and enforcement of existing by-laws, rules and regulations at the Dandora Dumpsite remain weak and inadequate. Dandora is not a sanitary landfill; it is

dumpsite at which attempts are made to destroy most solid waste through uncontrolled open burning at the site on one hand while criminal gangs compete over control of solid waste business rights on the other hand. What is probably crucial is for the City Council of Nairobi to acquire financial and technical capabilities and capacities in solid waste management that can serve to improve the management of various activities and services at the dumpsite, which constitutes a complex problematic situation. This study focuses on understanding adverse impacts of the dumpsite on the immediate neighbourhood and if this impacts were experienced in the same by the communities neighboring the dumpsite and the larger urban populations so that policy and programmes could be directed where the risk is greatest. Such policy and programme initiatives would contribute towards achieving environmental equity among urban populations of Nairobi with respect to solid waste management.

1.3 Research Questions

The current study attempted to answer the following research questions:

1. What common diseases, attributable to the dumpsite, are prevalent among the neighbouring communities?
2. Are the common diseases, attributable to the dumpsite, similar among dumpsite neighbourhood communities ?
3. Is the vulnerabilityto the environmental health risks the same among the neighboring communities?
4. What factors contributes to differences in vulnerability?
5. Does a relationship exist between socio-economic status and exposure to health risks associated with the dump site?

1.4 Research Objectives

The general objective of the research study was to assess whether the urban population shares equitably the burden of the solid waste management in the Metropolitan area of Nairobi, Kenya.

The specific objectives of the study are to:

1. Identify the common diseases, attributable to the dumpsite, prevalent among dumpsite neighbourhood communities;

2. Establish if the common diseases, attributable to the dumpsite, are similar among the dumpsite neighbourhood communities ;
3. Examine vulnerability differences among the neighboring communities;
4. Establish the causes of vulnerability differences;
5. Determine the relationship between socio-economic status and exposure to environmental health risks.

1.5 Research Hypotheses

a) There is no significant relationship between the respondent's location of residency, waste disposal mechanism, source of water and frequency of disease occurrence.
b) There is no significant relationship between the respondent's nature of employment, household income, level of education and frequency of disease occurrence.
c) There is no significant difference between respondent's length of stay in the current location and frequency of disease occurrence.

1.6 Justification of the Study

Solid waste collection and disposal within Nairobi city has attracted much attention from its populace and among environmental justice movements within and beyond the country. The attention is partly due to the importance of Nairobi as a host city to global headquarters of the United Nations Environment Programme (UNEP) and the United Nations Human Settlements Programme (UN-Habitat), besides many other international organizations that have offices in Nairobi. In other words, Nairobi is the environment headquarters of the world and the pressure and drive by various stakeholders to have a cleaner Nairobi is understandable.

The issues and challenges of solid waste management facing Nairobi are not different from other Third World cities – a dysfunctional solid waste management system. One of the most conspicuous evidences of such a system dysfunctionality in Nairobi city is the inequitable way in which the burden of solid waste is shared. For example, whereas the affluent population segments of the city generate more per capita solid

waste than the poor segments, most dumping and disposal facilities are located within the less affluent and poor neighbourhoods.

All over the world, environmentalism is now equated to social justice and civil rights, of which environmental equity is a part. However, in the Third World, it is hard to come by studies that examine the impact of inequitable waste management systems on the poor who are often recipients of LULUs such as dumpsites. A lack of vibrant grassroots activism among poor communities is probably one reason for waste management systems that tend to favour the rich in terms of environmental benefits and deliver much disservice to the poor in terms of environmental degradation. Such absence of grassroots activism could be as a result of local communities' unawareness of the full impacts of degraded environment and the fact that they bare a greater environmental and health risks more than their share while enjoying few ecological benefits when compared with others in the society especially the affluent communities.

The current study set out to assess environmental equity at Dandora dumpsite in Nairobi with focus on the dumpsite neighbourhood communities. The study analyzed disproportionate effects of environmental risks on various population segments. The study will contribute to formulation of policies and programmes that enhance environmental equity and specifically directed to communities where environmental risks are greatest. Further, the study generated information that would be useful to stakeholders who have a role to create awareness and a desire to change the way government implements environmental, health, and civil rights laws. Information on differential sharing of the mismanaged solid waste burden is significant to local communities to participate towards enhancement of environmental sustainability. Through grassroots activism that draws from empirical evidence, the local communities would be able to influence the implementation and enforcement of environmental laws and regulations and participate in the decision making processes which would ensure better environmental risk management at the dumpsite. Finally, the study is an important reference to students and researchers searching for information on environmental equity issues and concerns in developing nations.

1.7 Scope of the Study

The general aim of the study was to assess if there were environmental inequities with regard to mismanaged municipal solid waste. The study was carried out in Nairobi's residential suburbs of Dandora, Kariobangi North, and Korogocho, which form the immediate neighborhoods of the Dandora dumpsite for solid waste. The said neighbourhoods hosted over 200,000 inhabitants with about 73,519 households (KNBS, 2009). The study carried out an assessment of environmental equity among the communities neighboring the Dandora dumpsite. Though matters of environmental equity includes local community participation in decision making processes, implementation of policies, access to information, and health impact assessments among others, the study focused mainly on the impact of the degraded environment on human health. The study identified the common diseases, attributable to the dumpsite, prevalent within the study population and assessed if there was difference in disease prevalences among the neighbourhoods. In addition, the study assessed variations in vulnerability among the communities. Vulnerability variations was assessed by looking at factors that could lead to differential exposure to environmental health risks.

Further, the study attempted to draw a relationship between socioeconomic status of households and exposure to health risks with respect to the dumpsite. The study used education, income, employment and length of stay in the area as independent variables and frequency of disease occurences as the dependent variable.

1.8 Study Limitations

This study encountered several limitations and challenges. First, the researcher anticipated a likelihood of some respondents giving wrong information. This was as result of the respondent not wanting to appear uninformed about his/her environment or a desire to exaggerate the whole situation. The researcher discarded any data that was skewed from the usual data. Apart from respondents giving wrong information, some respondent were unwilling to provide information and some actually responded only when financial tips were given. This had a financial implication on the side of the researcher. Insecurity was also a major challenge particularly in Korogocho estate. Most of the residents even after briefing them of the intention of the study still felt

that the researcher was a media person wanting to make a story from them. Infact majority who eventually agreed to participate did not want to be recorded or photographed for oral interview. Traversing the area was also insecure and the researcher had to hire a local person from local administration which was an extra costs. In addition, the criminal gang that rules the dumping site made the study area insecure and difficult to access the people who work at the site. In order to overcome insecurity at the dumpsite, the study sort assistance from local government administration and from CCN officers working at the dumpsite.

Unanticipated relocation away from the study area by the researcher interrupted data collection schedule thus prolonging the data collection timeframe. The study area is about 8km from the Nairobi city centre and transport was through public busses and '*matatus'*. The poor state of infrastructure limited the accessibility to the local residents' homes and large area was accessed by foot thus more time was spent in data collection. The majority of the population is poor and level of illiteracy is high, thus it was a challenge to acquire all the relevant information. Another limitation was language barrier during personal interviews and informal discussions with the local residents. Swahili language which majority of the residents understands was used.

1.9 Definition of Terms

The poor: Poor people are defined as those people who live below the poverty line according to World bank standard of $1.25 for the poorest countries and $ 15 for the richest countries and majorly those who are in the informal economic sector. These people in most cases are not able to provide for their basic needs such as proper and adequate shelter among other basic needs.

LULUs: Locally Unwanted Land Uses, refers to land uses that communities would not welcome to their neighborhodds e.g. solid waste dumpsite.

Environmental equity: refers to the fair treatment of all people despite their race, culture or income with respect to developing, implementing and enforcing of environmental policies

Environmental justice: This refers to proportionate sharing of both the negative environmental consequences and environmental benefits, meaningful participation of all people regardless of their status and access to information by all.

Environmental injustice: This refers to disproportionate sharing of the environmental risks and benefits across the society

Environmental justice movement: This refers to locally organized groups working together to achieve a common environmental justice goal.

Socio-economic status: This refers to the position an individual holds regarding the ability to fulfill given needs such as housing, material possession, education, and earnings among other features.

NIMBY: Not In My Back Yard, which refers to any local actions aimed at resisting any actions or land use that can lead to devaluation of the local land.

Green city: This refers to urban areas that are environmentally friendly and which enhances better living environment for everybody living in them.

CHAPTER TWO: LITERATURE REVIEW

2.1 Background

Rapid urbanization and the fact that urban areas becoming the choice of residency by majority population has led to increased generation of solid waste across the globe. Increased waste generation has become a major challenge for many cities worldwide. The challenge is more serious in developing world since solid waste management is the most resource intensive services provided by municipalities and these nations lack the requisite resources to cope with the increasing waste generation. As a result, there is inadequate waste management and these nations mostly depends on uncontrolled open dumping which occasionally happens at poor neighbourhoods.

Open dumping leads to environmental degradation and pollution which have negative effects on the health and well being of the communities living near the dumpsite mostly the poor in the society. This creates a disproportionate solid waste burden whci than contributes to enormous disparities in health by socioeconomic class. This disparities raises vital environmental equity issues resulting from solid waste management.

2.2 The Challenge of Solid Waste Management in Urban Areas

Since the times of the industrial revolution, employment prospects in urban areas have always influenced rural-urban migration, which has been the main driver for urban population growth. The annual urban areas population growth rate exceeds 4% in most countries (UN-HABITAT, 2010). With rapidly increasingly populations in cities came enormous challenges in service delivery such as solid waste management, a challenge that has continued to overwhelm many governments and municipal authorities especially in the developing world. Majority of the local governments spend 20% to 40% of their revenues on solid waste management but they are unable to keep up with the growing problem (UN-HABITAT, 2010). According to the World Health Organization, governments in developing countries should prioritize health issues based on environmental concerns (WHO, 2010). In most developing and under-developed countries less than 30% of urban areas have proper and regular garbage collection and disposal systems (Onibokun, 1999).

Central governments often leave the function of waste management to respective local authorities, which often lack the requisite capacity to cope with the the service demands of rapidly growing populations. In other words, municipal authorities in most developing countries simply lack the technical and infrastructural resources required to confront the waste management problem (UNEP, 2007). The lack of capacity in local authorities often results from weak and dysfunctional waste management systems, in which little or little investment is channelled. Solid waste management systems are designed to collect, store, handle, transport, treat and dispose solid wastes in a manner that is ecologically sound (protects ecosystems), socially acceptable and economically profitable. Sustainable solid waste management has been reported in North America and Australia, and it mainly involves landfills and recycling methods (Reddy, 2011).

2.3 Sustainable Urban Solid Waste Management

The effectiveness of a Municipal Solid Waste Management (MSWM) system depends on its adaptation to the prevailing context of the urban area and/or country in which it operates. Prevailing urban contexts consist of political, socio-cultural, economic and environmental aspects (Beed & Bloom, 1995), which influence MSWM. The existing relationship between local and central governments, the form and extent of citizen participation in the public processes of policy making and the role of party politics in local government administration all affect the character of management, governance and the type of MSWM system which is possible and appropriate (Zamberia, 2007).

While municipal politics affect the functioning of MSWM systems, the attitudes of urban residents, which are rooted in people's social and cultural contexts, have one of the strongest influences (Beed& Bloom, 1995). Programs to disseminate knowledge and skills, or to improve behavior patterns and attitudes regarding waste management, must be based on sound understanding of the social and cultural characteristics. Fast growing low-income residential communities may comprise a considerable diversity of social and ethnic groups, and this social diversity strongly influences the capacity of communities to organize local waste management. At the same time, low-income

urban communities often preserve rural traditions of mutual self-help and cooperation, which significantly enhance the potential for community-based waste management (Abhay, 2010).

The effectiveness of a municipal waste management system therefore depends on the degree to which the served population socioculturally identifies with and takes ownership of the systems and facilities (Onibokun, 1999). To this end, it is important that the people be involved from the outset in the planning of the local segments of waste management systems. Community involvement is particularly important regarding the siting of facilities such as waste transfer stations and landfill sites.

The character of waste management tasks as well as the technical and organizational nature of appropriate solutions depend a great deal on the economic context of the country and/or city in question and, in fact, on the economic situation in the particular area of a city. For example, the level of economic development is an important determinant of the volume and composition of wastes generated by residential and other users. At the same time, the effective demand for waste management services, and the willingness and ability to pay for a particular level of service is also influenced by the economic context of a particular city or area (Beed& Bloom, 1995).

Firstly, at the level of the built environment, the size and structure of a settlement has an important influence on the character and urgency of waste management needs. In low-density semi-urban settlements, for example, some form of local or even on-site solution to the management of organic solid wastes may be more appropriate than centralized collection and disposal. In urban areas, the physical characteristics of a settlement including such factors as density, width and condition of roads, topography, and so on need to be considered when selecting and/or designing waste collection procedures and equipment such as containers and vehicles (Beed& Bloom, 1995).

Secondly, at the level of natural systems, the interaction between waste handling procedures and public health conditions is influenced by climatic conditions and characteristics of local natural and ecological systems. The degree to which uncontrolled waste dump sites become breeding ground for insects, rodents and other

disease vectors, and a gathering place for dogs, wild animals and poisonous reptiles depends largely on prevailing climatic and natural conditions. In practical terms, climate determines the frequency with which waste collection points must be serviced in order to limit negative environmental consequences (Schübeler, 1995). Finally, environment health conditions may also be indirectly affected through the pollution of ground and surface water by leachates from disposal sites. Air pollution is often caused by open burning at dumps, and foul odors and wind-blown litter are common. Methane, an important greenhouse gas, is a by-product of the anaerobic decomposition of organic wastes in landfill sites. In addition, waste dumps may also be a source of airborne bacterial spores and aerosols. The suitability of a disposal site depends upon many factors, including specific characteristics of the subsoil, ground water conditions, topography, prevailing winds and the adjacent patterns of settlement and land-use (Abhay, 2010).

2.4 Trends in Urban Solid Waste Management

One major challenge facing many local authorities responsible for solid waste management in urban areas provision of adequate services within their limited finances. For most local authorities, the challenge of inadequate finances would continue into the unforesseable future unless such agencies address problems of revenue efficiency and investment into waste management systems. There must also be a cultural revolution in the practice of solid waste management that emphasizes local citizen participation. Integrated solid waste management that incorporates sustainability principles place emphasis on minimizing waste at the sources, waste management nearby the source, generators of waste to pay for its management, conversion of waste to energy and full address to environmental concerns of waste management (Abhay, 2010). Integrated approaches guarantee active public participation and a healthy environment and society (UN-HABITAT, 2010).

