THE INFLUENCE OF ECOLOGICAL SANITATION ON THE IMPROVEMENT OF LIVELIHOODS OF PEOPLE LIVING IN INFORMAL SETTLEMENTS

A CASE OF MJI WA HURUMA BIO-CENTRE

BY

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DECLARATION

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

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This research project report has been submitted for examination with my approval as University Supervisor

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DEDICATION

This work is dedicated to my beloved family, my father Alex Memia Icharia, my mother Nellie Wanjiru Icharia, my brother Marvin Icharia Memia and my sister-in-law, Rose Njeri Wakahiu who have relentlessly encouraged me.

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ABBREVIATIONS AND ACRONYMS

CBO: Community Based Organizations

DoI: Diffusion of Innovations

ECOSAN: Ecological Sanitation

GDP: Gross Domestic Product

MDG: Millennium Development Goal

NGO: Non-Governmental Organizations

SLA: Sustainable livelihood approaches

UDDT: Urine Diverting Dry Toilets

UNDP: United Nations Development Fund

UNEP: United Nation Environment Programme

UNICEF: United Nations Children's Fund

VIP: Ventilated improved pit

WASH: Water, Sanitation and Hygiene

WHO: World Health Organization

WSP: Water and Sanitation Programme

ABSTRACT

The purpose of the study was to investigate the influence of ecological sanitation on the improvement of livelihoods of people living in informal settlements. The study focused on the case of Mji wa Huruma's Bio-Centre project and was guided by the following objectives: to assess the extent to which technical skills imparted to the community has improved the livelihoods of people living in the informal settlements; to assess the extent to which environmental awareness & sanitation promotion has improved the livelihoods of people living in the informal settlements; to establish the relationship between the level of financing of the ecological sanitation systems and the improvement of livelihoods in informal settlements; and to evaluate the effectiveness of the management of the ecological sanitation systems on improvement of livelihoods of people living in informal settlements. The literature review provided a global/regional view of sanitation and ecological sanitation; and explained the influence of ecological sanitation on improvement of livelihoods of people in the informal settlements. The research design was descriptive in nature and utilized a mixed-methods design; in particular, an explanatory mixed methods design. A mixed method of sampling was used to select the sample size which was ninety six (96) in total constituting officials of Mji wa Huruma's Bio-Centre project and Mji wa Huruma residents. Data was collected by administering questionnaires, use of focus group discussions and observation and then analyzed using both quantitative and qualitative methods. The collected data from the questionnaires and interview guides was analyzed using Statistical Package for Social Sciences (SPSS) program. Study findings indicated that although it is evident that ecological sanitation has influenced the improvement of livelihoods of people living in informal settlements through technical skills imparted to the community, environmental awareness and sanitation promotion, level of financing and effectiveness of the management of the ecological sanitation, there are a few mechanisms that are either not known to the residents or are not functioning as stated by the officials. For instance, the researcher established that the small fee charged for using the Bio-latrine discouraged quite a number of residents from using the facility. Also, lack of electricity at the Bio-Centre encouraged the use of pit latrines and to a large extent open defecation during the night hours. Lastly, the state of Ruaka river was not good since a lot of human activities were being undertaken on the river plus all the drainage systems in the settlement were directed towards it. The researcher recommended to UNEP/Umande trust that electricity should be installed at the Bio-Centre to enable the community to use the facility during the night. Also, in order to encourage the use of the Bio-Centre by the entire population thereby realizing the full effects of ecological sanitation, UNEP/Umande trust should for a specified period (*two years*) bear the cost of operating the facility. A further study should be undertaken with a larger sample that includes Bio-Centres/Bio-latrines all over Kenya, as different results may be found.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

According to a joint programme by the World Health Organization and the United Nations Children's Fund, an estimated 2.5 billion people are without improved sanitation and more than 5000 children under the age of five die daily as a consequence. The Millennium Development Goals (MDGs) include a target (7c) that aims to halve the proportion of people without sustainable basic sanitation by the year 2015 (United Nations, 2012). Although 1.8 billion people have gained access to improved sanitation since 1990, the world is likely to miss the MDG sanitation target. The number of people resorting to open defecation globally has decreased by 271 million since 1990. Still, open defecation is practiced by 1.1 billion people – 15 per cent of the global population (UNICEF and WHO, 2012).

The challenge, however, goes well beyond this, since much of the world's sanitation coverage is inadequate and threatens the lives and livelihoods of both rural and urban communities. Inadequate access to sanitation impacts human health, environmental safety and the economy at large. We also know that proper sanitation positively affects the individual's nutritional status, disease resistance, income opportunities, self-esteem, personal security, etc.

Sanitation means different things to different people but its definition has to include 'the safe management of human excreta' usually by means of a toilet that confines faeces until they are composted and safe, or enables them to be flushed away into a sewer. Sanitation also includes environmental cleanliness; hand washing; garbage removal and waste water disposal (UN-WATER, 2008). Adequate sanitation, together with good hygiene and safe water, are fundamental to good health and to social and economic development. That is why in 1925, Mahatma Gandhi said, 'sanitation is more important than independence' (Nirmal, 2013).

From a regional perspective, Southern Asia and sub-Saharan Africa still struggle with low coverage (41 per cent and 30 per cent, respectively). In Southern Asia, the proportion of the population using shared or unimproved facilities is much lower, and open defecation is the

highest of any region. In sub-Saharan Africa, 45 per cent of the population uses either shared or unimproved facilities, and an estimated 25 per cent practice open defecation. With population growth, this means that the number of people practicing open defecation has actually increased by 33 million. That said, sub-Saharan Africa has the highest proportion of people using some sort of unimproved sanitation of any region (UNICEF and WHO, 2010). Tanzania, Ethiopia and Nigeria are among the 11 countries that make up more than three quarters (76 per cent) of the global population without improved sanitation facilities. Coming closer home, Kenya, although the number of people using improved sanitation facilities has decreased by 7%, 14% of the population still practice open defecation translating into 5.67 Million people (UNICEF and WHO, 2012).

Poor management of water and sanitation has a detrimental impact on the sustainable development's pillars namely social, economic and environmental. Taking a closer look at health which is part of the social pillar, evidence-based analysis shows that hygiene and sanitation are among the most cost effective public health interventions to reduce childhood mortality. Access to a toilet alone can reduce child diarrheal deaths by over 30 %, and hand washing by more than 40 percent (UN-Water, 2008). In Kenya, approximately 19,500 Kenyans, including 17,100 children under 5, die each year from diarrhea – nearly 90% of which is directly attributed to poor water, sanitation and hygiene (WASH).

A water and sanitation programme (WSP) study found that the economic costs of poor sanitation and hygiene amounted to over US$9.2 billion a year (2005 prices) in Cambodia, Indonesia, Lao PDR, the Philippines, and Vietnam with a total population of more than 400 million. In Africa, 18 African countries are losing about US$5.5 billion every year due to poor sanitation, Kenya being amongst them. These countries account for 448million people, which are almost half of Africa's population (WSP, 2012). In the case of Kenya, it loses Ksh 27 billion each year, equivalent to US$324 million due to poor sanitation. This sum is the equivalent of US$8 per person in Kenya per year or 0.9% of the national GDP (WSP, 2012).

From an environmental perspective and taking the case of the developing world, roughly 90% of sewage is discharged untreated into rivers, polluting waters and killing plants and fish. This presents a major health threat to people who depend upon open streams and wells for their drinking water as well as an economic blow to people whose livelihoods depend upon

fisheries. Water pollution stemming from poor sanitation costs Southeast Asia more than US$ 2 billion per year and in Indonesia and Vietnam creates environmental costs of more than US$ 200 million annually, primarily from the loss of productive land (UN-Water, 2008). In Nairobi, 75% of residents in informal settlements lack toilet facilities within their homes, and most residents use dilapidated toilets that are emptied to the nearby rivers leading to water pollution (JKUAT-IFRA, 2010).

So what is required are sustainable sanitation systems that protect and promote human health, minimize environmental degradation and depletion of the resource base, are technically and institutionally appropriate, socially acceptable and economically viable also in the long term. Sanitation systems that safely recycle excreta and other organic waste products to crop production in such a way that the use of non-renewable resources is minimized are referred to as ecological sanitation systems (SEI, 2008).

Ecological sanitation can be viewed as a four-step process dealing with human excreta: source-separation, containment, sanitization and recycling. The objective is to protect human health and the environment while reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilizers in agriculture.

In Kenya, Mji wa Huruma, an informal settlement contiguous to the Karura Forest in Nairobi, with a Bio-centre Project is an example of a community with a project that applies ecological sanitation principles to ensure human waste in ablution blocks is turned into wealth by producing gas through bio-digester systems and producing fertilizer as a by-product.

Mji wa huruma means *home of mercy.* The name derives from the neighboring centre for the aged people ran by a religious agency. The village measures approximately 500 square metres and is home to between 1500 and 2000 people. The plot on which the village stands belongs to the government. The United Nations Environment Programme (UNEP) in collaboration with the local community at the Mji wa Huruma Village and Umande trust, a national trust that supports communities completed the construction works for the community Bio-centre which became operational on 1st July, 2010. The Bio-Centre project comprises of two parts: Bio-latrine and Capacity Building.

The project was going to contribute to UNEP's Nairobi River Basin Programme whose aim was to improve the water quality and environment within the Nairobi River Basin area by: resolving the existing sanitation problems and alleviate the negative impacts caused by human waste; improve the overall water quality and health of residents in Mji wa Huruma; promote renewable energy application by shifting from fuel-wood to biogas for cooking which will in turn improve the energy efficiency, reduce the carbon dioxide emissions and alleviate the pressure on karura forest resulted from the community's need for firewood for fuel; provide a source of income for the community; promote environmental awareness and education at informal settlement level; and lastly build the capacity of the community on environmental project management.

1.2 Statement of the Problem

As a result of poor economic activities, a growing population and an increasing shortage of affordable housing, there is a rapid expansion of informal settlements where residents live without security of tenure and with limited access to basic infrastructure (Penrose, 2010). With this, inadequate water and sanitation facilities remain among the biggest menace in the informal settlements.

In the case of Africa, the scale of the sanitation crisis is enormous with 43 percent of the population of sub-Saharan Africa – over 303 million people – had no access to basic sanitation in the year 2000. Between 1990 and 2000, the number of people gaining access to improved sanitation failed to keep pace with population growth. The combination of poor progress, population growth, extremely weak economies and sometimes civil strife means that the MDG targets facing Africa seem almost insurmountable (WSP, 2005). Inadequate access to sanitation has severe consequences on human health, environmental safety and the economy at large.

With this problem in mind, a large number of NGOs and CBOs have come forward to address this issue by collaborating with community members in the informal settlements and constructing sanitation ablution blocks. Though the initiative helps the communities, it only slightly improves their livelihoods.

Mji wa Huruma, like any other informal settlement in Nairobi, households lacked access to decent affordable, secure and adequate sanitation services. The few toilets that existed were shallow, overfilled and constructed using old iron sheets or polythene walling. A significant number of households disposed human waste in the adjacent karura forest. Filled toilets were manually emptied and discharged directly into the nearby Ruaka river downstream thereby polluting the vital water resources. In this scenario, poor excreta disposal methods led to an increase in the incidence of waterborne diseases, unpleasant odour and threaten the environment.

The United Nations Environment Programme (UNEP) in collaboration with the local community at the Mji wa Huruma Village and Umande trust, a national trust that supports communities completed the construction works for the community Bio-Centre which became operational on 1st July, 2010. The Bio-Centre project comprises of two parts: Bio-latrine and Capacity Building.

Unlike other sanitation projects instituted by NGOs/CBOs, this pilot project combines sanitation improvement, renewable energy promotion and income generation thus far and large improving their livelihoods.

This research sought to find out whether ecological sanitation methods could improve the livelihoods of people in informal settlements leading to a green economy thus enhancing sustainable development. The research took a closer look at Mji wa Huruma.

1.3 Purpose of the study

The purpose of the study, therefore, was to investigate the influence of ecological sanitation on the improvement of livelihoods of people living in informal settlements. The study focused on the Bio-Centre in Mji wa Huruma, Nairobi, Kenya.

1.4 Objectives of the study

The objectives of this study were:

1) To assess the extent to which technical skills imparted to the community has improved the livelihoods of people living in the informal settlements.

2) To assess the extent to which environmental awareness and sanitation promotion has improved the livelihoods of people living in the informal settlements.
3) To establish the relationship between the level of financing of the ecological sanitation systems and improvement of livelihoods in informal settlements.
4) To evaluate the effectiveness of the management of the ecological sanitation systems on improvement of livelihoods of people living in informal settlements.

1.5 Research Questions of the study

1) How do the technical skills imparted onto the community influence the improvement of livelihoods of people living in informal settlements?
2) To what extent does environmental awareness and sanitation promotion improve the livelihoods of people living in the informal settlements?
3) To what extent does the level of financing of the ecological sanitation systems influence the improvement of livelihoods in informal settlement?
4) How does the management of the ecological sanitation systems influence the improvement of livelihoods of people in informal settlements?

1.6 Significance of the study

This research seeks to demonstrate that small scale ecological sanitation initiatives could lead to a greener society which is low carbon, resource efficient and socially inclusive.

To the government and civil societies at large, these findings could help determine if ecological sanitation is improving the livelihoods of people in the informal settlements and what impacts are being witnessed in those communities. The findings will help them understand that sanitation is a precondition for sustainable development. Sanitation underpins the three pillars of sustainable development and also contributes to a green economy.

Also, the findings of this study could guide project managers in civil societies on the factors that would lead to the successful implementation of ecological sanitation systems. To the youth, the findings will assist them recognize the income generating opportunities that ecological sanitation has to offer. To policy makers, the findings of this study will show how sanitation is linked to the three pillars of sustainable development and that ecological sanitation has a vital role in improving sanitation and eradicating poverty.

Lastly, to the Mji wa Huruma community, the findings will assist them realize the many advantages ecological sanitation has to offer over and above sanitation provision.

1.7 Delimitation of the study

The study focused on Mji wa Huruma Bio-Centre project. The project was selected as an ecological sanitation model in Nairobi due to its multiplier effect of addressing more than one problem: improving the sanitation of the community, generation of renewable energy (Biogas which could be used for cooking), mitigating the collection of firewood from the Karura forest, creating environmental awareness to the community and many more.

The village measures approximately 500 square metres and is home to between 1500 and 2000 people.

1.8 Limitation of the study

The researcher envisaged the following limitations that hindered the successful achievement of the research objectives and affected the subsequent answering of the research questions. During data collection, residents of Mji wa Huruma expected a handout in order to fill out the questionnaires. To counteract this, the researcher worked closely with a focal point from the community who talked with the residents. Also, due to the level of illiteracy, not all of the residents were able to fill out the questionnaires. To mitigate this, the researcher conducted a focus group discussion. Lastly, resources or materials are never enough when carrying out the research. In this case, the researcher conducted a focus group discussion and made observations.

1.9 Assumption of the study

It was assumed that the time for the research study would be sufficient and that the residents of Mji wa Huruma would contribute and respond effectively in answering the questions correctly and truthfully. It was also assumed that the sample represented the population and that the data collection instrument had validity and would measure the desired constructs.

1.10 Operational Definition of Significant Terms

Influence: Factors that will lead to the improvement of the livelihoods of people living in informal settlements.

Ecological Sanitation: These are sustainable sanitation systems that protect and promote human health, minimize environmental degradation and depletion of the resource base. These sanitation systems are technically and institutionally appropriate, socially acceptable and economically viable in the long term.

Livelihoods: This is a means of supporting one's existence, especially financially or vocationally.

Informal Settlements: An area characterized by inadequate access to basic services, by lack of security and unresolved cases of land tenure.

Bio-Centre: This is a community latrine block, owned, built and operated by CBOs and designed in collaboration with the local community. Bio-Centres mix human waste and water in underground anaerobic digesters, which generate biogas that can be used for cooking.

Technical Skills: The knowledge and abilities needed to accomplish mathematical, engineering, scientific or computer-related duties, as well as other specific tasks.

Environmental Awareness: An awareness and subsequent desire to preserve natural resources and the environment.

Sanitation Promotion: To raise or advance the cause of sanitation, raise the profile and status of sanitation, further the growth and expansion of proper sanitation and to further its popularity.

Financing: The act of providing funds for an activity or project.

Effectiveness: The degree to which objectives are achieved and the extent to which targeted problems are solved.

1.11 Organization of the study

This chapter outlines the issue of sanitation from a global, regional and local perspective and the consequences of sanitation if not resolved. The chapter also explains the purpose of the study which was to investigate the influence of ecological sanitation on the livelihoods of people living in informal settlements. The study focused on the Bio-Centre in Mji wa Huruma, Nairobi, Kenya. In addition, the chapter has clearly outlined the purpose of the study and the four research questions that guided the study which was bound to a specified geographical and time scope.

Finally, the chapter outlines the beneficiaries of the research and provides a list of the definitions of unusual terminologies and concepts used in the context of this study.

Chapter Two reviews the literature available on ecological sanitation, how ecological sanitation protects and promotes human health, minimizes environmental degradation and depletion of the resource base. Chapter Three describes the methodology used in the study; this includes population, sample size and sampling techniques as well as methods of data collection and data analysis.