In the future, solid waste management systems should be guided by the various alternatives of turning waste into energy, and strong policies dictating solid waste reduction especially at the source. In addition, new advancements in technology are likely to open new opportunities for efficient waste management especially in the recycling subsector. Technology could revolutionalize the waste management sector

through upgrade of collection and transfer of waste, improvement of waste disposal, maximization of waste recovery and treatment, reduction of waste generated, strengthening waste management and organizational capacity, and raising awareness while increasing the involvement of key stakeholders.

2.5 Environmental Equity

In most literature, the terms environmental equity and environmental justice are used to express the same concept. There are no major distinctions in their definitions but each carries its own connotations. In general, environmental equity and justice refer to the complex interrelationships between low-income communities and the factors which influence local environment (Bullard, & Johnson, 2000). The concept of environmental equity is continually evolving because the factors that influence any local environment also keep evolving. Environmental equity is particularly a concern in populations where there is a disproportionate sharing of environment benefits and adverse impacts of environmental degradation. Environmental equity addresses the issue of tribal and racial minority communities and low-income populations bearing the burden of lopsided exposure to toxic waste and ecological risks (Bullard, 1994).

There are vital equity issues that arise as a result of waste management. Firstly, not everything that is thrown to the garbage is invaluable. What is not valuable to one person can be valuable to other people. When we lack waste management systems, we tend to continuously throw away valuable used products, hence our wastefulness necessitates that we draw more raw resources fom the biophysicalresource base to create new products. The extraction of the raw products and their production is many a time destructive to the environment, hence our quest for new products deprives natural resources from our environment and the people creating the new products work in hazardous environments. Secondly, waste management activities will affect future generations by creating environmental contamination problems and by wasting valuable materials. Finally, our waste management practices hurt other species from birds to fish to domestic animals, by being wasteful and continually depriving our environment of vital resources that other species depend on (Reilly, 1992).

Environmental equity therefore refers to the fair treatment of all people despite their race, culture or income with respect to developing, implementing and enforcing of environmental policies (Bullard, 1994). There have been recent concerns on environmental justice leading to both public and private studies at regional and national levels. These studies (Bullard, 1993, 1994, 1995, Lee, 1992, Alston & Brown, 1993, Bullard & Johnson, 2000, and Schueler, 1992) point to the fact that low-income populations are more likely to be exposed to health effects resulting from pollution exposure than the general population. In the early 1990's there were extensive public concerns on issues relating to risks in the environment to low-income populations especially in the United States (Bryant, 1995). These concerns forced the United States Environmental Protection Agency to create an Office of Environmental Equity with the responsibility of facilitating integration of environmental justice into its policies, programmes and activities (Bryant, 1995). Pollution prevention is one way in which governments are addressing the issue of environmental justice (Reilly, 1992). By reducing pollution exposures to the local communities the government improves the quality of life to its people. The United States government in an attempt to counter skepticism among the people has established collaborative models that attract community and tribal participation in partnerships aimed at preventing pollution of the environment (Bryant, 1995).

Environmental justice is naturally coupled with pollution prevention, protection of natural resources and source reduction to offer a variety of benefits to the minority communities and low-income populations.The environmental justice movement is a growing movement that will continue to offer benefits in diverse areas. Firstly, it attracts the desirable diversity by allowing all segments of the populations to participate in environmental decision-making processes. The movement involves broader segments of populations, and creates room for better understanding of environmental problems and proposed environmental policies and their implications are readily perceived by the public. In addition, the movement has recorded positive results in increasing the knowledge of the general public on environmental problems and their solutions. The eventual outcome of the environmental justice movement is better decisions and policies supported by a larger consensus. Additionally, the

movement advocates that distribution of environmental hazards and protection of the environment should be impartial across societies (Bryant, 1995).

Secondly, the environmental justice movement is committed to actively seek ways of reducing, if not eliminating, environmental pollution and adverse health risks associated with pollution while improving the quality of the environment to low-income populations and minority tribal communities (Taylor, 1992). In the USA, the movement has pressured the government to show fairness in the decision making process on environmental issues. Socially, environmental justice is a cause aimed at promoting fairness and equity to all people. To a certain degree, environmental justice ensures that implementation of a set environmental policies complies with civil rights laws. The concerns of environmental justice are issues of public concern that include fairness and equity, health and safety of human beings, economic development and healthy living environments. Other concerns of environmental justice movement are sustainable environmental practices and the quality of the environment (Reilly, 1992).

2.6 The Poor and Environmental Equity

Despite significant improvements in environmental protection over the past years, millions of people continue to live in unsafe and unhealthy physical environments. Many economically impoverished communities and their inhabitants are exposed to greater health hazards in their homes, on the jobs and in their neighborhoods when compared to their more affluent counterparts (Bryant &Mohai, 1992. Bullard, 1994). The dominant environmental protection paradigm institutionalizes unequal enforcement; trades human health for profit; places the burden of proof on the victims and not on the polluting industry; legitimizes human exposure to harmful chemicals, pesticides, and hazardous substances; promotes risky technologies; exploits the vulnerability of economically and politically disenfranchised communities; subsidizes ecological destruction; creates an industry around risk assessment and risk management; delays cleanup actions; and fails to develop pollution prevention as the overarching and dominant strategy (Austin &Schill, 1991; Bullard, 1994).

Many studies have concluded that racial and class biases are responsible for the fact that many of the 'cities' poor and marginalized communities lack waste management services or are serviced with less efficiency than their richer counterparts (Bryant &Mohai, 1992, Austin &Schill, 1991& Bullard, 1994). These communities are also the recipients of environmental Locally Unwanted Land Uses LULUs (Pellow, 2004) such as waste disposal sites as well as widespread health and social consequences of mismanaged waste (Schübeler, 1995). In this respect, an environmental issue affecting the general population has been addressed in a manner that displaces the problem in a new form onto more politically marginalized sectors of the population (Faber, 1998). Though most studies show that an interplay of socio-economic factors along racial and class biases can explain environmental inequities, there is no exclusive study on effects of socio-economic factors in matters of equity. Hence, it is difficult to generalize the findings of these studies specifically on communities in developing countries like Kenya.

2.7 Socio-political and Economic causes of Environmental Inequity

The cost of the present explosion of globalization can result to impacts on activities of local residents arising primarily by the decisions made from world's major economic and political power located in a far distance. The impinged communities are deprived of access and involvement in such decision making systems and also decision makers are not obliged to pay any consequences for damages in local environment generated by their own decisions. In such circumstances environmental degradation and human mistreatment proceeds and eventually bring about environmental inequity (Taylor, 1992). This goes on until local inhabitants can completely benefit from the right for use and conservation of their natural resources.

The major reason of environmental inequity is rampant social inequity arising from disproportionate treatment of all people of class, caste, ethnicity, gender, or geographical origins. This leads to environmental degradation which yet again prepares the state for diverse social prejudice and inequities (Faber, 1998). A cycle of injustices are hence perpetuated in the society and this substantiates the fact that social and environmental conditions are inseparable and issue of environmental equity becomes a political subject.

Effects of undesirable environmental costs and other hazards more often than not come to the side of socially deprived or disproportionably affected segment in the society where unfairness and asymmetrical treatment is rather frequent. This leads to environmental classism, racism or similar conditions. Select few and extremely advantaged segment of the society has the opportunity to utilize and privatize common resources for their own benefits as well as environmental benefits through their painless access and stronghold in political influence. Likewise, their strong political influence can be used as a machinery to restrain the voice and dissent of impacted communities. The response usually seen at the time of discharge of waste matter in urban locality 'Not In My Backyard (NIMBY)' is an outcome of such social discrepancy, which makes the discarding of waste in or close to the communities of underprivileged and deprived inhabitants (Bullard & Johnson, 2000).

Given that the capitalist economic and political structure fortifies such circumstances of injustice and inequity, it aids in establishment and advancement of environmental inequity and as a result environmental degradation. Hence the present tendency of development of capitalism and globalization, which point towards the expansion of power to manage economic and political structure by few individuals and private corporations, is continued to impinge the common resources in addition to public voice and disputes. Decision makers are not focused to the voice arising from the lower segment of the society and this is because the economic structure in capitalism fully pays attention only on how to gain more benefits. It does not think about other features diverse from anthropocentric outlook. Hence the social destruction occurs. Thus, unless diverse social inequities and crises are rectified and an adoption of participatory communicative democratic processes (Faber, 1998), conditions of environmental equity remains unaffected and impedes realization of sustainability.

It is hard to clearly articulate how development affects sustainability. The primary means of achieving sustainable community development is through proper local control over decisions on development. Sustainable communities are credited for protecting the environment and also promoting humane local societies. To achieve sustainable community, it is important to strike a balance between development ideas

and environmental concerns, and at the same time enhance relationships within the local societies. In a sustainable urban community, the people accept responsibilities of maintaining a healthy interdependence between the ecosystem and human activity. The seven acceptable indicators of an urban communities' sustainability are housing, local government, infrastructure, transport, background data, management of the environment and socioeconomic development (Bryant, 1995). In such communities, the environment and human live in harmony.

2.8 Model Green Cities: Lessons in Waste Management

By concentrating people and activities, urban areas have become centres of the waste economy which plays an overriding role in urban ecological footprint. However, urban areas have demonstrated significant resilience in finding green solutions that reduce overall waste, increasing and pionerring new forms of environmentally friendly treatment of unavoidable waste (Zurbrü gg et al, 2005). When an urban area is environmentally friendly it is referred to as a green city (Satterthwaite, 2008). This is determined by the levels of pollution, carbon emissions, consumption and quality of water, and energy and waste volumes, recycling rates among other environmentally friendly factors (Satterthwaite, 2008). Green cities are not only defined by their performance on environmental factors but also on social equity issues. It is a proven fact that greener cities provide better living environments and further makes it equitable for all residents living in such cities (UNEP, 2011). Additionally, there are those cities that are considered green because of their ambitious policies and projects towards greener better environment.

Green strategies have been initiated in several cities in Europe, Unites States and Canada. The city of Freiburg in Germany is well known for its sustainable building and investment in recycling. Between 1992 and 2003 the city recorded a reduction of 12 per cent in carbon emissions per capita (UNEP, 2011). In 1980s, Singapore introduces the first ever road-charging scheme in the world, and over the years it has made considerable sustainable policies on waste greening the environment (Suzuki et al, 2010). Green cities have adopted several policies to enhance poverty reduction and social equity. For instant, to reduce carbon emissions and increase equity in accessing public services, some of the cities have enhanced public transport systems. Also in an

attempt to reduce pollution, the cities are encouraging their residents to switch to cleaner and more efficient fuels for transport, generation of power and cooking.

Solid waste management plays a considerable role in determining a city's ecological footprint. Green cities offer solutions to reducing waste through increased recycling processes and environmentally friendly treatment of waste. One of the common green cities in Europe, Copenhagen recycles over 50 per cent of its solid waste and only 3 per cent is sent to landfills (UNEP, 2011). Another critical component of green solid waste management is composting programs that have been worked in cities like Dhaka (decentralized composting) and San Francisco (food composting) (Medina, 2008).

An urban setting which have a tendancy of encouraging a diverse and compact system of production and consumption have an advantage of advancing the concept of 'industrial ecology' (Lowe & Evans, 1995 cited in UNEP, 2011) by optimising and synergising various industrial sectors and resource flows, where outputs of one sector become the input of another creating a circular economy (Suzuki et al, 2010). The principle of symbiosis helps in reducing or recycling waste. These prospects have led to increased efforts in structuring cross-sectoral green city strategies when developing eco-cities. Examples of green cities employing these startegies include Masdar city in Abu Dhabi, South Korea, Tianjin in North China and Amsterdam (Barret et al, 2006). Greening the cities has social benefits such as creation of job opportunities on a number of fronts like urban and peri-urban green agriculture (Smit & Nasr, 1992), renewable energy, waste management and recycling among others (Medina, 2008). Thus, there are clear opportunities to exploit urban areas and reduce the externalities. The consequently improved access to jobs, safe drinking water, sanitation among other services may hold the key to lifting the urban poor out of poverty altogether.

2.9 Theoretical Framework

Three basic theories of justice and equity– utilitarianism, contractarianism, and egalitarianism informed this study. The three theories represent distributive justice by use of varied products and/or services. According to Smith (1994), egalitarianism can be seen as the equity in distribution of justice and the manner in which individuals

are treated. Therefore according to the theory, everyone should receive equal resources and thereafter produce similar outputs despite one's geographical location. Utilitarianism on the other hand states that the production and distribution of products should be aimed at maximizing the average social utility for all people (Liu, 1997). The theory therefore ignores concepts of individual inequity but instead emphasizes the aggregate distribution of justice to the society. Contractarianism Theory is of the view that social contracts should oversee equal distribution of goods and services by individuals in all cases unless if unequal distribution would favour the disadvantaged persons (Rawls, 1980). The theory therefore supports equity for all in accessing all basic rights where all forms of inequity (whenever they exist) should be seen to favour the most disadvantaged in the community.

Unlike egalitarianism which strives towards the elimination of inequity, this theory basically champions for fairness and not equity. Libertarianism Theory states that freedom for all people to do what pleases them must be respected as long as whatever they aspire to do considers the freedom of other people in doing the same (Liu, 1997). Though the theory does not provide for means to resolve conflicts like pollution, it is popular for its emphasis on freedom of choice, free market economy as well as property rights. However, this theory lacks the ability to offer solutions for environmental injustices because such injustices involves large groups whose members experience different levels of injustice.

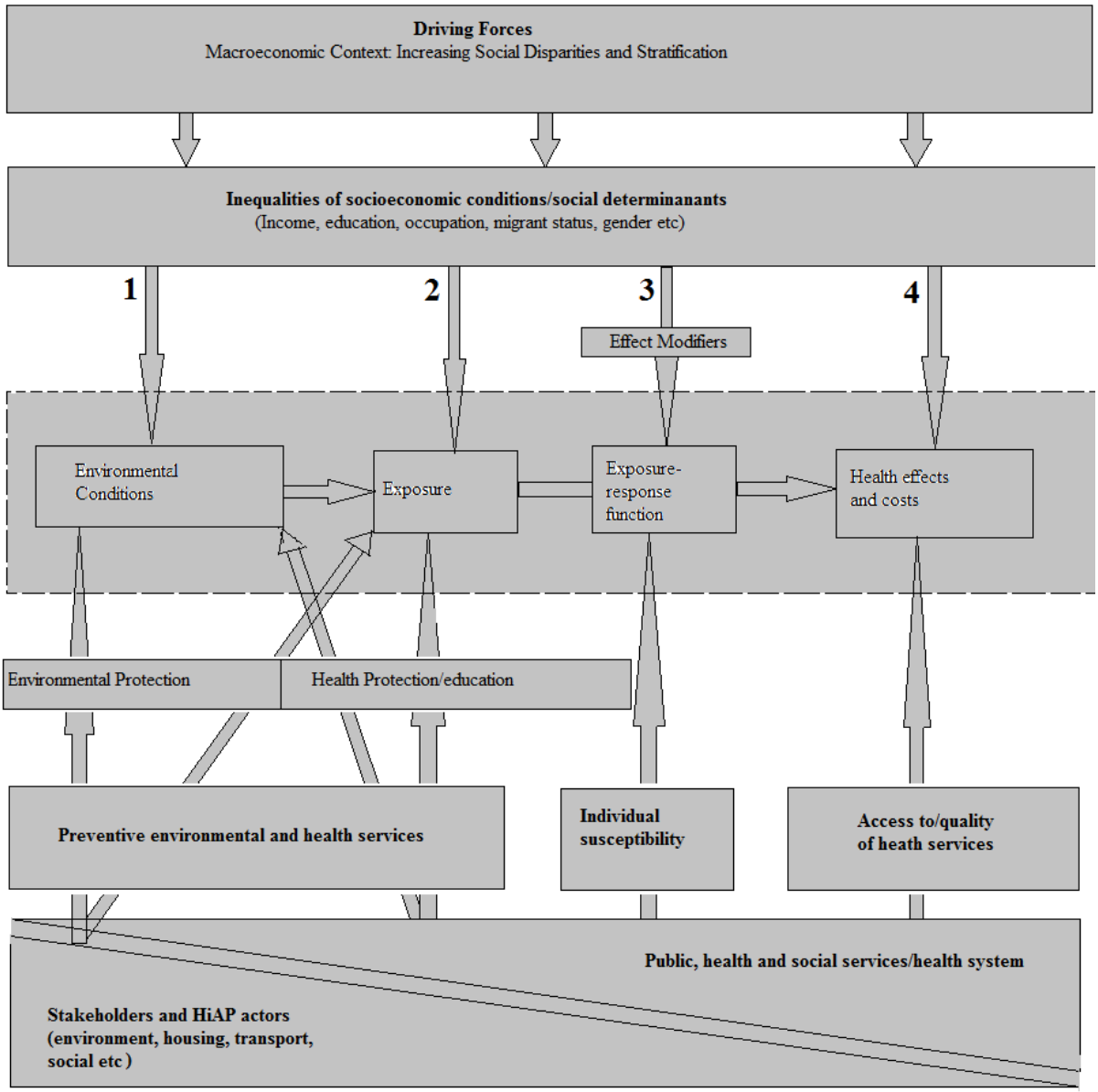
In addition to these three theories of distributive justice, this study was also informed by theories of economics and location that offers explanation as to why environmental pollution continues to concentrate mainly in the neighbourhood of the minority and low income people. Liu (1997) argues that economics dictates the principles of Pareto efficiency where making one to be better off in the society means sacrificing the status of others by making them worse off. For example, industrial advancement poses better lives for majority in the society while the pollution (air, land and water) emanating from the industries lead to adverse and disproportionate health effects on a section of the population (Clinton, 1994). Theories of economics and location teaches that industrial locations mainly follow paths of low resistance where there is no much political pressure, availability of cheap labour and affordable land.

According to Mohai and Bryant (1992) such conditions are easily met in places away from cities and it is residents within such neighbourhoods that bear the greatest pressure from industrial pollution. According to house location theory, locations are not only determined by accessibility and space but also by the availability of environmental amenities to the habitants (Fujita, 1989). According to Kanemoto (1987), the polluted lands adjacent to industrial zones are cheap and can only attract the lower cadre of the society who in return provide labour to the industries as they seek for means to sustain their livelihoods. People within the middle and upper income brackets are pushed away by the presence of such pollution creating more room for low income earners.

There is scanty literature on environmental equity in developing nations. Much of available literature are drawn in developed nation and according to these literature, race has been established to be a key factor in determination of environmental inequities. The literature then can only be generalized to nations where race is in existence. The current study sought to assess whether environmental inequities were in existence in developing nations or nation where race was absent and if such inequities existed, identify the causes of such inequities.

2.10 Conceptual Framework

Figure 1. Conceptual framework on environmental equity



Source: Adapted after WHO, 2010, pg 3.

The researcher has used the above framework model to structure and decomposite the possible pathways under which socio-economic determinants and inequities can probably affect environmental conditions and lead to increased environmental risk exposure and undesirable health outcomes. The conceptual framework suggests four major pathways.

In **arrow 1**, socio-economic determinants affect the environmental conditions of an individual and may contribute to increased exposure of specific individuals or population groups to potentially harmful environmental conditions.

In **arrow 2**, socio-economic determinants may directly influence exposure beyond and in addition to the exposure that is associated with arrow 1 that is within the same environmental conditions, the affect populace could still be more exposed through for instance the mechanism of education and health behavior.

In **arrow 3**, given the same exposure, socio-economically disadvantaged populations could show more severe health impacts if the socio-economic disadvantage is linked with some mechanism that modifies the impacts and hence influences the exposure response function.

In **arrow 4**, adequate evidence is available that socio-economic determines impact on health but what is not clear is the relative significance of socio-economically determined exposure to environmental risk factors.

Arrows 1 and 2 represent the exposure differential showing the variation of exposure. On the other hand, arrow 3 is representing the vulnerability differential showing the variability of exposure response function and hence the vulnerability of individuals. The two differentials combined could be expected to explain the degree of environmental inequities identified.

In addition to processes leading to inequities in the distribution of environmental risks and outcomes, the conceptual framework establishes the institutional landscape and the respective services and actions to tackle inequities. A number of players are called upon to reduce and mitigate the occurrence of environmental inequities whether they are socio-economically determined or not. In first place, accountability is held by environmental players and stakeholders towards shaping the environmental conditions, for instance players on environment, transport, housing, occupational settings among others. Nevertheless, the health sector has a noble role to play which is not limited to the provision of health care but also in preventative action in addition to

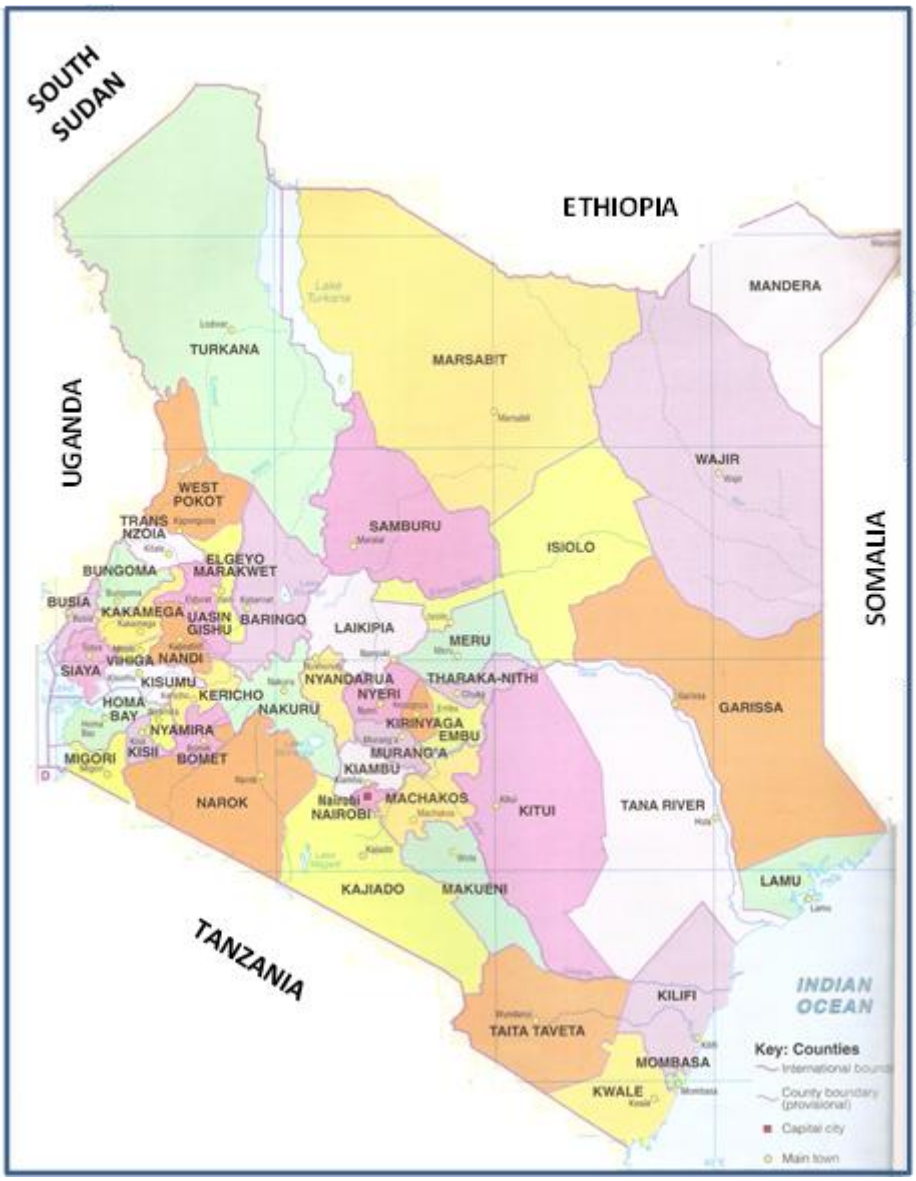
environmental health services which in most cases must be based on collaboration with other sectors, shaping a common health in all policies approach. Markedly, health and welfare structures need to tackle the expanding problem of health inequities, and as environmental inequities are a major contributor to health inequities, it is vital to join forces with other sectors.

CHAPTER THREE: METHODOLOGY

3.1 Study Area- the Dandora dumpsite

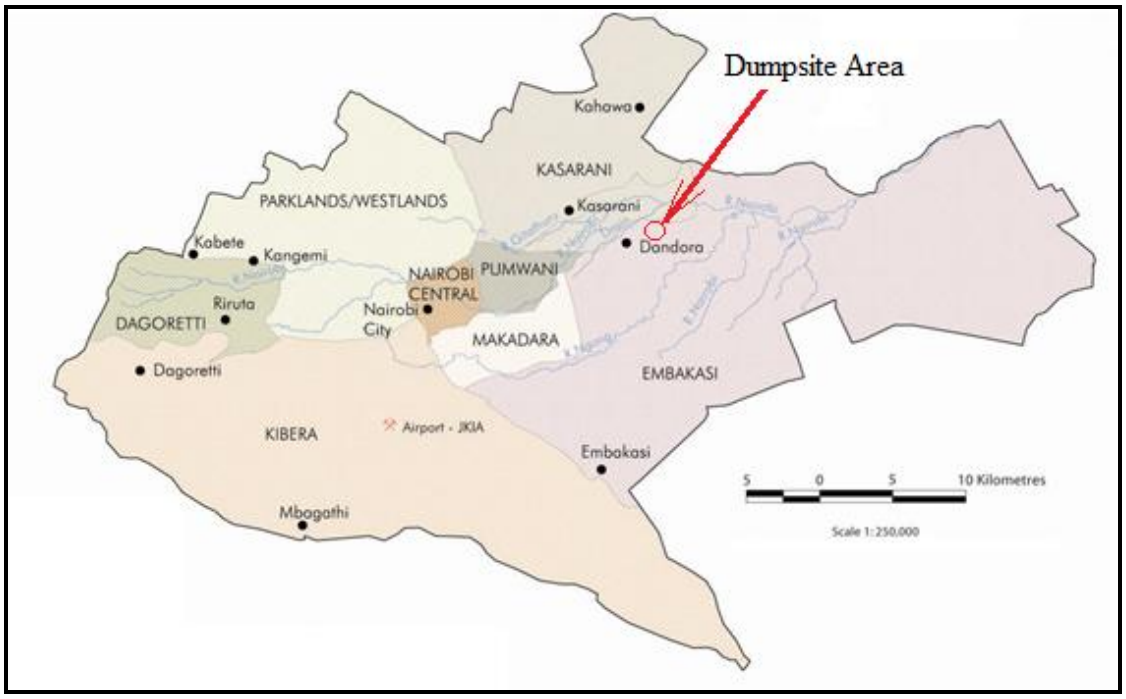
The Dandora Municipal waste dumping site is located on the East of Nairobi City centre, about 8 kilometers from the Kenya capital city centre.

Map 1: Map of Kenya showing major regional urban centres



Source: Moran Atlas

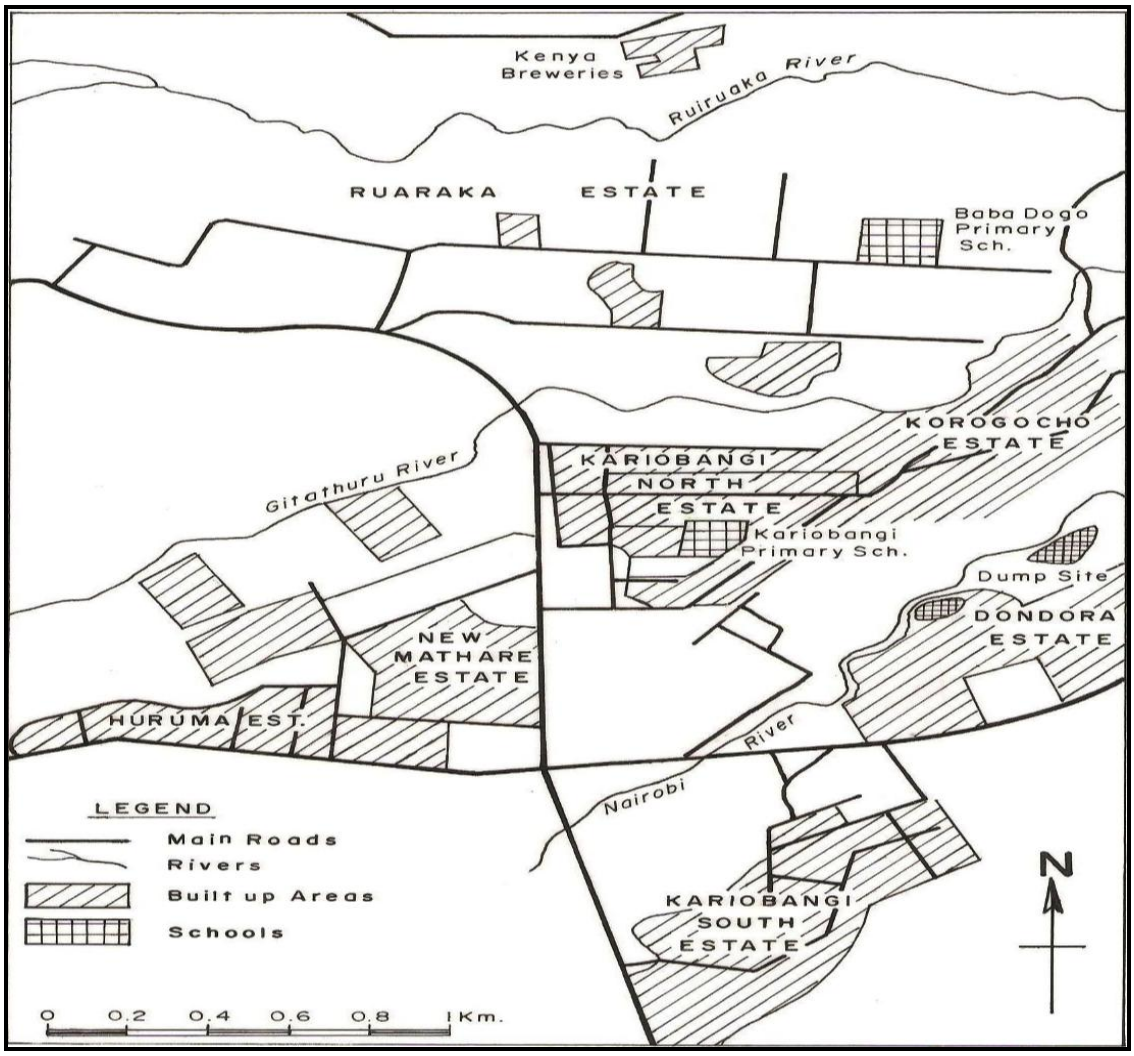
Map 2: Map of Nairobi showing the location of the dumpsite



Source: Google Maps (www.unep.org/roa/Nairobi date of access 24/06/13)

The dump site occupies about 30 acres of land that was once a quarry and is the main solid waste facility in the city. Bordering the dumping site, are the residential areas of Kariobangi North, Korogocho slums and Dandora estates (Map 3) .