Chapter Four focuses on the presentation, interpretation and analysis of findings based on primary data collected from the respondents using questionnaires, focus group discussion and an observation guide. It describes the response profile of the research study by highlighting the response rate of the survey, and the nature and number of the respondents that completed and returned the questionnaire. It then highlights and discusses the findings of the surveys presented under thematic areas and sub-sections in line with the study objectives.

Chapter Five outlines the conclusions of the research study presented under the themes of each of the objectives of the research. The chapter concludes by making recommendations and suggestions for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the relevant literature relating to the research problem outlined in the previous chapter. It introduces the concepts of sanitation, livelihood, ecological sanitation; and explained the influence of ecological sanitation on improvement of livelihoods of people in the informal settlements. The conceptual framework illustrating the relationship between different variables in the study is also outlined.

2.2 Sanitation

Sanitation means different things to different people but it's defined as the *hygienic disposal or recycling of waste*. It is an important measure to prevent the outbreak of diseases and thus protect public health and control environmental pollution. From this definition, one could conclude that sanitation refers to all types of waste. However, nowadays sanitation refers in most cases only to the hygienic disposal or recycling of human excreta and grey water (waste water from washing, laundry and kitchens) produced by households. According to guidelines for the selection of sanitation services, sanitation refers to *the means of collecting and disposing of excreta and community liquid waste in a hygienic way so as not to endanger the health of individuals or the community as a whole* (Cotton & Saywell, 2010). Lack of sanitation is a serious health risk and an affront to human dignity. It affects billions of people around the world, particularly the poor and disadvantaged (World Health Organization, 2011).

The Millennium Development Goal (MDG) Target 7c for water and sanitation aims to halve the proportion of people without sustainable access to safe water supply and basic sanitation by the year 2015. The MDG drinking water target has been reached with almost 6.1 billion people, 89 per cent of the world's population, were using an improved water source in 2010 (United Nations, 2012). Although 1.8 billion people have gained access to improved sanitation since 1990, the world is likely to miss the MDG sanitation target.

An estimated 2.5 billion people are still without improved sanitation; almost three quarters of them live in rural areas. In urban areas, 8 out of 10 people use an improved sanitation facility,

compared to only half of the rural population. However, the number of people without improved sanitation in urban areas has grown by 183 million since 1990, during a time of rapid urbanization. The number of people resorting to open defecation globally has decreased by 271 million since 1990. Still, open defecation is practised by 1.1 billion people – 15 per cent of the global population (UNICEF and the World Health Organization, 2012).

Southern Asia and sub-Saharan Africa still struggle with low coverage (41 per cent and 30 per cent, respectively). In Southern Asia, the proportion of the population using shared or unimproved facilities is much lower, and open defecation is the highest of any region. Although the number of people resorting to open defecation in Southern Asia has decreased by 110 million people since 1990, it is still practiced by 41 per cent of the region's population, representing 692 million people. In sub-Saharan Africa, 45 per cent of the population uses either shared or unimproved facilities, and an estimated 25 per cent practice open defecation. With population growth, this means that the number of people practicing open defecation has actually increased by 33 million. That said, sub-Saharan Africa has the highest proportion of people using some sort of unimproved sanitation of any region (WHO/UNICEF, JMP 2012). Tanzania, Ethiopia and Nigeria are among the 11 countries that make up more than three quarters (76 per cent) of the global population without improved sanitation facilities. Coming closer home, Kenya, although the number of people using improved sanitation facilities has decreased by 7%, 14% of the population still practice open defecation translating into 5.67 Million people (WHO/UNICEF, JMP 2012).

Kenya's towns and cities have been growing rapidly as a result of both migration from rural areas and the natural expansion of the existing population. By the year 2000, a third of the population (33.4%) was living in the country's towns and cities. The majority of Nairobi's residents (about 60%) live in these informal settlements with very poor infrastructure, especially for water and sanitation. Most of these people live in poverty and atrocious/unsanitary conditions, finding their own means of coping by drinking polluted water and disposing of waste in open spaces within and around the neighbourhood. The health effects are obvious, with high levels of exposure to a range of diseases (ITDG and ODI, 2005).

According to Kenya's demographic and health survey for 2008-2009, less than a quarter of the households in Kenya use an improved toilet facility that is not shared with other households as shown in *Table 2.1*. Urban households are only slightly more likely than rural households to have an improved toilet facility (30 percent and 20 percent, respectively). The most common type of toilet facility in rural areas is an open pit latrine or one without a slab (47 percent of rural households), while in urban areas toilet facilities are mainly shared with other households (52 percent). Overall, 12 percent of households have no toilet facility at all; they are almost exclusively rural, accounting for 16 percent of rural households.

Table 2.1: Household Sanitation Facilities

	Households			**Population**		
Type of toilet/Latrine Facility	Urban	Rural	Total	Urban	Rural	Total
Improved, not shared facility	**29.8**	**20.1**	**22.6**	**34.3**	**21.8**	**24.3**
Flush/pour flush to piped sewer system	18.7	0.6	5.3	20.2	0.6	4.4
Flush/pour flush to septic tank	5.5	0.3	1.7	6.6	0.3	1.5
Flush/pour flush to pit latrine	1.5	0.2	0.5	1.6	0.2	0.5
Ventilated improved pit (VIP) latrine	2.3	9.0	7.3	3.4	9.5	8.4
Pit latrine with slab	1.8	10.0	7.8	2.5	11.2	9.5
Non-improved facility	**70.1**	**79.8**	**77.3**	**65.7**	**78.1**	**75.7**
Any facility shared with other Households	52.2	16.7	25.9	47.6	13.5	20.1
Flush/pour flush not to sewer/ septic tank/pit latrine	3.3	0.2	1.0	3.3	0.1	0.7
Pit latrine without slab/open pit	13.5	46.5	37.9	13.3	46.4	40.0
Bucket/Hanging toilet, latrine	0.2	0.4	0.4	0.4	0.4	0.4
No facility/bush/field	0.9	16.0	12.1	1.1	17.7	14.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Number	2350	6,707	9057	7365	30704	38069

Source: Kenya Demographic and Health Survey, 2008 - 2009

A survey conducted in maili saba, one of the informal settlements in Nairobi, the respondents were asked to rate the importance of a number of problems facing them, and then rank them in the order in which they felt they should be addressed. Water was rated as very important by all respondents, with the next most important being food and sanitation as shown in *Table 2.2*.

Table 2.2: Level of importance and rating of access to services

	Rankings (%)					**Importance (%)**	
	1	**2**	**3**	**4**	**5**	**Very Important**	**Important**
Water	80.0	15.0	2.5	2.5	0	100	
Food	5.0	62.5	17.5	15.0		90	10
Sanitation	2.5	15.0	55.0	20.0	7.5	90	10
Health	2.5	20.0	12.5	52.5	12.5	47.5	52.5
Employment	15	7.5	17.5	10.0	50.0	50	50
Education	5.0	2.5	30.0	27.5	35.0	65	35

Source: ITDG and ODI, 2005

When an open-ended question was asked about problems with the sanitation facilities and their use, the most commonly mentioned (38% of respondents), was the terrible smell. Some related this to problems with maintenance and cleaning. Another cause of bad smells is that latrines filled up quickly and needed to be exhausted. This is exacerbated by the shallow bedrock, so pits tend not to be very deep. Apart from that, there is little space to build new latrines. The existing ones overflow when it rains heavily, and diseases such as diarrhoea and typhoid are prevalent during the rainy season. It is not easy to find someone to empty the pit, and this is expensive for the owners. They are breeding grounds for flies and mosquitoes. Three women mentioned in particular that it was risky to use the toilet during the night time, especially if the toilet is some distance away. Women and girls fear being raped. It is also more difficult when it is raining because there is much more mud, and the ground is slippery. A small number (8%) also mentioned the long queues in the mornings to use the latrines (ITDG and ODI, 2005).

From the picture painted above, it would be safe to say that a contaminated environment places people at obvious risk of exposure to pathogens, harmful organisms that lead to infection and disease. Those most affected are poor people - children, women and men living on marginal rural land and in urban slums - in an environment contaminated with pathogens. Poor people are victims caught in a vicious circle - a "pathogen" cycle - in which offenders and victims live, work and play in close proximity to each other (Esrey, Andersson, Hillers, & Sawyer, 2001). Pit latrines may leak or the contents may spread during floods, placing others at risk of infection and disease (*Fig. 1*).

Source: Esrey, Andersson, Hillers, & Sawyer (2001)

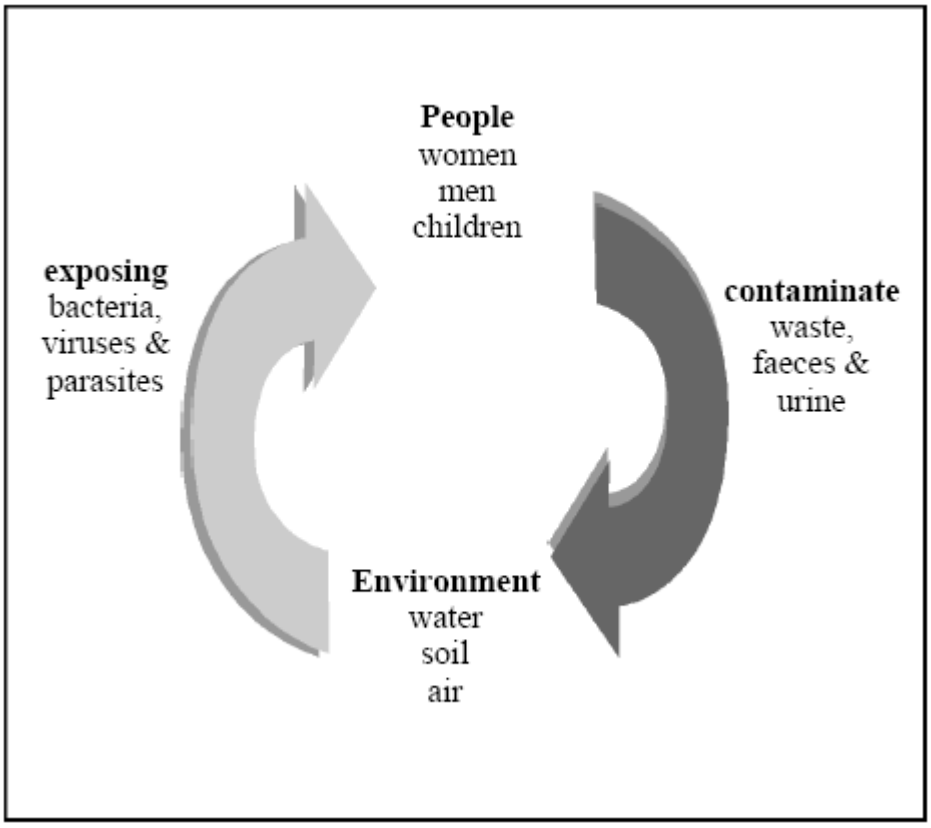

Figure 1: People contaminate environment and are affected by it.

2.3 Enhancing livelihoods

Borba, Smet, & Sijbesma (2007) defines livelihood as the use of capacities and resources by poor men and women in rural areas and on the periphery of towns and cities to undertake activities in order to survive in adverse circumstances. Livelihoods are therefore people's means of survival, and are fundamentally affected by the situation in which people find

themselves, especially their physical, economical, social, environmental and psychological conditions. The activities are meant especially to: generate an income which contributes to improving life conditions and enhance human dignity; improve family members' health, – especially of those most affected: children, women and the elderly; and lastly, improve their immediate environment.

Livelihoods thinking dates back to the work of Robert Chambers in the mid-1980s (further developed by Chambers, Conway and others in 1992). They proposed the following definition for sustainable livelihoods which applies commonly at the household level:
"A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term." (Krantz, 2001)

UNDP came up with Sustainable livelihood approaches (SLA).These are a way of thinking about the objectives, scope and priorities for development. They place people and their priorities at the centre of development. They focus poverty reduction interventions on empowering the poor to build on their own opportunities, supporting their access to assets, and developing an enabling policy and institutional environment. (Haidar, 2009)

These livelihoods approaches are based on a conceptual framework to aid analysis of the factors affecting peoples' livelihoods, including: the priorities that people define as their desired livelihood outcomes e.g. increased income, reduced vulnerabilities, increased well-being, improved food security and many more; their access to social, human, physical, financial and natural capital or assets, and their ability to put these to productive use; the different strategies they adopt (and how they use their assets) in pursuit of their priorities; the policies, institutions and processes that shape their access to assets and opportunities; and lastly, the context in which they live, and factors affecting vulnerability to shocks and stresses e.g. seasonal fluctuations in prices, production, health, employment opportunities, economic trends, health shocks, etc.

As a linkage between sanitation and livelihoods, Borba, Smet, & Sijbesma (2007), state that the poor are consumers, producers and workers with sanitation. As consumers, they are offered different toilet models according to what they want and can afford. As producers, they emerge as small-scale entrepreneurs for the delivery of sanitation services or for manufacturing products e.g. the male and female latrine builders in Lesotho. They also gradually become workers in water and sanitation projects as they gain access to training in technical or social aspects related to community work, to wages and to an income from their work.

According to Lennartsson (2009), the connection between livelihood in a broader sense and sanitation has several different aspects: *Environment*: Contamination of common property resources, such as lakes, rivers and coastal areas, directly translates into less food, income and time for the people dependent on the resource. Different sanitation systems stress the natural resource base differently. Environmental protection, especially with respect to water, is not a luxury but a prerequisite for a well-functioning society; *Poverty:* Poor people are more likely to live in areas subject to environmental hazards of all kinds. Poverty also results in lesser quality and quantity of food intake, which in itself is contributing to a poor health status. Ill health related to poor water and sanitation lead to further impoverishment that has severe financial and personal costs; and lastly, *Dignity and gender equality:* Privacy while defecating is one important element of dignity, as well as not having to fear physical abuse as a possible risk during the visit to the sanitation facility. In many South African townships women and children never leave the house after dark due to the risk of being raped, which means that the use of any toilet facility outside the house is impossible at night for women and children. Lack of proper school sanitation might make girls drop out of school prematurely.

2.4 Ecological Sanitation

Ecological Sanitation is one alternative which was defined under the 'Bellagio Principles', (EAWAG, 2000). The Meeting at Bellagio on 1-4 February 2000, brought together the Environmental Sanitation Working Group of the Water Supply and Sanitation Collaborative Council. They focused on correcting waste management policies and practices which were abusive to human well-being, economically unaffordable and environmentally unsustainable.

Ecological Sanitation offers an alternative to conventional sanitation, and it attempts to solve some of society's most pressing problems: infectious disease, environmental degradation and pollution, and the need to recover and recycle nutrients for plant growth. In doing so, ecological sanitation helps to restore soil fertility, conserve freshwater and protect marine environments –which are sources of water, food and medicinal products for people (Esrey, Andersson, Hillers, & Sawyer, 2001).

According to the water and sanitation program, ecological sanitation is based on three main principles namely: hygienic practices, environmental soundness and resource preservation. When we talk of hygienic practices, ecological sanitation can be said to offer a safe sanitation solution that prevents disease and promotes health by successfully and hygienically removing pathogen-rich excreta from the immediate environment. For environmental soundness**,** ecological sanitation does not contaminate groundwater or use scarce water resources. The last principle is resource preservation and it states that ecological sanitation creates a valuable resource that can be productively recycled back into the environment. Over time, through proper management and storage, excreta are transformed from a harmful product into a productive asset.

The Ecological Sanitation concept sees human excreta not as a waste product, but as a valuable resource that can be used for the production of organic fertilizer and/or compost and biogas. For human excreta to be used as a resource for fertilizer in agricultural food production, pathogens present in the excreta must be destroyed. There are two main methods of doing this: dehydration and decomposition (Water and Sanitation Program, 2010). In dehydration, the urine and faeces are collected and stored separately by the use of specially designed pedestals and slabs *(Fig. 2).* The urine is collected and stored until it can be used as a fertilizer on plants or crops. The faeces drop into a pit, vault or container to which a handful of either ash or lime is added. This has the effect of drying the faeces and increasing the pH which has a positive impact on reducing smell (less ammonia emission) and destroying pathogens. After 12 months of storage the resulting 'humanure' can be applied to the land. Some form of alternating double or multiple storage system is required to avoid mixing fresh and composted manure (Smet & Sugden, 2006).

An example of a dehydrating toilet is Sky-loo urine diverting toilet. Sky- loo refers to a step up toilet built with a vault above the ground to minimize the possibility of ground water contamination especially in areas where the water table is very high. A wooden or brick super structure is placed on top of the vault. The faecal matter drops directly into the vault or into the plastic dish place in the vault.

The Sky-loo urine diverting toilet is fitted with a urine-separating pedestal that diverts urine and ensures that urine and faeces do not mix. The separation of urine from faeces reduces the production of odours it is said that the bad odours in a toilet are cause by the metabolic process of some bacteria in urine "bacterium urea" that feeds on organic matter and produce bad smells. The separation of urine and the addition of soil and ash accelerate drying of faeces and create an environment that hinders multiplication of pathogenic bacteria. The diverted urine go through a network of pipes into a small soak away where a tree is planted to absorb all the nitrates from the urine to prevent contamination of underground water (Guzha, 2002).

Source: (Esrey, Andersson, Hillers, & Sawyer, 2001).

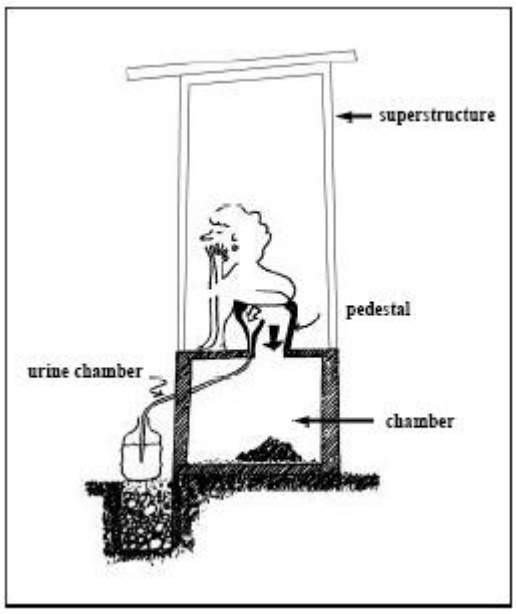

Figure 2: Sky-loo urine diverting toilet

In decomposition, the vault composting pits do not separate the faeces and urine, so that both enter the same vault or pit. A handful of a mixture of soil and ash is added to the pit after

each use which has the effect of keeping the pit contents relatively dry and aerobic, as opposed to anaerobic and smelly. 'Composting' is not technically the correct name as the temperatures never rise high enough to create themophilic composting conditions. After 12 months of storage the resulting 'humanure' can be applied to the land as a fertilizer and soil conditioner (Smet & Sugden, 2006).

The two most popular types of composting toilets are:

1. **Arborloo**: This is the compost toilet that eventually becomes a tree. A shallow pit (1metre depth is recommended) is dug and a concrete slab and easily movable superstructure is placed on top. The family uses the latrine, adding a mixture of soil and ash after each use, until the pit is nearly full – this usually takes between four and nine months. After this, both the slab and superstructure are moved to another pit. A thick layer of soil is added to the full pit and a young tree is planted in the soil. The tree grows and utilizes the compost to produce fruit. After a few years the result is an orchard producing fruit with a good economic value. The Arborloo is the simplest of all Ecological Sanitation latrines because it is easy and cheap to construct. Importantly, it requires minimal behavior change in relation to using a traditional pit latrine (WSP, 2007). A further advantage is that the compost is never physically handled. *Fig.3*
2. **Fossa Alterna:** This is the alternating pit compost toilet. Two shallow pits (about 1.5 meters deep) are dug near to each other; these are often housed within the same superstructure. The pits are used like a twin pit latrine, i.e. one filling up whilst the other is maturing. When the first pit is full, the latrine slab is moved to the second pit. The first pit is then covered with soil. While the second pit is in use, the contents of the first pit are composting. When the second pit is full, the first pit is emptied of compost and used again. The compost is either stored in sacks for future use or dug into the garden to increase soil fertility. This alternate use of the two pits can continue almost indefinitely. As with the Arborloo, a dry mixture of soil and ash is added after each use, which assists the aerobic decomposition process and also helps to reduce odors and discourage flies. This differs from the traditional toilet pit, which is saturated, anaerobic and smelly. To ensure sufficient reduction in pathogens the compost should ideally be processed for at least 12 months before it is spread on the

land. However in warmer climates a 6 – 9 month period has been found satisfactory (WSP, 2007).

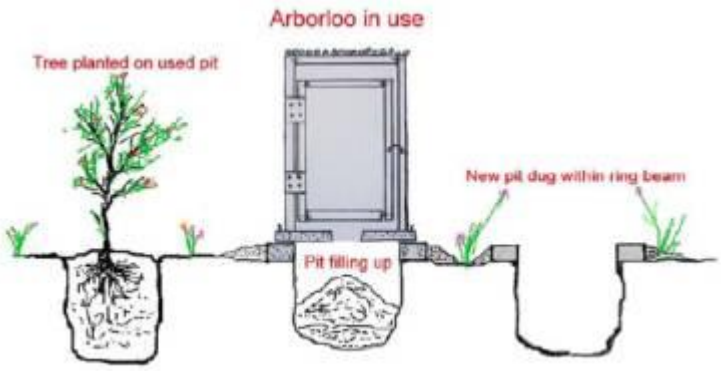

Figure 3: An Arborloo toilet

Ecological Sanitation (EcoSan) is not new in some cultures, for example in china, EcoSan systems have been in use for thousands of years. Globally, most of the EcoSan pilot projects that have been carried out have focused on countries in Europe (German, Sweden and Austria) & Asia (China). Over the past 15 years, some projects have also been started in Africa (South Africa, Zimbabwe, Uganda, Ethiopia, Tanzania, Mozambique and Kenya). In Kenya, the EcoSan technology was first introduced in the late nineties (WSP, 2005). Though it has not been widely tested, EcoSan projects can be found in Wajir, Kisumu and Mombasa. Mji wa Huruma is one of the completed pilot EcoSan projects in Nairobi.

2.5 Adoption of Ecological Sanitation in Africa and beyond

There are a number of case studies where ecological sanitation has been implemented globally. In Bangladesh, Open defecation was a common practice to all until they implored the community-led total sanitation approach. The communities managed to construct ecological toilets and convert human excreta to organic fertilizer for their own agricultural use. On a community level, there was better health in the community, social innovations, such as slogans to promote toilets and penalties for open defecation were introduced and many more (Borba, Smet, & Sijbesma, 2007).

One of the largest EcoSan projects in Africa has been set up in South Africa in Northern Cape Province. This was done to replace 25,000 bucket toilets in the poor and remote towns of the most arid province in South Africa. A study that was conducted by mvula trust shows

that communities preferred the EcoSan toilets because of various factors which included privacy & convenience, little labour and lastly, ease of construction & maintenance (WSP, 2005). Another case study is eThekwini Metropolitan Municipality. eThekwini Metropolitan Municipality was created in the year 2000 and includes the city of Durban and the surrounding areas. With funding from Central government in form of municipal infrastructure or housing grants, the municipality assists low-income households to improve their latrines. Traditionally, eThekwini funded the construction of VIP latrines to eligible households and also provided an emptying service free of charge once every five years. But pit emptying is expensive due to the remote locations and difficulties of access – approximately US$ 150 to empty a VIP latrine. Due to the high costs for sanitation in these areas, the Municipality promotes UDDTs as an alternative to pit latrines to avoid the pit emptying costs. eThekwini's UDDT program has already funded the construction of 74,000 UDDTs (WSP, 2009). In zimbabwe, about 1800 EcoSan toilets (38 Arborloos, 27 blair composting toilets, 295 sky-loos & 1487 fossa alternas) have been constructed by the mvuramanzi trust (WSP, 2005).

In the Eastern Africa region, Uganda has made the biggest advances in EcoSan. By May 2003 about 550 EcoSan facilities had been introduced in south western Uganda (Kisovo, kabale, Bushenyi). Taking a closer look at Kabale, it is a small market town in Southwest Uganda located on a main transport route between Kampala and Rwanda. It is a hilly area and the land is fragmented. Many households own more than one small plot of land. The population connected to water supply is estimated to be approximately 53,000 (out of a total of 83,000), but there are less than 500 connections to the sewerage network in the centre of the town. Therefore, pit latrines and other forms of on-site sanitation serve the majority of the population, approximately 6,000 households. There are approximately 150 households with UDDTs promoted under the South Western Towns Water and Sanitation Program (SWTWSP), (WSP, 2009).

In Kenya, the EcoSan has widely been accepted in Kisumu and Makueni regions. The Fossa Alterna toilet has been well received in two pilot areas in Kisumu. At least 15 toilets are being used in schools and public places such as fish landing sites. A demonstration toilet constructed in a primary school has attracted the interest of parents who want to copy the design in their homesteads. The Arborloo toilet has been enthusiastically received in Makueni

District (a semi-arid region south east of Nairobi) and the initial 3 demonstration toilets have been replicated to 57 within a year (WSP, 2005).

2.6 Influence of ecological sanitation on the improvement of livelihoods of people Living in informal settlements

Sanitation underpins the three pillars of sustainable development namely social, economic and environmental. Improving sanitation will lead to improvement of the three pillars thus leading to eradication of poverty. According to ITDG and ODI, (2005), there were reported improvements on the environment upon development of ablution blocks. It was noticed that there was less evidence of 'flying toilets' or human excreta flowing in open drains due to over full pit latrines. The smell from latrines, urine and stagnant bathing and cleaning water had also been reduced in the narrow pathways of the settlement (Maili Saba). The respondents began to notice fewer hygiene related diseases, and fewer flies, rodents and cockroaches in their homes.

According to Umande Trust, a rights-based agency which has built a number of Bio-Centres in some informal settlements Nairobi has outlined a number of social impacts as a result of the Bio-Centres. Firstly, the ablution blocks have improved people's lives enabling them to have access to water and sanitation facilities hence improving their health and reducing diseases such as cholera. Privacy has been enhanced as there are separate bathrooms and toilets for women and men. Security has improved especially for women and children as the facilities are situated near the households. Hygienic practices have been enhanced with hygiene education in the schools and in the community being carried out through door-to-door sensitization. Communities now have a sense of ownership having been involved in the project processes which have also made them responsible for the facilities. Lastly, the hand wash sinks in the facilities have increased hygiene levels among the beneficiary community members (Binale, 2011). From an economic perspective, the community members have benefited from improved hygiene therefore reducing the occurrence of diseases as a result of poor hygiene consequently reducing cases of hospitalization and increasing their disposable income.

For ecological sanitation to be fully realized thus enhancing the livelihoods of the people living in informal settlements, the following factors must be considered:

2.6.1 Technical skills imparted to the community

The initial education and training of potential users is perhaps the most important step of realizing a successful ecological sanitation (EcoSan) project. Failure to properly approach and educate users from the start would seriously hinder an EcoSan project's chances (SOIL, 2011). It is essential in training selected community members in eco-sanitation promotion, Bio-Centres, community cookers, etc. The purpose of training the promoters is to assist in successive training of the rest of the community members. Also, during the construction phase, selected community members are trained in basic business skills and how to operate and maintain the toilets and its related income-generating activities. An example is cited in Rachuonyo North & Radienya Nyakach districts where communities are trained on Urine Diverting Dry Toilets (UDDT) Construction (Osumba, 2010).

To further integrate the community into the project, the construction of the toilets should include carpenters, masons and labourers from the same community as much as possible. Once the toilets are finished, these individuals should have a general understanding of the technical aspects of the toilets and can be called upon for repairs when needed.

2.6.2 Extent of environmental awareness & sanitation promotion

To enable the community to accept/own the project, awareness programs must take place. Their perceptions of what ecological sanitation should be right from the word go. This initial meeting with the committee or community offers an opportunity for hygiene promotion and general education around the benefits of proper sanitation as well as a forum to introduce ecological sanitation as a viable solution to sanitation needs. Prior to constructing any toilets, the community should not only understand the differences between EcoSan toilets and other existing sanitation options, but also understand the benefits and responsibilities that come along with operating and managing an EcoSan toilet (SOIL, 2011). Also the community should be educated on how to properly use the EcoSan toilets and how to maintain them. This will enhance the sustainability of this system.

2.6.3 The level of financing

Financial arrangements probably shape the success or failure of sanitation projects more than any other factor. Answers to the basic questions of finance - "Who pays for what, when, and

how?"- determines the extent to which projects can replicate, expand sanitation, and meet household needs (WSP, 2012). Projects with financial designs that match local needs and capacities can take off, while projects with poor or unrealistic financial designs will stall at the end of the project cycle.

According to the GLAAS 2012 report, funding for water and sanitation costs can come from three main sources, commonly referred to as the "3Ts" of WASH: "tariffs", which are funds contributed by users of WASH services (and also including the value of labour and material investments of households managing their own water supply); "taxes", which refer to funds originating from domestic taxes that are channeled to the sector by the central, regional and local governments; and "transfers", which refer to funds from international donors and charitable foundations. Transfers include grants and concessional loans, such as those given by the World Bank, which include a grant element in the form of a subsidized interest rate or a grace period. In many respondent countries, external development aid remains a major source of financing for sanitation and drinking-water as shown in *table 2.3*.

Table 2.3: Respondent countries reporting greater than 25% donor finance

Country	Donor finance (as % of government finance)	Major Donors	Number of Donors	Sector-wide approach or Other sectoral framework implemented for water and sanitation	Investment plan implemented
Madagascar	26	World Bank, African Development Bank, EU	12	Yes	yes
Honduras	39	Spain, Japan, World Bank	14	Being defined	Under preparation
Kenya	41	Germany, World Bank, France	24	Yes	Under preparation

Afganistan	46	World Bank, USA, Germany	13	Being Defined	Rural water supply
Yemen	46	World Bank, Germany, Netherlands	12	Yes	Yes
Bangladesh	63	Asian Development Bank, Japan, World Bank	19	Drinking water only	Yes
Lesotho	67	Ireland, World Bank, USA	9	Drinking water only	Urban rural supply

Source: GLAAS 2012 report, 2011 GLAAS country survey

Partial public funding can trigger significantly increased access to household sanitation**.** One study, *Financing On-Site Sanitation for the Poor—A Six-Country Comparative*, based on an analysis of case studies from Bangladesh, Ecuador, Maharashtra, Mozambique, Senegal, and Vietnam, shows that public investments of varying forms enabled an absolute increase in the fraction of the target population gaining access to sanitation, which varied between 20 percent and 70 percent. The study revealed that the most important question is not **'**Are subsidies good or bad?' but rather 'How best can we invest public funds?' It also reveals that, households are key investors in on-site sanitation, and careful project design and implementation can maximize their involvement, satisfaction, and financial investment. Poor households can make substantial sanitation investments (up to 25 or 30 percent of annual income, as in Vietnam) if they can see the need and potential benefits from it. (Trémolet, Kolsky, & Perez, 2010).

2.6.4 Effectiveness of the management of the ecological sanitation systems

While the development of an appropriate design and the actual construction of the Bio-Latrines are necessary for a successful project, effective management of the latrines is an ongoing requirement that keeps the toilets functioning and clean (SOIL, 2011). The last factor that also shapes the success or failure of sanitation projects is management; management of the system after implementation. This factor majorly depends on the other three factors mentioned above. Example, the community members whom were trained on the technical aspects of the toilets, can be called upon for repairs, trouble shooting and administration. According to SOIL (2011), during the construction of the public toilets in IDP camps in Haiti, over 130 masons and carpenters were trained and hired in the ecological sanitation construction.

At a community level, have committees being set up to run/maintain the toilets? Were these committees trained on financial management, record keeping & on financial monitoring, control and audit? Financial management is a key component of community post implementation process. Record keeping makes the leaders concerned with handling money to acquire skills in record keeping. Records are important in addressing transparency & accountability among the group members. Lastly, to remain accountable to the community and to avoid misuse of money, leaders and those that will handle money are trained on financial monitoring, control and audit (SOIL, 2011).

This report focused on Mji wa Huruma Bio-Center Project situated at Mji wa Huruma, informal settlement contiguous to the Karura Forest in Nairobi. The village measures approximately 500 square metres and is home to between 1500 and 2000 people. The plot on which the village stands belongs to the government. Like other informal settlements in Nairobi, households lacked access to decent affordable, secure and adequate sanitation services. The few toilets that existed were shallow, overfilled and constructed using old iron sheets or polythene walling. A significant number of households disposed human waste in the adjacent karura forest. Filled toilets were manually emptied and discharged directly into the nearby Ruaka river downstream thereby polluting the vital water resources. In this scenario,

poor excreta disposal methods lead to an increase in the incidence of waterborne diseases, unpleasant odour and threaten the environment.

The United Nations Environment Programme (UNEP) in collaboration with the local community at the Mji wa Huruma Village and Umande trust, a national trust that supports communities completed the construction works for the community Bio-centre which became operational on 1st July, 2010. The Bio-Centre project comprises two parts: Bio-latrine and Capacity building. The Bio-latrine is a 3-storey building with the ground floor hosting the pit latrines & shower places; the first floor being offices for rent and the second floor being the open conference space for rent. The capacity building activities include training courses on project management & participatory hygiene and sanitation transformation (PHAST). Within one month of project inception, the members of the community formed a coalition bringing together 8 groups with a total membership of 300. This is 20% of the entire population of the community. The various groups were involved in various activities including water and sanitation, savings & credit, tree planting and bee keeping. Each group was asked to bring 2 persons from their respective groups to form the executive committee responsible for implementing the project.

2.7 Theoretical Framework

A theoretical framework is a collection of interrelated concepts. A theoretical framework guides your research, determining what things you will measure, and what statistical relationships you will look for (Borgatti, 1999).

According to Chigona & Licker (2008), there are four benefits of any theoretical framework. The first benefit is the ability to make *predictions.* If the theory is generally true, the predictions from the theory should also be true. The second benefit is purely *procedural;* it allows researchers as well as those managing or offering an innovation to proceed systematically, to observe or measure only some things and not have to measure everything. The third benefit is to *explain* what is happening, using the terms of the theory. This leads indirectly to empowerment, since the control of the explanatory forces leads to improvement. The final benefit is to put the theory under stress to *improve* it. If the theory doesn't do a good job of predicting, managing, or explaining, it needs to be improved.

This study was based on Rogers' *diffusion of innovations (DoI)* theory.

2.7.1 Diffusion of Innovations (DoI) Theory

The Diffusion of Innovations (DoI) theory places its emphasis on innovation as an agent of behaviour change, with innovation defined as *'an idea, practice, or object perceived as new by an individual or other unit of adoption'* (Rogers, 1983). Rogers went further and defined *diffusion* as the process by which an innovation is communicated through certain channels over time among the members of a social system. So diffusion is a special type of communication, in which the messages are concerned with a new idea. It is this newness of the idea in the message content of communication that gives diffusion its special character. Diffusion is also a kind of *social change*, defined as the process by which alteration occurs in the structure and function of a social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs.