Map 3: Sketch map of Dandora dumpsite and its neighbourhoods



Source: Field data

Majority of the inhabitants of these three residential areas either work in informal economic sectors or are unemployed. Self-employment and smallhold foodcrop farming is common along Nairobi River to produce food crops for household subsistence and income. Some of the waste disposed at the site spill over to the river and also leachate polluting the water. The polluted water is used by the smallhold farmers to irrigate their crops exposing them and the consumers of their produce to toxic heavy metals. Apart from foodcrop farming, the residents also keep domestic animals such as chicken, cows, goats and pigs to boost their food supply he and income. Most of these domestic animals forage in the dumpsite.

Plate 1: A pig forage in the dumpsite

Products from such domestic animals i.e meat, milk and eggs exposes the population further to toxic heavy metals through food chain.

Over 2000 tons of waste generated and collected from various locations in Nairobi and its environs are deposited on a daily basis at the Dandora dumpsite. Initially, dumping of waste at the site was meant to refill and rehabilitate the old quarry (Zamberia, 2007). The quarry filled up but dumping continues todate and the piece of land now teems with mountains of garbage. In order to create room for more waste, an onsite earth mover spreads the waste mountains and some of the waste end up being pushed into the Nairobi River. This extends the risk potential to communities living downstream who could be using the water for domestic and agricultural purposes. Some of the waste heaps are simply reduced by burning and they emit potentially poisonous gases into the atmosphere. Dumping at the site is unrestricted and many types of solid waste – industrial, agricultural, domestic and medical wastes (especially used needles and other sharps) – are seen strewn all over the dumping site. Movement into and out of the dumping site is unrestricted and scores of people are on

site scavenging for valuables that they can reuse or sell to get income. Some groups focus specifically on waste for recycling and compost generation. The compost (organic fertilizer) is sold to potential customers for use in farmlands . The dumpsite area also harbors criminal elements and the adjacent residential communities are reportedly some of the most insecure areas of Nairobi (Zamberia, 2007). The dumpsite is beehive of activity and is probably an illustration of the unexploited potential in the solid waste industry in Kenya. Apart from the communities around the dumpsite being directly exposed to serious environmental risks, people far off are also at risk of exposure by consumption of meat or poultry products as well as vegetables cultivated using compost from the site.

3.2 Research Design

The current study sought to answer the question 'how' and 'why' in sharing the burdens that comes with management of solid waste in the society. The Case study design was used as it is the most preferred strategy when 'how' and 'why' questions are posed (Yin, 1994). As defined by Bromley (1990), a case study is a systematic inquiry into an event or set of related events which aims to describe and explain the phenomenon of interest. The current study sought to explore events that would lead to different exposure to health risks among urban society and especially people living in the same neighbourhood. The study explored the events in their natural and sociocultural setting a strategy of case study design a contrast of other designs such as experiment which isolates a phenomenon from its natural setting (Stake, 1995). The information obtained from the case study could also be statistically generalized to other dumpsite cases across and beyond Kenya (Yin, 1994). The information in this case study helped in exploring data in real life environment (naturalistic approach by Stake) and explaining complexities of real life situations which is not practical in experimental or survey design. Case study design helped the research to acquire an understanding of environmental equity issues through the perspectives of selected actors by answering the question 'How' and 'Why' (Yin 1994). The study used the information acquired to describe situations (Mariano, 1993) as they were as well as explaining chain events that lead to certain environmental equity outcomes (Bromley, 1990).

3.3 Types and Sources of Data

Primary and secondary data are the two types of data used in carrying out any research. Primary and secondary sources are contacted for primary and secondary data respectively.The research employed both primary and secondary data sources. Primary data was sourced through the use of questionnaires, structured interviews and key informant interviews techniques used in gathering data in a case study (Yin, 1994). Questionnaires and structured interwiew targeted heads of households in the study communities. Secondary data on the other hand was generated from existing documents about previous studies, international and national agencies as well as official statistics which were relevant to the current study. The documents used were obtained from libraries (Universities and research institutions), Kenya National Bureau of statistics, United Nations agencies, and government ministries. Secondary data was important in confirming the dependability of the primary data. Secondary data from UNEP (2007) was used to confirm diseases prevalent among the communities in the neighbourhood of Dandora dumpsite attributable to the dumpsite which would have taken more time to gather from primary sources thus escalating the cost of the research. Secondary data also guided the researcher to identify informational gaps and reveal a deeper understanding of the problematic situation. Studies conducted in regard to Dandora dumpsite (UN-HABITAT, 2008; UN-HABITAT, 2010; UNEP, 2007; ENVILEAD, 2005; Zamberia, 2007) have not exhibited if the health risks posed by the Dandora dumpsite are equally borne by the communities living near the dumpsite and the entire urban population. To enhance environmental equity, it would require one to know if there were environmental inequities and the causes of such inequities an intent of the current study.

3.4 Target Population

The general aim of the study was to assess whether the burden of solid waste is equitably shared among the urban population, with a focus on the health and disease burden.The study targeted communities in Dandora, Kariobangi North and Korogocho settlements, which are located in the immediate neighbourhoods of Dandora dumpsite. Dandora dumpsite is one of the biggest in Africa (UNEP, 2007) and is one main reason it was purposively selected for the study. Studies (UNEP, 2007; ENVILEAD,2005) have been carried out on the health impacts of waste

dumpsites on neighbouring communities, some of which formed the basis of this study. Most members in the target population are classified in the low socio-economic group characterized by high unemployment and illiteracy levels (GOK, 2008; UN-HABITAT, 2008). Majority of people in these communities work as casual labourers in nearby industries, while others engage in small and micro enterprises to earn a living. Many others especially women are employed as domestic workers in the nearby middle income settlements such as BuruBuru and Komarock. The most chronic challenges in the study communities were lack of or inadequate solid waste management, and exposure to environmental health risks emanating from the dumpsite among others. However, the nature and magnitude of these challenges among the study populations could be different, a phenomenon that the study sought to unravel. In addition, the study desired to understand if the entire urban population was affected similarly like the study community from health risks emanating from mismanaged waste. A control group from middle class population was used for comparison purposes.

3.5 Sampling Procedure

Sampling procedure is the technique a researcher uses to gather people, places or things to study. It is the process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of the characteristics found in the entire group (Orodho & Kombo, 2002). Sampling techniques are divided into two broad areas that is, probability and non-probability sampling. Probability sampling is a random selection which gives each unit in the population an equal chance of being included in the study. Non-probability sampling on the other hand is interested in the representativeness of the concepts in their varying forms and is applied to find out how a representative group is doing for purposes of illustration or explanation (Kombo & Tromp, 2006). The study employed both probability and non-probability sampling procedure. Non-probability sampling was used where the probability sampling could not be used either due to the vastness of the target population and cost implication it would have if undertaken.

3.5.1 The Sample Size for the Household Survey

The household was used as the primary unit of measurement. The households in the study region was enumerated at 73,519 households (KNBS,2009). The study applied the formulae in Watson (2001) to calculate the sample size for the household survey.

$$n = \frac{\left[\frac{P(1-P)}{\frac{A^2}{Z^2}+\frac{P(1-P)}{N}}\right]}{R}$$

Where: n= sample size required

N= number of households in the population

P= estimated variance in population, as decimal (0.1)

A= precision desired, expressed as a decimal (0.05)

Z= based on confidence level (1.96)

R= estimated response rate, as decimal (0.9)

Using the above formulae, the study obtained sample of 58 households. To obtain this sample size, the study accepted a 95% confidence level (margin of error or level of doubt of 5% or 0.05), a 10% level of precision choosen to balance between accuracy and resources as well as acceptability of study outcomes (Krejcie & Morgan, 1972; Blalock, 1972; Glen, 1992) and 10% variability in the attributes that were measured. The attributes that the study measured in the household sample were education, income, employment, health status, and length of stay at the current residential place . The degree of variability in these attributes among the study population was expected to be low since they belonged to the same socio-economic group (G.O.K, 2008) and hence a 10% variability (Smith, 1983; Taylor & Ellen, 1998) in these attribute was accepted. In any research work, there are chances that part of the sample population will fail to respond. The current study took care of the non-responses and estimated a 90% response rate. The final sample size was obtained by dividing the initial sample size of 58 (Appendix 1) household by the response rate of 90% (0.9) thus providing us with a sample size of 64.44 households rounded to 65 households.

3.5.2 Selection of the Household Sample from the Population

Household sample selection employed non-random sampling. In obtaining the 65 households, first, the study region was divided into six administrative clusters (Dandora A, Dandora B, Korogocho, Nyayo, Gitathuru and Kariobangi North) with known population size (**Appendix 4**). Second, each administrative cluster was divided into several quotas so that quota sampling (Kombo & Tromp, 2006) could be applied. Roads, streets and buildings were used to demarcate the quotas. The number of quotas in each cluster was directly proportional to the actual size of cluster population. A total of 22 quotas were established in the six clusters. Convenience sampling was applied to draw the actual households to be surveyed in each quota with at least two household selected form each quota.

3.5.3 Selection of Sample for In-depth Interviews

In-depth interviews were used to fully understand the perception and perspective of the target population. Household survey used closed questionnaire to avoid irrelevant and voluminous information. This technique restricted the respondents to certain information provided by the researcher thus not expressing fully their perception and perspective. In-depth interview helped in expounding the information provided in the household survey together with providing clarification where needed. Structured and unstructured questions were used to gather the complimentary information. Respondents for in-depth interview were obtained from household survey respondents. Simple random sampling was carried out among the 65 households selected in the household survey. Five (5) households were selected.

3.5.4 Selection of Sample for Key Informant Interviews

Key informants were used, first, to counter-check the information provided by the communities respondents in order to establish if there were deviations and secondly to provide necessary information for better understanding of issues surrounding the study communities and the dumpsite. Key informant highlighted the issues surrounding municipal solid waste management including sources and types of waste dumped at the site and implementation and enforcement of laws and regulation governing these wastes. These information helped in understanding the magnitude of

exposure to health hazards and perpetuation of environmental inequities by agencies mandated to protect our environment and health. Structured and unstructured questions were used to gather information on areas of concern. Key informants were selected conveniently. Religious and community based organisations leaders who were believed to be more conversant with the target population and were available were contacted. Waste transporters and those sorting waste either for reuse or for selling to recyclers that were available at the dumpsite during the time of data collection and were willing to participate were contacted. The CCN staff at the site was also contacted.

3.5.5 Selection of Sample for Control Group

The general aim of the study was to assess whether solid waste burden were shared equitably among the urban population. To achieve this, a control group from a population which was not neighboring the dumpsite and in a different societal stratum from the study community was used. A clinic based in a middle class population was contacted to identify if the diseases suffered by the study community were prevalent among this group. Out of a hundred and fifty seven (157) clientele files, fifteen files were systematically sampled to provide data on diseases prevalence among this population.

3.6 Methods of Data Collection

3.6.1 Questionnaire

The household survey employed a structured questionnaire in **appendix 2**. The questions in the questionnaire were closed to restrict the respondent to certain answers provided by the researcher. Due to high illiteracy level, the study supervised the filling of the questionnaire. This facilitated gathering of all intended information through answering any questions that the respondent had about the questionnaire and interpreting questions to respondent who were unable to read and understand as well as interpreting the questionnaire into Kiswahili which was well understood by the majority. This ensured that all the questions were fully understood and completed. Although supervised questionnaire is expensive due to the time needed to collect data, the data obtained are accurate and reliable (Kombo & Tromp, 2006).

3.6.2 In-Depth Interviews

Interviews are questions asked orally to respondent. Interviews consisted of face-to-face conversations with the respondents to capture perceptions and perspectives of the respondents that are useful to the study. Interviews comes in various forms such as unstructured interviews, semi-structured interviews and structured interviews (Kombo & Tromp, 2006).The study used open-ended questions (structured interview-**Appendix 3**) and unstructured questions to solicit information from selected respondents. The data was captured by note taking and audio recording.

3.6.3 Key Informant Interviews

Key informants who had unique knowledge or expertise on the field of study and vast knowledge of the study community were contacted to validate the information provided by the respondent and to provide more information on the study area. Key informants helped the study to gain better understanding of the issue at hand as well as respondents, their backgrounds, behaviors, attitudes among other aspects (Kombo & Tromp, 2006). The study used CCN staff at the site, waste transporters and those sorting out waste either for reuse or for selling to recyclers from the dump site to understand the types and sources of waste dumped at the site. These group also helped in understanding the implementation and enforcement of regulations governing municipal solid waste management.

CBOs and religious leaders were used to gain better understanding of the socio-economic status of the population in the study area, their environment and issues of environmental equity. A previous study by Zamberia (2007) exhibited the attempt made by these leaders in an attempt to have the dumpsite closed down due to the harm it was bringing to the neighboring communities, thus were vital in this study. The CBOs and religious leaders helped the study to understand the community take on the dumpsite, their livelihood and life challenges. Data gathered from key informants provided in-depth understanding about Dandora dumpsite and the communities neighboring the dumpsite. The in-depth understanding helped in the analysis of data to determine issues of environmental equity. Unstructured and structured questions were used in collecting data from key informants. The unstructured questions was

used where more information on issue at hand or clarification of an answer was needed. Note taking was employed to capture the information from the informants.