The four main elements in the diffusion of innovations theory are innovation, communication channels, time and the social system. For Rogers (1983), communication is a process in which participants create and share information with one another in order to reach a mutual understanding. Diffusion is a particular type of communication in which the information that is exchanged is concerned with new ideas. The essence of the diffusion process is the information exchange by which one individual communicates a new idea to one or several others. At its most elementary form, the process involves: (1) an innovation, (2) an individual or other unit of adoption that has knowledge of, or experience with using, the innovation, (3) another individual or other unit that does not yet have knowledge of the innovation, and (4) a communication channel connecting the two units. A *communication channel* is the means by which messages get from one individual to another. The nature of the information-exchange relationship between the pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer.

The third element is time. Time is an important element in the diffusion process. The innovation-diffusion process, adopter categorization, and rate of adoptions all include a time dimension. Social system is the last element in the diffusion process. Rogers defines a social system as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems. Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. For Rogers (1983), structure is "the

patterned arrangements of the units in a system". He further claimed that the nature of the social system affects individuals' innovativeness, which is the main criterion for categorizing adopters.

The Innovation-Decision Process

The Innovation-Decision Process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. This process consists of a series of actions and choices over time through which an individual or an organization evaluates a new idea and decides whether or not to incorporate the new idea into ongoing practice (Rogers, 1983). This process is shown in *Fig. 4.*

Source: Diffusion of Innovations, third Edition by Everett M. Rogers

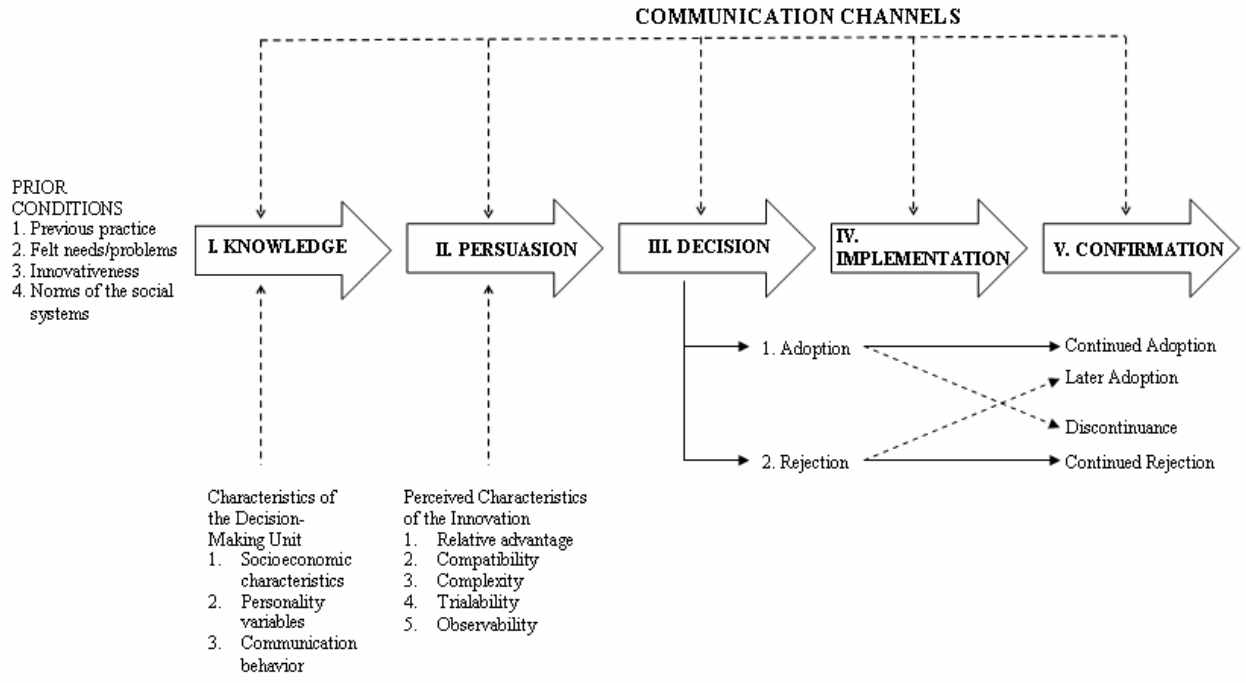

Figure 4: The Innovation-Decision Process

The innovation-decision process starts with the *knowledge stage*. In this step, an individual learns about the existence of innovation and seeks information about the innovation. "What" "how" and "why" are the critical questions in the knowledge phase. During this phase, the individual attempts to determine "what the innovation is and how and why it works". The *persuasion stage* occurs when the individual has a negative or positive attitude toward the

innovation. The individual shapes his or her attitude after he or she knows about the innovation, so the persuasion stage follows the knowledge stage in the innovation-decision process. At the *decision stage* in the innovation-decision process, the individual chooses to adopt or reject the innovation. While adoption refers to "full use of an innovation as the best course of action available," rejection means "not to adopt an innovation". At the *implementation stage*, an innovation is put into practice. However, an innovation brings the newness in which "some degree of uncertainty is involved in diffusion". Uncertainty about the outcomes of the innovation still can be a problem at this stage. Thus, the implementer may need technical assistance from change agents and others to reduce the degree of uncertainty about the consequences. Reinvention usually happens at the implementation stage, so it is an important part of this stage. Reinvention is "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation".

Also, Rogers (1983) explained the difference between invention and innovation. While "invention is the process by which a new idea is discovered or created," the adoption of an innovation is the process of using an existing idea" (Rogers, 1983). The innovation-decision already has been made, but at the *confirmation stage* the individual looks for support for his or her decision. According to Rogers (1983), this decision can be reversed if the individual is "exposed to conflicting messages about the innovation". However, the individual tends to stay away from these messages and seeks supportive messages that confirm his or her decision. Thus, attitudes become more crucial at the confirmation stage. Depending on the support for adoption of the innovation and the attitude of the individual, later adoption or discontinuance happens during this stage.

The relevance of innovation and diffusion perspective in this study is that the theory focuses on the way ecological sanitation plays a role in ensuring that the society are able to adopt new technology and methodologies and use them as a way to address sanitation among the community thereby improving their livelihoods. The theory looks at empowering residents of Mji wa Huruma with the necessary skill, knowledge and technology that will help them address the sanitation issues that are rather common in informal settlements and in the end, help improve their livelihoods. The theory also magnifies the role of the change agent which in this case is UNEP through Umande trust. A change agent is an individual who influences

clients' innovation decisions in a direction deemed desirable by a change agency. In most cases a change agent seeks to secure the adoption of new ideas.

2.8 Conceptual Framework

Defined as an aspect of thought, a *concept* is a kind of unit in terms of which one thinks; a unit smaller than a judgment, proposition, or theory, but one which necessarily enters into these (Gould & Kolb, 1964). A conceptual framework is a set of coherent ideas or concepts organized in a manner that makes them easy to communicate to others.

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The aim of the researcher's conceptual framework was to study the influence of ecological sanitation on the improvement of livelihoods of people living in informal settlements. The conceptual framework states the factors that will lead to the successful implementation of ecological sanitation: technical skills imparted to the community; extent of environmental awareness & sanitation promotion; level of financing; and effectiveness of the management of the ecological sanitation systems (*Fig. 5*).

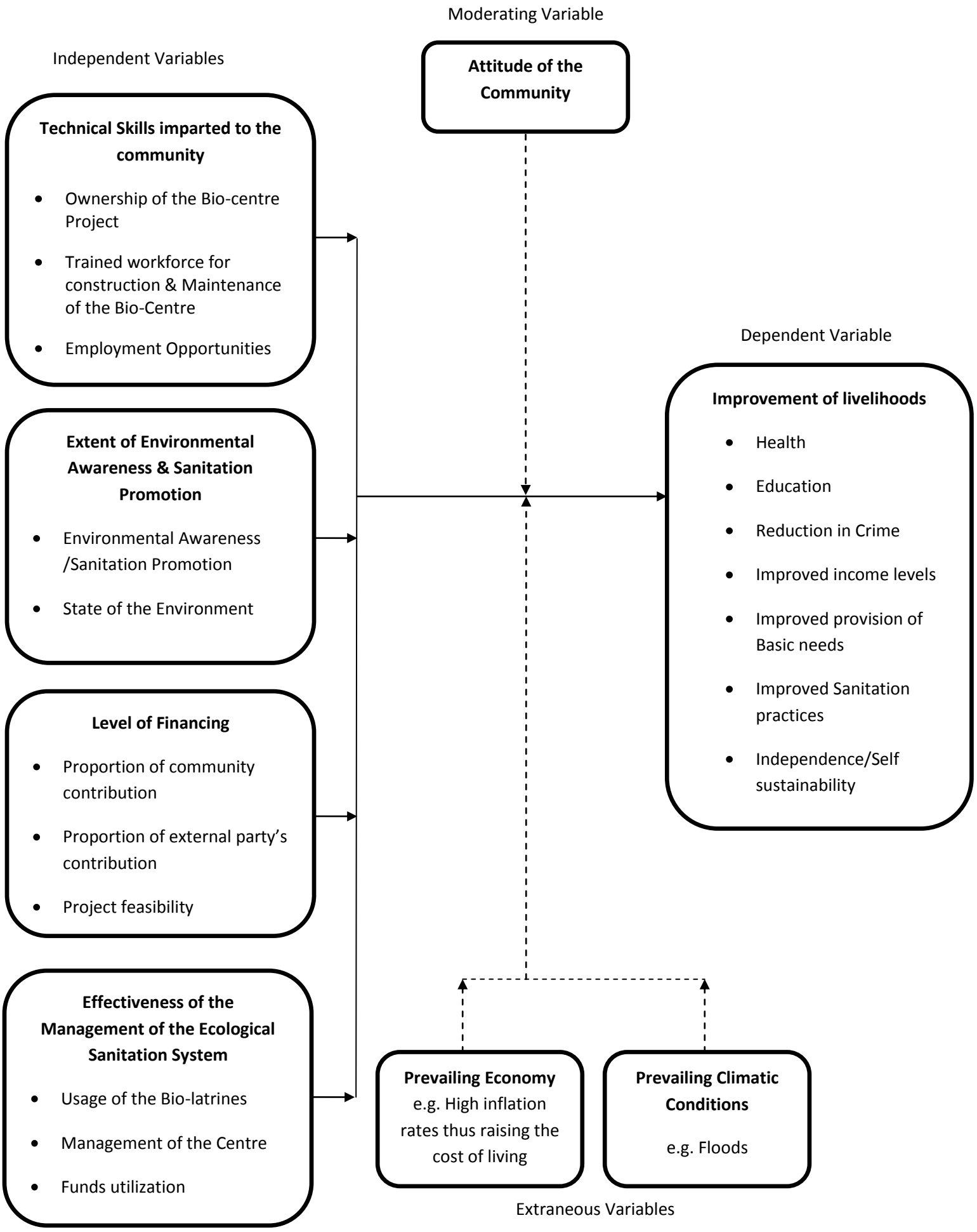

Figure 5: Conceptual Framework

In the conceptual framework, for successful implementation of an ecological sanitation, there are four independent variables that will lead to the improvement of the livelihoods of people living in informal settlements. These include:

1) **Technical skills imparted to the community**: These would be through empowering selected community members with specialized skills that would enable them construct and maintain the Bio-Center. This is a community managed process which empowers community members to play a central role in tendering, procurement, works, supervision and audits. Even after the completion of the Bio-Centre, the community members could source for various employment opportunities with the specialized skills garnered.

2) **Extent of environmental awareness & sanitation promotion**: These capacity building sessions enable community members fulfill their mandate in promoting sustainable environmental practices, securing land tenure and demanding better services. Also community members are able to understand their responsibility in promoting hygiene practices, not only within the Bio-Centre but also within the neighborhood. Through sanitation promotion, the levels of infections and sanitation related diseases would decrease. Also the disposable income per household would increase since the resources that could be used for hospital bill expenses could be diverted to other areas in the household.

3) **The level of financing** talks about; who pays for what, when and how. Will there be any subsidy to supplement the community's contribution towards the successful implementation of the project?

4) **The effectiveness of the management of the ecological sanitation system** is purely hinged on the successful implementation of the first three factors. Whether the community gets to own the project will be based on whether awareness of the project was created through training on sustainability. Whether the community leaders will effectively & efficiently run the project will be based on the extent in which the ecological experts imparted their expertise onto the community representatives.

2.9 Summary

This chapter reviewed the relevant literature in relation to the research questions presented in this study. It demonstrated the concepts of sanitation, livelihoods, ecological sanitation and the various impacts of ecological sanitation to the ecosystem. The research went further by providing case studies around the globe where ecological sanitation has successfully being implemented. Factors that would lead to the successful implementation of ecological sanitation were clearly outlined. The conceptual framework model related to the research study was drawn to give a visual presentation of the independent and dependent variables being studied.

The reviewed literature showed a gap in the state of utilizing ecological sanitation in informal settlements thus improving the livelihoods of the community, which this study intended to fill. A majority of the literature reviewed, focused on the utilization of ecological sanitation in the rural areas.

Even though many studies have focused on ecological sanitation and the use of human excreta not as a waste product, but as a valuable resource that can be used for the production of organic fertilizer useful in small scale agriculture, single studies on ecological sanitation focusing on Biogas/renewable energy has been rare.

Another gap that existed and which the study tried to address was the role of capacity building and environmental awareness and how it enhances a sustainable livelihood for the people in the informal settlements.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a discussion of the research methodology that was used in this study. It details the research design to be used; the target population of interest; the sampling size and technique; research instruments; data collection methods and analysis; and presentation techniques of the findings.

3.2 Research design

According to Kerlinger (1964), the research design helps the researcher to find answers to research questions, as validly, objectively, accurately and economically as possible; by setting up a framework for 'adequate' tests of the relations among variables. It points out the observations to make; how to make them; and how to analyze the quantitative representations of the observations i.e. the type of statistical analysis to use and possible conclusions to be drawn from the analysis.

The aim of this study was to investigate the influence of ecological sanitation on the livelihoods of people living in informal settlements. This study utilized a mixed-methods design; in particular, an explanatory mixed methods design. Explanatory mixed methods designs are characterized by an initial and extensive quantitative phase built upon by a subsequent qualitative phase. Usually, the qualitative results serve to explain the quantitative results (Borrego, 2009). Quantitative research involves data collection, analysis and interpretation. It explains phenomena by collecting numerical data that are analyzed using mathematically based methods (in particular statistics). Qualitative research is based on texts and images, pictures etc, (Creswell, 1994).

The purpose of quantitative studies is for the researcher to project his or her findings onto the larger population through an objective process. Data collected, often through surveys administered to a sample or subset of the entire population, allow the researcher to generalize or make inferences. Results are interpreted to determine the probability that the conclusions found among the sample can be replicated within the larger population. Conclusions are derived from data collected and measures of statistical analysis (Creswell, 2002).

3.3 Target Population

According to Cooper and Schindler (2000), a target population is the total collection of elements about which we wish to make inference. The population constitutes the residents of Mji wa Huruma. When a population is large, it becomes too expensive and time consuming to collect data. Therefore it is cheaper to carry out the research from a sample rather than from the entire community.

Mji wa Huruma village measures approximately 500 square meters and has a resident population of 1,608 people according to the Mji wa Huruma Baseline survey (2007/2008). The research focused on individuals within the age brackets of 17 years and above, thus the target population of Mji wa Huruma was 868 people. The target population of the officials of Mji wa Huruma was 6 people.

In closing, the research had a total target population of 874 people.

3.4 Sample size and Sample Technique

Sampling is the process of selecting a number of individuals for a study in such a way that the individuals selected represent the large group from which they are selected. A sample is a small proportion of an entire population; a selection from the population. Sampling procedure may be defined as a systematic process of identifying individuals for a study to represent the larger group from which they are selected, (Mugenda and Mugenda, 2003).

The sampling technique used by the researcher was a mixed method of sampling that included both probability sampling and non-probability sampling. The researcher used stratified random sampling to stratify the residents of Mji wa Huruma into strata. These strata are Men (17 years and above) and Women (17 years and above) as shown in *Table 3.1*. The advantage of using stratified random sampling is that it provides better accuracy compared to simple random sampling and systematic random sampling. Stratified random sampling requires a smaller sample hence saves money and time and at the same time avoids unrepresentative populations (Kish, 2011).

The first sample size has randomly been selected from each stratum using the formula explained by Kish (2011), as indicated below:

$$n = N/ [1+ N (e)^2]$$

$$n_h = (N_h / N) * n$$

Where:

N = Total population size

n = Total sample size

N_h = Population size for stratum

n_h = Sample size for stratum

e = error margin (0.1)

Example:

$$n = 868/ [1 + 868(0.1)^2] = \mathbf{90} \text{ (sample size)}$$

Men sample size is: (423/ 868) * 90 = **44** respondents

Women sample size is: (445/ 868) * 90 = **46** respondents

Table 3.1 shows the sample sizes for each of all the clusters.