Plate 2: The researcher Peris Nduta speaks to CCN staff (right)

3.7 Methods of Data Analysis

The general aim of the study was to carry an assessment of environmental equity among communities living around Dandora dumpsite. Previous study by UNEP (2007) which was core to this study exhibited diseases that were suffered by Korogocho resident attributable to the dumpsite. The current study wanted to identify if these diseases were suffered by other communities neighboring the dumpsite and establish if the magnitude of diseases among the population living in these communities were the same including Korogocho. To achieve this the study used table and graphs to analyze and visualize the data. The study also sought to examine if these communities were similarly vulnerable to health risks by exposure. To achieve this, the study used a four scale measurement 'More often' representing once every two months, 'often' for quartely, 'less often' for twice a year and 'rarely' for once a year or absent for a whole year. to examine how frequent the study population was

falling sick. Respondents falling under 'more often' scale were considered more vulnerable and less vulnerable those who fell under 'rarely scale'. A graph was used to analyze vulnerability differences. Regression analysis was carried out to test if there was significant relationship between factors (location, sources of drinking water and waste disposal mechanism) that were considered important in determining vulnerability to health risks by exposure. Regression analysis was also used to test whether there was significant relationship between socioeconomic status (nature of employment, income and education) and frequencies of disease occurrences. The study attempted to determine if a relationship existed between socioeconomic status and equity in sharing the burden of municipal solid waste (frequency of disease occurences). Relationship tests between frequency of disease occurrences and socioeconomic variables were carried out to determine their significance in environmental equity among urban population.

Regression analysis, a statistical tool for investigation of relationship between variables was chosen to ascertain the causal effect of causal (independent) variables upon variable influenced (dependent variable) by causal variables. This techniques have for a long time been used in economic statistics and have increasingly become significant to lawyers and policy makers as well. For instance, in the USA, regression has been used to provide evidence of racial bias in death penalty litigation under Title VII of the Civil Rights Act of 1964. It has also been used to illustrate the possibility that earnings are impermissibly influenced by gender in violation of Federal Civil Rights Laws (Alan Sykes).Tables were used to present the results.

Disease occurrence in many cases is influenced by incubation period. Some diseases take longer to manifest while others manifest almost immediately after infection.This means that people who had been exposed to health risks for longer period (stayed for longer period in this locality) were expected to experience high frequencies in disease occurrence and also manifest diseases that takes long to manifest unlike those who have stayed for shorter period in the same locality. The study used chi-square to test if there was significant difference in frequency of disease occurrence and length of stay at the current residency. Chi-square was selected since it is a test of difference and is commonly used in social science. Length of stay was measured on a four scale measurement of equal interval and tested against frequency of disease occurrence.

CHAPTER FOUR: RESULTS AND DISCUSSION

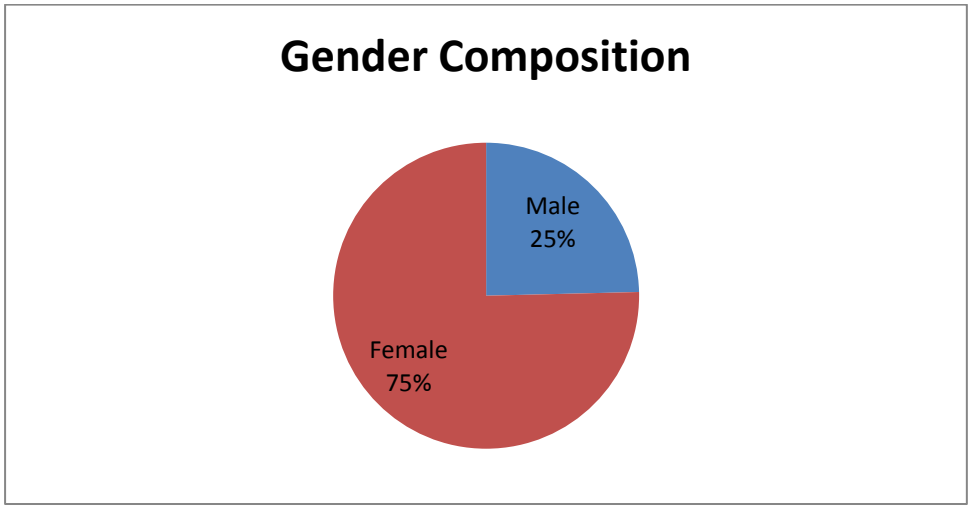
4.1 Background

The study was carried out in low socioeconomic class of urban population with a general aim of assessing whether the burdens of degraded environment and pollution were borne equitably among the urban population. A control group data was sourced from middle class population. Diseases that were attributable to the dumpsite were prevalent among the study population but with differing degrees of prevalence and frequency of occurrence, thus differing burden sharing. The difference in burden sharing is much greater across the entire urban population with the poor being the hard hit. Thus socioeconomic disparities explains the 'who' and 'how much' in the sharing of burdens emanating from degraded environment and pollution.

4.2 Demographic characteristics of the household sample

The household sample was composed of household heads but where the heads were not available, an adult member of the household was contacted. Out of the 65 respondents, 49 were female and 16 were male (**fig 1)**. 41 respondents were married, 6 divorced, 7 separated and 11 were single.

Figure 1: Gender Composition of Sample Population



Source: Field Data

4.3 Disease Prevalence in the Neighbourhoods of Dandora Dumpsite

Study conducted by UNEP (2007), exhibit the various diseases that were tested in Korogocho attributable to the dumpsite. These data formed the basis of identification of diseases prevalent among communities surrounding the dumpsite. Other diseases that were not tested in the UNEP study but are linked with the dumpsite were included in the study. The study investigated the prevalence of these diseases among the study population as well as in the control group that was to give a clear picture of the entire urban population. According to study results, all the diseases were prevalent among the population of three study communities except Hepatitis and HIV/AIDS which were absent in Kariobangi North community. However, absence of these diseases does not in anyway mean that this community is free of these diseases. This could be as a result of respondents concealing information to avoid stigmatization or ignorance about the disease in question. Among the middle class population most of the diseases were not prevalent with respiratory diseases recording the highest frequency in this group.

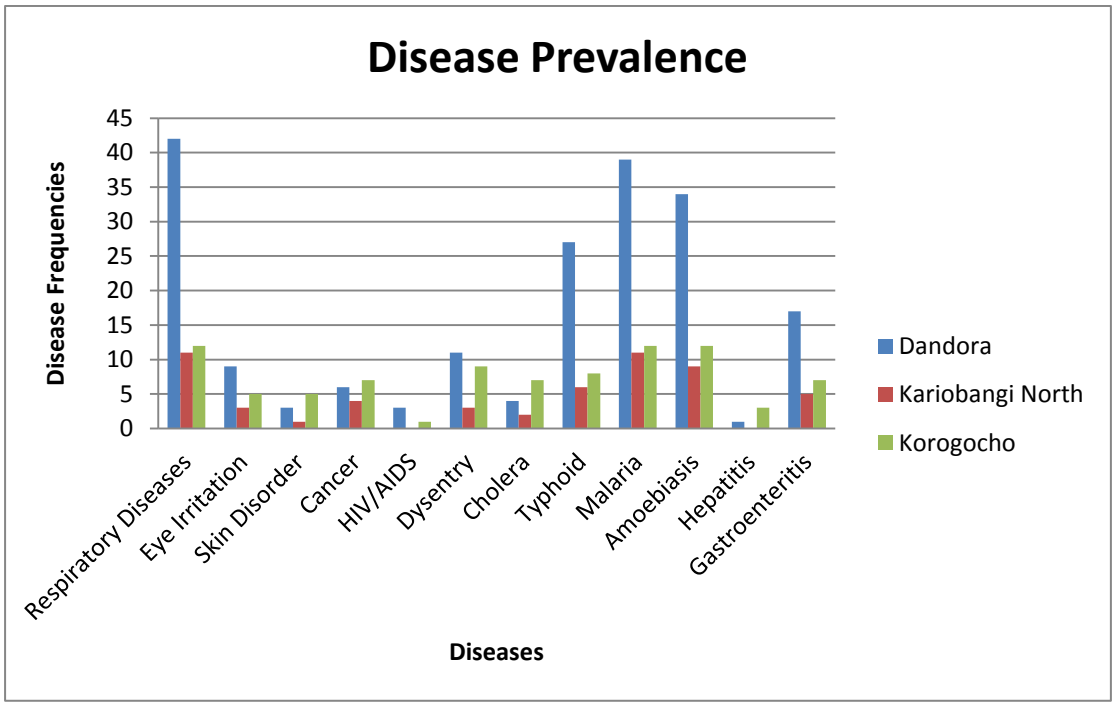
The high frequency in respiratory diseases can be explained by the fact that these are air borne diseases thus transmitted over long distance depending on the direction of the wind. The skin disorder recorded in the middle class is not attributable to the dumpsite but rather was a birth condition known as Eczema. According to these results it is clear that all the three communities neighboring the dumpsite were affected negatively by the dumpsite. However, the middle class population exhibited absence of many diseases attributable to the dumpsite. This is a clear indication that burdens emanating from the dumpsite and generally from mismanaged solid waste was not equitably shared among the urban population with the lower cadre bearing the greatest burden. **Table 1 & Fig 2** presents the disease prevalences in frequencies

Table 1: Disease Prevalence

	Respiratory diseases	Eye Irritation	Skin disorder	Cancer	HIV/AIDS	Dys-entry	Cholera	Typhoid	Malaria	Amoebiasis	Hepatitis	Gastroenteriti
Dandora	42	9	3	6	3	11	4	27	39	34	1	17
Kariobangi North	11	3	1	4	0	3	2	6	11	9	0	5
Korogocho	12	5	5	7	1	9	7	8	12	12	3	7
Middle class	9	3	1*	0	0	0	0	0	3	0	0	0

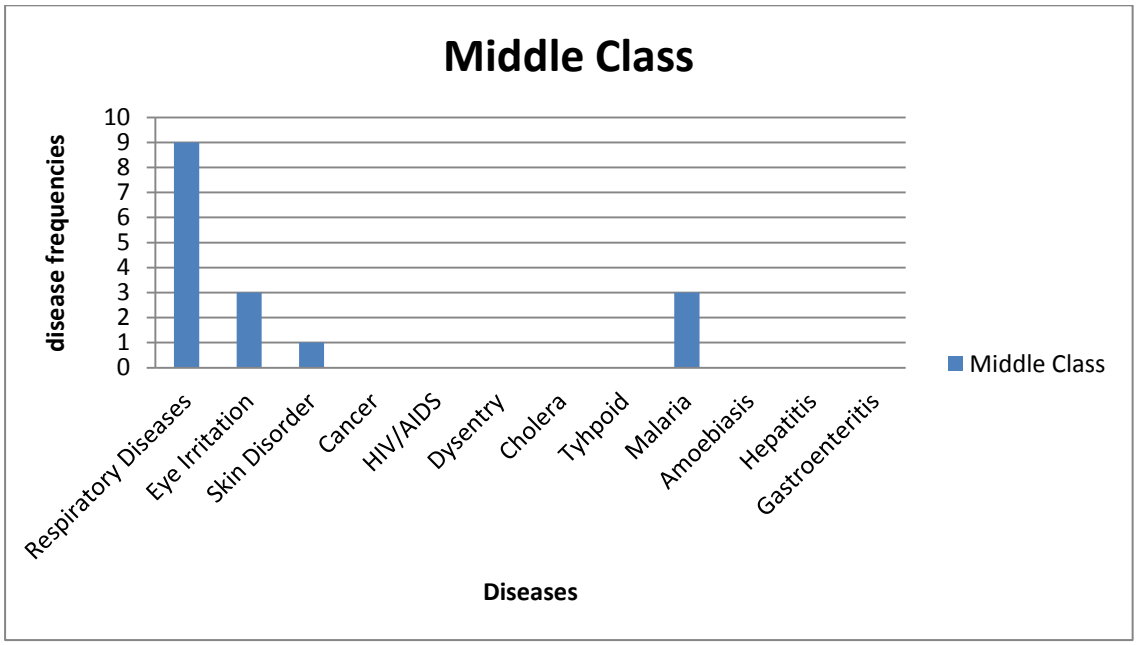
Source: Field Data

Figure 2: Disease Prevalence in Frequencies



Source: Field data

Figure 3: Diseases Prevalence among Middle class Population

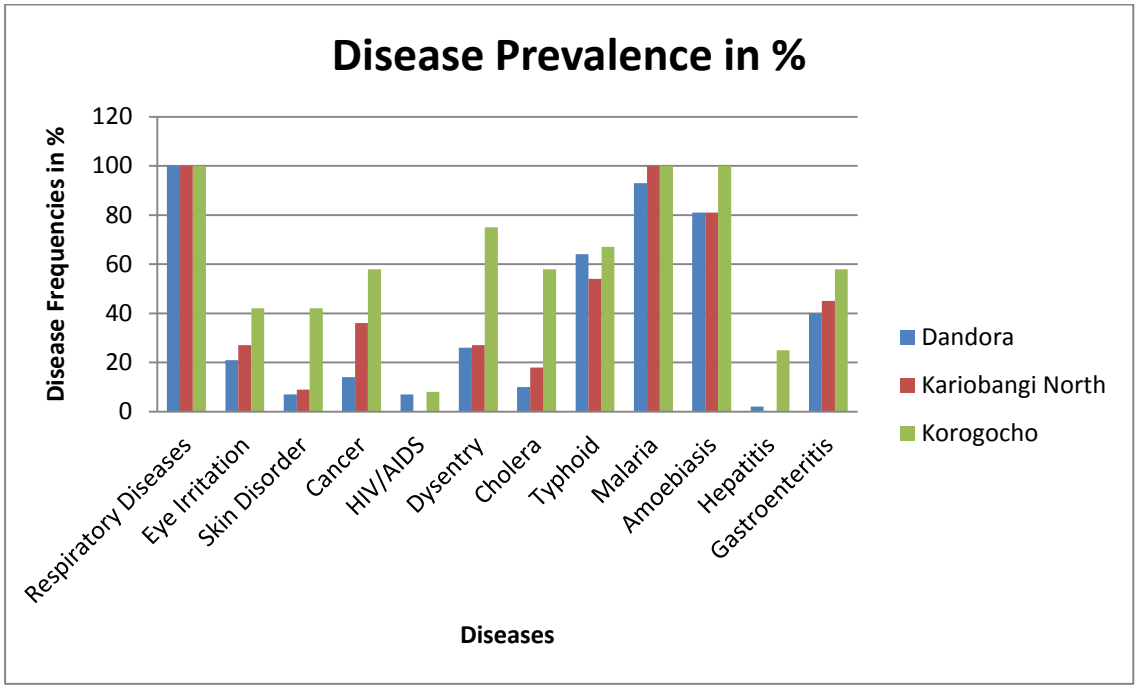


Source: Field data

4.4 Similarities and Differences in Disease Prevalence

The study also sought to establish if these diseases affected the study population in the same way. The frequencies of disease occurrence were converted into percentages in relation to sample size for each community. According to the results of the study, most of the diseases were not suffered the same among the three communities with Korogocho estate being the hardest hit by almost all diseases. However, respiratory diseases were similar among the three communities. Kariobangi North and Korogocho recorded similar output in Malaria. The result thus exhibit that the burden of waste even among communities leaving in the same neighborhood is not shared equitably. **Fig 4** show the differences in percentages of each disease investigated among the study communities.