Table 3.1: Sample Size for Mji wa Huruma residents

Category	**Target Population from each strata**	**Percentage of each strata**	**Sample Size**
Men (17 years and above)	423	48.7%	44
Women (17 years and above)	445	51.3%	46
Total	**868**	**100%**	**90**

To select the officials of Mji wa Huruma, the researcher used purposive sampling. Since the target population was less than 30, the entire population was used as a sample hence the use of purposive sampling. The officials of Mji wa Huruma were 6 in total. *Table 3.2* shows the sample population for the study.

Table 3.2: Sample population for the study

Category	Population	Sample Size
Officials of Mji wa Huruma		
Men	4	4
Women	2	2
Mji wa Huruma Residents		
Men (17 years and above)	423	44
Women (17 years and above)	445	46
Total	**874**	**96**

The researcher developed two questionnaires to be administered to the 96 respondents (Appendix II and III).

Data were also collected by use of a focus group discussion. According to Best and Kahn (2006), focus groups are group discussions centered on a single or narrow range of topics. The information gathered is qualitative (insights, personal responses and opinions) as opposed to quantitative (uniform facts), as it provides an opportunity to gather and probe insights of participants. A typical focus group session lasts for 90 to 120 minutes, including a summing up session at the end.

3.5 Research Instruments

Data collection was done through the use of a questionnaire, observation and a focus group discussion in order to capture all the dimensions of the study such as views, opinions, perceptions and feelings of the respondents. Questionnaires were administered to both the officials of the Bio-Center project and the residents of Mji wa Huruma. Close-ended questions were used to collect the quantitative data, while the open-ended were used to collect qualitative data. The sample size was also generally large (96 respondents) and given the time constraints, questionnaires were the ideal tool for collecting data (Kish, 2011).

The questionnaire administered to the residents of Mji wa Huruma had five sections; the first section had questions on the background information about the respondent. The remaining four sections addressed the four independent variables namely: technical skills transfer,

environmental awareness and sanitation promotion, level of financing and lastly; effectiveness of the management of the Ecological sanitation system. Lastly, the questionnaire administered to the officials of Mji wa Huruma Bio-Center project had four sections which addressed the four independent variables of the research study.

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Qualitative data was collected through the use of a focus group discussion, where open-ended questions were applied. These themed interviews were qualitative and in-depth with key informants who knew what was going on in the community (Best and Kahn, 2006). The purpose of the focus group discussion is to collect information from people who have firsthand knowledge of the Mji wa Huruma project. According to Kish (2011) there is always an option of using themed or unstructured interviews. In these interviews, the researcher has a list of themes and questions to be covered although these may vary from interview to interview. This means that some questions maybe omitted in particular interviews, given the specific organizational context which is encountered in relation to the research topic.

Data on the condition of the toilets, state of the environment at Mji wa huruma were collected through observation. The researcher prepared an observation guide/checklist which enabled the observer to record evidence of criteria by placing a check in the appropriate column and also comment on what was observed.

3.5.1 Pilot Testing

The research instruments were pre-tested by conducting a pilot test with a sample of 23 respondents. The respondents included 21 Mji wa Huruma residents and 2 officials of the Mji wa Huruma project. The pilot testing was conducted to find out whether the questions measured what it was supposed to measure and that the respondents could understand and interpret questions correctly and also to measure how long the questions would take.

3.5.2 Reliability of the Instruments

The researcher performed a pre-test on the questionnaires to test reliability. Mugenda and Mugenda (1999) define reliability as a measure of the degree to which a research instrument yields consistent results or data after repeated trials. Split-half technique was used and aimed at determining the coefficient of internal consistency or reliability coefficient. The research

instrument was split into two subsets, one consisting of odd numbered questions and the other of even numbered questions. The score of all the odd and even numbered questions of responses in the pilot study were computed. If the correlation becomes greater than 0.8, is described as strong, whereas a correlation less than 0.5 is described as weak. The results showed a linear association with reliability of instrument with a Pearson Correlations coefficient (R) of 0.704 at 95% significance level p=0.05. Given this correlation value, the study concludes that the reliability of the research instrument is moderate.

3.5.3 Validity of the Instruments

Validity refers to the appropriateness, meaningfulness and usefulness of the inferences a researcher makes. It is important to note that it is the inferences about the specific uses of an instrument that are validated, and not the instrument itself thus the need for the inference to be appropriate, meaningful and useful (American Psychological Association, 1985). Professionals and experts from UNEP were requested to assess and check the instruments measurement capabilities and ensure that the content was within the linguistic capabilities and understanding of Mji wa Huruma residents. The researcher and the professionals checked how appropriate the content of the instrument was to the study; how comprehensive the content was in measuring all the constructs of the variable being measured; if the content logically got at the intended variable; how adequate the sample of items or questions represent the content to be measured; and if the instrument format was appropriate. For an instrument to be valid, it must be reliable.

3.6 Ethical Considerations

Ethical issues related to the study will be addressed by maintaining high level confidentiality of the information volunteered by the respondents and never intending to use the information for other purposes other than drawing the conclusion of the study. The names of the respondents will be optional and will not to be disclosed to protect their identities. All personal details will be limited to general information.

3.7 Operational Definition of Variables

Operational definition is a description of a variable, term or object in terms of the specific process or set of validation tests used to determine its presence and quantity. Properties described in this manner must be publicly accessible so that persons other than the definer

can independently measure or test for them at will (Kish, 2011). *Table 3.3* illustrates and summarizes the operational definitions that were used in the research.

Table 3.3: Operationalization Table of Variables

Research Objective	Variable	Indicator	Measurement	Level of scale	Data collection tool	Type of analysis	Level of analysis
To assess the extent to which technical skills imparted to the community has improved the livelihoods of people living in the informal settlements.	Independent variable Technical skills imparted to the community	a) Ownership of the Bio-centre Project	- Confirmation of participation in the Bio-centre design	Nominal	Questionnaires	Quantitative	Descriptive statistics
			-Level of satisfaction in the Bio-centre design	Interval	Questionnaires	Quantitative	Descriptive statistics
			-Level of involvement of the Community leaders	Interval	Questionnaires	Quantitative	Descriptive statistics
		b) Trained Workforce for construction & Maintenance of the Bio-Centre	-Confirmation on training	Nominal	Questionnaires	Quantitative	Descriptive statistics and correlation
			-Determine No. of sessions conducted	Ordinal	Questionnaires	Quantitative	Descriptive statistics
			-Determine whether any training materials were distributed to the participants	Nominal	Questionnaires	Quantitative	Descriptive statistics
			-No. of trained workforce	Ordinal	Questionnaires	Quantitative	Descriptive statistics

			-Level of individual assistance in construction of Bio-centre	Nominal	Questionnaires	Quantitative	Descriptive statistics
			-Determine whether the community was informed of the benefits and uses of the Bio-centre	Nominal	Questionnaires	Quantitative	Descriptive statistics
		c) Employment Opportunities	-Level of employment opportunities as a result of training	Interval	Questionnaires	Quantitative	Descriptive statistics and correlation
To assess the extent to which environmental awareness & sanitation promotion has improved the livelihoods of people living in the informal settlements.	<u>Independent Variable</u> Extent of environmental awareness & sanitation promotion	a) Environmental Awareness/ Sanitation Promotion	- Confirmation on environmental awareness training	Nominal	Questionnaires	Quantitative	Descriptive statistics
			-Determine the number of sessions conducted	Ordinal	Questionnaires	Quantitative	Descriptive statistics
			-Determine whether the community was informed of the benefits of Environmental	Nominal	Questionnaires	Quantitative	Descriptive statistics and correlation

			Awareness & Sanitation Promotion				
			- Level of cleanliness as a result of the awareness/sanitation promotion	Interval	Questionnaires	Quantitative	Descriptive statistics and correlation
			-Level of Hand washing practice after visiting the Latrine	Interval	Questionnaires	Quantitative	Descriptive statistics
		b) State of the Environment	-Level of cleanliness in the environment(i.e. Waste disposal practices, urine & stagnant water on narrow pathways)		Observation	Qualitative	Descriptive statistics
			- Condition of the Bio-latrines		Observation	Qualitative	Descriptive statistics
			-Good drainage		Observation	Qualitative	Descriptive statistics
			-Proper Piping		Observation	Qualitative	Descriptive statistics
To establish the	Independent	-a) Proportion of	- Level of	Nominal	Questionnaires	Quantitative	Descriptive statistics

relationship between the level of financing of the ecological sanitation systems and the improvement of livelihoods in informal settlements.	Variable The Level of financing	community contribution b) Proportion of external party's contribution c) Project feasibility	contribution made by community - Level of contribution made by external party -Feasibility of project without external aid	Nominal Nominal	Questionnaires Questionnaires	Quantitative Quantitative	Descriptive statistics Descriptive statistics
To evaluate the effectiveness of the management of the ecological sanitation systems on the livelihoods of people living in informal settlements.	Independent Variable Effectiveness of the Management of the ecological sanitation	a) Usage of the Bio-latrines b) Management of the Centre c) Funds utilization	- Confirmation on the ease of use -Determine who manages the Bio-centre -Determine who handles the technical problems of the Bio-centre when they arise -Determine where the residents contribute towards the maintenance of the Bio-centre	Nominal Nominal Nominal	Questionnaires Questionnaires Questionnaires	Quantitative Quantitative Quantitative	Descriptive statistics Descriptive statistics and correlation Descriptive statistics

3.7 Data Analysis Methods

The data collected from the field were entered and analyzed as per the research objectives by descriptive analysis using Statistical Package for Social Scientists (SPSS) software. The software is commonly used for analyzing survey data and its choice is underpinned on its numerous advantages ranging from user friendliness, ability to analyze multi-response questions, cross section and time series analysis, and cross tabulation capability to be used alongside Microsoft Excel and Word.

The process consisted of data cleaning and initial data analysis. Data cleaning ensures that erroneous entries are inspected and corrected where possible. The initial data analysis uses descriptive statistics to answer questions on the quality of the data, the quality of the measurements, the characteristics of the data sample and whether the implementation of the study fulfilled the intentions of the research design.

3.7.1 Quantitative Data Analysis

Quantitative data was converted to numerical codes referred to as 'coding', which involved including as much information as possible, to avoid initial omission of vital information which might be impossible to recover later and ensure consistency. Similar information was categorized and grouped together to give a summary of results using descriptive statistics on all variables. The descriptive statistics used include measures of central tendency (mean, mode and median) and the measures of dispersion, including the standard deviation, range and skewness (Nunnally, 1978).

The mean, the arithmetic average of the values in the set, is obtained by summing the values and dividing by the number of values. The median is the middle number in an array of values ordered in an ascending manner. The mode is the value that occurs with the highest frequency. Measures of dispersion indicate variation in the data set. Standard deviation measures the spread of the distribution about the mean. Skewness indicates departures from normality (Nunnally, 1978).

Skewness is another name for asymmetry; one tail of the curve is drawn out more than the other. A negative value indicates skewness to the left; a positive, skewness to the right. Kurtosis is the peakedness of the curve. A negative value indicates platy kurtosis (fewer

items at the mean and at tails but more in intermediate regions. A positive value shows leptokurtosis (more items near the mean and at the tails but fewer in the intermediate regions). One way of determining if the degrees of skewness or kurtosis are significantly non-normal is to compare the numerical value for skewness/kurtosis with the range formed by twice the standard error of skewness/kurtosis (Nunnally, 1978). If the value for skewness/kurtosis falls within this range, then the distribution will be considered to be sufficiently normal.

To uncover the relationships between different types of variables, Pearson's correlation coefficient (Pearson's r) was used to perform parametric statistical tests while Spearman's Rank correlation coefficient (Spearman's Rho) was used to perform Non-parametric statistical tests. Pearson's correlation coefficient requires both variables to be measured on an interval or ratio scale, and the calculation is based on the actual values. Spearman's rank correlation coefficient requires data that are at least ordinal and the calculation, which is the same as for Pearson's correlation, is carried out on the ranks of the data (Altman, 1991).

Pearson's correlation coefficient is a statistical measure of the strength of the association between the two variables (University of West England, 2013). Two letters are used to represent the Pearson correlation: Greek letter rho (ρ) for a population and the letter "r" for a sample. The correlation coefficient r, ranges from +1.0 to -1.0. If the value of r was 1.0, there was a perfect positive linear relationship. If the value of r was -1.0, there is a perfect negative linear relationship or a perfect inverse relationship. No correlation is indicated if $r = 0$. The correlation coefficient indicates both the magnitude and direction of the linear relationship (Nunnally, 1978).

Spearman's rank correlation coefficient is used as a measure of linear relationship between two sets of ranked data, i.e. it measures how tightly the ranked data clusters around a straight line. Spearman's rank correlation coefficient, like all other correlation coefficient, will take a value between -1 and +1. A positive correlation is one in which the ranks of both variables increase together. A negative correlation is one in which the ranks of one variable increase as the ranks of the other variable decrease. A correlation of +1 or -1 will arise if the relationship between the two variables is exactly linear. A correlation close to zero means there is no linear relationship between the ranks (Altman, 1991).

The correlation matrix and factor analysis was used as the standard form of reporting the correlation results because this statistical approach can be used to analyze interrelationships among a large number of variables and also explain the original variables.

3.7.2 Qualitative Data Analysis

Qualitative data analysis was used to summarize the group of words generated by the focus group discussions. The process commenced right from the first day of data collection where data was arranged into relevant themes at the end of the day's field work, so as to form a daily summary. Any other new idea that emerged in the subsequent day's field work was added into the summary of themes. At the end of every week of field work, an interim summary report was made. Finally, based on the weekly summaries, a decision was made on the type of data generated (whether quantitative or qualitative) so as to inform relevant statistical analysis.

3.8 Summary

This chapter describes the methodology that was used in carrying out the study. The research design took a mixed-method approach focusing on Mji wa Huruma's Bio-Centre project and seeked to answer the research questions. The sample size, the sampling techniques and instrumentation, have all been described. The questionnaires developed were pilot tested prior to the actual one being administered. The chapter has also indicated that, data was analyzed using SPSS; and presented in form of frequencies, chart and tables. The next chapter will present the findings of the research.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTEPRETATION

4.1 Introduction

This chapter focused on the presentation, interpretation and analysis of findings based on primary data collected from the respondents using questionnaires, focus group discussion and an observation guide. The research was conducted on the Residents of Mji wa Huruma and the Officials who spearheaded the Mji wa Huruma Project. The findings presented in this chapter have been discussed under thematic areas and sub-sections in line with the study objectives. The thematic areas include: study demographics, technical skills imparted to the community, extent of environmental awareness and sanitation promotion, level of financing, and the effectiveness of the management of the ecological sanitation.

4.2 Response Rate

In regards to the response rate, six (6) questionnaires were administered to the officials of Mji wa Huruma and all of them responded. However, the residents of Mji wa Huruma returned a response rate of 89% since eighty (80) out of the possible ninety (90) respondents were available and willing to provide the required information. The second group of respondents from the focus group discussion returned a 100% response rate since twenty one (21) respondents were interviewed. In order to achieve these results, the researcher was assisted by two research assistants who personally administered the questionnaires and conducted the focus group discussion.

4.3 Demographic Characteristics of Respondents

Since data were collected from officials and residents of Mji wa Huruma, an attempt was made to present data first in terms of demographics of respondents.

4.3.1 Distribution of Respondents by Gender

During data collection, the respondents' gender was noted. Resulting distribution showed that out of 80 residents interviewed, 41 (51.3%) were male while 39 (48.8%) were female as shown in *Table 4.1*. The table shows that the distribution of gender is evenly skewed.

Table 4.1: Gender Distribution of Mji wa Huruma Residents

		Frequency	Percent
Valid	Male	41	51.3
	Female	39	48.8
	Total	**80**	**100.0**

As shown in *Table 4.2*, the resulting distribution showed that out of the 6 officials interviewed, 4 (66.7%) were male while 2 (33.3%) were female.

Table 4.2: Gender Distribution of Mji wa Huruma Officials

		Frequency	Percent
Valid	Male	4	66.7
	Female	2	33.3
	Total	**6**	**100.0**

4.3.2 Distribution of Respondents by Age

The findings presented in *Table 4.3* shows that out of 80 residents, 14 (17.5%) were within the age bracket of 10–17 years, 36 (45%) respondents were within the age brackets of 18–30 years, 22 (27.5%) respondents were within the age brackets of 31–55 years and 7 (8.8%) were within the age brackets of 56–80 years. *Table 4.4* shows that out of 6 officials, 4 (66.7%) were within the age bracket of 18-30 years and the 2 (33.3%) were within the age racket of 31-55 years.

Table 4.3: Age Distribution of Mji wa Huruma Residents

		Frequency	Percent
Valid	10-17	14	17.5
	18-30	36	45.0
	31-55	22	27.5
	56-80	7	8.8
	Total	79	98.8
Missing	99	1	1.3
Total		**80**	**100.0**

Table 4: Age Distribution of Mji wa Huruma Officials

		Frequency	Percent
Valid	18-30	4	66.7
	31-55	2	33.3
	Total	6	100.0

4.3.3 Distribution of Respondents by Level of Education

The findings presented in *Table 4.5* shows that out of 80 residents, 5 (6.3%) had no level of education, 26 (32.5%) had primary level education, 41 (51.3%) had secondary level education, 3 3.8%) had tertiary level education, 4 (5.0%) had adult literacy level education, and there was no response from 1 respondent.