Figure 4: Differences in Disease Prevalences In Percentages

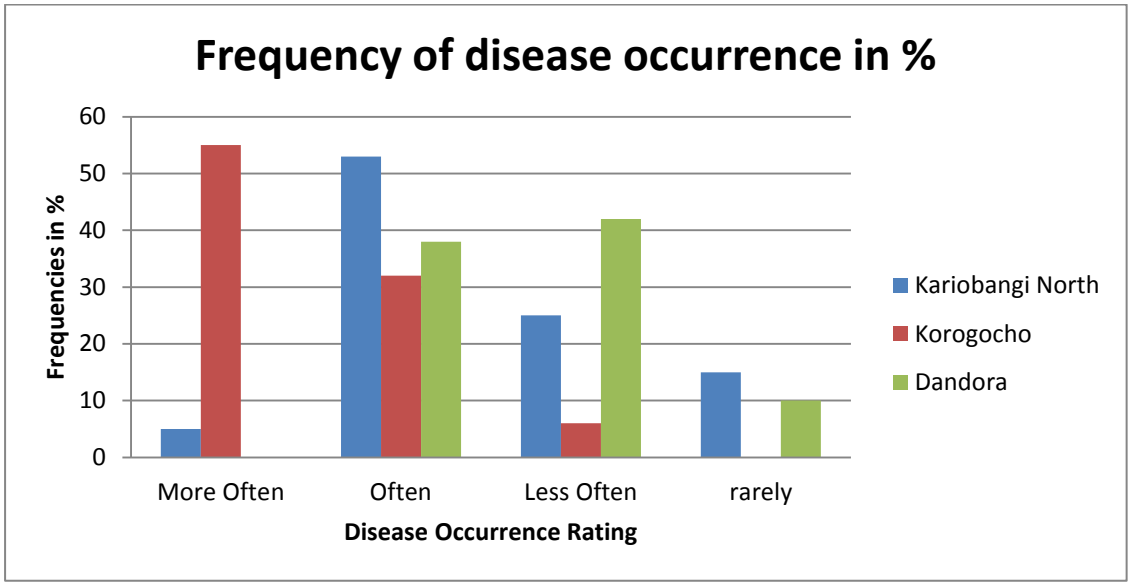


Source: Field data

4.5 Similarities and Differences in Disease Vulnerability

Differences in diseases prevalence frequency among the study population necessitated the need to understand why part of the study population suffered more yet they were in the same neighborhood. The study examined if the three neighboring communities were equally vulnerable to environmental health risks exposure. A four scale measurement ('More often', 'Often', 'Less often' and 'Rarely')was used to measure frequency of disease occurrences in each community to help examine vulnerability differences. Those classified in 'more often' were considered more vulnerable and 'rarely' as less vulnerable. **Fig 5** presents the findings. According to the results, residents of Korogocho estate were found to be more vulnerable than those in Kariobangi North and Dandora. This led to a need to understand why Korogocho residents were more vulnerable and a number of factors which can cause differences in vulnerability were tested.

Figure 5: Frequency of Disease Occurrence



Source: Field data

4.6 Determinants of Disease Vulnerability Differentials

Relationship tests between frequencies of disease occurrences and location of the respondent, source of drinking water and methods of waste handling by the respondent were carried out to establish their significance in determining vulnerability to health risks. Analysis was carried out using regression analysis. **Table 2** below provides the variables measured and their frequencies. Relationship is statistically significant at p = 0.05 (or 95% confidence level). Results from each significant is reported. The results were as follows:-

Table 2: Variables Measured and their Frequencies

VARIABLES	FREQUENCIES
Location of Resident	
Dandora	42
Kariobangi North	11
Korogocho	12
Frequency of Disease Occurrences	
More Often	09
Often	27
Less Often	22
Rarely	07
Waste Disposal Mechanism	
Collected by waste handlers	38
Dumped at the Dumpsite	03
Dumped at the Neighborhood	24
Sources of Drinking Water	
Piped into dwelling	20
Piped into plot/yard	45
Open public well	00
Protected well in plot/yard	00
Protected public well	00
Spring	00
River/stream	00
Pond	00
Tankers/track	00
Income	
≤ 5000	10
5000- 9,999	36
10,000-14,999	14
≥15000	05
Education	
No formal Education	01
1-4 years of Education(lower primary)	03
5-8 years of Education(upper primary) `	15
9-12 years of Education(secondary education)	27
13-16 years of Education (tertiary education)	19
Length of Stay	
Less than 1 year	01
1-5 years	17
6-10 years	25
Over 10 years	22

Source: Field data

H0: There is no significant relationship between respondent's location of residency and frequency of disease occurrences.

H1: There is a significant relationship between respondent's location of residency and frequency of disease occurrences.

The results from regression analysis shows that there is no significant relationship between respondent's location and frequency of disease occurrences (P-value= 0.062) greater than 0.05 (95% confidence level). The null hypothesis (H0) that there is no significant relationship between respondent's location and frequency of disease occurrences could not be rejected since there was not enough evidence to reject it. The assumption was that respondents from Korogocho estate would experience high frequency of disease occurrence due to their close proximity to the dumpsite. However, some section of Kariobangi North and Dandora estate were also close to the dumpsite. This also explains why even in the two communities (Dandora and Kariobangi North), part of the population were more vulnerable to the impact of the dumpsite.

Plate 3:A section of Dandora Estate Touching the Dumpsite

Further, given the study area (Korogocho) had slums where hygiene is expected to be low, it had been expected that those is slums suffer more from diseases than those in other areas. It is worth noting that despite the lack of direct relationship, the 0.1 difference in *P-value (P=0.06-0.05)* could statistically indicate a weak relationship exists. The table below summarises the findings.

Table 3: Location & Disease Occurrences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.948	1	1.948	3.611	.062[a]
	Residual	32.909	61	.539		
	Total	34.857	62			

a. Predictors: (Constant), Which estate do you live in?

b. Dependent Variable: How often do members of your household fall sick?

H0: There is no significant relationship between waste disposal mechanism employed by the respondents and frequency of disease occurrences.

H1: There is a significant relationship between waste disposal mechanism employed by the respondents and frequency of disease occurrences.

The results from regression analysis shows that there is a significant relationship between waste disposal mechanism employed by the respondents and frequency of disease occurrences (P-value= 0.02) greater than 0.05 (95% confidence level). The null hypothesis (H0) that there is no significant relationship between waste disposal mechanism employed by the respondents and frequency of disease occurrences was **rejected**. The assumption was that poor waste disposal methods employed by residents act as a breeding ground for disease pathogens as well as transmission networks. The table below summarises the findings.

Table 4: Waste Management & Disease Occurrences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.962	1	2.962	5.665	.020[a]
	Residual	31.895	61	.523		
	Total	34.857	62			

a. Predictors: (Constant), How do you handle your solid waste?

b. Dependent Variable: How often do members of your household fall sick?

H0: There is no significant relationship between sources of drinking water in respondent's households and frequency of disease occurrences.

H1: There is a significant relationship between sources of drinking water in respondent's households and frequency of disease occurrences.

Regression analysis shows that there is a strong relationship between sources of water in respondent's households and frequency of disease occurrences (P-value= 0.01) greater than 0.05 (95% confidence level). The null (H0) hypothesis that there is no significant relationship between sources of water in respondent's households and frequency of disease occurrences was therefore **rejected** and the alternative adopted. The main assumption was that most of the water used for human consumption in the estates was contaminated with disease causing pathogens; therefore, households using contaminated water were bound to report more disease cases. The table below summarizes the findings.

Table 5: Drinking Water Sources & Disease Occurrences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.844	1	5.844	12.287	.001[a]
	Residual	29.013	61	.476		
	Total	34.857	62			

a. Predictors: (Constant), Sources of drinking water

b. Dependent Variable: How often do members of your household fall sick?

4.7 Socioeconomic Status and Disease Prevalence

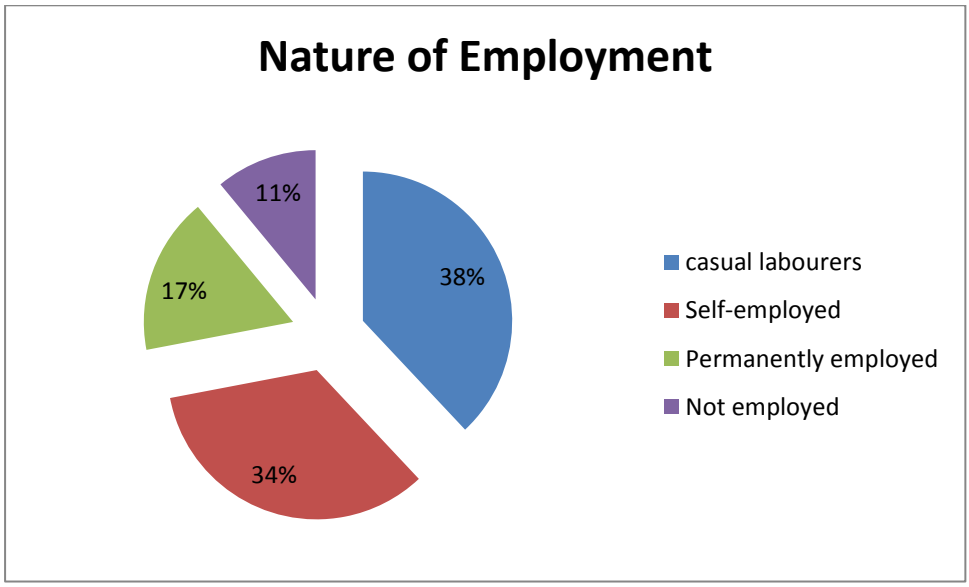
The study desired to understand why the study population resided where they were, disposed their solid waste the way they did, and why they sourced their drinking water from the sources they were using. This is because, according to the earlier finding, the three factors brought differences in diseases occurrence frequencies among the study population.The study assessed whether there was a cause-effect relationship between socio-economic status and frequency of disease occurrences. Analysis was carried out using regression analysis and Chi-square to test relationship and differences. The findings were as follows:

H0: There is no significant relationship between nature of respondent's employment status and frequency of disease occurrences.

H1: There is a significant relationship between nature of respondent's employment status and frequency of disease occurrences.

Regression analysis results indicated that there is no significant relationship between nature of respondent's employment status and frequency of disease occurrences (P-value= 0.202) greater than 0.05 (95% confidence level). The null (H0) hypothesis that there is no significant relationship between nature of respondent's employment status and frequency of disease occurrences could not be rejected since there was not enough evidence to reject it. The assumption was that respondents in more reliable employment had lower incidences of disease reported since they were in a position to afford a cleaner environment. Majority of the respondents in the study area are either casual labourers at 38%, self-employed at 34% and the rest are permanently employed at 17% and not employed at 11% (**figure 6)**

Figure 6: Nature of Employment



Source: Field data

The findings are summarized in the table below.

Table 6: Employment & Disease Occurrences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.425	1	1.425	1.664	.202[a]
	Residual	52.226	61	.856		
	Total	53.651	62			

a. Predictors: (Constant), What is the nature of your employment

b. Dependent Variable: How often do members of your household fall sick?

H0: There is no significant relationship between respondent's household income and frequency of disease occurrences.

H1: There is a significant relationship between respondent's household income and frequency of disease occurrences.

Regression analysis findings show that there is a significant relationship between respondent's household income and frequency of disease occurrences (P-value= 0.025) greater than 0.05 (95% confidence level). The alternative (H1) hypothesis that there is a significant relationship between respondent's household income and frequency of disease occurrences **failed to be rejected.** The assumption was that household with higher monthly income were able to practice better disease prevention mechanisms such as sleeping under mosquitoe net and others, or even live in better and cleaner parts of the study estates. Therefore, the households are less exposed to disease causing pathogens. The table below summarizes the findings

Table 7: Income & Disease Occurrences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.787	1	2.787	5.302	.025[a]
	Residual	32.070	61	.526		
	Total	34.857	62			

a. Predictors: (Constant), Household monthly income

b. Dependent Variable: How often do members of your household fall sick?

H0: There is no significant relationship between respondent's education level and frequency of disease occurrences.

H1: There is a significant relationship between respondent's education level and frequency of disease occurrences.

Regression analysis show that there was a significant relationship between respondent's education level and frequency of disease occurrences (P-value= 0.021) greater than 0.05 (95% confidence level). The alternative (H1) hypothesis that there is a significant relationship between respondent's education level and frequency of

disease occurrences was **accepted.** The assumption was that cases of disease infections would be less in households with educated members. The finding therefore suggests that education is vital in fighting diseases that affected households due to poor hygiene among others. The table below summarizes the findings

Table 8: Education & Disease Occurences

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.945	1	2.945	5.605	.021[a]
	Residual	31.523	60	.525		
	Total	34.468	61			

a. Predictors: (Constant), Level of education

b. Dependent Variable: How often do members of your household fall sick?

H0: There is no significant difference between length of time the respondents lived in the current estate and frequency of disease occurrences.

H1: There is a significant difference between length of time the respondents lived in the current estate and frequency of disease occurrences.

Chi-square tests revealed that there is no significant difference between length of time the respondents lived in the current estate and frequency of disease occurrences {$\chi 2$ (6, N = 62) = 6.692a, p =0 .35) greater than 0.05 (or 95% confidence level)}. The null (H0) hypothesis that there was no significant relationship between length of time the respondents lived in the current estate and frequency of disease occurrences was not rejected due to lack of enough evidence. The main assumption was that respondents who had lived in their current neighbourhood for long had a likelihood of being exposed to diseases that take long to mature than those who had lived in the neighbourhood for short time. The table below summarises the findings.

Table 9: Length of Stay & Disease Occurrences

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Chi-Square	6.692[a]	6	.350	.358		
Likelihood Ratio	7.326	6	.292	.413		
Fisher's Exact Test	6.178			.373		
Linear-by-Linear Association	2.601[b]	1	.107	.123	.068	.026
N of Valid Cases	62					

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .73.

b. The standardized statistic is -1.613.

4.8 Discussions of the Findings

Solid waste management has become a major challenge globally and particularly a bigger challenge for developing nations that have insufficient or lack sound solid waste management system. This insufficiency is occasioned by lack of sufficient funds and mismanagement of the little funds that are available for management of solid waste. Lack of sound solid waste management has led to degradation of environment which is posing health risks to people and particularly the urban population. The burden of mismanaged waste in urban areas is not borne equitably by the urban population. The study findings exhibit that the communities living close or near the dumpsite have suffered various diseases attributable to the dumpsite (table 1 & fig 2). Laxity in enforcing laws and regulation governing municipal solid waste disposal has exacerbate the situation. Some of the diseases such as those linked with biological waste (medical waste) and industrial waste can be prevented if such waste are restricted from getting into the dumpsite. Failure by relevant authorities (public health and environmental agencies) to implement and enforce relevant laws and regulations have seen the communities neighboring the dumpsite exposed to health hazards.