Table 4.5: Level of Education of Mji wa Huruma Residents

		Frequency	Percent
Valid	None	5	6.3
	Primary School	26	32.5
	Secondary School	41	51.3
	Tertiary	3	3.8
	Adult literacy	4	5.0
	Total	79	98.8
Missing	99	1	1.3
Total		**80**	**100.0**

Table 4.6 shows that out of 6 officials, 2 (33.3%) had undergraduate education while 4 (66.7%) had postgraduate education.

Table 5: Level of Education of Mji wa Huruma Officials

		Frequency	Percent
Valid	Undergraduate	2	33.3
	Postgraduate	4	66.7
	Total	**6**	**100.0**

4.3.4 Distribution of Respondents by Use of Bio-Centre

The findings presented in *Table 4.7* shows that out of 80 residents, 69 (86.3%) use the Bio-Centre facilities while 9 (11.3%) do not use it. There was no response from 2 respondents. This shows that a majority of the residents use the Bio-Centre.

Table 4.7: Distribution of Respondents by use of Bio-Centre

		Frequency	Percent
Valid	Yes	69	86.3
	No	9	11.3
	Total	78	97.5
Missing	99	2	2.5
Total		**80**	**100.0**

4.3.5 Distribution of Respondents by the benefits of the Bio-Centre

The findings presented in *Table 4.8* shows that out of 80 residents, 73 (91.3%) find the Bio-Centre to be beneficial to either them or the community while 6 (7.5%) do not find it beneficial. There was no response from 1 respondent.

Table 4.8: Distribution of Respondents by the benefits of the Bio-Centre

		Frequency	Percent
Valid	Yes	73	91.3
	No	6	7.5
	Total	79	98.8
Missing	99	1	1.3
Total		**80**	**100.0**

4.3.6 Recommendation of the Bio-Centre to others

The findings presented in *Table 4.9* shows that out of 80 residents, 65 (81.3%) would recommend the Bio-Centre to others, 14 (17.5%) wouldn't recommend it to others and there was no response from 1 respondent.

Table 4.9: Recommendation of the Bio-Centre to others

		Frequency	Percent
Valid	Yes	65	81.3
	No	14	17.5
	Total	79	98.8
Missing	99	1	1.3
Total		**80**	**100.0**

In accordance to the results distribution in *Table 4.8 and 4.9,* it can be said that the Bio-Centre has benefited the residents of Mji wa Huruma. For a community to recommend a facility to others, it means the facility has benefited them.

The following section answers the findings of the research questions. Various variables have been used to establish the influence of ecological sanitation on the improvement of livelihoods, including: technical skills imparted to the community, extent of environmental awareness and sanitation promotion, level of financing and effectiveness of the management of the ecological sanitation.

4.4 Technical skills imparted to the community

The first objective of this study was to assess the extent to which technical skills imparted to the community improved their livelihoods. This section was divided into two segments: ownership of the Bio-Centre project by the local residents and the trained workforce.

4.4.1 Ownership of the Bio-Centre project by the local residents

The Mji wa Huruma residents' data indicated that out of the 80 respondents, 64 (80%) reported that the community participated in the Bio-Centre design workshop. Also a majority of the respondents strongly agreed that the community was involved in the Bio-Centre design having the highest frequency and percentage of 36(45%). However, a large percentage of the respondents were not satisfied with the Bio-Centre design 33 (41.3%). Overall, the percentage index revealed that a majority of the respondent strongly agreed with the two questions asked (*Table 4.10*).

Table 4.10: The Opinion of Mji wa Huruma Residents

	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
The Community leaders were involved in the Bio-Centre design	36 (45%)	19 (23.8%)	16 (20%)	6 (7.5%)
The community is satisfied with the Bio-Centre design	22 (27.5%)	15 (18.8%)	33 (41.3%)	7 (8.8%)
Percentage Index	**36.25%**	**21.3%**	**30.65%**	**16.3%**

The Mji wa Huruma officials' data indicated that out of the 6 respondents, 5 (83.3%) reported that the community participated in the Bio-Centre design workshop plus they strongly agreed that the community was involved and satisfied with the Bio-Centre design (*Table 4.11*).

Table 4.11: The Opinion of Mji wa Huruma Officials

	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
The Community leaders were involved in the Bio-Centre design	5 (83.3%)	0 (0%)	0 (0%)	0 (0%)
The community is satisfied with the Bio-Centre design	5 (83.3%)	1(16.7%)	0 (0%)	0 (0%)
Percentage Index	**83.3%**	**16.7%**	**0%**	**0%**

The results illustrated in this section, justifies that the community did accept/own the Bio-Centre project.

4.4.2 Trained workforce

The questions asked in this section wanted to determine whether the community was empowered with technical skills to enable them either construct and maintain the Bio-Centre or seek other employment opportunities.

Table 4.12: The Opinion of Mji wa Huruma Residents on trained workforce

	Was the community trained in the construction & maintenance of the Bio-Centre?	How many sessions were conducted?	How many Members of the community were trained?	Were any brochures/materials distributed during the course of the training?	Has there been increased employment opportunities due to the training received?	Was the community taught about the benefits and uses of the Bio-Centre?	What assistance did the community receive in the construction of the Bio-Centre?
N Valid	76	65	66	77	78	76	77
Missing	4	15	14	3	2	4	3
Mean	1.20	1.92	3.44	1.45	1.33	1.29	2.73
Median	1.00	2.00	3.00	1.00	1.00	1.00	3.00
Mode	1	2	3	1	1	1	4
Std. Deviation	.401	.714	1.125	.501	.474	.457	1.392

The findings presented in *Table 4.12* show that a majority of the respondents stated the following: the community was trained in construction and maintenance of the Bio-Centre , *61 (76.3%)*; between 6-10 sessions were conducted, *32 (40%)*; 11-15 members of the community were trained, *31 (38.8%)*; training brochures/materials were indeed distributed to the community, *42 (52.5%)*; there was increased employment opportunities as a result of the training received, *52 (65%)*; the community was indeed taught on the benefits and uses of the Bio-Centre, *54 (67.5%)*; and lastly, the community received construction material as assistance in the construction of the Bio-Centre, *32 (40%).*

According to the standard deviation presented in *Table 4.12*, it is also important to highlight that there was a huge variation on the responses provided in two questions namely, '*members of the community trained*' and '*the assistance the community received*'.

Table 4.13: The Opinion of Mji wa Huruma Officials on trained workforce

		Was the community trained in the construction and maintenance of the Bio-Centre?	How many sessions were conducted?	How many members of the community were trained of this?	Were any brochures/materials distributed during the course of the training?	Was the community taught about the benefits and uses of the Bio-Centre?	What assistance did the community receive in the construction of the Bio-Centre?
N	Valid	6	5	5	5	6	6
	Missing	0	1	1	1	0	0
Mean		1.00	2.00	1.00	1.00	1.00	4.50
Median		1.00	2.00	1.00	1.00	1.00	5.00
Mode		1	2	1	1	1	5
Std. Deviation		.000	.000	.000	.000	.000	1.225

The findings presented in *Table 4.13* show that a majority of the respondents stated the following: the community was trained in construction and maintenance of the Bio-Centre , *6 (100%)*; between 6-10 sessions were conducted, *5 (83.3%)*; 1-5 members of the community were trained, *5 (83.3%)*; training brochures/materials were indeed distributed to the community, *5 (83.3%)*; the community was indeed taught on the benefits and uses of the Bio-Centre, *6 (100%)*; and lastly, the community received Construction Advice, Skilled Labor and Construction Material as assistance in the construction of the Bio-Centre, *5 (83.3%)*.

From the focus group discussion, participants stated that the training they received did indeed increase employment opportunities thus translating into two things: improved income levels and improved provision of basic needs. An example given by the participants was that some of the community members were hired to run the Bio-Centre project. The researcher asked the participants whether there was a significant drop in crime in the area due to increased employment opportunity, the participants responded that Mji wa Huruma is a peaceful community and are not involved in any criminal activities.

4.4.3 Relationship between community training and increased employment opportunity

A bi-variate analysis was done on community training and increased employment opportunity for the Residents of Mji wa Huruma. Spearman's rank correlation coefficient (rho) was then computed and tested at 0.05 (5%) significant level. The result showed a weak positive relationship (rho=0.283) between community training and increased employment opportunities. This relationship was statically significant at 5% level. This is shown in *Table 4.14* below.

Table 4.14: Relationship between community training and increased employment

			Was the community trained in the construction & maintenance of the Bio-centre?	Has there been increased employment opportunities due to the training received?
Spearman's rho	Was the community trained in the construction & maintenance of the Bio-centre?	Correlation Coefficient	1.000	.283*
		N	76	75
	Has there been increased employment opportunities due to the training received?	Correlation Coefficient	.283*	1.000
		N	75	78

*. Correlation is significant at the 0.05 level (2-tailed).

From *Table 4.14* above, it confirms that there exists a positive relationship between each of the determinants. However if a negative correlation existed, it would mean one set of variable increases as the other decreases. We can therefore conclude that as each determinant increases the other also increases (positive correlation).

4.5 Extent of environmental awareness and sanitation promotion

The second objective of this study was to assess the extent to which environmental awareness and sanitation promotion improved the livelihoods of the people living in informal

settlements. This section sought to determine whether environmental awarenesss and sanitation promotion in the community had an impact in their sanitation practices, health, finances, environment, and many more.

4.5.1 Environmental awareness

From the three questions stated in this section, the standard deviation ranges between 0.494 and 0.836 showing that there was little variation in the responses provided. A majority of the residents reported that they were trained on environment awareness and sanitation promotion, 1-5 sessions were conducted and they were taught on its benefits, having the highest frequency and percentage of 46 (57.5%), 35 (43.8%) and 50 (62.5%) respectively. Likewise, the officials gave a similar response with the residents generating a frequency and percentage of 6 (100%), 3 (50%) and 6 (100%) respectively.

From the Focus group discussion, the participants stated that since the environmental awareness trainings were conducted, there was a downward trend of people going to karura forest to relieve themselves. The participants also pointed out that it took some time for the residents to stop going to the forest and commence using the Bio-Centre. It was also stated that, if the residents had no money to access the Bio-Centre, they opted to use the pit latrines in the community. Further to this point, people usually use pit latrines during the night since the Bio-Centre is locked at 7pm due to lack of electricity at the facility.

4.5.2 Sanitation promotion

Table 4.15: The Opinion of Mji wa Huruma Residents on sanitation promotion

Sanitation Promotion	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The Bio-Centre is clean and hygienic all day long	53 (66.3%)	17 (21.3%)	10 (12.5%)	0 (0%)
Soap is provided for hand washing after using the Bio-Centre	21 (26.3%)	7 (8.8%)	29 (36.3%)	21 (26.3%)
Tissue paper is provided for use when visiting the Bio-Latrine	50 (62.5%)	23 (28.8%)	4 (5%)	3 (3.8%)

Water is provided for hand washing after using the Bio-Latrine	53 (66.3%)	21 (26.3%)	5 (6.3%)	1 (1.3%)
Showers are available for use at the Bio-Centre	57 (71.3%)	16 (20%)	6 (7.5%)	0
The doors in the Bio-Centre are lockable	44 (55%)	31 (38.8%)	3 (3.8%)	0
Waste disposal methods have improved in Mji wa Huruma	29 (36.3%)	18 (22.5%)	16 (20%)	15 (18.8%)
Ruaka river and the entire surroundings of Mji wa Huruma are much cleaner	27 (33.8%)	14 (17.5%)	30 (37.5%)	7 (8.8%)
Percentage Index	**52.2%**	**23%**	**16.1%**	**7.4%**

The residents' data indicated that majority of the respondents strongly agreed that the Bio-Centre is clean and hygienic all day, tissue paper is provided for use, water is provided for hand washing after Bio-latrine use, showers are available for use, doors at the Bio-Centre are lockable, waste disposal methods have improved, having the highest frequency and percentage of 53 (66.3%), 50 (62.5%), 53 (66.3%), 57 (71.3%), 44 (55%) and 29 (36.3%) respectively. The respondents disagreed that soap is provided for hand washing after Bio-latrine use, Ruaka river and the entire surroundings of Mji wa Huruma are much cleaner, having the highest frequency and percentage of 29 (36.3%) and 30 (37.5%) respectively. Though there are no sanitary bins and dust bins at the Bio-Centre, a majority of the respondents reported that the Bio-Centre is cleaned throughout the day.

From the Focus group discussion, participants stated that someone had been hired on a full time basis to ensure that the facility remained clean throughout the day. It also came out in the discussion that the residents had to part with a small fee (*Ksh 5*) every time they had to use the facility. The fees collected went towards the provision of toiletries and the maintenance of the Bio-Centre project. These fees hinder a proportion of the population in the settlement from using the facility. However, participants also noted that there had been a significant decline in sanitation related diseases in the community which could be attributed to the trainings offered to the community by UNEP/Umande Trust initiative. With regards to

the environment, the general surroundings in the community are much cleaner since people are not helping themselves anywhere thereby reducing the number of flies, rodents and cockroaches in the community and also reducing the contraction of sanitation related diseases.

Lastly, the participants bitterly expressed their anguish on the state of ruaka river. They reported that sewer from some of the neighboring runda residents was flowing into the river and also some people were washing clothes, cars, donkey carts in the river thus its waters could not be used for consumption.

4.5.3 State of the environment

This section sought to determine the general state of the environment at Mji wa Huruma. The researcher through the use of an observation guide made general observations of Mji wa Huruma.

With regards to the state of the environment, the researcher observed the following: the community had good disposal practices, they had one general area where litter was dumped; no faeces were visible thus implying open defecation was not practiced; there was proper drainage systems though the researcher observed that all the drainage channels were directed towards ruaka river; clean water was available in the community; other than the Bio-Centre, there were a couple of pit latrines in the community. The researcher observed that the general condition of the environment was averagely clean.

With regards to the condition of the Bio-Centre , the researcher observed the following: the superstructure was good meaning there were no visible cracks on the wall, the roofing had no leaks/holes; the general cleanliness of the Bio-Centre was average though it should be noted that the researcher visited the community in a rainy season; there was no smell emanating from the Bio-latrine; there was no biogas being generated, the researcher was informed that water had leaked into the doom thus making biogas production impossible; the second floor of the Bio-Centre contained 4-5 rooms which had been rented out as homes to some of the residents; the third floor of the Bio-Centre was used as a teaching area during the week and a church during the weekends. Overall, the Bio-Centre was in good condition.

With regards to Ruaka river, the researcher observed the following: some residents were washing there utensils and clothes at the river; since the community seats on a hill, all the drainages/trenches point to the river.

4.5.4 Relationship between environmental awareness/sanitation promotion training and improved sanitation practices

In order to determine whether there was an improvement in sanitation practices due to the environmental awareness training that the residents received, the researcher performed a bi-variate analysis between environmental awareness/sanitation promotion training and four of the sanitation practices namely: cleanliness of the Bio-Centre, tissue paper provided for use, water provided for hand washing after using the Bio-latrine and lastly, improved waste disposal methods. Pearson correlation coefficient (r) was then computed and tested at 0.05 (5%) and 0.01 (1%) significant level. The results showed the following: a moderate positive relationship (r=0.4) between environmental awareness/sanitation promotion training and the cleanliness of the Bio-Centre; a weak positive relationship (r=0.228) between environmental awareness/sanitation promotion training and tissue paper provided for use when visiting the Bio-Latrine; a weak positive relationship (r=0.261) between environmental awareness/sanitation promotion training and water provided for hand washing after using the Bio-Latrine; and lastly, a moderate positive relationship (r=0.358) between environmental awareness/sanitation promotion training and improved waste disposal methods. This is shown in *Table 4.16* below.

Table 4.16: Relationship between environmental awareness/sanitation promotion training

		The Bio-Centre is clean and hygienic all day long	Tissue paper is provided for use when visiting the Bio-Latrine	Water is provided for hand washing after using the Bio-Latrine	Waste disposal methods have improved in Mji wa Huruma	Was the community taught the benefits of Environmental Awareness and Sanitation Promotion?
The Bio-Centre is clean and hygienic all day long	Pearson Correlation	1	.409**	.406**	.252*	.400**
	N	80	80	80	78	76

Tissue paper is provided for use when visiting the Bio-Latrine	Pearson Correlation	.409**	1	.519**	.243*	.228*
	N	80	80	80	78	76
Water is provided for hand washing after using the Bio-Latrine	Pearson Correlation	.406**	.519**	1	.400**	.261*
	N	80	80	80	78	76
Waste disposal methods have improved in Mji wa Huruma	Pearson Correlation	.252*	.243*	.400**	1	.358**
	N	78	78	78	78	74
Was the community taught the benefits of Environmental Awareness and Sanitation Promotion?	Pearson Correlation	.400**	.228*	.261*	.358**	1
	N	76	76	76	74	76

4.6 The Level of financing

The third objective of this study was to determine the extent to which the level of financing of the ecological sanitation systems influences the improvement of livelihoods in informal settlement? This section sought to determine what each party in this project contributed and also whether the community would have implemented the project without external aid. As shown below in *Table 4.17*, there was a large variation in the responses given by the residents on the community's and the external party's contribution towards the construction of the Bio-Centre with a standard deviation of 1.743 and 1.498 respectively. A majority of the residents reported that the community contributed skilled labor towards the construction of the Bio-Centre, *25 (31.3%)* while the external parties contributed money, *34 (42.5%).*

Table 4.17: The Opinion of Mji wa Huruma Residents on the level of financing

		What did the community contribute in the construction of the Bio-Centre?	What did the external parties/Bio-Centre experts contribute in the construction of the Bio-Centre?	Would the community have built the Bio-Centre if it had not received any assistance?
N	Valid	79	78	75
	Missing	1	2	5
Mean		2.84	4.06	1.67
Median		3.00	4.00	2.00
Mode		1	4	2
Std. Deviation		1.743	1.498	.475

On the other hand, the officials reported that the community contributed unskilled labor towards the construction of the Bio-Centre, *6 (100%)* while the external parties contributed skilled labor, construction material and money, *5 (83.3%)*.