However, diseases attributable to the dumpsite are not suffered the same among the study population. Some part of the study population experienced more diseases than other parts (fig 3), an indication that environmental inequities exist among urban population. A closer look at the larger urban society (fig 4), the affluent population experiences lesser burden from the mismanaged solid waste.These differences can be explained by factors such as location, source of drinking water and waste disposal mechanism among the communities. Residents at close proximity to the dumpsite, had unsound waste management practices, and unsafe sources of drinking water and were more vulnerable to various diseases unlike their counter part (fig 4 & 5). The frequency of disease occurrences was also measured against the three factors.As shown by the study findings, the differences in diseases occurrence is occasioned by a number of factors that make part of the population to be more vulnerable and suspetible to health risks.Three factors (location, source of drinking water and waste disposal mechanism) were thought to be responsible of differences in disease prevalent and vulnerability to health risks.

However, the study results did not establish any relationship between location of respondents and vulnerability to health risks. It was assumed that residents of Korogocho estate would experience high frequencies in disease occurrence more than those in Dandora or Kariobangi North estates. Lack of a relationship between locations of residents and disease occurrence can be as a result of some of the residents from Kariobangi North and Dandora estate living next to the dumpsite. This was one of the study limitation as distance from the dumpsite rather than estate location would have established a strong relationship between location of residents and frequencies of disease occurence.

The results of relationship test between socio-economic status and effects of the dumpsite suggest that the urban poor bear the greatest burden and are more vulnerable to the negative effects of the degraded environment. Socio-economic status which included education, nature of employment and income has shown to play a key role in determining environmental equity in solid waste among urban population (Table 6,7 &8). In this study, the ‘poor of the poor’suffered the most from the effects of the dumpsite. However, length of stay for the residents which was thought to be

key in determination of frequency of disease did not present any relationship(table 9). This could be as a result of disease incubation period with some diseases taking long to manifest.

In the real world, all communities are not created equal economically, politically and socially. Such inequities have perpetuated unequal protection and play an important role in sorting out residential amenities and disamenities. Low socio-economic population experiences greater burdens that come along with mismanaged solid waste and at the same time enjoying little benefits provided by the environment. According to the results of this study, environmental costs are not equitably borne among the low socio-economic populations living in the same neighborhood.The poorest in this neighborhood suffers the most and this could be the general trend for the entire urban population. The section of the society that has better education which leads to better employment and income can afford cleaner environment as evidenced by the results of this study. They can afford houses that have piped water and also pays for collection of their solid waste. They also live further away from degraded environment since they can afford such environment. On the contrary, the section of the society that has no education or inferior education lacks the power to access better employment leading to meager earnings. They can hardly afford cleaner environment and in most cases they settle in areas where the value of land is low and such are in environment that are degraded.

Similar studies (Bullard, 1993, 1994, 1995, cited in Bullard & Johnson 2000, Lee, 1992, Alston & Brown, 1993, Bullard & Johnson, 2000) carried out in other parts have exhibit the same trend of the poor who were ethnic minorities bearing the greatest burden of degraded environment. A study by Faber and Krieg (2002) particularly exhibited that even among the ethnic minorities the burden is borne differently with areas with African American being affected more than areas occupied by Latinos and Hispanics. In these studies, ethnic minorities bore the greatest risks and were recipient of LULUs thus Race coupled with socio-economic status was key in determination of environmental inequities. However, these findings can not be wholely generalized since not all regions are affected by race. The findings of this study which pin-point socio-economic status as the determinant of environmental

equity then can be generalized globally as socio-economic status cuts across all the regions.

According to house location theory, locations for habitation are determined by accessibility, space, and availability of environmental amenities. In addition, affordability and commuting costs affects the decision of residing in a given location. Majority of residents living in the neighborhood of Dandora dumpsite works in the same locality and a majority eke a living from the dumpsite.

Plate 4: *Researcher and People Sorting Waste for Recycling and Reuse at Dandora Dumpsite*

Re-location for such population to cleaner locations is next to impossible since this would mean an increase in their spending caused by commuting costs. Their income prohibits such increased spending and thus opts to live near their work places. Among those earning a livelihood from waste facility fights against relocation of such waste facility as this would deny them their livelihoods.

Land use affects the value of land and property. Locally unwanted land uses (LULUs), reduces the value of land and that of property. Most of the houses that are next to the waste facility attracts low rental costs and this costs increases with increase of distance from the waste facility. Low rental houses attract those with low income and as income increase there is possibility of moving further away from the waste facility. Population with better incomes hence experiences lesser negative effects from the waste facilities. This explains the difference in disease prevalence among the communities neighboring Dandora dumpsite (**Figure 1**), and those living further from the dumpsite.

Environmentalism is nowdays equated with social justice and civil rights. Any form of environmental inequities is seen as a violation of environmental rights and an environmental injustice those who are affected negatively by the inequities. According to theories of distributive justice, there should be equity in distribution of justice and the manner in which individuals are treated regardless of their geographic location (egalitarian theory of justice). A study commissioned by UNEP showed that the Dandora dumpsite was affecting the communities surrounding it negatively and recommended the closure of the dumpsite. However, solid waste still find its way there todate thus continuing to harm the communities within its vicinity. According to the theory of utilitarian, the rightness of an action, rule or principle is to be judged by its presumed consequences. The theory continues to state that the distribution of products should be aimed at maximizing the average social utility for all people. Continued dumping of solid waste at Dandora dumpsite can not be judged as right for its negative consequences to the communities. In addition, it minimizes the social utility of the low socio-economic communities while maximizing that of the affluent communities whose waste are dumped at the site thus a perpetuation of environmental injustices.

This injustice is further explained by the theories of economic and location which operates on the principle of 'Pareto efficiency'. The principle states that making one better off in the society means sacrificing the status of others by making them worse off. The poor at the neighborhood of Dandora dumpsite are sacrificed to make the affluent communities better thus making them to bears more burden. This is an

enhancement of environmental inequities in the society. The theory of contractarianism argue that such inequities should only be allowed if they would favour the disadvantaged persons. The theory advocates for fairness and not equity. However, continued dumping of solid waste does not favour the neighboring communities whose socio-economic status place them at a vulnerable position to health risks posed by the dumpsite but rather makes them worse off thus enhancing environmental inequity.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Background

Rapid urban population increase has led to increased solid waste generation. The increasing volumes of waste has become a major challenge for the municipal government especially among the developing world who lacks the capacity to handle the growing waste generation. As a result, only small portion of the generated waste is managed in a sound manner and the rest dumped in open fields in uncontrolled manner. This mismanaged waste have been a disproportionate burden to a segment of the urban society where much of the open dumping is happening. Communities living next or close to dump site are disproportionately affected by the negative effect of the degraded environment and pollution thus raising environment equity issue among the urban population.

Environmental inequities are perpetuated along socioeconomic class with the poor bearing the greatest burden. Infact, even among the low socioeconomic class, the "poor of the poor" bears greater burden of the degraded environment and pollution. Towards achieving environmental equity, there is need to address the socioeconomic disparities which is the cause of environmental inequities among the urban population.

5.2 Summary of Findings

The general objective of the research study was to assess whether the urban population shares equitably the burden of the solid waste management. The research study sought to identify the common diseases suffered by the study communities that were attributable to the dumpsite. The diseases that were prevalent among these communities included: respiratory diseases; eye irritation; skin disorder; cancer; HIV/AIDS; dysentery; cholera; typhoid; malaria; amoebiasis; hepatitis and gastroenteritis. All these were suffered in the three communities except HIV/AID and hepatitis which recorded zero occurrence in Kariobangi North estate. The research study in assessing equity issues, sought to establish if the above diseases were suffered similarly among the study communities. According to the findings, only respiratory diseases were suffered similarly among the three communities and

Korogocho estate recorded the highest frequency in all the other diseases. The study examined vulnerability differences among the study communities. Results exhibited that Korogocho estate residents were more vulnerable to health risks than Dandora and Kariobangi North estates. To understand these vulnerability differences, the study sought to established the causes of such differential vulnerability. Three factors including location of residents (estate), sources of drinking water and waste disposal mechanism were considered to determine vulnerability differences. A relationship between location and vulnerability was not established but a strong relationship was established between sources of drinking water and waste disposal mechanisms and vulnerability. Finally, the study sought to determine whether a relationship existed between socio-economic status and exposure to environmental health risks. A strong relationship was established between socio-economic status factors including education, income and nature of employment. Length of stay at the neighborhood of the Dandora dumpsite was also thought to be a factor can determine levels of exposure. However a retionship was not established on this factor. The assessment exhibited that there was inequitable sharing of burdens emanating from solid waste management.

5.3 Conclusions

In the recent past, there has been significant improvement in environmental protection. However, this improvement has not benefitted all in the society. Majority of communities that are socio-economically impoverished in urban areas are exposed to greater health hazards in their residency. It is evident that environmental inequity is real in urban areas especially in Municipal Solid Waste Management, with the urban poor bearing the greatest burden of mismanaged solid waste. Environmental inequity is extended further among the low socio-economic group (the poor) in urban areas. Differential exposure to environmental health risks among the low socio-economic population living in the same neighborhood exists and within this group the poorest bear the greatest burden. Much of environmental equity literature in existence have pin-pointed race coupled with other factors as a key determinant of environmental inequity. These knowledge is only viable to regions that are affected by racism. In non-racist region socio-economic factors have been pin-pointed as the key determinant of environmental equity issues. This revelation should be a wakeup call

for policy makers to formulate policies that will bridge the gap between the rich and the poor toward realization of environmental equity.

5.4 Recommendations

The analysis of the study shows that issues of environmental inequities are present in non-racist nations. As a result, the following recommendations can be made.

- Environmental inequities are real in urban areas and are perpetuated along rich-poor divide with the poor bearing the greatest burden. There is therefore need for the government and policy makers to formulate policies that will improve the livelihood of the urban poor towards achieving environmental equity. Environmental policies targeting reduction of greatest risks should also be formulated.
- A lot of improvement has been made on protection and conservation of environment through formulation of laws and regulation governing environment. It is therefore important that all relevant agencies ensure that such laws and regulation are implemented to the letter. This would ensure equitable treatment for all citizens and would reduce the externalities borne by certain section of the society.
- Exposure to environmental health risks is not the only concern about environmental equity. There is therefore need to further this study to establish environmental equity issues in the perspective of gender and age, access to information and participation in decision making processes.

REFERENCES

Abhay, K.R. (2010). "Problems of Municipal Solid Waste Management in Urban Areas". In: *Solid Waste Management: Present and Future Challenges*, edited by Singh, J. andRamanathan AL.2010 New Delhi: I.K. International Publishing House Pvt. Ltd.

Alston, D. Brown, N. (1993). Global Threats to People of Color. In R. D. Bullard (Ed), Confronting Environmental Racism: Voices from the Grassroots. Boston.

Austin, R &Schill, M. (1991). Black, Brown. Poor, and Poisoned: Minority grassroots environmentalism and the Quest for Eco-justice. Kansas Journal of Law and Public Policy 1, 69-82.

Barrett, J., Birch, R., Baiocchi, G, Minx, J. and Wiedmann, T. (2006). Environmental impacts of UK consumption: Exploring links to wealth, inequality and lifestyle. IABSE Henderson Colloquium, Cambridge.

Beasley, C. (1990). Poverty and Pollution: Deadly Threat on Native Lands. *Buzzworm **2**(5): 39-45.*

Beed, D. & Bloom, E. (1995). The Economics of Municipal Solid Waste. The World Bank Research observer 10: 113-115.

Blalock, H. (1972). Social Statistics. New York: McGraw-Hill.

Bromley, D. B. (1990). Academic contributions to psychological counselling: I. A philosophy of science for the study of individual cases. *Counselling Psychology Quarterly, 3*(3), 299-307.

Bryant, B. &Mohai, P. (1992). Race and the Incidence of Environmental Hazards: A Time for Discourse. Boulder: Westview.

Bryant, B. (1995). *Environmental Justice: Issues, Policies, and Solutions*. United States of America: Island Press.

Bullard, R. & Johnson, S. (2000). Environmental Justice: Activism & its Impact on Public Policy Decision Making. *Journal of Social Issues* 56, 555-578.

Bullard, R. (1994). Unequal Protection: Environmental Justice and Communities of Colour. San Francisco.

Clinton, W. J. 1994. Executive Order 12898: Federal actions to address environmental justice in minority populations and low-income populations. The White House.

Edelstein, R. (1990). Global Dumping Grounds.*Multinational Monitor 11(1), 26-29.*

Faber, D. (1998). The Struggle for Ecological Democracy: Environmental Justice Movements in the US. New York: Guildford.

Faber, R. & Krieg, J. (2002). Unequal Exposure to Ecological Hazards: Environmental Injustices in the Commonwealth of Massachusetts. *Environmental Health Perspectives* 110 (2), 277-288.

Fujita, M. 1989. *Urban Economic Theory: Land Use and City Size*. Cambridge, England: Cambridge University Press.

G.O.K. Korogocho Slum Upgrading Programme.

Glen D. (1992). Determining Sample Size. Program Evaluation and Organizational Development, IFAS. University of Florida.

http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_12_Cities .pdf. Retrieved on March 3, 2012.

Kanemoto, Y. ed. 1987.Externalities in space.In Urban dynamics and urban externalities. Switzerland: Hardwood Academics.

KNBS. (2009). Report for 2009 Enumeration. Kenya National Bereau for Statistic.

Kombo, D. and Tromp, D. (2006). Proposal and Thesis Writing: An Introduction. Pauline Publications Africa. Kenya.

Krejcie, R. & Morgan, D. (1970).Determining Sample Size for Research Activities. *Educational and Psychological Measurement, 30, 607-610.*

Lee, B. (1990). Environmental Litigation on Behalf of Poor, Minority: Matthews v Coye: A Case Study. Chicago.

Liu, F. 1997. Dynamics and causation of environmental equity, locally unwanted land uses, and neighborhood changes.*Environmental Management* 21 (5):643-656.

Mariano, C. (2000). Case study: the method. Chapter 10. In P. Munhall & C. Oiler Boyd, Eds. *Nursing Research. A Qualitative Perspective* (2nd ed.) (pp. 311-337). Sudbury, MA: Jones and Bartlett Publishers.

Medina, M. (2008). The informal recycling sector in developing countries. *Gridlines*, Note No. 44. Public-Private Infrastructure Advisory Facility (PPIAF), Washington, D.C.