Both groups of respondents concurred that the community would not have built the Bio-Centre if they had not received any assistance.

4.7 The effectiveness of the management of the ecological sanitation

The fourth objective of this study was to evaluate the effectiveness of the management of the ecological sanitation systems on improvement of livelihoods of people living in informal settlements. The respondents were asked questions related to the management of the Bio-Centre. The residents' findings presented state that 53 out of 79 respondents reported that the community contributed towards the maintenance of the Bio-Centre. The findings also stated that the community had already encountered problems with the Bio-Centre and they usually repaired/maintained it themselves. The same sentiments were shared by the officials with the exception of repair/maintenance. The officials reported that the community in collaboration with Umande trust maintained/repaired the Bio-Centre in case of a problem *(83.3%)*.

From the focus group discussions, the participants stated that after the construction of the Bio-Centre, they had never received any support or assistance from UNEP/Umande trust.

They went further and stated that Umande trust usually visited the informal settlement when they wanted to show potential investors/partners the projects they had implemented in various informal settlements. As per the time of this research's data collection, the Bio-Centre's doom was filled with water which had leaked in during the rainy season thus hindering the production of Biogas. At that time of the field visit, the community was sourcing for funds to carry out the relevant repairs.

From the questionnaire findings, both groups of respondents reported that there was a focal point from UNEP/Umande trust who responded to queries related to the Bio-Centre, with the residents' highest frequency and percentage being *41(51.3%)* while the officials' being *5 (83.3%).*

Lastly, the Bio-Centre project officials were asked whether the initial project objectives were achieved. All the officials stated that the initial objectives that had being set out, had been achieved, *6(100%).*

4.7.1 Relationship between community training in the construction & maintenance of the Bio-centre and Self sustainability

A bi-variate analysis was done on the community's training in the construction & maintenance of the Bio-centre and the Self sustainability of the Community which in our case would be measured through: the residents' contribution towards the maintenance of the Bio-Centre and who maintains/repairs the Bio-Centre. Spearman's rank correlation coefficient (rho) was then computed and tested at 0.01 (1%) significant level. The results showed the following: a moderate positive relationship (r=0.372) between the community training in the construction & maintenance of the Bio-centre and residents' contribution towards maintenance of the Bio-Centre; a moderate positive relationship (r=0.327) between the community training in the construction & maintenance of the Bio-centre and who maintains/repairs the Bio-Centre in case a problem arises. It is also important to note the positive relationship (r=0.433) between whether the residents contribute towards the maintenance of the Bio-Centre and who maintains/repairs the Bio-Centre in case a problem arises. This is shown in *Table 4.18* below.

Table 4.18: Relationship between community training in the construction/maintenance of the Bio-Centre and the Self sustainability of the Community

			Was the community trained in the construction & maintenance of the Bio-centre?	Do the residents contribute towards the maintenance of the Bio-centre?	Who maintains /repairs the Bio-Centre in case a problem arises?
Spearman's rho	Was the community trained in the construction & maintenance of the Bio-centre?	Correlation Coefficient	1.000	.372**	.327**
		N	76	75	75
	Do the residents contribute towards the maintenance of the Bio-centre?	Correlation Coefficient	.372**	1.000	.433**
		N	75	79	78
	Who maintains /repairs the Bio-Centre in case a problem arises?	Correlation Coefficient	.327**	.433**	1.000
		N	75	78	78

**. Correlation is significant at the 0.01 level (2-tailed).

4.8 Summary

This chapter focused on the presentation, interpretation and analysis of findings based on primary data collected from the respondents using questionnaires, focus group discussion and an observation guide. The data collected from the field were entered and analyzed as per the research objectives by descriptive analysis using Statistical Package for Social Scientists (SPSS) software. Research findings from the focus group discussion and observation were clearly brought out in this chapter. The researcher also performed parametric and non-parametric statistical tests in order to uncover the relationships between the different types of variables.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes and discusses the findings of the study and presents conclusions, recommendations and suggestions for further research. The purpose of this study was to investigate the influence of ecological sanitation on the improvement of livelihoods of people living in informal settlements. The study focused on the Bio-Centre in Mji wa Huruma, Nairobi, Kenya.

5.2 Summary of Findings

The summary of findings have been categorized following the study themes; the technical skills imparted to the community; the extent of environmental awareness and sanitation promotion; the level of financing of the ecological sanitation systems; and the effectiveness of the management of the ecological sanitation systems on improvement of livelihoods of people living in informal settlements

5.2.1 The technical skills imparted to the community

In terms of ownership of the Bio-Centre project, Mji wa Huruma officials say that the community leaders were involved in the project design and that the entire community was satisfied with the design. From the findings, the researcher found that whereas the officials strongly agreed that the community leaders were involved in the project design and that the entire community was satisfied with the design, having the highest frequency and percentage of 5 (83.3%) and 5 (83.3%) respectively; the Mji wa Huruma residents felt that though the community leaders were involved in the project design, the community was not satisfied with the design.

According to *Table 4.12 and 4.13*, a majority of the residents and officials stated that the community was trained in construction and maintenance of the Bio-Centre; between 6-10 sessions were conducted; training brochures/materials were indeed distributed to the community; there was increased employment opportunities as a result of the training received; and lastly, the community was indeed taught on the benefits and uses of the Bio-centre.

Whereas the officials stated that 1-5 members of the community were trained, the residents stated that 11-15 members of the community were trained. Also, where the officials stated that the community received construction advice, skilled labor and construction material as assistance in the construction of the Bio-centre, the residents stated that the community only received construction material as assistance.

On the correlation analysis, the study found out that there exists a positive correlation between community training and increased employment opportunities (See *Table 4.14* below).

5.2.2 The extent of environmental awareness and sanitation promotion

From the findings, the researcher found out that UNEP/Umande trust had trained the community on environmental awareness and sanitation promotion. Through these trainings, the residents were carrying out proper hygienic practices. This can be supported by the correlation analysis conducted. The study also found out that there exists a positive relationship between environmental awareness/sanitation promotion training and the following sanitation practices: cleanliness of the Bio-Centre; tissue paper provided for use when visiting the Bio-Latrine; water provided for hand washing after using the Bio-Latrine; and lastly, improved waste disposal methods.

From the questionnaires filled, a majority of the residents reported that they were trained on environment awareness and sanitation promotion, 1-5 sessions were conducted and they were taught on its benefits, having the highest frequency and percentage of 46 (57.5%), 35 (43.8%) and 50 (62.5%) respectively. The officials gave similar responses to those of the residents. Both groups of respondents agreed that open defecation in the forest or in the settlements' surroundings had drastically reduced. It was also noted that during the night, residents resorted to using pit latrines since the Bio-Centre is locked at 7pm due to lack of electricity at the facility.

In terms of sanitation promotion, the residents strongly agreed that the Bio-Centre is clean and hygienic all day, tissue paper is provided for use, water is provided for hand washing after Bio-latrine use, showers are available for use, doors at the Bio-Centre are lockable and that waste disposal methods have improved. However, the residents disagreed that soap is provided for hand washing after Bio-latrine use, that Ruaka river and the entire surroundings of Mji wa Huruma are much cleaner, having the highest frequency and percentage of 29

(36.3%) and 30 (37.5%) respectively. Though there are no sanitary bins and dust bins at the Bio-centre, a majority of the respondents reported that the Bio-Centre is cleaned throughout the day.

It also came out in the focus group discussion that the residents had to part with a small fee every time they had to use the facility hindering part of the population from using the facility. The residents also expressed their anguish on the poor state of Ruaka river.

With regards to the state of the environment, the researcher observed the following: the general condition of the environment was averagely clean; the Bio-Centre was in good condition; some residents were washing their utensils and clothes at the river; since the community seats on a hill, all the drainages/trenches point to the river.

5.2.3 The level of financing

The officials of Mji wa Huruma project say that the community contributed unskilled labor towards the construction of the Bio-Centre while the external parties contributed skilled labor, construction material and money. On the other hand, Mji wa Huruma residents say that the community contributed skilled labor while the external parties contributed money.

Both groups of respondents concurred that the community would not have built the Bio-Centre if they had not received any assistance.

5.2.4 The effectiveness of the management of the ecological sanitation systems

From the findings, the researcher found out that the residents indeed contributed towards the maintenance of the Bio-Centre. This response came out strongly in the questionnaires filled and the focus group discussion that was held. It also came out that the community had encountered some problems in using the Bio-latrine and that there was a focal point from UNEP/Umande trust who responded to queries related to the Bio-Centre.

Despite the fact that the officials of Mji wa Huruma project say that the community in collaboration with Umande trust usually maintain/repair the Bio-Centre in case of a problem, the residents say that they usually handle the repair/maintenance work themselves. The residents go further and state that they have never received any support or assistance from

UNEP/Umande trust since the construction of the Bio-Centre. Also, all the officials agreed that the initial objectives that had being set out had been achieved.

On the correlation analysis, the study found out that there exists a positive correlation between community training in the construction & maintenance of the Bio-centre and the following: residents' contribution towards maintenance of the Bio-centre; and who maintains/repairs the Bio-centre in case a problem arises (See *Table 4.18* below).

5.3 Discussion of Findings

The research study was guided by Diffusion of Innovations (DoI) theory by Rogers (1983) and the theory looks at empowering residents of Mji wa Huruma with the necessary skill, knowledge and technology that will help them address the sanitation issues that are rather common in informal settlements and in the end, help improve their livelihoods.

5.3.1 The technical skills imparted to the community

From the study results, it can be noted that the residents of Mji wa Huruma were empowered with specialized skills that enabled them construct and maintain the Bio-Centre. According to a report, *The SOIL Guide to Ecological Sanitation* (2011); the initial education and training of potential users is perhaps the most important step of realizing a successful ecological sanitation (EcoSan) project. Failure to properly approach and educate users from the start would seriously hinder an EcoSan project's chances.

The report goes further and states that: the community should be educated on how to properly use the EcoSan toilets and how to maintain them. This will enhance the sustainability of the system. This study concurs with the report as the community was also taught about the benefits and the uses of the Bio-Centre. Currently, due to the training administered to the community, they are able to operate and maintain the project independently.

As a linkage between sanitation and livelihoods, Borba, Smet, & Sijbesma (2007), stated that the poor are consumers, producers and workers with sanitation. As consumers, they are offered different toilet models according to what they want and can afford. As producers, they emerge as small-scale entrepreneurs for the delivery of sanitation services or for manufacturing products e.g. the male and female latrine builders in Lesotho. They also gradually become workers in water and sanitation projects as they gain access to training in

technical or social aspects related to community work, to wages and to an income from their work. This study concurs with the above findings, Mji wa Huruma residents were indeed the producers because they built the Bio-Centre and they were workers since from the training they received, they were able to source for employment opportunities which translated into two things: improved income levels and improved provision of basic needs.

In a study by Binale (2011), he mentioned that upon construction of Bio-Centres in informal settlements, communities have a sense of ownership having been involved in the project processes which have also made them responsible for the facilities. The same can be said about Mji wa Huruma residents who were involved in the project design from the very beginning. The community leaders were involved in the Bio-Centre design. The researcher however noted that though the leaders were involved in the design process, the community was not satisfied with the Bio-Centre design.

5.3.2 The extent of environmental awareness and sanitation promotion

According to the report, *The SOIL Guide to Ecological Sanitation* (2011); it mentions that initial meetings with the community offers an opportunity for hygiene promotion and general education around the benefits of proper sanitation as well as a forum to introduce ecological sanitation as a viable solution to sanitation needs. From the findings, the researcher noted that before commencement of the Bio-Centre construction, the community took a training course on participatory hygiene and sanitation transformation (PHAST) which was administered by Umande trust in collaboration with UNEP. In this course, they were trained on environmental awareness and sanitation promotion plus there benefits.

In a study by Binale (2011), he mentioned that the ablution blocks have improved people's lives enabling them to have access to water and sanitation facilities hence improving their health and reducing diseases such as cholera. Privacy has been enhanced as there are separate bathrooms and toilets for women and men. Security has improved especially for women and children as the facilities are situated near the households. Hygienic practices have been enhanced with hygiene education in the schools and in the community being carried out through door-to-door sensitization. The researcher noted that Mji wa Huruma Bio-Centre project concurs to this study, that the Bio-Centre has improved the lives of the residents. The residents have embraced proper hygienic practices in the following ways: the Bio-Centre is

clean and hygienic all day long, tissue paper is provided for use when visiting the Bio-latrine, water is provided for hand washing after using the Bio-latrine, showers are available for use and lastly, there improved waste disposal methods. From an economic perspective, the community members have benefited from improved hygiene therefore reducing the occurrence of diseases as a result of poor hygiene consequently, reducing cases of hospitalization and increasing their disposable income. In addition, from the findings, privacy has been enhanced with the Bio-latrines and showers having lockable doors. According to Lennartsson (2009), Privacy while defecating is one important element of dignity, as well as not having to fear physical abuse as a possible risk during the visit to the sanitation facility.

According to ITDG and ODI (2005), there were reported improvements on the environment upon development of ablution blocks. It was noticed that there was less evidence of 'flying toilets' or human excreta flowing in open drains due to over full pit latrines. The smell from latrines, urine and stagnant bathing and cleaning water had also been reduced in the narrow pathways of the settlement (Maili Saba). Through observations made by the researcher, he concurs with the study. The researcher observed the following: there was no smell emanating from the Bio-latrine; no faeces were visible thus implying open defecation was not practiced; there was proper drainage systems; no stagnant bathing and cleaning water were visible; and lastly, few flies were noticed in the informal settlement.

According to Borba, Smet, & Sijbesma (2007), in Bangladesh, Open defecation was a common practice to all until they implored the community-led total sanitation approach. On a community level, there was better health in the community, social innovations, such as slogans to promote toilets and penalties for open defecation were introduced and many more. Just like in Bangladesh, the same can be said about Mji wa Huruma community. Since the introduction of the Bio-latrines, open defecation has drastically reduced leading to better health in the community.

Lastly, the researcher noted the following, the Bio-Centre neither had sanitary bins nor dustbins; the Bio-Centre was in good condition; the condition of the environment at Mji wa Huruma was averagely clean; Ruaka river was not in a good state and lastly, all the drainage channels were directed towards Ruaka river.

5.3.3 The level of financing

According to the GLAAS 2012 report, funding for water and sanitation costs can come from three main sources: “tariffs”, which are funds contributed by users of WASH services (and also including the value of labour and material investments of households managing their own water supply); “taxes”, which refer to funds originating from domestic taxes that are channeled to the sector by the central, regional and local governments; and “transfers”, which refer to funds from international donors and charitable foundations. From the findings, the cost of constructing the Bio-Centre emanates from tarrifs and transfers. This concurs to the study that for the construction of the Bio-Centre to take place, the community needed aid from the donors while the external party required the input of the local community for them to own the project and ensure the sustainability of it.

According to Trémolet, Kolsky, & Perez (2010), local households are key investors in on-site sanitation, and careful project design and implementation can maximize their involvement, satisfaction, and financial investment. This study concurs with the above findings; the community was involved in the initial project design thus making them own/accept the project, making it easy for them to be trained on construction and maintenance of the Bio-centre. The community’s skilled labor is a form of financing.

From the study results, although both officials and residents agreed that the community would not have built the Bio-Centre if they had not received any assistance, they differed in responses on what the community and the external parties contributed in the construction of the Bio-Centre. The residents reported that the community contributed skilled labor towards the construction of the Bio-Centre while the external parties contributed money. On the other hand, the officials stated that that the community contributed unskilled labor towards the construction of the Bio-Centre while the external parties contributed skilled labor, construction material and money.

5.3.4 The effectiveness of the management of the ecological sanitation systems

According to the report, *The SOIL Guide to Ecological Sanitation* (2011); while the development of an appropriate design and the actual construction of the Bio-latrines are necessary for a successful project, effective management of the latrines is an ongoing requirement that keeps the toilets functioning and clean. The officials of Mji wa Huruma

concur with the statement as they say that UNEP/Umande trust had achieved the initial objectives they had set out to achieve. One of the objectives was building capacity of the community through empowering them with specialized skills e.g. masonry, carpentry, financial management, record keeping, financial monitoring and many more. Through this, the community would be able to manage the project thus ensuring its sustainability. The other objectives were: resolving the existing sanitation problems and alleviate the negative impacts caused by human waste; improve the overall water quality and health of residents in Mji wa Huruma; promote renewable energy application by shifting from fuel-wood to biogas for cooking which will in turn improve the energy efficiency, reduce the carbon dioxide emissions and alleviate the pressure on karura forest resulted from the community's need for firewood for fuel; provide a source of income for the community; and lastly, promote environmental awareness and education at informal settlement level.

From the study results, the researcher noted that the residents indeed contributed towards the maintenance of the Bio-Centre through a small fee that was charged every time the residents had to use the facility. The fees collected went towards the provision of toiletries and the maintenance of the Bio-Centre project. It also came out that the community had encountered some problems in using the Bio-latrine and that there was a focal point from UNEP/Umande trust who responded to queries related to the project.

Despite the fact that the officials of Mji wa Huruma Project say that the community in collaboration with Umande trust usually maintain/repair the Bio-Centre incase of a problem, the residents say that they usually handle the repair/maintenance work themselves. According to a briefing note by UN World Water Assessment Programme and UN Habitat (2011), the water and sanitation sector suffers from a tendency to invest in the creation of new assets and facilities, while neglecting the management and maintenance of those assets over time. This statement is true since Umande trust has not assisted the community in maintenance of the project since the official opening of the Bio-centre.

Lastly, from the study results, the researcher noted that the community found the Bio-Centre beneficial to either them or the community at large and would recommend the Bio-Centre to others.

5.4 Conclusion of the Study

Data analysed from the questionnaires revealed that the residents and officials agreed on 87% of the questions asked. The differences in responses were resolved from the focus group discussion and observation conducted by the researcher. Following the research findings from both groups of respondents, the researcher concluded that although it is evident that ecological sanitation has influenced the improvement of livelihoods of people living in informal settlements through technical skills imparted to the community, environmental awareness and sanitation promotion, level of financing and effectiveness of the management of the ecological sanitation, there are a few mechanisms that are either not known to the residents or are not functioning as stated by the officials.

In technical skills imparted to the community, the researcher concluded that UNEP/Umande trust indeed trained the community and empowered them with specialized skills which enabled the local community to construct the Bio-Centre and in the long run operate and maintain it. It was also noted that there was increased employment opportunities as a result of the training which translated into improved income levels and improved provision of basic needs. Also for the community to have being trained in these specialized skills, it means that they had already accepted/owned the project. The findings also revealed that, though the community leaders were involved in the design of the project, the community was not satisfied with the design. The officials should have queried the views of the community with regards to the design of the Bio-Centre.

In environmental awareness and sanitation promotion, the researcher concluded that UNEP/Umande trust indeed taught the community on environmental awareness and sanitation promotion. The researcher also noted that there were improved hygienic practices as a result of the training which in turn improved the three pillars of sustainable development (social, economic and environmental) leading to the eradication of poverty. The researcher concluded that the small fee charged for using the Bio-latrine discouraged quite a number of residents from using the facility. Also, lack of electricity at the Bio-Centre encouraged the use of pit latrines and to a large extent open defecation during the night hours. Lastly, the state of Ruaka river was not good since a lot of human activities were being undertaken on the river plus all the drainage systems in the settlement were directed towards it.

In the level of financing, the researcher concluded that both local and foreign financing are important in the successful implementation of an EcoSan project. It was noted that the local community would not have developed the Bio-Centre were it not for the aid they received from the external parties and at the same time, the external parties needed the skills and labor of the local community in order to implement the project. The researcher noted that the community was unaware of the contribution made by the external parties in the construction of the Bio-Centre which was construction material, money and construction advice.

In the effectiveness of the management of the ecological sanitation, the researcher concluded that the community is effectively managing the project. The researcher also concluded that the community carried out the repairs and maintenance of the Bio-Centre without the assistance of Umande trust. The researcher also concluded that the officials did not achieve two of their objectives since currently, the Biogas is not being generated. These objectives are: promote renewable energy application by shifting from fuel-wood to biogas for cooking which will in turn improve the energy efficiency; reduce the carbon dioxide emissions and alleviate the pressure on karura forest resulted from the community's need for firewood for fuel.

5.5 Recommendations of the Study

In view of the above findings and discussions of the study, the researcher made the following recommendations to UNEP/Umande trust:

1. Electricity should be installed at the Bio-Centre to enable the community to use the facility during the night. The researcher was informed that electricity installation at the Bio-Centre was part of the initial budget when the Bio-Centre was being constructed but it was never implemented.
2. In order to encourage the use of the Bio-Centre by the entire population thereby realizing the full effects of ecological sanitation, UNEP/Umande trust should for a specified period (*two years*) bear the cost of operating the facility.
3. Though the community maintain and manage the Bio-Centre effectively, they still require the technical assistance from Umande trust e.g. currently, the community is facing a challenge of extracting the water that leaked into the doom during the rainy season and thus hindering Biogas production.

To those managing the Bio-Centre, the following is recommended:

1. The management of the Bio-Centre should ensure that soap is provided for hand washing at all times after using the Bio-latrine.

To the National Environmental Management Authority (NEMA), the following is recommended:

1. Stern action should be taken to those individuals or group of individuals polluting Ruaka river.
2. Policies should be put in place to prevent pollution of rivers e.g. sewers from private residents flowing into rivers and also human activities undertaken in rivers.

5.6 Suggestions for Further Research

Based on the findings of the study, the researcher made the following suggestions for further research:

1. The four objectives that have been investigated are quite broad and could be delved into in detail. A study of each objective could be undertaken.
2. Following that EcoSan projects have been built in a number of towns in Kenya; a research should be undertaken with a larger sample that includes Bio-Centres/Bio-latrines all over Kenya, as different results may be found.
3. The researcher also recommends a similar research to be done focusing on Biogas/ renewable energy, as this would give a different viewpoint.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
SCHOOL OF CONTINUING AND DISTANCE EDUCATION
DEPARTMENT OF EXTRA-MURAL STUDIES
NAIROBI EXTRA-MURAL CENTRE

Your Ref:

Our Ref:

Telephone: 318262 Ext. 120

Main Campus
Gandhi Wing, Ground Floor
P.O. Box 30197
N A I R O B I

7th May 2013

UON/CEES//NEMC/15/127

TO WHOM IT MAY CONCERN

RE: MEMIA KELVIN MUINAMI- REG.NO. L50/68196/2011

This is to confirm that the above named is a student at the University of Nairobi College of Education and External Studies, School of Continuing and Distance Education, Department of Extra- Mural Studies pursuing Master of Arts in Project Planning and Management.

She is proceeding for a research entitled **"the influence of ecological sanitation on the improvement on livelihood of people living in informal settlement".** A case of Mji wa Huruma Bio-Centre.

Any assistance given to him will be appreciated.

CAREN AWILLY
CENTRE ORGANIZER
NAIROBI EXTRA-MURAL CENTRE

UNIVERSITY OF NAIROBI
P. O. Box 30197
NAIROBI
NAIROBI EXTRA-MURAL CENTRE

APPENDIX II: OFFICIALS OF MJI WA HURUMA QUESTIONNAIRE

MJI WA HURUMA BIO-CENTRE PROJECT

Questionnaire No.: _____ Date/ *Tarehe*: _____ Category: _____

Dear respondent,

Kindly answer the following questions. The researcher would like to assure you that the information gathered will be kept confidential and used strictly for the purpose of this research only. Do not write your name anywhere in this paper. However, the usefulness of the information to the researcher will solely depend on your honesty.

SECTION A: BACKGROUND INFORMATION

1. What is your gender?
   Male ( ) Female ( )
2. What is your age?
   10-17 ( ) 18-30 ( ) 31-55 ( ) 56-80( )
3. What is your highest level of education?
   None ( ) Primary ( ) Secondary ( ) Undergraduate ( ) Postgraduate ( )
4. What is your occupation?
   Self Employed// *Nimejiajiri* ( ) Employed/*Nimeajiriwa* ( ) Casual work/*Kibarua* ( )
   Unemployed/ *Sijaajiriwa* ( )

SECTION B: TECHNICAL SKILLS IMPARTED TO THE COMMUNITY

5. Did the community participate in the Bio-Centre design workshop?
   Yes ( ) No ( )

Please put a circle where a question Indicates the extent to which you agree with the statements by using a scale of 1 to 4 where 1= strongly disagree and 4 = strongly agree.

6.	Strong Agree	Agree	Disagree	Strongly Disagree
a) The Community leaders were involved in the Bio-Centre design	1	2	3	4
b) The community is satisfied with the Bio-Centre design	1	2	3	4
c) A large number of the community members were trained in the construction and maintenance of the Bio-Centre	1	2	3	4
d) There has been increased employment opportunities due to the training received	1	2	3	4

7. Was the community trained in the construction and maintenance of the Bio-Centre?

Yes ( ) No ( )

8. How many sessions were conducted?

1-5 ( ) 6-10 ( ) Above 15 ( )

9. How many members of the community were trained of this?

1-5 ( ) 6-10 ( ) 11-15 ( ) 16-25 ( ) Over 25 ( )

10. Were any brochures/materials distributed during the course of the training?

Yes ( ) No ( )

11. Was the community taught about the benefits and uses of the Bio-Centre?

Yes ( ) No ( )

12. What assistance did the community receive in the construction of the Bio-Centre?

Construction Advice ( ) Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( )

SECTION C: EXTENT OF ENVIRONMENTAL AWARENESS & SANITATION PROMOTION

13. Was the community trained on environmental awareness and sanitation promotion?

Yes ( ) No ( )

14. How many sessions were conducted?

1-5 ( ) 6-10 ( ) Above 15 ( )

15. Was the community taught the benefits of Environmental Awareness and Sanitation Promotion?

Yes ( ) No ( )

SECTION D: THE LEVEL OF FINANCING

16. What did the community contribute in the construction of the Bio-Centre?

Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( ) Money ( ) Construction Advice ( )

17. What did the external parties/Bio-Centre experts contribute in the construction of the Bio-Centre?

Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( ) Money ( ) Construction Advice ( )

18. Would the community have built the Bio-Centre if it had not received any assistance?

Yes ( ) No ( )

SECTION E: EFFECTIVENESS OF THE MANAGEMENT OF THE ECOLOGICAL SANITATION

19. Have the initial project objectives being achieved?

Yes ( ) No ( )

If No, please provide the reasons _____

20. Do the residents contribute towards the maintenance of the Bio-centre?

Yes ( ) No ( )

21. Has the community encountered any problem in using the Bio-latrine or the Bio-Centre in general?

Yes ( ) No ( )

22. Who maintains /repairs the Bio-Centre in case a problem arises?

1. Community ( ) 2. UNEP ( ) 3. Umande Trust ( ) 4. Others ( )

5. No one ( )

23. Is there a focal point from either UNEP/Umande Trust who responds to queries that the community might have with regards to the Bio-centre?

Yes ( ) No ( )

Thank you for participating

APPENDIX III: RESIDENTS OF MJI WA HURUMA QUESTIONNAIRE

MJI WA HURUMA BIO-CENTRE PROJECT

Questionnaire No.: _____ Date/ *Tarehe*: _____ Category: _____

Dear respondent,

Kindly answer the following questions. The researcher would like to assure you that the information gathered will be kept confidential and used strictly for the purpose of this research only. Do not write your name anywhere in this paper. However, the usefulness of the information to the researcher will solely depend on your honesty.

SECTION A: BACKGROUND INFORMATION

1. What is your gender? *Jinsia yako ni ipi?*
   Male/*Mwanaume* ( ) Female/*Mwanamke* ( )
2. What is your age? *Umri wako ni upi?*
   10-17 ( ) 18-30 ( ) 31-55 ( ) 56-80( )
3. What is your highest level of education? *Ni kipi kiwango cha masomo yako?*
   None/ *Bila* ( ) Primary/*Shule ya msingi* ( ) Secondary/*Shule ya upili* ( )
   Tertiary/ *Chuo* ( ) Adult literacy / *Masomo ya watu wazima* ( )
4. What is your occupation? *Kazi yako ni ya aina gani?*
   Self Employed// *Nimejiajiri* ( ) Employed/*Nimeajiriwa* ( ) Casual work/*Kibarua* ( )
   Unemployed/ *Sijaajiriwa* ( )
5. Do you use the Bio-Centre?
   Yes ( ) No ( )
6. Is the Bio-Centre useful/beneficial, either to you or the community?
   Yes ( ) No ( )

SECTION B: TECHNICAL SKILLS IMPARTED TO THE COMMUNITY

7. Did the community participate in the Bio-Centre design workshop?
   Yes ( ) No ( )

Please put a circle where a question Indicates the extent to which you agree with the statements by using a scale of 1 to 4 where 1= strongly disagree and 4 = strongly agree.

8.	**Strong Agree**	**Agree**	**Disagree**	**Strongly Disagree**
e) The Community leaders were involved in the Bio-Centre design	1	2	3	4
f) The community was satisfied with the Bio-Centre design	1	2	3	4
g) A large number of the community members were trained in the construction and maintenance of the Bio-Centre	1	2	3	4

9. Was the community trained in the construction and maintenance of the Bio-Centre?

Yes ( ) No ( )

10. How many sessions were conducted?

1-5 ( ) 6-10 ( ) Above 15 ( )

11. How many members of the community were trained?

1-5 ( ) 6-10 ( ) 11-15 ( ) 16-25 ( ) Over 25 ( )

12. Were any brochures/materials distributed during the course of the training?

Yes ( ) No ( )

13. Has there been increased employment opportunities due to the training received?

Yes ( ) No ( )

14. Was the community taught about the benefits and uses of the Bio-Centre?

Yes ( ) No ( )

15. What assistance did the community receive in the construction of the Bio-Centre?

Construction Advice ( ) Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( )

SECTION C: EXTENT OF ENVIRONMENTAL AWARENESS & SANITATION PROMOTION

16. Was the community trained on environmental awareness and sanitation promotion?

Yes ( ) No ( )

17. How many sessions were conducted?

None ( ) 1-5 ( ) 6-10 ( ) Above 15 ( )

18. Was the community taught the benefits of Environmental Awareness and Sanitation Promotion?

Yes ( ) No ( )

Please put a circle where a question Indicates the extent to which you agree with the statements by using a scale of 1 to 4 where 1= strongly disagree and 4 = strongly agree.

19.	**Strong Agree**	**Agree**	**Disagree**	**Strongly Disagree**
a) The Bio-Centre is clean and hygienic all day long	1	2	3	4
b) Soap is provided for hand washing after using the Bio-Centre	1	2	3	4
c) Tissue paper is provided for use when visiting the Bio-Latrine	1	2	3	4
d) Water is provided for hand washing after using the Bio-Latrine	1	2	3	4
e) Showers are available for use at the Bio-Centre	1	2	3	4
f) The doors in the Bio-Centre	1	2	3	4

are lockable				
g) Waste disposal methods have improved in Mji wa Huruma	1	2	3	4
h) Ruaka river and the entire surroundings of Mji wa Huruma are much cleaner	1	2	3	4

20. How many times is the Bio-Centre cleaned in a day?

Once ( ) Twice ( ) Throughout the day ( )

21. Are sanitary bins provided for use?

Yes ( ) No ( )

22. Are dustbins provided for use?

Yes ( ) No ( )

SECTION D: THE LEVEL OF FINANCING

23. What did the community contribute in the construction of the Bio-Centre?

Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( ) Money ( ) Construction Advice ( )

24. What did the external parties/Bio-Centre experts contribute in the construction of the Bio-Centre?

Skilled Labor ( ) Unskilled Labor ( ) Construction Material ( ) Money ( ) Construction Advice ( )

25. Would the community have built the Bio-Centre if it had not received any assistance?

Yes ( ) No ( )

SECTION E: EFFECTIVENESS OF THE MANAGEMENT OF THE ECOLOGICAL SANITATION

26. Do the residents contribute towards the maintenance of the Bio-centre?

Yes ( ) No ( )

27. Has the community encountered any problem in using the Bio-latrine or the Bio-Centre in general?

Yes ( ) No ( )

28. Who maintains /repairs the Bio-Centre in case a problem arises?

1. Community ( ) 2. UNEP ( ) 3. Umande Trust ( ) 4. Others ( )
5. No one ( )

29. Is there a focal point from either UNEP/Umande Trust who responds to queries that the community might have with regards to the Bio-centre?

Yes ( ) No ( )

30. Would you recommend the Bio-centre to others?

Yes ( ) No ( )

Thank you for participating

APPENDIX IV: FOCUS GROUP DISCUSSIONS

MAIN THEMES FOR FOCUS GROUP DISCUSSIONS AT MJI WA HURUMA

1. How has the construction of the Bio-centre improved your life?
2. Compare the residents' views on the sanitation methods now, and their views on previous methods of sanitation used.
3. Determine if there is an improvement on health, security, source of income as a result of the Bio-Centre.
4. Determine the views of the residents with regards to the Bio-gas generated and methods of cooking.
5. What are the main effects of Environmental Awareness/Sanitation Promotion?
6. What recommendations would you make to UNEP/Umande trust so as to improve the Bio-centre system?
7. What is the residents' relationship with UNEP/Umande trust?

APPENDIX V: OBSERVATION GUIDE

QUESTIONS	WHAT WAS OBSERVED	CATEGORIZATION
1. Is litter visible in the Community?		[ ] Good disposal practices [ ] Poor disposal practices
2. Are faeces visible in the Community?		[ ] Open defecation practice [ ] Open defecation is not practiced
3. Proper drainage system (Are there stagnant water on the pathways)		[ ] Good drainage system [ ] Poor drainage system
4. Is there piped water?		[ ] Availability of clean Water [ ] Scarcity of clean Water
5. No. of different types of toilets - Pit latrine -Bucket toilet -Septic Tank		Pit latrine Bucket toilet Septic tank
6. General Condition of the community		[ ] Clean [ ] Dirty
<u>Condition of the Bio-latrine</u>		
7. Superstructure		[ ] Good (roof in good repair, no visible drainage) [ ] Bad (Holes, cracks)
8. Cleanliness		[ ] Clean [ ] Dirty
9. Smell		[ ] Tolerable [ ] Intolerable