Onibokun, G. A. (1999). *Managing the Monster: Urban waste and Governance in Africa*. Canada: International Development Research Centre.

Orodho, J. & Kombo, D. (2002). Research Methods. Nairobi: Kenyatta University.

Pellow, D. (2004). Garbage Wars: The Struggle for Environmental Justice in Chicago, London.

Rawls, J. 1980. *John Rawls' Theory of Social Justice*: Ohio University Press.

Reddy, J. P. (2011).Municipal Solid Waste Management: Processing – Energy Recovery – Global Examples. India, BS Publications.

Reilly, W.K. (1992). "Environmental Equity: EPA's Position", *EPA Journal*, vol.18, no.1, pp.18-22.

Satterthwaite, D. (2008). Cities' contribution to global warming: Notes on the allocation of greenhouse gas emissions. *Environment and Urbanization*, 20, 2, 539-549.

Schübeler, P. (1995). Urban Sanitation Management in Developing Countries: Three Conceptual Tools. Swiss Agency for Development Cooperation.

Smit, J. and Nasr, J. (1992). Urban agriculture for sustainable cities: Using wastes and idle land and water bodies as resources. *Environment and Urbanization*, 4, 2, 141-152

Smith, D. M. 1994. *Geography and Social Justice*. Oxford: Blackwell Publishers Inc.

Smith, M.F. 1983. Sampling Considerations in evaluating Cooperative Extension Programs. Cooperative Extension Service, IFAS, University of Florida. DRAFT.

Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage Publications.

Suzuki, H., Dastur, A., Moffatt, S., Yabuki, N. and Maruyama, H. (2010). *Eco2 Cities: Ecological cities as economic cities*. The World Bank, Washington D.C.

Sykes Alan. An Introduction to Regression Analysis. *The Inaugural Course Lecture.*

Taylor, D. (1992). "The Environmental Justice Movement", *EPA Journal*, vol.18, no.1, pp. 23-25.

Taylor-Powell, Ellen. May 1998. Sampling. Program Development and Evaluation, University of Wisconsin Extension. G3658-3.

UNEP (2007). Environmental Pollution and Impacts on Public Health: *Implications of the Dandora Municipal Dumping Site in Nairobi, Kenya*.www.unep.org/urban.../pdfs/dandorawastedump-reportsummary.pdf. Retrieved on March 4, 2012.

UNEP (2011).Cities Investing in Energy and Resource Efficiency. UNEP.

UN-HABITAT (2010).Solid Waste Management in World's Cities: Water and Sanitation in the World's cities 2010. UN-HABITAT.

UN-HABITAT. (2008). The State of African Cities: A Framework for Addressing Urban Challenges in Africa. UN-HABITAT.

Watson, J. (2001). How to Determine a Sample Size: Tipsheet #60. University Park, Penn State Cooperative Extension. Accessed on 15th july 2012 at http://www.extension.psu.edu/evaluation/pdf/TS60.pdf

WHO (2010).Environment and Health Risks: A Review of the Influence and Effects of Social Inequalities. Fifth Ministerial Conference on Environment and Health Report. Italy.

Yin, R. K. (1994). Case study research: Design and methods (2nd ed.). Newbury Park, CA: Sage Publications.

Zamberia, C. (2007). Social Conflict and the Garbage Divide: Projecting Race and Class Debates to Community Action in Johannesburg and Nairobi. University of Johannesburg.

Zurbrugg et al, 2005 Zurbrugg, C., Drescher, S., Rytz, I., Sinha, M. and Enayetullah, I. (2005). Decentralised composting in Bangladesh, a win-win situation for all stakeholders. *Resources, Conservation and Recycling*, 43, 281-292.

APPENDICES

Appendix I

Table for finding a base sample size with +/-5% Margin Error

	Variability				
Population	50%	40%	30%	20%	10%
100	81	79	63	50	37
125	96	93	72	56	40
150	110	107	80	60	42
175	122	119	87	64	44
200	134	130	93	67	45
225	144	140	98	70	46
250	154	149	102	72	47
275	163	158	106	74	48
300	172	165	109	76	49
325	180	173	113	77	50
350	187	180	115	79	50
375	194	186	118	80	51
400	201	192	120	81	51
425	207	197	122	82	51
450	212	203	124	83	52
500	222	212	128	84	52
600	240	228	134	87	53
700	255	242	138	88	54
800	267	252	142	90	54
900	277	262	144	91	55
1000	286	269	147	92	55
2000	333	311	158	96	57
3000	353	328	163	98	57
4000	364	338	165	99	58
5000	370	343	166	99	58
6000	375	347	167	100	58
7000	378	350	168	100	58
8000	381	353	168	100	58
9000	383	354	169	100	58
10000	385	356	169	100	58
15000	390	360	170	101	58
20000	392	362	171	101	58
25000	394	363	171	101	58
50000	397	366	172	101	58
100000	398	367	172	101	58

Source: Watson, 2001 http://www.extension.psu.edu/evaluation/pdf/TS60.pdf (accessed last 20/06/2013)

Appendix II

Household Survey Questionnaire

Kindly fill each of the questions below by ticking the answer that best represents your opinion. Be as honest as possible

Section One: General Information

1. Name (Optional) _____
2. Gender Male [ ] Female [ ]
3. Marital status
   - A. Married [ ]
   - B. Divorced [ ]
   - C. Separated [ ]
   - D. Single [ ]
4. Which estate do you live in?
   - A. KariobangiNorth [ ]
   - B. Korogocho [ ]
   - C. Dandora [ ]

Section Two: Health Status

5. Which of the following diseases are commonly experienced in your family?(tick all the diseases experienced in your family)
   - A. Respiratory diseases [ ]
   - B. Eye irritation [ ]
   - C. Skin disorders [ ]
   - D. Cancer [ ]
   - E. HIV/AIDS [ ]
   - F. Dysentery [ ]
   - G. Cholera [ ]
   - H. Typhoid [ ]
   - I. Malaria [ ]
   - J. Amoebiasis [ ]
   - K. Hepatitis [ ]
   - L. Gastroenteritis [ ]
   - M. Others (specify) _____

6. How often do members of your household fall sick?
    A. More often [ ]
    B. Often [ ]
    C. Less often [ ]
    D. Rarely [ ]
7. Tick the number of days lost when you fell sick last.
    A. 1-2 [ ]
    B. 3-4 [ ]
    C. 5-6 [ ]
    D. 7-8 [ ]
    E. Above 8 [ ]
8. Where do you go for treatment?
        A. NCC dispensary/ health centre [ ]
        B. Private hospital [ ]
        C. Chemists [ ]
        D. I buy counter drugs [ ]
        E. Do not go for treatment [ ]
        F. Others (specify)----------
2. How do you rate the quality of service received from these service provider?
    A. Excellent [ ]
    B. Good [ ]
    C. Fair [ ]
    D. Poor [ ]
3. Why do you prefer these places for your treatment?
    A. It's the best [ ]
    B. Its affordable [ ]
    C. It's the only available option [ ]
    D. Easy to access [ ]
    E. Others (specify)----------

Section Three: Factors that can Affect Health Status Apart from Dumpsite

4. What are the sources of cooking energy for your household?(Tick all sources used by your household)

A. Electricity [ ]
B. LPG (Gas) [ ]
C. Kerosene [ ]
D. Charcoal [ ]
E. Firewood/Straws [ ]

5. What are the sources of drinking water for your household?
   A. Piped into dwelling [ ]
   B. Piped into plot/yard [ ]
   C. Open public well [ ]
   D. Protected well in plot/yard [ ]
   E. Protected public well [ ]
   F. Spring [ ]
   G. River/stream [ ]
   H. Pond [ ]
   I. Tankers/track [ ]
6. Which sanitation facility does your household use?
   A. Flush toilet [ ]
   B. Pit latrine [ ]
   C. No facility [ ]
7. How do you handle your solid waste?
   A. Collected by waste handlers [ ]
   B. Dump at the dumpsite [ ]
   C. Dump at the neighbourhood [ ]

Section Four: Socio-economic Status

8. What is the nature of your employment?
   A. Employed permanently [ ]
   B. Casual labourer [ ]
   C. Self-employed [ ]
   D. Not employed [ ]
9. What is the monthly income for your household Kshs?
   A. Less than or 5,000 [ ]
   B. 6,000-10,000 [ ]
   C. 11,000- 15,000 [ ]

D. Above 15,000 [ ]

10. What is the level of your education?

A. No formal education (0 years) [ ]

B. Lower primary (1-4 years) [ ]

C. Upper primary(5-8 years) [ ]

D. Secondary school (9-12 years) [ ]

E. Post-secondary education (13-16 years) [ ]

11. How long have you lived in this estate?

A. Less than a year [ ]

B. 1-5 years [ ]

C. 6-10 years [ ]

D. Over 10 years [ ]

12. My socio-economic status has contributed to my general health status.

A. Strongly Agree [ ]

B. Agree [ ]

C. Neutral [ ]

D. Disagree [ ]

E. Strongly Disagree [ ]

Thank you very much for your time

Appendix III

Interview Schedules

Appendix 3.1 In-depth interview schedule

1. How often do your family members suffer from ailments that you have indicated?
2. Do your family members receive treatment every time they fall sick? If not why?
3. Is the choice of treatment facility by your household members the best? If not, why the choice?
4. Which would be the best treatment facility for your household members?
5. Do you think Dandora dumpsite may be the cause of ailments affecting your family members?
6. If you think dandora dump site is the cause of ailments, what do you think could be done to improve the general health status of your family members?
7. Do you consider your current residence as the ultimate place of choice? If NO what factors forces you to reside within this neighbourhood?

Appendix 3.2 Key informant interview schedule

Appendix 3.2.1 CCN staff, waste transporters and waste recyclers

1. Are all waste dumped here licenced?
2. Are there regulations governing dumping of waste? If yes, are they implemented?
3. How are they implemented?
4. What are the sources of waste dumped here?
5. What are the types of waste found here?
6. What are some of the challenges you face in handling waste?
7. What measures would you consider to be solutions for Dandora dump site?

Appendix 3.2.2 CBO and Religious Leaders interview schedule

1. What are your views concerning Dandora dumpsite and the communities surrounding it?
2. Among the residents of Kariobangi North, Dandora, and Korogocho, do you think they suffer the same the negative impacts of the dump site?

3. If there is difference, what could be the cause of the difference?
4. What do you think could be the ultimate solution for the Dandora dumpsite?

Thank you for taking your time to participate in this study

Appendix IV:

Population Distribution by Sex, Number of Households, Area, Density and Administrative Units

	Male	Female	Total	Households	Area in Sq. Km.	Density
KENYA	**19,192,458**	**19,417,639**	**38,610,097**	**8,767,954**	**581,313.2**	**66**
NAIROBI EAST	**582,554**	**561,862**	**1,144,416**	**369,866**	**226.7**	**5,048**
EMBAKASI	468,097	457,678	925,775	296,942	203.6	4,546
DANDORA	71,452	70,594	142,046	47,808	3.9	36,254
DANDORA 'A'	28,362	28,115	56,477	20,163	2.0	28,673
DANDORA 'B'	43,090	42,479	85,569	27,645	2.0	43,918
EMBAKASI	45,354	42,616	87,970	25,982	60.0	1,467
EMBAKASI	32,674	32,360	65,034	19,815	45.0	1,444
MIHANGO	12,680	10,256	22,936	6,167	14.9	1,537
KARIOBANGI SOUTH	26,995	28,994	55,989	17,119	4.8	11,613
KARIOBANGI SOUTH	15,363	17,673	33,036	9,869	1.4	23,480
MOWLEM	11,632	11,321	22,953	7,250	3.4	6,722
KAYOLE	85,860	90,089	175,949	53,711	5.5	32,176
NAIROBI NORTH						
CENTRAL	142,097	132,510	274,607	87,519	10.7	25,640
HURUMA	54,787	51,532	106,319	34,017	1.4	77,656
HURUMA	37,734	34,761	72,495	23,800	0.7	103,431
KIAMAIKO	17,053	16,771	33,824	10,217	0.7	50,620
NGARA	12,325	13,029	25,354	7,749	2.6	9,797
NGARA EAST	7,507	8,076	15,583	5,067	1.3	11,931
NGARA WEST	4,818	4,953	9,771	2,682	1.3	7,623
KARIOKOR	22,278	23,702	45,980	11,961	2.5	18,297
PANGANI	17,702	19,360	37,062	9,343	1.7	22,002
ZIWANI	4,576	4,342	8,918	2,618	0.8	10,764
MATHARE	47,113	39,984	87,097	31,426	1.6	54,979
MABATINI	15,286	12,974	28,260	9,809	0.4	79,740
MATHARE	11,205	9,258	20,463	6,617	0.8	25,040
MLANGO KUBWA	20,622	17,752	38,374	15,000	0.4	93,005
STAREHE	5,594	4,263	9,857	2,366	2.7	3,712
CITY CENTRE	5,450	4,161	9,611	2,331	1.3	7,184
CITY SQUARE	144	102	246	35	1.3	187
KASARANI	266,684	258,940	525,624	164,354	86.4	6,082
GITHURAI	41,463	46,112	87,575	29,465	5.0	17,683
GITHURAI	24,893	26,717	51,610	17,966	2.0	26,357
KAMUTHI	2,087	2,313	4,400	1,190	1.2	3,765
ZIMMERMAN	14,483	17,082	31,565	10,309	1.8	17,290
KAHAWA	29,866	26,571	56,437	14,950	15.1	3,740
KAHAWA WEST	13,066	9,972	23,038	6,074	5.1	4,487
KIWANJA	9,035	7,921	16,956	3,813	8.8	1,937
KONGO SOWETO	7,765	8,678	16,443	5,063	1.2	13,649
KARIOBANGI	19,902	19,440	39,342	12,802	1.1	35,778
KARIOBANGI NORTH	19,902	19,440	39,342	12,802	1.1	35,778
KASARANI	48,087	52,385	100,472	29,925	30.5	3,299
MWIKI	19,450	19,706	39,156	12,213	18.8	2,084
KASARANI	28,637	32,679	61,316	17,712	11.7	5,254
KOROGOCHO	21,958	19,988	41,946	12,909	0.9	46,961
GITATHURU	11,379	10,356	21,735	6,480	0.5	45,262
KOROGOCHO	5,376	5,000	10,376	3,129	0.2	46,136
NYAYO	5,203	4,632	9,835	3,300	0.2	52,286
ROYSAMBU	24,536	23,142	47,678	15,003	27.7	1,723
GARDEN	6,516	5,808	12,324	3,653	12.6	979
NJATHAINI	3,901	3,446	7,347	2,348	5.3	1,385
ROYSAMBU	14,119	13,888	28,007	9,002	9.8	2,864
RUARAKA	80,872	71,302	152,174	49,300	6.3	24,286
RUARAKA	31,395	29,346	60,741	18,651	3.9	15,581

Source: KNBS, 2009